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Faculty of Humanities

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Native and Non-Native Processing of Structural Ambiguities

by

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Thesis for the degree of Doctor of Philosophy

December 2019

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Abstract

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The main goal of this thesis is to approach adult second language L2 acquisition through the analysis of the processing behavior of non-native speakers of English and Russian at the intermediate level of L2 proficiency. Specifically, the thesis investigates how sentence processing in L2 is performed and whether the attested processing behavior can be explained by the existing theories of L2 acquisition. The thesis claims that in both native and non-native languages sentence processing is incremental with a structural parse being its initial stage. Structural parse combines top-down and bottom-up algorithms of mental structure-building which complement each other throughout the sentence. The dissertation believes that L2 acquisition is UG-governed and the human parser is sensitive to the properties of the L2. It is within the capacity of the human parser to spot the minimal differences between the L1 and the L2, assign new meaning to the L2-specific properties and start their acquisition. The experimental part consisted of two self-paced reading experiments investigating (a) monolingual speakers of English and Russian, and (b) L2 speakers of English and Russian at the intermediate level of L2 proficiency. The L2 participants were divided into two sub-groups to be tested in either their respective L1s or L2s. The results of the experiments show that in both native and non-native languages, sentence parsing begins with a top-down structural prediction. This prediction undergoes a bottom-up check for grammatical fitness of the incoming constituents. During the grammatical check, the structure can be amended if needed and a new projection is generated. The cycle repeats. The study established that L2 speakers are sensitive to highly salient L2-specific linguistic phenomenon. However, the participants mainly show L1-like behavior in the L2. The findings add to the existing literature in L2 acquisition. The thesis goes in line with the theories that argue for L1 transfer in L2 acquisition and shows that at the intermediate level of L2 proficiency, the parser is implementing the L1 parsing hypothesis to the new linguistic material. The thesis captures the stage of L2 acquisition, when the parser starts showing sensitivity to L2-specific linguistic cues. It means the effects of L1 transfer are being overcome and target-language-like behavior in the L2 has started developing. Besides theoretical implications, the dissertation contributes to the methodological aspects of studies in L2 processing. It shows that using bilingual speakers tested in the L1 as a control group for the bilinguals tested in the L2 provides a clearer picture of the non-native behavior and is more informative for psycholinguistic research.

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Research Thesis: Declaration of Authorship

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I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

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To my husband

Acknowledgements

I would like to express my gratitude to the many people who contributed in various ways to this thesis. First and foremost, I would like to thank my supervisor, Roumyana Slabakova, whose constant feedback, encouragement and drive have been crucial for the success of this thesis. I am saying thank you to Roumyana Slabakova for her patience, motivation and immense knowledge. I cannot imagine a better thesis director. I am also thankful to Laura Domínguez and Sarah Rule for their attention to my work and valuable comments throughout the process of the thesis preparation. I am very grateful to Ian Cunnings for agreeing to examine this dissertation and for his valuable suggestions.

I thank the University of Southampton for providing funding for this project. The Vice Chancellor's award and the research travel funds (Humanities PGR Student Research Funds) were crucial financial support in my thesis completion. I would like to extend my gratitude to the Humanities Graduate School Team, in particular to Danni Saroni, Luke Fletcher and Safia Siddiki-Hibbert for their prompt answers to different administrative issues and for being always ready to help in various situations.

I would like to address special thanks to Masaya Yoshida and Viorica Marian in Northwestern University, USA, for hosting me in their labs. Learning from these notable scholars and their outstanding group of students and post-doctoral scientists was a challenging and rewarding experience. I would like to thank Psycholinguistics and Neurolinguistics Lab in the School of Psychology and Clinical Language Sciences, The University of Reading, UK; Bilingualism Research Lab, University of Illinois at Chicago, USA; Comparative and Diachronic Syntax Lab. Department of Second Language Studies, Indiana University Bloomington, USA; and Center for Language and Brain, Higher School of Economics, Moscow, Russia for inviting me to give dissertation-based talks. The questions and suggestions received in those discussions shaped the thesis and provided vital feedback. I would like to thank the department of Second Language Studies at Indiana University Bloomington, USA, where I received the MA degree and became interested in non-native language processing.

I am grateful to the wonderful scholars who I met during this journey (in no particular order) Bonnie Schwartz, Susan Flynn, Rex Sprouse, Lidia White, Laurent Dekydtspotter, David Stringer, Tomas Grano, Steven Franks, Maria Shardakova, Luis López, Tania Ionin, Silvina Montrul, Natasha Müller, Holger Hopp, Ian Cunnings, Claudia Felser, Maria Carmen Parafita Couto, Nuria Sebastian, Carmen Pérez Vidal, Silvia Perpiñán, Tanya Leal, Theo Marinis. The fruitful conversations with these scholars made me rethink the thesis many times and turned the dissertation writing into a memorable experience.

My successful thesis completion would be hard to imagine without friendship and support of several fellow graduate students at the University of Southampton, UK, and at Indiana University Bloomington, USA. I say thank you to Jeanne McGill, Bora Nam, Elena Doludenko, James Corbert, Amy Wallington and to the post-graduate fellow Eloi Puig Mayenco for all the support, advice and friendly conversations that left wonderful memories.

I would like to thank all the participants of my studies without whom the dissertation would not have been possible: native speakers of English in Chicago and Chicago area in the US and native speakers of Russian in Nizhny Novgorod and Rybinsk in Russia, students and young professionals, L2 speakers of English and Russian, in Chicago, USA and in N. Novgorod and Rybinsk, Russia. I am also very grateful to Irina Nikitina, N. Novgorod Linguistics University, Russia, to Eduard Gaidukov, Rybinsk State Academy of Aviation Technology, to Evgeny Plisov, Minin University, N. Novgorod, Russia, to Natalia Malinina and Elizabeth Elliot, Northwestern University, USA, to Irina Ruvinsky, University of Illinois at Chicago, USA, and to Polina Maksimovych, Loyola University, Chicago, USA, for their help in recruiting participants.

Finally, I would like to thank my family and friends for all the support throughout the years. I would like to address my special thanks to my husband for his endless patience and moral and intellectual support throughout the entire process.

Definitions and Abbreviations

Theories of Second Language Acquisition

NE	Native English speakers
NR	Native Russian speakers
ER-R	Bilinguals: L1-English, L2-Russian, tested in Russian (L2)
ER-E	Bilinguals: L1-English, L2-Russian, tested in English (L1)
RE-E	Bilinguals: L1-Russian, L2- English, tested in English (L2)
RE-R	Bilinguals: L1-Russian, L2- English, tested in Russian (L1)
L1	First Language
L2	Second Language
NL	Native Language
TL	Target Language

Linguistic Analysis

S	Sentence
DP	Determiner Phrase
NP	Noun Phrase
VP	Verb Phrase
RC	Relative Clause
PR	Pseudo-relative Clause
SC	Small Clause
CP	Complementizer Phrase
Fem	Feminine
Masc	Masculine

Data Analysis

Group	Belonging to either of the experimental groups above.
Nchoice	Noun chosen as a referent of the anaphora: 1 = the mother; 2 = the woman
VerbType	The type of the matrix verb: 0 = perception verb; 1 = non-perception verb
AnaType	The type of anaphora: 0 = the reflexive; 1 = the pronoun
Group NL	Native language of the speakers of an experimental group
Language	Language of testing (different from native language in ERR and REE)
AnaPred	Structural prediction triggered by the feminine pronoun *her*
RT	Reading time taken to read a certain word in the target sentence
RespTime	Response time, or the time taken to answer a comprehension task

Chapter 1 Introduction

1.1 Objectives of this thesis

Studies in non-native language processing investigate how the incoming linguistic information is processed by the human brain and whether knowledge of more than one language influences sentence processing. The answers obtained inform approaches to language instruction, language policy and language-related treatment of monolingual and multilingual populations. The current dissertation adds to existing research and investigates online language processing by adult second language (L2) learners of English and Russian.

The main objectives of this thesis are (1) to investigate how the human parser performs mental structure building in native and non-native languages and (2) to describe the intermediate level of L2 proficiency through the analysis of parsing strategies implemented by the participants in their respective L1s and L2s. To address the first objective, the dissertation analyses the existing literature on human language processing and extends its theoretical assumptions to the field of processing in L2. The dissertation summarizes the contemporary experimental findings on non-native processing and argues for fundamental similarity of parsing mechanisms in native and non-native languages.

The novelty of the dissertation is in offering an experimental study showing that two main parsing algorithms complement each other in sentence processing. The results of the dissertation demonstrate that sentence parsing begins with a structural anticipation which unfolds incrementally in a top-down manner. A processed node is checked for its compatibility with the anticipated structure in a bottom-up manner. In the case of a structural mismatch, the originally anticipated projection is amended, and a new top-down structural anticipation is generated. The cycle repeats.

The second objective of the thesis is to approach L2 development through the analysis of the participants' parsing behaviour. Having the ambiguous relative clause (RC) in the experimental design, the thesis uses the established variation in RC resolution in English and Russian (see Fodor 2002 for summary). There is no linguistic constraint that would regulate RC resolution in either of the languages. Besides, a certain preference for RC interpretation is not a topic of any language course book. To interpret the RC, native speakers of Russian and English follow the internal prosodic organization of their languages. Being an integrated part of every linguistic system, prosodic organization of a language should be acquired by L2 speakers. From this perspective, successful L2 acquisition will results in switching from the Russian-like pattern of RC resolution in the L1-Russian to the English-like pattern of RC resolution in the L2-English and vice-versa. At the intermediate level of L2 proficiency, this process is in development and the dissertation is aimed at establishing how the early stages of L2 acquisition show through parsing in the target-like manner in L2.

The dissertation summarizes evidence for L2 speakers' sensitivity to the linguistic cues in non-native processing and explains the role of the human parser in language acquisition. The literature shows that new L2-specific phenomena can be spotted, processed and acquired in the L2 (Prévost & White 2000, Lardiere 2009, Slabakova 2014, among others). The dissertation shows evidence that the parser is sensitive to highly salient L2-spesific phenomena and adjusts its parse in the L2 accordingly. This sensitivity shows in increased processing time in the relevant regions in the L2. The results obtained are evidence that the parser stops relying on the L1 in L2 processing and starts developing L2-specific parsing strategies.

The selection of the target groups is innovative for the field of non-native processing. Intermediate level of L2 proficiency is an early post-initial stage of L2 acquisition, which is not a frequent research target. At this level of L2 proficiency, sentence processing is L1-guided and shows L1-like responses to most of the processing cues in the L2. However, the dissertation shows that intermediate L2 parser is already sensitive to salient L2 phenomena. The dissertation argues that the parser starts showing the first signs of developing towards L2-like parsing in the L2 as early as intermediate level of L2 proficiency. Full parsing in a target-like manner in the L2 can be obtained with the growth in the participants' L2 proficiency.

The dissertation is particularly interested in the question of ecological validity of the experimental results where non-native processing is compared to the performance of monolingual controls. The experimental study takes L2 processing as an independent object of research. It bears in mind that direct comparisons between adult monolinguals and adult L2 learners can be misleading (Dekydtspotter, Schwartz & Sprouse 2006). The first drawback of such approaches is in comparisons between a fully developed monolingual grammar of an adult L1 and a developing L2 grammar of an L2 learner. The dissertation is also mindful about the pitfalls of comparisons between monolingual children and adult L2 learners (see Felser, Marinis & Clahsen 2003). On the one hand, such comparisons solve the problem above as they are comparing two developing grammars: the L1 grammar in children and the L2 grammar in adults. On the other hand, adult L2 learners are seriously different from L1 children. Adult L2 speakers have a fully developed grammar of the L1 which can have either facilitative or non-facilitative influence on the developing L2. At the same time, monolingual children are developing their first and only grammar. The latter brings ecological validity of direct comparisons between adult L2ers and monolingual children into question.

The dissertation does not claim that monolingual results should be disregarded in the studies of L2 acquisition but warns of possible comparative fallacy (Dekydtspotter et al. 2006) of direct comparisons between monolinguals and L2 learners and offers a solution to this problem. The dissertation conducts two separate experiments. Experiment 1 examines monolingual processing. Experiment 2 studies processing by L2 speaking participants. There are two independent analyses of monolingual and bilingual results. The bilingual participants are split into two subgroups and tested in their respective L1s and L2s. In this approach, L2 speakers tested in their L1s become a control group for the participants tested in their L2s. The latter allows for a clearer picture of bilinguals' behaviour in both their native and non-native languages. Afterwards, any comparisons between native and non-native parsing become more informative and provide a finer-grained description of the processing behaviour in human language processing.

The dissertation fulfils its main objectives. It investigates parsing algorithms in non-native processing and describes the intermediate level of L2 proficiency. It is innovative in viewing human sentence processing as parsing performed bit-by-bit where top-down and bottom-up algorithms complement each other. The dissertation shows that first instances of target-like parsing behaviour appear as early as intermediate level of L2 proficiency. The dissertation adds a new control group between monolingual and bilingual populations. Bilinguals tested in the L2 are compared to the bilinguals tested in the L1. Only afterwards, the general patterns of monolingual behaviour can be compared to the processing patterns demonstrated by L2 speakers in their respective L1s and L2s. The dissertation argues that this approach is most beneficial for the studies in L2 processing.

1.2 Second Language Processing and Second Language Acquisition

In sequential language acquisition, a learner starts her second language having a fully developed grammar of her L1. As described by Schwartz and Sprouse (1996), the initial state of L2 can be viewed as the final (current) state of the L1 grammar. In other words, a start of L2 acquisition is a point in time when the existing grammar begins upgrading to accommodate the norms of the new language. Among the existing approaches to L2 acquisition, the scholars developing Universal Grammar (UG)-based accounts have provided the most consistent explanation of how a new language can develop and co-exist with the already formed system on L1 (Swartz & Sprouse 1996, Vainikka & Young-Sholten 1996, Prévost & White 2000, Slabakova 2000, Dekydtspotter, Schwartz & Sprouse 2006, Montrul & Slabakova 2008, Dekydtspotter et al. 2008, Lardiere 2009, Sprouse

2011, Slabakova 2014, Sokolova 2018, Rothman & Slabakova 2018, Sokolova & Slabakova 2019, see Hawkins & Chen 1997, Tsimpli & Dimitrakopoulou 2007 for discussion). The dissertation follows this research and contributes to its findings with the investigation of how a certain stage of L2 development manifests itself in sentence processing.

UG-based approaches argue that language acquisition in general is governed by a universal potential of the human mind to acquire any human language. In other words, humans are born with an innate sense of hierarchy which allows them to assign certain structures to the incoming sounds, words, sentences (Adger 2019, Meisel 2019, see also Fodor 1998a). This intuitive knowledge of how to organize the flow of sounds into meaningful units is UG and it ensures people's ability to acquire a human language. Being a human specific feature, the UG is equally available to guide language acquisition at any age and for any number of languages being acquired (Swartz & Sprouse 1994, 1996, Vainikka & Young-Sholten 1996, Prévost & White 2000, among others). Therefore, the process of L2 acquisition is fundamentally similar to the process of L1 acquisition in childhood.

The first theories of L2 acquisition viewed it as a process of verification of the current grammar against the new linguistic input (Schwartz & Sprouse 1994, 1996). In other words, a learner starts the L2 with a subconscious assumption that the current grammar of L1 constrains the new language. The latter leads to a parsing failure and the human brain becomes aware of the differences between the L1 and the L2 (Schwartz & Sprouse 1996, Dekydtspotter et al. 2006).

Initially, the theories of L2 acquisition assumed that acquisition in both the L1 and the L2 was fulfilled through the work of the Language Acquisition Device (LAD, see Meisel 2019 for an overview), a metaphor for all mental operations that are performed to acquire languages. Being UG-governed, the LAD ensured the noticing of linguistic differences between the newly learnt language and the L1 and triggered a 'parameter re-setting' in the L2. 'Parameter setting' is a term originally used in the studies in language acquisition. It meant a set of language-specific rules relevant for a given language (Fodor 1998a). In application to L2, parameters originally set for the L1 needed to be re-set in the L2. This broad theoretical approach to the process of L2 acquisition was specified by the studies of Prévost & White (2000), Slabakova (2000), Dekydtspotter et al. (2006), Montrul & Slabakova (2008), Lardiere (2009), Sprouse (2011), Slabakova (2014). These scholars explained L2 acquisition as a process where a set of morphological features specific for the L1 got re-assembled in accordance with the rules of the L2. The entire process was possible because the UG governed any language acquisition.

The dissertation understands the process of L2 acquisition as the process where all new linguistic information is initially checked against the L1 grammar (Dekydtspotter et a. 2006, Lardiere 2009).

Due to cross-linguistic differences, the parser fails to establish direct equivalence, between the L1 and the L2. This mismatch triggers L2 acquisition, where the human mind creates a new representation for a linguistic feature (Lardiere 2009), the new feature is labelled and added to the current grammar (Prévost & White 2000).

The UG-governed human parser plays a crucial role in L2 acquisition. It implements the known L1-like parse in the L2 and establishes the limits of the latter in the new language. The dissertation views the parser as a device that can predict a structure of a real sentence based on the abstract rules of grammar. Therefore, the parser starts the L2 with L1-like parsing governed by the rules of grammar of the native language. After the grammar of the L1 has proven insufficient for L2 input processing, the universally possible rules of grammar start governing the parser and prompt possible structural solutions for the new language. Dekydtspotter et al. (2006) argued that the difference between the L1 and the L2 was the difference between the current state of grammar and the new input being processed. Step by step, the human mind became aware of optionality in sentence parsing between the L1 and the L2 and started showing sensitivity to L2-specific linguistic cues (Dekydtspotter, Donaldson, Admonds, Fultz, Petrush, 2008; Sokolova & Slabakova, 2019).

The dissertation assumes that the human parser is a device responsible for the noticing of linguistic differences between the languages that triggers L2 acquisition. In the process of L2 acquisition the parser can develop in two ways. First, together with the growth in L2 proficiency, the parser may learn the parsing strategies specific for the L2, i.e. it will learn how to differentiate between the L1 and the L2 and how to keep them separate. In this scenario, highly proficient L2 learners will be able to parse their L2 in the target-like manner, which is different from the parsing they implement in the L1. Alternatively, the parser can develop a set of unified parsing strategies applicable for both languages of the speaker. The latter will show in the absence of clear preferences in parsing of structurally ambiguous sentences. The reason the parser becomes aware of structural optionality equally possible in the two languages and activates this information in online processing. This assumption is checked in the dissertation.

The dissertation studies the intermediate level of L2 proficiency with the purpose of finding evidence for either of the developmental paths. The development towards full specification of the parsing strategies in the L2 will show clearly different parsing behavior between the bilinguals tested in their L2s and the bilinguals tested in their L1s. On the other hand, the absence of a clear difference between processing in the L1 and the L2 can signal a tendency to create a unified set of parsing mechanisms applicable for the system ‘L1+L2’.

1.3 Psycholinguistic Approaches to Language Processing

1.3.1 Problematizing Non-Native Processing

Studies in non-native sentence processing began with a debate on the nature of parsing algorithms performed by native and non-native speakers. The Shallow Structure Hypothesis (SSH, Clahsen & Felser, 2006) claimed that non-native processing relied on non-structural information in sentence parsing. It was fundamentally different from parsing in the native language (NL), which was structural (Felser, Roberts & Marinis, 2003; Papadopoulou & Clahsen, 2003; Clahsen & Felster, 2006). The opponents of the SSH argued that L2 processing was fundamentally similar to native processing and, as in native languages, it was based on structural parse (Fodor, 1998; Dekydtspotter et al., 2006; Dekydtspotter et al., 2008; Sprouse, 2006, 2011; Hopp 2014a, 2014b, 2015, 2016; Cunnings 2017; Sokolova in press).

The scholars advocating structural parse in non-native languages built their argument around the role of the human parser in L2 acquisition, i.e. they highlighted the capability of the parser to spot, process and trigger acquisition of a new feature (Slabakova 2000; Dekydtspotter et al. 2006; Montrul & Slabakova 2008, Dekydtspotter & Renuad 2009, Lardiere 2009). Dekydtspotter et al. (2006) claimed that no successful sentence comprehension was possible without deep structural analysis of the sentence. Dekydtspotter et al. (2008) and Sokolova and Slabakova (2019) showed that intermediate speakers of L2 were sensitive to structural cues in their target languages. Hopp (2016) provided evidence that attested behavioural differences in native and non-native processing were of non-linguistic nature.

The scholars concluded that behavioural differences observed through direct comparisons in monolingual and bilingual processing did not necessarily mean fundamentally different processing mechanisms in native and non-native languages. The revised version of the SSH preserved the assumption that non-native processing was more susceptible to the influence of non-structural information than processing in the L1 (Clahsen & Felser, 2018). However, there appeared an alternative explanation of the data obtained. The article by Cunnings (2017) commented on the L2 speakers' susceptibility to the influence of non-structural information but argued that the susceptibility manifested itself at the stage of retrieval of the parsed information from memory.

Currently, the debate is not over. However, the proponents of both approaches agree that the field needs more processing experiments where the focus of the study would shift to the exact mechanisms of sentence processing in non-native languages. The dissertation offers such a study and makes L2 parsing an object of detailed investigation. The study builds its theoretical assumptions on the research findings in monolingual language processing.

1.3.2 Nature of Human Sentence Processing

Human language processing is a complex multi-staged task that begins with joining separate words into meaningful and processable units. To join even the smallest string of two words together, the human brain consults the rules of grammar. The grammar is an abstract set of rules that allows for predicting possible sentences in the language of an individual. Following the rules of grammar, the parser can organize the incoming strings of words into syntactic units that are ready for a semantics check (Frazier & Fodor, 1978; Stowe, 1986; Fodor, 1998; among others). In other words, the human mind builds a mental structural description of a sentence (Phillips, 1996), which is the core of human sentence processing.

To investigate sentence parsing in L2, the dissertation relies on the main research findings in monolingual processing and extends their assumptions to the field of parsing in non-native languages. One of the first characteristics of the human parser established in processing experiments is its incremental nature (Frazier & Fodor, 1978). Sentence processing is performed in chunks and observes the principles of Minimal Attachment and Late Closure. The two strategies were offered by one of the first processing theories – the Garden Path Theory by Frazier and Fodor (1978). The application of these principles means that a sentence is parsed gradually, and every newly processed node can either be attached to the nearest existing node, or a new minimal node can be generated.

The Garden Path Theory highlighted the two capabilities of the human parser: to work bottom-up and attach a new node to the existing structure; and to look top-down and generate a minimally needed node for the up-coming linguistic information. The bidirectional nature of the human parser was further defined as the "left-corner parser" by Crocker (1999). The left-corner parser combines two parsing algorithms, the top-down and the bottom-up one. This parser goes bottom-up to get the information on the existing open nodes and to generate a top-down prediction for the new upcoming nodes.

In a study by Kazanina, Lau, Leiberman, Yoshida, Phillips (2007), the parser's top-down nature is demonstrated in its ability to find a possible antecedent for the cataphora. The spotted antecedent is then checked for gender and number match. This check is performed against the cataphora which has been processed earlier and is placed higher up in the syntactic tree. In other words, the evaluation of the morphological features of the antecedent is performed in the bottom-up manner. The study argues for the grammar-constrained sentence parsing and does not specifically discuss the directionality of parsing operations. However, the interpretation of its findings can be extended to suggest a combination of top-down and bottom-up algorithms in sentence parsing.

Alongside Kazanina et al. (2007), there are many studies that argue for the parser's sensitivity to the rules of grammar. For example, mental structure building is sensitive to island constraints (Stowe 1986, among many others), to binding constraints (Sturt 2003, Kazanina et al., 2007; among others), and to grammatically licenced gaps (Aoshima et al., 2004; Phillips 2013). These studies show that the parser is not trying to locate a gap or find an antecedent in the places not licenced by the rules of grammar. These psycholinguistic findings allow for a conclusion that the human sentence parser is grammatically constrained.

The incremental nature of the parser and its sensitivity to grammar ensures the parser's ability to recover from erroneous structure building. Erroneous structure building is a garden path effect. It occurs when, for example, a sequence of words can be parsed as *subject – verb – object* and the sentence can finish after the object. However, another verb appears and forces the parser to reconsider the existing structure towards two clauses within a complex sentence.

Reanalysis is a cognitively costly procedure and the parser would try to avoid it (Phillips & Schneider, 2000). The scholars argue for an exclusive role of the top-down parser in mental structure building and claim that parsing decisions of the higher processing cycles shape the parsing of lower processing cycles. The only condition that can cause reanalysis is a grammatical conflict of the incoming structure with the predicted one. The study by Phillips and Schneider (2000) opens a door for further investigation. In top-down parsing, there could be a hierarchy of processing cycles because Phillips and Schneider (2000) show that parsing decisions made at the top of the syntactic tree can influence sentence parsing at the bottom.

The dissertation considers the main characteristics of the human parser in its approach to non-native sentence processing. The human parser is grammar-constrained, it uses top-down and bottom-up parsing algorithms, and it is incremental and may be performed in cycles. The study anticipates a structural perdition generated by a perception matrix verb at the top of the tree to be confronted with the bottom-up process of anaphora resolution at the end of the sentence, at the bottom of the tree structure (Grillo & Costa 2014).

1.4 Parsing strategies in sentence processing

The dissertation investigates the implementation of the two main parsing algorithms in sentence processing. It uses the structural flexibility of an ambiguous RC to show how implementation of either the top-down or the bottom-up algorithm can result in two different interpretation patterns of the sentence in (1.1).

(1.1) Bill saw the mother of the woman that was talking about herself / her in the yard

This person was talking about:

(a) the mother (b) the woman

If sentence processing is approached from a perspective of hierarchical organization of processing cycles, the parsing of lower cycles directly depends on the structural prediction triggered by the matrix predicate. A top-down structural prediction will upfold phrase-by-phrase and parsing milestones will be: VP → DP → CP.

At the VP-level, a perception verb in the matrix clause creates an anticipation for several possible complements: VP = V → who-NP / what-NP, for an eventive complement *(ex. The mother of the woman talking)*. At the DP-level, the parser encounters the complex head DP *[DP the mother of the woman]* and marks the who-NP continuation as complete. However, the eventive complement, or the what-continuation, has not been dismissed yet.

The eventive continuation can have a form of a SC *[SC the mother of the woman talking…]* (or a CP, in Russian), VP = V → SC/$_{\text{Rus.}}$CP; SC / CP = NP → VP. Irrespectively of whether the complex NP is parsed as part of a SC in English or as part of a CP in Russian, the upcoming VP will modify the higher DP *[DP the mother of the woman]* in the eventive complement. Consequently, the first noun will become the only grammatically possible doer of the action of talking. Thus, the eventive structural anticipation creates a potential to attach the upcoming constituents to the higher DP.

At the CP-level, the parser encounters the complementizer *<u>that</u>* which is a signal of the RC-continuation. The anticipated eventive structure should be dismissed at this point. On processing the complementizer *<u>that</u>*, the parser changes the structural anticipation from the eventive complement to a restrictive RC. However, it may not need to abandon the prepared modification of the higher DP. The anticipated verbal constituent within the SC will be replaced by the RC and attached to the higher DP *[DP the mother of the woman]*.

The target sentence contains a restrictive relative clause (RC) whose ambiguity to attach higher or lower in the tree cannot create a grammatical conflict with the generated structure with the anticipated modification of the higher DP. Therefore, HA after a perception verb is a feasible parsing option.

The effect of top-down hierarchy of processing cycles will show through anaphora resolution. Anaphora resolution is used as a proxy for RC resolution. When the anaphora is placed at the end of the RC, HA has the higher DP *[DP the mother of the woman]* as the nearest c-commanding element to the anaphora. Following the binding principles (Chomsky, 1981) an event-oriented structural projection that favours HA of the RC yields the pattern of anaphora resolution 'herself = the mother // her = the woman'.

Top-down sentence parsing will result in the overall preference for anaphora resolution like 'herself = the mother // her = the woman' in both languages of the experiment and in all the groups of participants.

Alternatively, sentence parsing can be performed in the bottom-up manner. The bottom-up parser accumulates a certain amount of words before is starts assigning them phrase structure. Therefore, the bottom-up parser does not predict structures but waits to get enough information to assign them.

In the bottom-up algorithms, the VP-level does not anticipate any processing difficulties caused by a perception verb as the parser needs and is waiting for more information about the upcoming constituents. On processing the complex DP, the parser does not experience any additional processing difficulties as no competing structural anticipation exists in bottom-up parsing. The DP-level in bottom-up parsing assigns the complex DP to the matrix verb. At the CP-level, the parser waits till the end of the phrase, then assigns the RC to the higher DP in Russian and to the lower one in English. The bottom-up parser is insensitive to any structural information of a perception verb that can potentially override the established preference for low attachment in English. In Russian, the effect of a perception verb patterns with the established preference for RC resolution.

In accordance with the Binding Principles (Chomsky, 1981), anaphora resolution at the end of the RC works as a proxy for RC resolution. More specifically, the reflexive is bound by the DP which the RC modifies. HA of the RC returns the pattern of 'herself = the mother' in reflexive resolution. LA of the RC results in co-reference like 'herself = the woman.' The pronoun can be bound within the clause if the antecedent does not c-command the pronoun or it is not the nearest c-commanding constituent to the pronoun.

The comprehension task forces the participants to make their interpretation choices between the two head nouns in the complex DP. Therefore, anaphora resolution can return two language-specific patterns following the two options of RC attachment. The Russian-like pattern of anaphora resolution will be 'herself = the mother // her = the woman', and the English-like pattern will be 'herself = the woman // her = the mother'. The two language-specific patterns of anaphora resolution that follow the preferred type of RC attachment are the expected outcomes of bottom-up parsing in English and Russian.

It has been established that the pronoun can be more difficult to process than the reflexive. The reason is in the potential of the pronoun to demonstrate long distance binding and seek co-reference with the matrix subject (see Kenninson 2003 for a detailed analysis). In the given design, the pronoun and the matrix subject do not match in gender. However, the processing of the pronoun may involve additional co-reference check with the matrix subject, which prolongs its processing time as compared to the processing of the reflexive.

The third possible parsing mechanism combines the top-down and the bottom-up algorithms. The dissertation anticipates seeing how the two algorithms complement each other. For example, a top-down structural prediction can be generated phrase-by-phrase and encounter a parsing conflict at the level of the complementizer *that*. At this point, a bottom-up check can amend the generated structure towards a restrictive RC and attach it higher in Russian and lower in English. In a combined use of top-down and bottom-up parsing, the anaphora resolution will yield a language specific pattern, but a perception verb will cause a processing complexity at the level of the complementizer*. The complexity will show in prolonged reading time at and after the complementizer that* in English.

1.5 Research Questions addressed in the thesis

The dissertation puts forward two main research questions (RQ). The first question is focused on a detailed investigation of human sentence parsing. The second one describes the intermediate level of L2 proficiency through the analysis of the parsing behaviour of the participants.

RQ 1: Do top-down and bottom-up parsing algorithms complement each other in sentence parsing?

Hypothesis 1 to RQ 1

Top-down and bottom-up algorithms complement each other in sentence processing: parsing starts with a top-down structural prediction that undergoes bottom-up checks for grammatical fitness at every processing cycle.

RQ 1.1: Is there an overall preference for the pattern of anaphora resolution ‘herself = the mother / her = the woman’?

RQ 1.2: Is there a language-specific pattern of anaphora resolution 'herself = the mother / her = the woman' in Russian and 'herself = the woman / her = the mother' in English?

RQ 1.3: Does a perception verb in the matrix clause increase sentence complexity at the embedded verb?

RQ 1.4: Does a perception verb in the matrix clause increase general sentence complexity?

RQ 1.5: Are there any factors other than a perception verb that increase sentence complexity?

RQ 2: Does knowledge of another language at the intermediate level of proficiency have an effect on sentence parsing?

Hypothesis 2 to RQ 2

L2 processing at the intermediate level of proficiency is L1-governed and shows no evidence of L2 processing in the TL-like manner.

RQ 2.1: Is sentence parsing at the intermediate level of L2 proficiency influenced by L1 parsing hypothesis?

RQ 2.2: Is there evidence for L2-like sentence parsing in intermediate L2 speakers of Russian and English?

1.6 Organization of this thesis

The dissertation investigates the first level of sentence processing – structural parse – and addresses the question what parsing algorithms native and non-native speakers of English and Russian use. To provide a well-rounded description, the study registers the participants' interpretation preferences, measures their reading time and records the time taken to answer a comprehension question. The study describes the established processing patterns of monolingual and bilingual groups. The analysis also comments on the effects of knowledge of another language on sentence processing.

The thesis starts with a theoretical overview of human language processing. The first chapter discusses the existing approaches to language processing and the possible parsing mechanisms. The chapter also highlights the approaches to non-native processing and the main scholarly debate in the field.

The second chapter reviews the linguistic literature on RC attachment resolution, anaphora resolution and the phenomenon of a perception verb. This chapter explains how sentence structure in Russian and English informs the main processing predictions of the dissertation.

The third chapter explains the psycholinguistic predictions of the dissertation. It explains the notion of processing cycles in both Russian and English. This chapter also describes how the flexibility of the ambiguous RC shows that top-down and bottom-up parsing can result in different patterns of anaphora resolution and what processing behaviour is expected if the two algorithms complement each other.

The fourth chapter provides rationale for the research questions and puts forward the hypothesis of the dissertation. Chapter 5 describes the experimental methods and the ethics procedure. Chapters 6 and 7 provide results of two experiments. Experiment 1 described in Chapter 6 is a study with monolingual participants. Experiment 2 is a study investigating L2 speakers of Russian and English. Chapter 7 is devoted to Experiment 2. Chapter 8 is a general discussion of results, of their scholarly significance and of the implications for the thesis for future research.

The dissertation also contains a reference list and appendices.

Chapter 2 Human Language Processing: Theoretical Approaches

2.1 Introduction

Human sentence processing is a complex mental operation that brings together humans' abstract knowledge of the rules of grammar and their implementation in real life processing. A big question in human language processing concerns mental structure building in sentence parsing. In real-life reading, sentences appear word-for-word and word orders vary from language to language. However, the human parser organizes word sequences into meaningful units, assembles the units into sentences, and sentences into discourses. Moreover, the parser knows how to implement the relevant rules in more than one language. The latter motivates a scholarly interest in native and non-native language processing for comprehension. Processing studies try to address a question of how exactly the human brain organizes the incoming strings of words to meet the rules of the grammar and ensures successful sentence comprehension.

This chapter summarizes the main scholarly achievements in the studies of human language processing. It starts with a historic overview of processing studies that approach language processing from linguistic and non-linguistic perspectives. The chapter provides arguments that sentence comprehension is a multi-staged, complex computational process, which starts with assigning a structural form to a sentence and ends up with checks for meaning and semantics interpretation (Ferreira & Clifton, 1997, following Frazier, 1974, 1990; Rayner, Carlson & Frazier, 1983; Frazier & Fodor, 1978).

The chapter focuses on the first processing stage – mental structure building or, in terms of Phillips (1996), on building structural descriptions of sentences during language processing. It analyses the top-down and the bottom-up algorithms of structure building, as well as their possible alternative – a hybrid parsing algorithm or left-corner parsing (Crocker, 1999).

The chapter also explains how the findings in monolingual sentence parsing motivated a scholarly debate in non-native processing. It gives an overview of the two opposed approaches to non-native processing. The debated hypotheses are shallow processing (Clahsen & Felser, 2006, 2018; among others) vs. structural processing (Dekydtspotter et al., 2006; among others) in non-native (L2) languages. The chapter provides arguments in favour of structural processing in the L2. The reviewed approaches form the framework for the experimental part.

In summary, the chapter reviews scholarly theories on native and non-native processing with the focus on the approaches where mental structure building is the baseline of sentence comprehension. It provides theoretical rationale for the detailed study of parsing algorithms in native and non-native languages taken in the dissertation.

2.2 The Garden Path Theory

Active research in human sentence processing started with the Garden Path theory (the GP, Frazier & Fodor, 1978; see also Kimball, 1973), which described human language processing as a mental process constrained by the Universal Grammar (UG). The GP prioritized the role of syntactic information in sentence processing and offered a model of serial sentence parsing which began with the syntactic processor and involved several processing modules (syntactic, thematic, etc) (Frazier and Fodor, 1978).

A subdivision of the entire mechanism of sentence processing into several modules suggested a certain hierarchical order of parsing operations. According to the GP theory, sentence comprehension started in the syntactic module, which was only sensitive to the information expressed in its representational vocabulary. The syntactic module processed phrase-structure information and verb subcategorization information (Ferreira & Clifton, 1986; Frazier & Clifton, 1997; Frazier & Traxler, 2008). The GP scholars argued that the syntactic parser was not sensitive to semantic properties of nouns, even when those properties pointed to certain thematic roles (Frazier & Fodor, 1978; Ferreira & Clifton, 1986; Frazier & Clifton, 1997; Traxler & Pickering, 1996; Traxler, Pickering & Clifton, 1998, 2000; Frazier & Traxler, 2008).

The GP viewed mental structure building as the foundation of sentence processing and understood structure as a source of meaning. In the GP approach, sentence processing started with structure building that was performed at the initial parse. Afterwards, a fully formed structure was sent to other processing modules for semantics and pragmatics checks.

Being a model of serial parsing, which occurred at different levels, the GP also explained how the initial structural parse was performed. Human sentence parsing followed two main principles: Late Closure and Minimal Attachment (Frazier & Fodor, 1978). Late Closure enabled the parser to attach the incoming words to the nearest syntactic node. If the attachment was impossible the parser was licensed to create a new minimally needed node (Minimal Attachment).

According to the GP, the principles of Late Closure and Minimal Attachment worked together, which assigned the human parser certain characteristics. First, it was incremental and occurred while a string of words in the sentence was encountered (Frazier & Rayner, 1982). Second, it could recognize the incoming syntactic category, backcheck its structural fitness to the processed nodes, and anticipate and generate a new node. This functional description of the human parser motivated many studies of parsing algorithms (Frazier & Clifton, 1997; Traxler, Pickering & Clifton, 1998, 2000; Hawkins, 1999; Aoshima et al., 2004; Frazier & Traxler, 2008; Hofmeister & Sag, 2010; Phillips, 2013). At the same time, the priority for structural parse in sentence processing faced resistance in the field.

The GP theory was opposed by the constraint-based model of language processing (MacDonald, Pearlmutter, Seidenberg, 1994; Trueswell & Tannenhaus 1994). The authors of the constraint-based model argued that semantic and syntactic information was equally available in the course of sentence parsing. The model rejected the priority of mental structure building to semantic information in sentence processing. Another challenge came from the functionalist approaches to human language processing (Pritchett, 1992; Kluender & Kutas, 1993; among others). These scholars argued that rules of grammar did not govern sentence processing. Functionalists claimed sentences could be too complex to process but processing did not depend on grammatical constraints.

Despite the scholarly challenges, the GP was an influential theory which started the field of sentence processing by putting together word-for-word sentence presentation as it appears in real-life (reading) and mental structure building. In other words, the GP showed how a linear sequence of words could get organized into a hierarchical structure with different levels of syntactic modification.

2.2.1 Structural Processing at the Initial Parse

The main assumptions of the GP theory have been supported by Stowe (1986), Gilboy, Sopena, Clifton, & Frazier (1995), L Ferreira and Clifton (1996), Pickering and Traxler (1996), Frazier and Clifton (1997), Traxler, Pickering and Clifton (1998, 2000), Hawkins (1999), Aoshima et al. (2004), Frazier and Traxler (2008), Hofmeister and Sag (2010), Sprouse, Wagers, and Phillips (2012), Phillips (2013, see also Lewis & Phillips, 2015), among others. These studies used various syntactically complex sentences to show that the syntactic processor and the thematic processor operated in two different modules and structural parse occurred before the semantic one. However, this approach caused a scholarly disagreement and was opposed by the models claiming that syntactic and lexical-semantic information were equally available to the parser and were used simultaneously (MacDonald et al. 1994, Trueswell and Tannenhaus 1994, Mitchell 1987).

Studies that debated the priority of structural parse took a closer look at processing of structural ambiguities. For example, the study by Trueswell, Tannenhaus and Garnsey (1994) measured semantics effects in ambiguity resolution in sentences *like The defendant / evidence examined by the lawyer turned out to be unreliable*. The target sentences of the experiment were temporarily ambiguous. The *-ed* on the examined could be a past tense marker for a verb in the main clause, or a participle marker in a reduced RC. According to the authors, the animate noun could be a potential Agent of the verb examined, which created temporary ambiguity between the past tense and the passive participle reading of examined in the target sentence. In other words, the animate noun created an ambiguity between the potential of the word examined to be either the matrix verb in the main clause or a past participle in the reduced RC. The inanimate noun the evidence was a plausible Theme in the target sentence whose semantics dismissed a potential for structural ambiguity.

Trueswell, Tannenhaus and Garnsey (1994) predicted that the semantics of the nouns would facilitate sentence processing, i.e. the inanimate nouns would be processed faster due to the facilitative effects of their semantics. At the same time, animate nouns were expected to cause difficulties in mental structure building of the unfolding sentence. The results of the experiment met the predictions of the authors and showed that animate nouns such as *the defendant*, increased processing difficulty of the target sentences even though the sentence structure remained the same.

Trueswell, Tannenhaus and Garnsey (1994) used their findings to argue that syntactic and semantic information was equally available to the parser and word semantics could also be used at the initial stages of sentence parsing. The authors proposed that structural information may lead sentence processing in unambiguous cases. However, the syntactic parser consulted the semantic information to make a difficult parsing decision in the case of structural ambiguity (see also MacDonald et al. 1994, Trueswell and Tannenhaus 1994б, Tannemhaus, Spivey-Knowlton, Eberhard & Sedivy 1995).

The findings by Trueswell and Tannenhaus (1994) were representative for constraint-based approaches (MacDonald et al. 1994, Trueswell and Tannenhaus 1994, Tannenhaus et al. 1995) and the Lexical Likelihood Model (Mitchell, 1987). These scholars brought the strength of a semantic constraint to the foreground and claimed that sentences with a strong semantic fit between the subject and its verb were processed as easily as unambiguous controls. However, there was no clear definition of the “strength” of the semantics factor and the scholars explained it through structural or lexical frequency of a given linguistic phenomenon in the discourse.

The terminological uncertainty about the “strength” or ‘weakness” of a processing constraint and the findings that the parser may be consulting semantic information to resolve structural ambiguities motivated more research in the field (Stowe 1986, Ferreira and Clifton 1996, Pickering and Traxler 1996, Frazier and Clifton 1997, Traxler, Pickering and Clifton 1998, 2000). The new studies measured whether parser’s sensitivity to either structural or non-structural information was prompted by discourse.

The use of discourse to prompt a certain option of ambiguity resolution eliminated the problem of the “strength” of a constraint, which was based on “local frequency”. In the experiments by Ferreira and Clifton (1996) and Pickering et al. (2000), all the non-structural information that could influence sentence parsing was organized in a text that preceded the target sentences and straight-forwardly prompted their ambiguity resolution. Ferreira and Clifton (1996) and Pickering et al. (2000) tested the predictions of the GP theory as opposed to the predictions of the models that claimed parallel activation of syntactic and semantic information in the course of sentence processing (MacDonald et al. 1994, Trueswell & Tannenhaus 1994). The studies used behavioural methods to check whether semantic or discourse-pragmatic information would influence the participants’ reading times or gaze direction and duration.

A study by Ferreira and Clifton (1996) investigated the effects of discourse and pragmatic information on the reaction time in processing of reduced relative clauses (RC) in an eye-tracking study and in a self-paced reading experiment. The target sentences were ambiguous RCs. They followed a text that favoured a certain RC interpretation. If discourse information was considered at the initial parse, the study expected to see faster reading times of the prompted constituents. However, the study did not report any effect of the disambiguating context on the reading time of the RC. Ferreira and Clifton (1996) concluded that discourse-prompted sentences were not read faster because discourse information did not help sentence parsing.

Another study (Pickering et al. 2000) tested the human parser and its sensitivity to the effects of discourse and semantics. The scholars studied how English monolinguals read a set of complex sentences. Some of the sentences contained syntactically plausible nouns, the other ones had semantically or discourse-prompted nouns. The plausibility of a word was expected to speed up the reading time of the participants. The effect was only reported for syntactically plausible nouns, which were read faster. However, the participants’ reading time was not affected by semantic or discourse plausibility of the nouns. The authors concluded that sentence parsing did not consider either semantics or discourse-related information at the initial parse.

On the one hand, the results of Pickering et al. (2000) and Ferreira and Clifton (1996) contradicted the findings by the proponents of constraint-based processing. Pickering et al. (2000) and Ferreira and Clifton (1996) concluded that non-syntactic information did not guide the initial stages of sentence processing or was not used at the initial analysis. However, these findings were not completely opposite to what was claimed by Trueswell, Tannenhaus and Garnsey (1994) or MacDonald et al. 1994 (among others), since none of the approaches rejected the importance of syntactic information. The studies by MacDonald et al. (1994), Trueswell and Tannenhaus (1994) Trueswell, Tannenhaus and Garnsey (1994) stated that semantic and discourse-pragmatic information guided structural processing when syntactic alternatives were possible. At the same time, they agreed with Pickering et al. (2000), or Pickering and Traxler (1996), or Frazier and Clifton (1997) about the priority of structural parse in sentences with no syntactic ambiguities.

In other words, the models of constraint-based processing (MacDonald et al., 1994; Trueswell & Tannenhaus, 1994; Mitchell, 1987) claimed that both structural and non-structural information was co-activated throughout the entire process of sentence parsing. However, the effects of non-structural information were only noticeable in the condition of structural ambiguity and the processing need for its resolution. The constraint-based approach to language processing put forward a question of when exactly the parser that started with structure building received the feedback that could cause reanalysis and the use of semantic information (see MacDonald, 1994 for discussion). This question challenged the findings by the GP scholars and significantly moved the field of language processing forward.

In attempts to answer the question when the parser starts consulting with non-syntactic information inspired a closer look into how processing was unfolding and what stages it was going through. In their immediate response, The GP scholars stuck to the assumption that the thematic processor operated after the syntactic processor and worked with ready-made structures (Ferriera & Clifton 1996, see also Frazier & Clifton, 1997; Traxler, Pickering & Clifton, 1998, 2000; Frazier & Traxler 2008). The GP scholars claimed that the thematic processor corrected the information so quickly that it was impossible to trace in either self-paced reading or eye tracking. In this approach only higher sensitivity experimental techniques could bring the answer to the question of the sequential order of parsing operations (see Ferreira & Clifton, 1996; Pickering & Traxler, 1996 Frazier & Clifton, 1997; Traxler, Pickering & Clifton, 1998, 2000 for full review).

A serious step in understanding how structural and semantic information informed the human parser was made by van Gompel and colleagues when the scholars proposed the Unrestricted Race Model of sentence parsing (van Gompel, Pickering & Traxler 2000). Frist, the study went against the hypothesis of parallel activation in syntax. The proponents of constraint-based approaches suggested that syntactic processing was the same as lexical processing, where all homophonous words were co-activated during word-recognition. As a result, lexical cognates were processed slower than the words with no homophonous competitors. Van Gompel et al. (2008) showed that globally ambiguous relative clauses (RC) were processed faster than the sentences with disambiguation towards one of the possible interpretations. Unlike in lexical processing, optionality in interpretation did not hinder sentence parsing. The race model suggested a serial parse where only one structure could be built at a time, but the structure could be predicted based on the information from multiple sources (van Gompel et al. 2000). The authors of the race model meant that the parser could anticipate multiple structures to follow a given word in a sentence, but it would generate the projection that received most support from non-structural sources of linguistic information (van Gompel et al. 2000). In this form, the race model put together the assumptions of the GP and the constraint-based processing models and suggested predictive parsing.

The question of predictive power of different linguistic sources that would inform mental structure building was developed by Levy in his Surprisal model (2008, see also Hale 2001). Unlike the race model, the Surprisal (Levy 2008) was a model of parallel processing. In this model, disambiguation in sentence comprehension was a process of resource re-allocation based on the probability that a certain word would follow the fragment already processed. In the Surprisal, processing difficulty could be pre-calculated and estimated as a certain amount of *surprisal* the word would give the comprehender, i.e. as the probability of certain elements to appear in a sentence. The calculations were based on linguistic corpora that showed word frequency in certain syntactic and semantic contexts: the higher the probability of the word to appear, the lower the *surprisal*, i.e. the easier this sentence fragment would be processed (Levy 2008). These probabilistic calculations went in line with the original GP theory and the race model when they predicted that globally ambiguous sentences were easier to process than locally ambiguous ones. In disagreement with the GP and the race model, the Surprisal advocated parallel processing that operated different types of linguistic information and built multiple structures at the same time.

More support in favor of serial parse came from the studies by Phillips (1996), Aoshima et al. (2004), Kazanina et al. (2007), Sturt (2014), and Phillips (2013, see also Lewis & Phillips, 2015) that focused on the investigation of parsing algorithms. These studies took a closer look at how exactly mental structure building was performed and attempted to describe how the initial parse unfolded and what exactly caused reanalysis. The experiments by Phillips (1996), Aoshima et al. (2004), Kazanina et al. (2007), and Phillips (2013) constitute the framework for the dissertation and will be reviewed in the following sections.

2.2.2 Processing Complexity or Grammatical Constraints

The previous section reviewed a scholarly debate over the role of structure building in sentence processing and showed that structural parse is the underlying mechanism of human language processing. However, none of the linguistic studies reviewed in the previous section considered general psychological factors that influenced sentence processing.

A psychological approach to sentence processing was taken by the functionalist scholars, who viewed the human language as a feature of human communication and denied the existence of an independent linguistic system outside the human mind. The functionalist approach assumed that psychological factors were enough to explain human sentence processing (Kluender & Kutas, 1993, see also Lewis, Vasishth, Van Dyke, 2006). In other words, functionalists denied the notion of the grammar as a set of rules that informed the human parser and could tell it whether the sentences were well-formed or not (Kluender & Kutas, 1993; see Pritchett, 1992; Hawkins, 1999; Sprouse, Wagers & Phillips, 2012 for discussion).

The disagreement between functionalism (processing accounts) and formalism (grammatical accounts) concerned the processing of certain types of sentences (2.1), which were normally rejected by native speakers of English (Stowe, 1986; Kluender and Kutas, 1993; Pritchett, 1992; Hawkins, 1999; Sturt, 2003). The debate between grammatical and processing accounts put forward a research question of whether sentences like in (2.1) were ungrammatical or unparseable and processable. In other words, the question aimed at explaining the processing difficulties that sentences like (2.1) caused.

*(2.1) What do you think [RC-island that I like *t______]?*

In (2.1), what forms a long-distance dependency, the question word is moved to the beginning of the sentence and leaves a trace behind it. In non-grammatical terms, the placement of a potential answer to the questions what is after the verb like in (2.1), i.e. the question word occurs at the very beginning of the sentence and the place of its answer incorporation is at the very end of the sentence.

According to Kluender and Kutas (1993), the sentence in (2.1) was difficult to parse because it overloaded the speaker cognitively. To comprehend the sentence, *what* should be held in short-term memory for a very long time because its possible placement was far. In other words, the longer the search for where to incorporate the *what* constituent, the more cognitive load was experienced, and the more complex the sentence was. Therefore, processing accounts claimed that sentences like (2.1) were unparseable and sentences like (2.1) overloaded human processing capacity due to their processing complexity.

Alternatively, a grammatical account for human language parsing offered a structural explanation of the complexity of (2.1). According to the grammatical accounts, the RC *[$_{RC}$ that I like]* in (2.1) was an island, or a grammatical constraint that blocked the movement of any constituents out of it (see Ross, 1967; Chomsky, 1977). In the grammatical accounts, wh-movement in (2.1) violated an RC island-constraint and made the sentence ungrammatical (Ross 1967, Chomsky 1977, Stowe 1986, Pickering and Traxler 1996).

Offering two alternative explanations of why (2.1) would be rejected by native speakers, the processing and the grammatical accounts demonstrated two different views of sentence complexity. In processing accounts, a lengthy sentence would be more difficult to process because the human brain must hold a lot of information in the memory buffer for long time. From this perspective, longer sentences were always more complex. This view was belied by grammatical approaches that showed that longer did not necessarily mean more complex.

In linguistic approaches, sentence complexity meant structural complexity, which did not necessarily result in increased length of a sentence. For example, a long sentence with a series of coordinated constituents in (2.2) would be easier to parse than a shorter sentence with a wh-dependency in (2.3).

(2.2) I like ice-cream, Bill likes yogurt, Jeanne likes coffee and Ross likes tea.

(2.3) What do you think________ I like_______?

The sentence in (2.3) is shorter that in (2.2), but its structure contains a moved wh-constituent *what*, a trace like *t*_____ and an intermediate trace think *t*_____. The example in (2.2) is a series of simple clauses joined together, which increased the length of the sentence but not its structural complexity.

In summary, the main difference of a linguistic approach is that sentence complexity is not estimated through its length but through its syntactic structure. This framework shaped a series of processing studies that opposed functionalist accounts and investigated how grammatical constraints manifested themselves in sentence processing (Stowe, 1986; Hawkins, 1999; Sturt, 2003; Aoshima et al., 2004; Kazanina et al., 2007; Hofmeister and Sag, 2010; Sprouse et al., 2012; Phillips, 2013; Cunnings & Sturt, 2014). These studies mainly used island-constraints and long-distance dependencies, like in (2.1).

The studies by Sturt (2003) and Hofmeister and Sag (2010) challenged the functionalist assumption of the crucial role of the length of a sentence. In Sag (2010), the target sentences in both experiments were matched in length: Half of the stimuli had multiple subordinations but no islands, while the other half of the stimuli were sentences with islands. The results showed that lengthy sentences without island constraints were processed successfully, whereas islands were impossible to parse.

These findings undermined the functionalist approach and showed that sentence length on its own did not explain processing difficulties, as the island and the non-island sentences were matched in length. An extended sentence length did not create enough complexity to make the target sentences unparseable. However, the grammatical island condition did.

The experiments by Stowe (1986), Pickering and Traxler (1996), Hawkins (1999) and Phillips (2013) used eye-tracking and self-paced reading techniques to measure the participants' sensitivity to structural gaps. In Phillips (2013), the target sentences were sets of sentences with grammatically licensed gaps vs. sentences with parasitic gaps. The participants slowed down their reading times or changed the direction of their gaze at the spots where structural gaps were grammatically licensed. Sentence fragments, where the grammar would not predict any gap, were read fast or without any change in gaze direction or duration.

Similar results were attested by Aoshima et al. (2004), Kazanina (2007) and Phillips (2013). The participants also slowed down their processing in the places with grammatically licensed gaps. The authors concluded that the parser anticipated a licensed gap, which was evidence of grammatical constraints in sentence parsing (Aoshima et al., 2004; Phillips, 2013).

A study by Kazanina et al. (2007) measured the increase in processing load in sentences with the cataphora and checked for possible structural predictions for a place of a potential antecedent. The authors reported that the parser started searching for a potential antecedent as soon as the anaphoric element was encountered. This provided more evidence for grammar-governed sentence parsing. The study also showed that the human parser was capable of generating structural predictions and checking for their validity.

The processing experiments reviewed in this section provided a historic overview of the scientific debate between functional and grammatical approaches to human language processing. This section showed that cognitive approaches to language processing did not exhaustively explain the nature of processing difficulties. At the same time, studies investigating the role of grammatical constraints in sentence processing achieved serious results and provided a well-rounded description of the nature of the human parser.

The linguistics-based studies established that human sentence parsing was incremental and grammatically constrained. Besides, the rules of grammar informed the parser and enabled structural predictions. The validity of a structural prediction could be verified throughout the time course of sentence processing, as shown in the study by Kazanina et al. (2007). This study was the first attempt to describe the combinatorial nature of the human parser. It motivated the investigation of the nature of parsing algorithms undertaken in the dissertation.

2.3 Parsing Algorithms

2.3.1 Parsing Operations: Relative Clause Attachment

As can be gathered from the previous sections, structural parsing is the primary mechanism of sentence comprehension that is implemented at the initial processing stage. This section reviews the existing literature that describes and analyses the mechanisms of mental structure building.

The first characteristics of the syntactic parser were provided by the GP theory. It spoke about the minimality of a processing step in structure building: in sentence processing, a new constituent was either attached to the nearest existing node or a minimally needed structural node was generated. Following the main assumption of the GP theory, early processing studies viewed Late Closure, as a universal principle of sentence parsing.

The main evidence for the universality of Late Closure came from an established preference for low attachment in RC resolution (2.4).

(2.4) Bill saw the mother of the woman [RC that was talking].

In sentences like (2.4), native speakers of English prefer the interpretation <u>*the woman was talking*</u>, where an alternative reading <u>*the mother was talking*</u> is grammatical too. To assign the RC to the head DP *[DP the woman]* is low attachment of the RC (LA) and it is generally preferred in English. An alternative grammatical interpretation is the mother was talking. It is high attachment (HA) resolution of the RC, because the RC is attached to the higher DP *[DP the mother of the woman]* in the syntactic tree.

The universality of LA in RC resolution was brought into question by Cuetos and Mitchell (1988). The study expected faster reaction times in the universally preferred LA condition. However, native speakers of Spanish showed HA preference and no faster reaction time in LA condition. The findings by Cuetos and Mitchell (1988) inspired further research. As a result, cross linguistic variation in RC resolution was established and RC attachment preference was classified as a language-specific phenomenon.

Nowadays, there are two language groups for RC resolution: HA languages and LA languages. The HA languages are German, Russian, French, Spanish, Italian, and Greek (Cuetos & Mitchell, 1988; Fodor, 2002; Grillo & Costa, 2014; Sokolova & Slabakova, 2019, Sokolova in press). The LA languages are Swedish, Norwegian and English (Fodor, 2002; Sokolova & Slabakova, 2019; Sokolova in press, among others).

Beginning with the experiments by Cuetos and Mitchell (1988), Late Closure, stopped being viewed as a parsing universal. However, it remained a focus of processing studies and lead to the revisions of the original version of the GP theory. In 1996, Gibson, Pearlmutter, Canseco-Gonsalez and Hichock offered the Construal model of sentence processing viewing the Principle of Recency as the main principle of structure building. The Principle of Recency held true within the argument structure of the verb, which was called the primary syntactic structure by Gibson et al. (1996). The study argued that parsing of the primary syntactic structure followed the principle *attach to the nearest node*. Meanwhile, this principle did not cover RC attachment resolution. According to Gibson et al. (1996), the RCs belonged to the secondary syntactic structure, or the group of adjuncts, which meant that RC resolution did not obey the Principle of Recency but needed to be attached as close to the main verb as possible.

The main theoretical claim of Gibson et al. (1996) was that the role of the verbal predicate was more important in processing secondary structures than primary structures. According to the authors, the incoming information was attached as close to the head of the matrix predicate phrase as possible. In the case of RC, the higher DP was always closer to the matrix predicate. For this reason, HA of the RC was preferred in many languages.

Frazier (1990) described the prominence of the verbal predicate as the principle of Relativized Relativity. Gibson et al. (1996, see also Gilboy et al., 1995) specified it as the principle of Predicate Proximity. The studies by Frazier and Clifton (1997), or Frazier (1990), or Gibson et al. (1996) claimed that the implementation of a certain parsing mechanism was not constant. It could vary depending on the types and the hierarchical order of syntactic modifications in a given sentence. However, these studies did not solve the mystery of cross-linguistic variation in RC attachment resolution.

The principle of Predicate Proximity explained HA in many languages, but it did not explain LA in English. As in other languages, the RC is a secondary structure in English. However, it remained unclear why English parsing observed the Principle of Late Closure whereas, for example, Russian parsing followed the principle of Predicate Proximity.

Even though the principle of Predicate Proximity did not provide an exhaustive explanation of the variance of RC attachment preferences across languages, it highlighted the role of the matrix predicate in sentence parsing. The significance of the matrix predicate and its effect on the parsing for RC resolution was revisited in the study by Grillo and Costa (2014). The experiments by Grillo and Costa (2014) and Grillo et al. (2015) investigated a universal ability of a perception verb in the matrix predicate to favour HA in RC resolution. The analysis by Grillo and Costa (2014) informed a prediction for top-down structure building in sentence parsing that was checked in the dissertation. The effect of a perception verb in the matrix clause on RC resolution will be described in detail in the following sections of the dissertation.

2.3.2 Directionality of Parsing Algorithms

The literature reviewed in the previous sections shows that processing studies began with a general description of the nature of human language processing. They established that human parsing was incremental, and it was governed by grammatical constraints. Later, the focus of the processing experiments narrowed down to the investigation of how exactly the main grammatical principles informed sentence parsing (Frazier & Rayne, 1982; Rayner, Carlson & Frazier, 1983; Clifton & Frazier, 1989; Phillips, 2013, among others). Studies by Aoshima et al. (2004), Kazanina et al. (2007), and by Phillips (2013) aimed at performing a detailed analysis of parsing mechanisms that would provide a clear picture of how the human parser worked. These studies investigated the order of parsing operations and how exactly mental structure building was performed.

First, Frazier and Clifton (1987) carried out a study of filler-gap dependencies and claimed that gaps were not analysed till the end of the sentence. Pickering and Barry (1991) suggested that the parser waited at least till the location of the gap was reached to form a dependency (see also Frazier & Rayner, 1982; Rayner et al., 1983). The findings of these studies can be summarized in the following way – the formation of dependencies in sentence parsing is performed in a bottom-up manner: the parser postpones the formation of a dependency till the relevant constituents are fully parsed.

An alternative algorithm of structure building was offered by Phillips (2003). His approach suggested top-down parsing, which was incremental and based on structural prediction. More experimental evidence for structural prediction and its role in sentence parsing came from the studies of long-distance dependencies in the sentences with parasitic gaps (Aoshima et al., 2004; Phillips, 2013; Phillips et al., 2013). In these studies, the parser started looking for the gap right after a filler was encountered. An early search for the gap suggested that the parser was charged to find the nearest possible location of the gap. In other words, the gap was predicted. In the search for a gap, the parser checked all grammatically possible options, which resulted in slowdowns of reading times at the location of the parasitic gaps (Aoshima et al., 2004; Phillips, 2013).

In summary, the suggested top-down mechanism of structure building claimed that every word that was encountered by the parser created a certain structural anticipation and the parser generated a structural prediction. This prediction took the form of a top-down structural projection that needed to be checked for its grammatical fit.

From the point of view of cognitive economy, a generated structure needed a grammatical check for its fitness and could not remain unnoticed till the end of the sentence. A study by Kazanina et al. (2007) showed that top-down structural predictions could be combined with bottom-up checks. The study used cataphora and showed that the parser started looking for an antecedent for the anaphora right after the pronoun element was encountered. This was taken as evidence for top-down prediction in sentence parsing. On finding a potential antecedent, the parser performed checks for the final grammatical match, i.e. it checked for the gender and number match. The study by Kazanina et al. (2007) did not speak about a combination of top-down and bottom-up algorithms but its findings can be understood as such. The description of the parsing mechanism in Kazanina et al. (2007) brought together the top-down and the bottom-up parsing algorithms and showed how they could complement each other.

The findings by Kazanina et al. (2007) supported the role of grammatical constraints in sentence parsing. At the same time, the results addressed the problem of cognitive economy in sentence processing. It is less costly for the parser to perform intermediary checks for a grammatical fit of the generated structural prediction than to keep it suppressed till the end of the sentence. Besides, bottom-up checks for grammatical fitness have the potential to spot a structural mismatch at early processing cycles. The erroneously built structure can be amended online, which reduces the cognitive costs of reanalysis.

2.3.3 The Problem of Reanalysis

Linguistic approaches to research in human sentence parsing and mental structure building have achieved a lot. They described the nature of the human parser and its possible functioning in online processing. Besides, the investigation of language processing has become an object of study of computational linguistics. Technical approaches to language processing vary from the assumptions that either top-down or bottom-up algorithms can solely account for sentence parsing to the claims that there could be multiple combinations of parsing algorithms where both top-down and bottom-up algorithms would be involved and complement each other. Crocker (1999) called the top-down and the bottom-up parsing the two endpoints on the direct line of all possible combinations of parsing algorithms.

Following the existing literature, the dissertation investigates mental structure-building in sentence comprehension and aims at establishing whether one of the parsing algorithms, either the top-down or the bottom-up, could account for the interpretation decisions in the experiment. Alternatively, there can be a combination of the two parsing algorithms, where they complement each other. If this is the case, it is worth checking whether each of the two algorithms is equally involved in mental structure building or whether one of them performs the main parse and the other one is responsible for a follow-up check for the grammatical completeness of the structure.

The top-down and the bottom-up parsing differ in the directionality of mental structure-building. As described by Crocker (1999), bottom-up parsing traces the incoming word back to the structural information that has already been processed and checks for the structural fitness of the incoming constituent. If this check is satisfactory, the formed mental structure of the tree is moved up to the top of the "stack"[1] and the parser is ready to process new constituents (Crocker 1999). Alternatively, top-down parsing begins from a structural expectation of a sentence (S / TP). On encountering the first word, the parser categorizes it. Then, it creates an expectation for possible incoming syntactic nodes based on the category of the first node. The triggered structural anticipation takes the form of a mental syntactic tree that expands downwards (Crocker 1999).

The description of top-down and bottom-up parsing provided by Crocker (1999) is shared by most linguists and psycholinguistics (see Frazier & Fodor, 1978; Pritchett, 1999; Phillips, 2003; Phillips et al., 2013). It describes parsing stages in accordance with the hierarchical order of the constituents in a syntactic tree and phrase structure. If applied to a linearly presented sentence, the top-down parsing will make structural predictions from the first word in the sentence to the last one, i.e. from beginning to end. The bottom-up parser, on the contrary, will accumulate the structural information and work from the end of a sentence to the beginning.

The bottom-up parser looks less prone to structural errors. Meanwhile, both algorithms have serious limitations. Neither bottom-up nor top-down parsing on its own is a sufficient parsing algorithm from the point of view of cognitive economy. In the bottom-up algorithm, all the

[1] A special term used in Crocker (1999) to describe the storage place for the processed structures.

processed sentence fragments are stored in memory. Therefore, to retrieve a constituent for reanalysis is cognitively costly (Frazier, 1990; Crocker, 1999; Frazier & Clifton, 1998; Phillips & Schneider, 2000; Cunnings, 2017). The main drawback of the top-down parser is the arbitrary nature of its prediction. It is next to impossible to predict the structure of the entire sentence right after the first element appears. To amend the wrong prediction the parser will have to go for reanalysis and the problem becomes the same as in bottom-up parsing: The processed constituents must be retrieved from the memory and reanalysed.

The problem of cognitive economy suggests an option for a combinatorial use of top-down and bottom-up parsing. The study by Kazanina et al. (2007) reviewed in the previous section provides experimental evidence for the top-down structure building that is followed-up by bottom-up checks for grammatical fitness. A combination of the two parsing algorithms can reduce the cognitive cost of reanalysis. However, no parser can completely avoid it. Any syntactic ambiguity assumes optionality of sentence structure, where only one analysis should be selected at the end. The way the human parser deals with the need for reanalysis was studied by Frazier (1990), Frazier and Clifton (1997), and Phillips and Schneider (2000). These studies showed that the parser tried to avoid reanalysis and provided a grammatical fit for the upcoming constituents for as long as possible (Frazier, 1990; Frazier & Clifton, 1997). The phenomenon gave a name to a processing principle Reanalysis as a Last Resort (Fodor & Frazier, 1980; Frazier, 1990; Frazier & Clifton, 1998; Phillips & Schneider, 2000).

The ability of the parser to avoid reanalysis was specifically studied by Phillips and Schneider (2000). The experiment created two processing conditions for English monolinguals in a self-paced reading task. The first condition required an easy local reanalysis to interpret a sentence with a subject RC. The second condition did not involve reanalysis but required non-local attachment, which created additional processing difficulties. In other words, the experimental conditions gave the parser a choice to either avoid reanalysis by performing non-local attachment, or attach the incoming constituents locally, which would entail reanalysis of the parsed sentence. The results showed that most participants preferred non-local attachment that entailed no reanalysis. Phillips and Schneider (2000) concluded that computational complexity of non-local attachment was less costly for the parser than reanalysis. The authors also claimed a hierarchy of processing cycles, where a parsing decision of the higher processing cycle shaped sentence parsing all the way down the syntactic tree.

The paper by Phillips and Schneider (2000) brought back the question of the incremental nature of human sentence parsing, originally mentioned in the GP theory (1978). Phillips and Schneider (2000) offered a term “processing cycles” and characterised mental structure-building as “cyclic”.

The cyclicity of parsing explains how reanalysis can be avoided in top-down structure building. Dividing the entire parsing process into cycles that pattern with the hierarchy of constituents in the syntactic tree, Phillips and Schneider (2000) claimed that parsing decisions made at higher processing cycles shaped the parsing at lower processing cycles. In other words, the hierarchy of processing cycles followed the structural organization of a sentence and was observed in the top-down structure building.

The main evidence supporting the hierarchical order of processing cycles came from the study by Phillips and Schneider (2000) described in this section. There was no grammatical conflict between the parsed constituents and the incoming linguistic information in the case of non-local attachment, which the informants preferred. Phillips and Schneider (2000) concluded that the parser stayed committed to the initial parsing decision made at the beginning of the sentence. The authors highlighted the role of a structural conflict during a parse and discussed it as a trigger for reanalysis. They specified that a structurally ambiguous sentence would give the parser a chance to look for other parsing options that would agree with the parse of higher constituents and the generated structural predictions. Another option would be structural reanalysis. The results of Phillips and Schneider (2000) showed that the parser stayed committed to the initial structural parse and non-local attachment was preferred to reanalysis with local attachment.

Summing up the findings of the scholars in theoretical and computational linguistics, there is a general agreement that sentence processing cannot be performed by one of the parsing algorithms in isolation. It is very likely that top-down and bottom-up algorithms complement each other. However, it remains unclear what role each parsing algorithm plays in mental structure building. As can be inferred from Kazanina et al. (2007), the top-down structure-building is a leading parsing algorithm that is accompanied by bottom-up checks for grammatical fit.

The dissertation develops further the theoretical predictions based on the findings by Kazanina et al. (2007) and the analysis by Phillips and Schneider (2000). Sentence processing is expected to be performed in the top-down manner and observe the hierarchy of processing cycles. Following the studies reviewed in this section, top-down structural prediction can undergo bottom-up checks for grammatical fitness of the incoming structure. The bottom-up checks help the parser to avoid serious reanalysis. They signal a grammatical mismatch and enable the online amendment of the generated structure.

2.4 Processing for Acquisition: Adult L2 Learners

Research in human language processing started from the studies in adult monolinguals which allowed for a well-rounded description of what a human parser was and how it functioned. At a later stage, processing research got focused on the role of the human parser in language acquisition and covered child acquisition of the native language and adult acquisition of an additional language (L2). The dissertation joins the line of research in non-native parsing and L2 acquisition in adulthood. The dissertation studies parsing mechanisms and linguistic decision-making in native and non-native speakers of Russian and English.

The target languages belong to different language families, Russian is a Slavic language and English is a Germanic language. The participants of the study are adult L2 learners, whose level of proficiency in the L2 is relatively low. The choice of L2 learners with low-intermediate level in their L2 as the target group for the dissertation allows studying the role of the parser in L2 acquisition and the possible influence of the fully developed system of the L1 on mental structure building in processing the L2.

At the low-intermediate level of L2 proficiency, the L2 grammar has started developing a language-specific subset of rules and is seriously influenced by the existing individual grammar, or the L1 grammar. However, it is a certain developmental stage, where the parser is expected to start getting over the direct effect of the L1 transfer and to show the first instances of sensitivity to L2 specific linguistic phenomena. The latter would shape further L2 acquisition. The intermediate level of L2 proficiency has not been approached from the processing perspectives and the dissertation bridges this gap. The thesis investigates an early post-initial stage of L2 acquisition through the analysis of processing mechanisms implemented by the L2 speakers in their respective native and non-native languages. In other words, the thesis checks whether a detailed description of L2 processing behaviour sheds light on how a new language is being acquired.

As defined by Fodor (1998), language acquisition is a change in the grammar that is licenced by the Universal Grammar (UG, Chomsky, 1986) or *supergrammar* (Fodor, 1998a, 1998b, see also Fodor, 1998c), and triggered by input analysis. Input analysis is a “parse test of the *supergrammar*” that triggers a change of a parameter value “if and only if it occurs as a part of a unique complete well-formed phrase-marker assigned to the input by the parser using the *supergrammar*” (Fodor, 1998a, p. 23). The definition by Fodor (1998a) gives the parser an important role in language acquisition – it triggers a change in the existing grammar.

The definition above can be extended to the field of L2 acquisition, especially, in the context of sequential L2 learning studied in the dissertation. In what follows from Fodor (1998a), it is within the capacity of the human parser to sport L2-specific linguistic properties that would trigger the change of the existing grammar to get it upgraded to accommodate the new norms of the L2. Fodor (1998a) highlighted the fact that the learner’s brain needed time to accumulate enough linguistic input that would start the change of the grammar. If applied to L2 acquisition, the parser needs to come across a phenomenon so many times that it would unambiguously signal the difference between the L1 and the L2, which in its turn, would trigger the upgrading of the existing grammar.

The ideas expressed by Fodor (1998a, 1998b, 1998c) concerned human language processing and the role of the human parser in L1 acquisition. However, they were widely supported by the field of psycholinguistic research in L2 acquisition contemporary to Fodor (1998). L2 theories started from the broad understanding of the process of L2 acquisition as the process of parameter resetting (Schwartz & Sprouse 1994, 1996) or the theories suggesting lexical transfer from the L1 and an independent acquisition of functional categories in the L2 (Vainikka & Young-Sholten 1996).

In line with Fodor (1998a, 1998b), Schwartz & Sprouse (1994, 1996) suggested that the parser began L2 acquisition with the use of the existing grammar. The scholars offered a model of the initial state of L2 acquisition – the Full Transfer / Full Access (FT/FA). They claimed that the L1 grammar was fully transferred into the L2 and formed its initial state for acquisition. Starting with the L1-like parse, the learner encountered problems which highlighted the differences between the L1 and the L2. The mismatch between the anticipated L1-like structures and the ones provided by the L2 input triggered L2 acquisition. The model of Schwartz and Sprouse (1996) viewed L2 acquisition as failure-driven, where input processing played a crucial role. Hypothetically, the human parser played a crucial role in L2 acquisition outlined in the FT/FA. However, the model did not specify how L2 acquisition based on L1-like parse would unfold. This question was partly addressed by Vainikka and Young-Sholten (1996).

The scholars suggested the Minimal Trees Hypothesis (MTH, Vainikka and Young-Sholten 1996) which claimed that L2 development replicated the form of a syntactic tree that was growing bottom-up. To be more specific, the grammar of L2 started from the stage of ‘one word’, for example, a noun. The second stage was the stage of a ‘verb phrase’, i.e. the verb and its complement(s). Then, L2 grammar developed further to the stage of a fully formed tree, which meant complex structures and involved movement. The MTH assumed that only lexical transfer into L2 was possible. The process of L2 learning occurred through the acquisition of functional categories in the L2. The MTH described the process of L2 acquisition as UG-governed, which meant there was an innate capability of the human brain to acquire a language and this innate capability ensured L2 learning as well.

Both the FT/TA (Schwartz & Sprouse 1994, 1996) and the MTH (Vainikka and Young-Sholten 1996) assumed that language acquisition was possible due to the work of a brain facility metaphorically called the Language Acquisition Device (LAD, see Miesel 2019 for a historic overview of the question). However, neither of the theories specified how exactly the LAD facilitated L2 acquisition and what role the human parser played in it. This question was addressed in a pool of studies in the following years. These studies investigated L2 acquisition beyond the initial state (Prévost & White 2000, Slabakova 2000, Ionin & Heejeong 2004, Ionin 2006, Tsimpli & Dimitrakopoulou 2007, Montrul & Slabakova 2008, Lardiere 2009, Slabakova 2014, Sokolova 2018, among many others).

The new studies abandoned the broad understanding of L2 acquisition as a mechanism of parameter resetting and viewed it as a process of reassembly of the sets of morphological features established for the L1. They claimed that functional morphology was the *locus of crosslinguistic variation* and the "bottleneck" for L2 acquisition (Slabakova 2014, see also Slabakova 2000, Ionin & Heejeong 2004, Montrul & Slabakova 2008, Lardiere 2009). Therefore, a process of L2 acquisition was a process where the bundles of morphological features set for the L1 underwent resetting to the standards of the L2. As a result, a learner had functional morphology specified for the L1 and the L2.

At this point, research in L2 acquisition divided into two streams. The first group of studies assumed full access to UG in L2 acquisition (Prévost & White 2000, Slabakova 2000, Ionin & Heejeong 2004, Ionin 2006, Montrul & Slabakova 2008, Lardiere 2009, Slabakova 2009, among others). Their opponents claimed a partial role of UG in the development of the L2 grammar (Hawkins & Chan 1997, Tsimpli & Dimitrakopoulou 2007). Even though all the researchers agreed that only the features that could be processed could be acquired, they debated whether full acquisition of L2-specific features was possible.

The approaches of partial access to UG, like the Interpretability Hypothesis (IH, Tsimpli & Dimitrakopoulou 2007) and the Failed Functional Features Hypothesis (FFH, Hawkins & Chan, 1997), argued that early L2 learners under-determined uninterpretable syntactic features in the L2, which created a learning problem. Therefore, L2-specific features, especially those, not instantiated in the L1, may never be fully acquired. The studies by Tsimpli & Dimitrakopoulou (2007) and Hawkins & Chan (1997) were challenged by the experimental evidence showing that a difficulty to acquire a certain feature did not mean it would never be acquired in full (Prévost & White 2000, Slabakova 2000, Ionin & Heejeong 2004, Ionin 2006, Montrul & Slabakova 2008, Lardiere 2009, Slabakova 2009).

Prévost and White (2000) showed that even advanced L2 learners of French and German could demonstrate non-target use of functional morphology. However, the scholars argued that erroneous L2 production occurred due to the difficulties in "the mapping of abstract features to their surface morphological manifestation" (Prévost and White 2000, p. 108) and did not mean impairment in syntactic development. Prévost and White (2000) showed that finite and non-finite forms did not alternate freely: finite forms did not occur after prepositions or negations and were not used with another verb in the same clause The fact that L2-learners applied feature checking mechanisms provided evidence that the features were present in their L2 grammars. The authors offered the Missing Surface Inflection Hypothesis (MSIH) and argued that there was a gap between acquisition of abstract features and the surface morphological realization of these features. The latter highlighted a long period of time between the internal acquisition of a feature and its external realization and prompted a link between the assumption of the FT/FA (Schwartz & Sprouse 1994, 1996), the MTH (Vainikka & Young-Sholten 1996) and the MSIH (Prévost & White 2000).

According to the FT/FA and the MTH, L2 acquisition was facilitated by the LAD which was capable of censoring the differences between the L1 and the L2. The MSIH showed that a process of feature acquisition occurred in at least several stages, i.e. the newly acquired features needed to be mapped to their surface morphological manifestation before their full acquisition can be attested in language production. Putting these three approaches together, a process of L2 acquisition can be described as: 1) noticing the differences between the L1 and the L2, 2) acquiring the new abstract features, 3) mapping the abstract features to the surface morphological forms, 4) target-like L2 production. In the given chain of stages in L2 acquisition, the human parser plays a critical role in noticing a new feature. The mismatch between the L1 and the L2 is spotted by the human parser when it fails to parse the L2 input in the L1-like manner. From this perspective, the parser can be viewed as a trigger for L2 acquisition.

The study by Lardiere (2009) argued that L2 learners tried to map the features of the new language to the existing linguistic system and would "seek morphological equivalent of assembled lexical items in the L1" (Lardiere, 2009, p. 213). In the absence of the direct equivalence, "the learner would associate the difference in a minimally contrasting form with some difference in meaning or grammatical function and *[would]* construct some sort of representation for it" (Lardiere, 2009, p. 214). The assumptions by Lardiere (2009) went in line with the first theories of L2 acquisition (Schwartz & Sprouse 1996, Vianikka & Young-Sholten 1996). She argued that the process of L2 acquisition was triggered by a failure to establish direct equivalence between the features instantiated in the L1 and the linguistic material introduced by the L2. Using the earlier term of Fodor (1998a), the brain performed an L1-like 'parse test' of the new L2 material and checked for its validity. When the L1-like parse failed, the human parser 'put forward' a learning task for L2 acquisition.

In their general approach, the studies in feature acquisition (Prévost & White 2000, Slabakova 2000, Montrul & Slabakova 2008, Lardiere 2009, Slabakova 2014) patterned with Fodor (1998a) claiming that the learner needed to wait till the parser provided enough “definitive triggers” (Fodor, 1998a, p. 26) for the development of the (new) grammar. During this ‘wating period’ the L2 learner would rely on the existing grammar of the L1. Therefore, at early post-initial stages of L2 acquisition, the parser tries out familiar parsing mechanisms with the new L2 input. If the initial L1-like parsing is not successful, the parser starts trying alternative structure building licenced by the *supergrammar*. The dissertation investigates this very stage of L2 acquisition and is aimed at capturing the period when the L1 grammar starts restructuring to accommodate the new norms of the L2.

In the dissertation study, the L1 of the participants is a fully developed grammar. The L2 is a developing sub-system that is being built in relation to the existing grammar. Adding an L2 restructures the existing linguistic system and develops the ‘L1+L2’ grammar. A crucial role in this development is played by the human parser. It has been studied in several processing experiments motivated by the Tuning Hypothesis (Michel, 1987; Cuetos & Mitchell, 1988; see also Mitchell & Cuetos 1991).

The Tuning Hypothesis (Mitchell & Cuetos 1991) assumed that the human parser was an adjustable mechanism that depended on the frequency of a certain phenomenon in a language. For example, the parser would adopt the interpretation of ambiguous sentences that was most frequent in a given language. The tuning ability of a bilingual human parser was supported by bilingual research. Dussias (2003) and Dussias and Sagarra (2007) reported an effect of prolonged exposure to the TL in heritage speakers and balanced bilinguals. In these studies, the preferred parsing pattern for attachment resolution of an ambiguous RC was the pattern of the language the participants were currently exposed to.

The assumptions made by the Tuning Hypothesis were also supported by Frenck-Mestre and Pynte (1997, 2005, see also Frenck-Mestre, 1997; Frenck-Mestre & Pynte, 2000). In the study by Frenck-Mestre (1997), L2 learners of French showed effects of L1 transfer from English when they read sentences in French. Frenck-Mestre (2002) showed that native speakers of English applied their native-like mechanisms of sentence processing in the L2-French after one year of residence in France. Meanwhile, after 5 years of residence, L2 learners overcame the effects of the L1 and processed L2 sentences in the TL-like manner. The author concluded that the parser attuned to the new language through the length of exposure to the L2 (Frenck-Mestre, 2002).

The studies in L2 acquisition (Schwartz and Sprouse 1994, 1996, Vainikka & Yong-Sholten 1996, Prévost & White 2000, Slabakova 2000, Montrul & Slabakova 2008, Lardiere 2009, Slabakova

2014) drew scholarly attention to the capabilities of the human parser and its potentially big role in L2 acquisition. Psycholinguistic research (Cuetos & Mitchell 1988, Mitchell & Cuetos 1991) highlighted the need for detailed investigation of how the human parser worked and motivated early processing studies in L2 (Frenck-Mestre & Pynte 1997, Frenck-Mestre 1997, 2002, 2005; Foucart & Frenck-Mestre, 2011). The early L2 processing experiments reported that the L2 parser started with the parsing hypothesis set to the existing grammar. Therefore, L2 speakers showed L1-like parsing at early stages of L2 acquisition. This picture changed towards the parsing in the TL-like manner with the participants' growth in L2 proficiency.

2.5 Non-Native Processing: Structural or *Shallow*

The field of non-native processing started with investigation of the role of the parser in L2 acquisition. The findings allowed for an assumption that the parser spotted linguistic differences between the fully developed sub-grammar of the L1 and the developing sub-grammar of the L2. Consequently, the functions of the human parser were understood as the driving force for L2 acquisition (Schwartz & Sprouse, 1996; Fodor, 1998; Slabakova, 2000; Dekydspotter et al., 2006; Montrul & Slabakova, 2008).

Parsing for acquisition motivated further research in linguistic decision-making in non-native languages. Motivated by the Tuning Hypothesis by Cuetos and Mitchell (1988), the studies by Frenck Mestre (1997, 2002, 2005) tried to trace the developmental trajectory in L2 processing from the L1-like parsing to the parsing in the TL-like manner. These studies used structurally ambiguous sentences and showed that highly proficient L2 speakers made the same interpretation decisions as monolingual controls in the languages in question.

Following the studies by Cuetos and Mitchell (1988) and Mitchell and Cuetos (1991), Frenck-Mestre and Pynte (1997), and Frenck-Mestre (1997, 2002, 2005) compared the initial state of L2 and the high levels of L2 proficiency. However, processing at intermediary stages of L2 acquisition remained uncovered and requested scholarly attention. The dissertation bridges this gap.

The dissertation follows the studies by Dekydtspotter et al. (2006), Dekydtspotter et al. (2008), Sokolova and Slabakova (2019), and Sokolova (in press) where the intermediate L2 speakers and the nature of L2 processing at this level of proficiency were in focus. The studies followed the assumption of Dekydtspotter et al. (2006), which developed the FT / FA theory to account for the development of adult L2 processing (see also Schwartz & Sprouse, 1996). Dekydtspotter et al. (2006) offered three characteristics of non-native processing: 1) a full transfer of the L1 at the initial state of the L2; 2) full access to the UG in L2 acquisition; and 3) full parse in the L2 and the capability to process L2 input for acquisition, the Full Transfer/Full Access/Full Parse (FT/FA/FP, Dekydtspotter et al., 2006).

The crucial point of the FT/FA/FP was that L1 and L2 processing used similar parsing strategies and both native and non-native processing reached successful sentence comprehension. At certain developmental stages, L2 processing may show some differences from monolingual processing in the respective native language. These differences result from the developing nature of the L2 (Dekydtspotter et al., 2006). Meanwhile, the behavioural differences between native and non-native speakers attested in processing experiments caused scholarly doubt and the FT/FA/FP was challenged by the Shallow Structure Hypothesis (SSH, Clahsen & Felser, 2006, 2018) and partly by the Interface Hypothesis (IH, Sorace, 2011).

The proponents of the SSH claimed that non-native processing was governed by non-structural information and was fundamentally different from processing in the L1. The IH specified this assumption and stated that interfaces between syntactic and non-syntactic information were vulnerable areas in the L2. In other words, L2 speakers had difficulty integrating syntactic and non-syntactic information and processed L2 sentences differently from monolinguals (Sorace, 2011).

The scholarly disagreement about the nature of non-native processing can be summarized as structural vs. shallow processing in the L2. The structural approach claims that mental structure building is the core algorithm of sentence parsing (Dekydtspotter, Schwartz & Sprouse, 2006; Dekydtspotter et al., 2008; Hopp 2014a, 2014b, 2015, 2016a, 2016b, Cunnings 2017, Sokolova and Slabakova, 2019; Sokolova, in press). The shallow approach assumes a big role of non-structural information in non-native processing and argues that parsing strategies are implemented differently from monolinguals (Felser, Roberts & Marinis, 2003; Papadopoulou & Clahsen, 2003; Clahsen & Felser, 2006; Clahsen & Felser, 2018, see also Hawkins & Chen, 1997; Tsimpli & Dimitrakopoulou, 2007; Hawkins & Casillas, 2008; Hawkins et al., 2008).

The contradiction of the two approaches can also be understood as the disagreement about the order of parsing operations. The structural parse in the L2 means that the parser builds a mental syntactic tree at the initial parse and the fully formed tree is then sent to the semantics and pragmatics check. The shallow parse claims that parsing decisions in the L2 are initially informed by non-structural information and the syntactic structure of the sentence is only built at the second parse with the purpose to provide a grammatical form for the parsed chunk.

2.5.1 The Shallow Structure Hypothesis

The idea of fundamental difference between native and non-native processing originated from the studies in the attachment resolution of ambiguous RCs and informed the Shallow Structure Hypothesis (the SSH, Clahsen & Felser, 2006, see the revised version Clahsen & Felser, 2018). The SSH scholars admit that L1 processing is structural and the parser initially builds a syntactic model of a sentence. However, structure building, or structural parsing, is not possible in a non-native language. L2 learners are susceptible to the interferences of non-structural information during sentence processing and structure building is not a primary mechanism of non-native parsing (Felser et al., 2003; Papadopoulou & Clahsen, 2003; Clahsen & Felser, 2006, among others).

The main argument in favour of processing differences between monolinguals and bilinguals came from Felser et al. (2003), Papadopoulou and Clahsen (2003), and Felser, Marinis and Clahsen (2003). First, the studies by Clahsen and collaborators refuted any transfer of parsing preferences from the L1. In their studies, advanced L2-learners of Greek showed neither L1-like nor TL-like interpretation patterns (Papadopoulou & Clahsen, 2003). The studies examined attachment resolution of ambiguous RCs in native and non-native languages. As interpreted by the authors, comprehension choices of L2 speakers were always around 50%, which meant performance at chance, or no distinct preference for a certain type of RC resolution (Papadopoulou & Clahsen, 2003).

The patterns of RC resolution were studied further by Felser et al. (2003) and Felser, Marinis and Clahsen (2003). Felser, Roberts and Marinis (2003) focused on advanced L2 speakers. They compared L2 adults to monolingual children in English. The studies reported performance at chance and no tuning to processing in the TL-like manner. At this point, the proponents of the SSH expressed a reasonable doubt in the assumptions of the Tuning Hypothesis (Cuetos & Mitchell, 1988) that predicted a developmental trajectory towards TL-like parsing at higher levels of L2 proficiency.

To further support their assumptions, the SSH scholars studied L2 speakers' sensitivity to linguistic changes within a sentence. Felser et al. (2003) compared adult L2-speakers of English and English-speaking monolingual children in how they processed ambiguous RCs with the preposition *with* between the head nouns, for example:

(2.5) Maria arrested the mother with/of the woman that was talking about cosmetics.

The authors contrasted two conditions. The sentence with the preposition *of* between the head nouns, *the mother of the woman*, was ambiguous. Either *the mother* or *the woman* could be the doers of the talking. The sentence had two grammatical interpretations: *The mother was talking* and *The woman was talking*. In the second condition, with the preposition *with*, the sentence remained ambiguous. However, the authors predicted that the semantics of the preposition *with* would favor the interpretation *The woman was talking*.

The study reported that adult L2-speakers changed their interpretation decision depending on the preposition. However, the preposition was irrelevant for monolingual children in RC resolution. Felser et al. (2003) concluded that children applied structural processing in their L1, but L2 adults used the non-structural information of the preposition within RC attachment resolution.

The effect of the preposition *with* was further tested by Papadopoulou and Clahsen (2003) with native speakers of German, Spanish and Russian, in the L2 Greek. All the investigated languages belonged to the high attachment resolution groupб i.e. native speakers of these languages preferred the first noun in the complex noun phrase when they were asked to interpret an ambiguous RC. Papadopoulou and Clahsen (2003) reported the effect of the preposition *with* on RC resolution with non-native speakers. It facilitated the choice of the lower noun. The study found no distinct preference for RC resolution in the sentences with the genitive preposition *of*. Like Felser et al. (2003), the authors decided that the lexical-semantic information of the preposition played the decisive role in RC parsing in the L2.

Based on the results of a series of studies with ambiguous RCs, the SSH proponents concluded that L2 learners processed their non-native languages in a fundamentally different manner from native speakers. Non-native processing was shallow, which meant it relied on “semantic, pragmatic, probabilistic, or surface-level information” rather than on mental structure building typical for the L1 (Clahsen & Felser, 2018, p. 2). The SSH claimed that non-native processing had a limited ability to build mental structure and relied on non-syntactic information in sentence processing (Clahsen & Felser, 2006, 2018).

In elaborating the thesis above, the main claim of the SSH in Clahsen and Felser (2006, 2017) is that “<…> even highly proficient L2 speakers tend to have problems building or manipulating abstract syntactic representations in real time and are guided more strongly than native speakers by semantic, pragmatic, probabilistic, or surface-level information” (Clahsen & Felser, 2017, p. 2).

The key assumptions of the SSH were challenged by various scholars approaching non-native processing from structural perspectives. To begin with, there are studies that compared processing difficulties caused by structural information vs. by lexical information. For example, Frenck-Mestre (1997, 2002, 2005) studied how NSs of English read L2 sentences in French. The study used an eye-tracker and reported that certain eye movements and slowdowns in reading times were sometimes caused by lexical difficulties, but the lexical effect was not strong enough to claim that lexical information guided L2 processing (Frenck-Mestre, 1997, 2002).

Frenck-Mestre (2005) reported that L2 learners had much more difficulties in overcoming the effect of L1-like structural preference than to overcome lexical difficulties. The author explained her findings in terms of the Tuning Hypothesis reviewed above (Cuetos & Mitchell 1988). With the growth in L2 proficiency, L2 speakers could tune the parser to the L2-like parsing patterns, thus, overcoming the effect of L1 transfer. In the study by Frenck-Mestre (2005), structural difficulties were much bigger than lexical ones, which undermined the significance of the non-structural, i.e. lexical, information in L2 processing pronounced by the SSH.

The effect of the preposition *with*, studied by Papadopoulou and Clahsen (2003) and Felser et al. (2003) can have a different explanation. The Construal Theory (Gibson et al. 1997) claimed that unlike the preposition *of*, the preposition *with* assigned a theta role and a change of RC-resolution is expected under the influence of this preposition. 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 the preference to attach the RC to the lower noun is a result of the semantics of the preposition *with* or this preposition belongs to a certain class of conjunctors and is a syntactic category.

A possible syntactic effect of the preposition with that changes the syntactic modification within the head noun phrase is supported by the results of Cuetos and Mitchell (1988). The scholars reported a similar an effect of the conjunctor and in monolingual speakers of Spanish. The participants changed their RC resolution preference to the lower noun in response to a change in coordination between the head nouns. Low attachment was preferred in the sentences that had *and (y)* between the head nouns, like in *the mother and the woman*.

Bringing together the monolingual results in Cuetos and Mitchell (1988) and the results of L2 speakers in Papadopoulou and Clahsen (2003) and Felser et al. (2003), we can see a similarity in the effect of preposition *with* and the conjunction *and*. The latter brings the conclusion of Papadopoulou and Clahsen (2003) and Felser et al. (2003) into question. Their participants showed sensitivity to the preposition *with.* So did monolingual speakers of Spanish in their native language (Cuetos & Mitchell 1988). The latter is evidence for similar sensitivity to a linguistic change in native and non-native languages. Besides, the preposition ***with*** changes the structure of the head noun phrase and L2 speakers' sensitivity to it cannot be a result of shallow processing.

In addition, the results of RC interpretation choices in Felser et al. (2003) and Felser, Marinis and Clahsen (2003) received an alternative interpretation from Cunnings (2018, personal communication). The scholar suggested that answer choices around 50% could mean more than just performance at chance. It could mean that L2 speakers were aware of the structural optionality of the ambiguous RCs and for this reason they did not show a clear language-specific preference for any type of RC resolution. The assumption by Cunnings (2018, personal communication) can mean that on top of the ambiguity of the RC and the eligibility of two ways of structural parsing, the "L1+L2" grammar may have both parsing options active in online processing. The latter annuls a distinct preference for any attachment resolution and can be evidence of co-activation of both languages of an L2 speaker.

2.5.2 Structural Processing in the L2

As can be gathered from the previous sections, the assumptions of the SSH were widely debated by the proponents of structural processing in the L2. These scholars stick to the point that native and non-native processing is fundamentally similar and the theoretical assumptions made in monolingual processing studies can be expanded to the field of processing in L2 (Dekydtspotter et al., 2008; Hopp, 2014a, 2014b, 2015, 2016a, 2016b; Cunnings, 2017; Sokolova & Slabakova, 2019; Sokolova, in press). Following the findings in L1 processing, L2 parsing should be incremental, modular and cyclic. The modularity and cyclicity of processing establish a certain order of parsing operations. The initial parse follows structural information and is based on the combinatorial use of top-down and bottom-up algorithms. The initial structural parse provides a structure that is ready for a semantic and pragmatic check, and full interpretation.

Serious theoretical arguments in favor of structural parsing in L2 came from Dekydtspotter et al. (2006), and Sprouse (2011), who claimed that L2 processing and L2 acquisition were closely connected. In their theory, L2 acquisition was failure-driven and depended on "the recognition of a mismatch between the current state of syntactic knowledge, which is used in processing, and Target Language (TL) input being processed" (Dekydtspotter et al., 2006, p. 35). To extend the claim, non-native processing is not simply sensitive to the minimal mismatches between the L1 and the TL, this sensitivity ensures the acquisition of the L2 and becomes its driving force.

The theoretical assumptions by Dekydtspotter et al. (2006) and Sprouse (2011) are critically important for the understanding of the nature of L2 processing for L2 acquisition. Explaining L2 acquisition though the capability of the parser to spot the mismatches between the L1 and the TL, the scholars claim that L2 processing cannot be anything else but structural and similar to the processing in native languages. If sentence parsing were taking different forms in different languages, no acquisition of the L2 would ever be possible. Approaching L2 sentences differently from what the TL would prompt, the parser would never notice any mismatch between the current state of syntactic knowledge and the TL input. Consequently, no restructuring of the existing grammar would ever be triggered by the parser (see Fodor, 1998a, 1998b). However, the literature reviewed earlier in this chapter shows quite the opposite.

There is experimental evidence that the parser is capable of spotting new features. Besides, new meanings are assigned to the new features even when they are minimally different from what is instantiated in the L1 (Slabakova 2000, Parodi, Schwartz & Clahsen 2004, Montrul & Slabakova 2008, Slabakova 2014). The capability of the parser to spot the structural mismatches between the L1 and the L2, as well as its capability to figure out the meaning of the new features and organize these newly acquired forms and meanings into the L2-specific set of parameters are the underlying mechanisms of L2 acquisition.

The studies reviewed above provide experimental evidence of how parsing for acquisition works. These studies show that human language processing is UG-governed and cannot be different between native and non-native languages (Schwartz and Sprouse 1996, Fodor, 1998 Dekydtspotter et al., 2006; Slabakova, 2000; Parodi et al., 2004; Montrul & Slabakova, 2008; Sprouse 2011, among others). The latter is problematic for the SSH, which claims that non-native sentence processing is successful and achieves full comprehension. However, there is no explanation of how the same level of comprehension is achieved via different routes in native and non-native languages.

More evidence for similarities in native and non-native processing came from Hopp (2014a, 2014b, 2015, 2016a, 2016b). Hopp (2014) investigated the role of lexical retrieval in non-native processing. The results showed a facilitative effect of cognates for non-native speakers. In the sentences with cognates, L2 speakers demonstrated native-like processing strategies. The author claimed that the differences between native speakers and L2 learners observed in the non-cognate condition did not speak for fundamental differences in their processing strategies because these differences were “amended” in the cognate-condition. In the follow-up study, Hopp (2015) showed that slowdowns in processing times could be explained by the difficulties to retrieve a non-frequent word from L2 lexicon. The difficulty in retrieving lexical information consumed the resources native speakers would use for mental structure building (Hopp, 2015).

Hopp (2016a, 2016b) studied individual differences in native and non-native processing. The study compared working memory capacity between the monolingual participants and the L2 speakers.

Non-native processing is more cognitively demanding than L1 processing (Dekydtspotter et al., 2006). Meanwhile, if native and non-native speakers were matched for working memory capacity, L2 learners showed target-language-like syntactic processing (Hopp, 2016).

The experimental results of Hopp (2014a, 2014b 2015, 2016a, 2016b) are in line with Dekydtspotter et al. (2006). The paper warns of the comparative fallacy in reading the experimental results. It explains why direct comparisons between a fully developed system of the L1 and the developing system of the L2 can be problematic. A single grammar of the L1 does not experience cross-linguistic influences through the process of lexical retrieval and structure building. Therefore, L1 processing is less costly in terms of general cognitive load. Direct comparisons between native and non-native speakers should take the general complexity of L2 processing into account. To be more specific, due to the higher cognitive demand, a linguistic factor that slows down native processing right away may show its effect in the spillover region in non-native speakers (Dekydtspotter et al., 2006). The latter is an example of how similar parsing strategies in native and non-native languages can result in different behavioral patterns.

One of the crucial theoretical arguments in favor of structural processing in the L2 in Dekydtspotter et al. (2006) and Sprouse (2011) is the fact that L2 sentences are processed successfully. To be processed, a sentence must be described by the existing grammar. Consequently, “these structures should receive a significantly detailed syntactic parse – not a shallow one” (Dekydtspotter et al., 2006, p. 35). In other words, every successful comprehension of a sentence is based on the successful parsing operations that occur as the initial parse. In this definition, successful comprehension always means TL-like parsing, or, in the extended version, parsing in the TL-like manner is achieved by non-native speakers if they manage to comprehend a target sentence.

Most scholars that advocate structural processing in L2 agree that L2 learners may experience difficulties in their non-native processing. However, these difficulties do not mean fundamental differences of parsing operations between the L1 and the L2. Cunnings (2017) writes that L2 learners are more susceptible to the interferences from non-syntactic linguistic domains than native speakers. At first glance, Cunnings (2017) sounds similar to the assumption of the SSH. However, the scholar insists that susceptibility to non-structural information shows at the stage of retrieval in language processing. For retrieval, the parser compares the fragment being processed to all possible linguistic structures previously encoded in memory. At the stage of retrieval, partial match of the constituents can be used as a processing cue. It would be temporarily misleading, and the speaker may use non-structural information to exclude the irrelevant analyses (see also Lewis et al. 2006, Van Dyke & Johns, 2012).

The assumptions by Cunnings (2017) make a clear distinction between mental structure- building performed at the initial parse and the role of non-structural information used at the point of doubt when the structure needs to be reanalyzed. The distinction between the use of different types of linguistic information at different stages of processing was attested in monolingual speakers. Sturt (2003, see also Cunnings & Sturt, 2014) carried out a study with monolingual speakers of English. The experiment tested anaphora resolution. When the gender of the local antecedent and of the reflexive matched, the participants did not consider the non-accessible antecedent. In the condition when the antecedent was a profession noun of a masculine gender and would be stereotypically assigned to be a male job, the reflexive of the feminine gender caused a difficulty. In this mismatch condition, the monolingual participants looked back at the non-accessible antecedent (Sturt 2003, Cunnings & Sturt, 2014).

If the studies by Cunnings (2017) and Sturt (2003) are considered together, one can conclude that susceptibility to non-structural information can be attested in both in native (Sturt 2003) and non-native processing (Cunnings 2017, Felser & Cunnings 2012). These results are contradictory and problematic for similar eye-tracking studies by Felser (2008) and by Felser and Cunnings (2012). The studies by Cunnings (2017) and Sturt (2003) claim similar behaviour in both native and non-native processing. The studies by Felser (2008) and by Felser and Cunnings (2012) claim that only non-native speakers consulted non-structural information. These four studies need to be reviewed in the form of a scholarly dialogue.

The studies by Felser (2008) and Felser and Cunnings (2012) examined anaphora resolution with a design similar to Sturt (2003). They manipulated a syntactically accessible antecedent against the non-accessible one. Another condition manipulated the gender match and mismatch between the antecedents and the reflexive. The experiment showed that L2 speakers consulted the non-accessible antecedent to process the reflexive, even when the local antecedent matched in gender. The authors interpreted these results as evidence for non-structural processing.

According to Felser and Cunnings (2012), the non-structural information was a guiding factor in non-native processing. The “wrong” antecedent was syntactically non-accessible but discourse prominent. Native speakers did not fall into the trap of discourse prominence and did not consider the non-accessible antecedents. Thus, the interference of the discourse-prominent antecedent was taken for an illustration of how non-structural information influenced non-native processing (Felser & Cunnings, 2012).

The conclusions of Felser (2008) and Felser and Cunnings (2012) contradicted a possible explanation that could be inferred from Sturt (2003), Dekydtspotter et al. (2006), Sprouse (2011) and the one that was provided by Cunnings (2017). To begin with, Cunnings (2017) highlighted the fact that both native and non-native processing reached the same results – the sentences were understood correctly. In terms of Dekydtspotter et al. (2006), both native speakers and L2 learners performed a successful parse, which, by definition, could not be shallow. Besides, Cunning (2017) pinpointed the fact that the differences between native and non-native speakers found in Felser and Cunnings (2012) occurred at the stage when the parsed information was retrieved from the memory, not at the stage of the initial parse. In this case, the interferences did not necessarily mean shallow processing (Cunnings 2017).

The studies reviewed in this section show that successful comprehension cannot be achieved through shallow processing and deep structural analysis is equally required in native and non-native languages (Dekydtspotter et al., 2006; Sprouse, 2011). This serves as additional evidence that oftentimes different behaviours in native and non-native processing are not the results of fundamentally different parsing mechanisms. The findings by Hopp (2014a, 2014b, 2015, 2016) and Cunnings (2017) provide alternative explanations of the behavioural differences noticed between native and non-native speakers in sentence processing. These differences can be amended by the experiment designs that consider the cognitive costs of non-native processing (Hopp 2014a, 2014b, 2015, 2016a, 2016b). Processing studies also need to take a closer look at how non-native processing unfolds and check whether non-structural information is considered at the level of initial structure building or whether it becomes relevant at the level of reanalysis (Cunnings, 2017).

Independently of what direction future research takes, it should be aware of the warning of a comparative fallacy in direct comparisons of the processing results between native and non-native speakers by Dekydtspotter et al. (2006) and Sprouse (2011). In other words, it may not be beneficial to go for direct comparisons between a fully developed monolingual processing system and the processing mechanisms in the developing grammatical sub-system of the L2. Such comparisons can provide an obscure picture of the parsing algorithms used in non-native processing. New processing studies would benefit more from developing experiments that would result in fine-grained descriptions of the mechanisms of non-native processing. The dissertation is going this way.

2.6 Conclusions and justification for the current study

Studies in human language processing began with the Garden Path (GP) theory (Frazier & Fodor, 1978; see also Kimball, 1973; Pritchett, 1992; Hawkins, 1999) that provided a linguistic account of how the human brain dealt with sentence comprehension. The linguistic approach of the GP theory was immediately challenged by processing accounts that highlighted the role of psychological factors in human language processing (Kluender & Kutas, 1993).

The debate between the GP-based grammatical accounts and processing approaches answered the question of why certain types of sentences were judged as impossible by native speakers of various languages. As a result, two ways of understanding of sentence complexity were offered. The complexity in processing accounts meant that sentence length could overloaded the speaker cognitively. The linguistic accounts showed that complexity meant structural hierarchy that would increase processing load.

A scholarly dispute between formal grammatical and functional psychological approaches to human language processing was scientifically beneficial. Linguistic approaches provided evidence that longer sentences were processed faster and without effort if they had no structural complexity (Stowe, 1986; Sturt, 2003, among others). At the same time, shorter sentences with, for example, moved elements increased processing load even though their length could not overload the working memory capacity (Stowe, 1986; Sturt, 2003).

As an outcome of the debate, linguistics-based approaches provided a better account of human sentence processing. They showed that language processing was grammatically constrained and proved that the use of linguistic theory could be beneficial in the studies of human language parsing. Processing accounts highlighted the importance of psychological factors, such as working memory capacity, in the studies on human language processing.

The next stage of processing research focused on the order of parsing operations in sentence processing. GP-based studies showed that words in sentences that appear in a linear order get organized into hierarchical structures ready for a semantic check (Frazier & Fodor, 1978; Carlson & Frazier, 1983; Frazier & Rayner, 1985; Ferreira & Clifton, 1986). Importantly, these studies considered structurally ambiguous sentences, where two interpretations were grammatically possible. A preference for one interpretation over the other meant a preference for one syntactic structure of the sentence over the other. Investigating structural ambiguities, the GP theory showed that structure was the source of meaning and advocated its prevailing role in sentence processing.

The priority of structural information over word semantics in sentence parsing was questioned by the constraint-based approach to language processing (MacDonald et al., 1994; Trueswell & Tannenhaus, 1994). These studies showed that word semantics had a disambiguating effect in the case of structural ambiguity and made sentence processing easier. In the constraint-based approach structural ambiguity was viewed as a point of doubt where the structural parser needed to consider word semantics to decide about further structure-building.

The constraint-based approach to sentence processing opposed the GP theory but did not refute the role of structure building proposed by the GP theory. It aimed at showing that semantic information was considered in online sentence processing alongside the structural information. Besides, Tannenhaus, Spivey-Knowlton, Eberhard & Sedivy (1995) showed that relevant visual contexts influenced auditory language processing. In their study, the participants showed different eye movements when they heard the definite article with the noun phrase in the context were several relevant objects were available than when the same phrase was presented in the contexts were the target object had no competitors. The latter cast doubt on the order of parsing operation suggested by the GP-based studies.

The scholars developing constraint-based approaches to processing put forward a vital question of when, or at what stage in processing, the structural parser consulted the semantic information. Unfortunately, their experimental results did not form a coherent processing theory and the debate whether human language processing was serial or parallel was not resolved. The crucially important question concerning the priority of structural parse over the semantics check remained unanswered within the debate initiated by the proponents of the constraint-based processing approach. It remained unclear how exactly word semantics helped ambiguity resolution in parallel processing. The GP proponents claimed that it was possible that the structural parser performed a quick online reanalysis unnoticeable in the current experimental techniques. Alternatively, the constraint-based scholars insisted that structural and semantic information were equally available in sentence parsing, but the role of word semantics was noticeable only in temporarily ambiguous sentences. In other words, the constraint-based approach highlighted a weak point of the GP theory but did not answer its own main question and did not explain when and how the semantic information would come into play to facilitate mental structure-building.

The dissertation approaches the GP-based and constraint-based processing studies from the diachronic perspective and views them as complementing each other in a scholarly dispute. These two approaches highlighted the weak points of each other and motivated further research in human language processing. If viewed as a scholarly debate that unfolded over time, the constraint-based approach specified the assumptions by the GP and drew scholarly attention to the need for a detailed explanation of certain stages of sentence parsing and the ways different types of linguistic information complemented each other. These questions were partly answered by the Unrestricted Race Model by van Gompel, Pickering & Traxler (2000) and the Surprisal Model by Levy (2008).

The race model suggested serial parse where only one structure could be built at a time. However, a structure could be predicted based on the information from multiple sources. The authors of the race model meant that the parser could anticipate multiple structures to follow a given word in a sentence, but it would generate one projection that received most support from non-structural sources of linguistic information (van Gompel et al. 2000). In this form, the race model put together the assumptions of the GP and the constraint-based processing models and suggested predictive parsing.

The question of predictive power of different linguistic sources that would inform mental structure building was developed by Levy in the Surprisal model (2008, see also Hale 2001). Unlike the race model, the Surprisal (Levy 2008) was a model of parallel processing, where disambiguation in sentence comprehension was a process of resource re-allocation based on the probability that a certain word would follow the fragment already processed. In the Surprisal, processing difficulty could be pre-calculated as a certain amount of *surprisal* in the context in which the word appears (Levy 2008).

The Surprisal goes in line with the original GP theory when it predicts that globally ambiguous sentences are easier to process than locally ambiguous ones but provides a different rational for the processing ease. However, the Surprisal advocates parallel processing that operates different types of linguistic information and builds multiple structures at the same time. In this respect, the Surprisal does not support either the race model or the GP. Even though the Surprisal is a computerized model of language processing and most of its predictions are compatible with the data from human language processing, there are cases where the model fails to explain ambiguity resolution. In my opinion, it can partly be explained by the fact that the model used statistical corpus information to predict the probability of the upcoming node. This model may lack the flexibility of the human parser that can amend the wrong structure online.

The reviewed models of sentence processing motivated several studies in parsing algorithms. However, the mechanisms of mental structure building remain poorly understood till now and are in need of further investigation. The dissertation contributes to the research in human sentence parsing and offers a study of a combinatorial use of top-down and bottom-up parsing in native and non-native processing.

Entering the field of non-native processing, the dissertation becomes one of the few studies that expand the findings of the monolingual processing experiments to the field of non-native processing (Frenck-Mestre 1997, 2002, 2005, Dekydtspotter et al. 2008, Hopp 2014a, 2014b, 2015, 2016a, 2016b). The dissertation builds its theoretical assumptions on the scholarly findings that non-native processing is fundamentally similar to processing in native languages and is based on mental structure-building (Dekydtspotter et al. 2006, Sprouse 2011, Hopp 2014a, 2014b, 2015, 2016a, 2016b).

There is an alternative approach to non-native processing – the shallow processing offered by the SSH (Clahsen & Felser 2006, 2018). Even though the SSH draws attention to the processing complexity of the L2 as compared to the L1, it falls into the same trap as constraint-based processing studies by Mac Donald (1994) and Trueswell and Tannenhaus (1994).

The SSH claims that mental structure-building is difficult in non-native languages and L2 speakers may use other linguistic cues to process L2 sentences. At this point, non-structural information, for example, word semantics, becomes a convenient source of information, which native processing may not need. However, the same as constraint-based approaches, the SSH does not answer the question at what stage of processing and how L2 speakers integrate the structural and non-structural information and what causes this very need to make the primary use of non-structural information. As suggested by Cunnings (2017), the use of non-structural information in the L2 may take place at the stage when the processed constituents are retrieved from the memory, which means the initial parse in the L2 is structural, the same as in native languages.

The proponents of structural parse in the L2 highlight the fact that non-native speakers comprehend L2 sentences successfully. A full sentence comprehension is impossible without a detailed structural analysis (Dekydtspotter et al., 2006; Sprouse, 2011). Besides, studies in L2 acquisition show an important role of the parser in spotting, processing and acquiring new syntactic features (Slabakova, 2000; Montrul & Slabakova, 2008, among others). Parsing for acquisition means establishing the difference between the current state of grammar and the new syntactic input coming from the L2 (Fodor, 1998; Dekydtspotter et al., 2006; Sprouse, 2011). Therefore, alternative parsing mechanisms, such as shallow parse, in L2 processing would result in no L2 acquisition.

Meanwhile, contemporary research cannot disregard behavioural difference in native and non-native processing established by the SSH scholars (Felser, Roberts and Marinis 2003, Papadopoulou and Clahsen 2003, Clahsen and Felser 2006, among others). There have been several attempts to explain the attested differences. For example, experiments that use cognates or match the participants by working memory capacity balance the cognitive load between native and non-native processing. As a result, native and non-native speakers show similar behaviour (Hopp, 2014a, 2014b, 2015, 2016a, 2016b). The assumption that L2 speakers are susceptible to interferences of non-structural information at the stage of retrieval (Cunnings 2017) points to the need for fine-grained experiments where non-native processing can be an independent object of investigation. The dissertation offers such a study and investigates the application of parsing mechanisms in L2 sentence processing.

The experimental study in the dissertation builds its predictions on the findings of the parsing experiments in monolingual speakers (Phillips, 1986; Schneider & Phillips, 2000; Phillips, 2003; Aoshima et al., 2004; Kazanina et al., 2007; Phillips, 2013). It has been established that mental structure-building is incremental and follows phrase structure (Frazier & Fodor, 1978; Stowe, 1986; Pickering & Traxler, 2006, among others). Sentence parsing starts with mental structure-building, which can be performed in either top-down or bottom-up manner or “a hybrid” (Crocker, 1999). Even though the bottom-up algorithm seems to be cognitively efficient and less prone to structural errors, there are studies showing an important role of the top-down structural prediction in sentence processing (Phillips & Schneider, 2000; Phillips 2003; Aoshima et al., 2004; Phillips, 2013). Besides, the top-down parser facilitates a search for an antecedent in sentences with, for example, the forward anaphora (Kazanina et al., 2007). This search is performed in the top-down manner and the parser performs bottom-up checks for grammatical fit on finding the possible antecedent (Kazanina et al., 2007). The latter means that top-down and bottom-up algorithms complement each other in online processing.

The reviewed literature shows that processing studies have achieved a lot. They provided a general description of the nature of the human parser and the way it functions. However, there are several unanswered questions which were highlighted by the scholarly debate in the field. There is a need to explain when and how semantic information comes into play and facilitates mental structure-building in both native and non-native languages.

There are studies clearly showing that non-native processing is structural (Frenck-Mestre, 2002, 2005; Dekydtspotter et al., 2008; Sokolova & Slabakova, 2019, among others). Meanwhile, the question of how exactly non-native mental structure-building is performed is awaiting its answer. Contemporary processing research has some evidence of combinatorial parsing, which is ‘top-down + bottom-up’ structure building (Kazanina et al., 2007). However, it remains unclear whether the two parsing algorithms take turns in online structure-building or whether either of them performs a leading role in processing.

Following the literature reviewed in this chapter, the dissertation addresses the questions of mental structure-building and the order of parsing algorithms in native and non-native sentence parsing. First, it checks whether there is a hierarchy of processing cycles and whether the parsing decisions made at higher processing cycles shape sentence parsing all the way down the syntactic tree (Schneider and Phillips, 2000). Second, it checks whether top-down and bottom-up algorithms complement each other in sentence parsing (Kazanina et al., 2007). Third, if sentence parsing involves two algorithms, the study investigates whether there is a certain order in which top-down and bottom-up structure-building is balanced during sentence parse.

Chapter 3 Psycholinguistic Considerations on Contexts under Investigation

3.1 Introduction

This chapter reviews psycholinguistic approaches to the linguistic phenomena under investigation and explains how the dissertation addresses the questions currently understudied in the field. It reviews the main approaches to cyclicity in processing and explains the main parsing algorithms. The latter answers a current scholarly need to study how exactly sentence parsing is performed. It can be fulfilled through experiments where linguistic targets allow for different interpretation patterns based on either top-down or bottom-up parsing algorithms. The dissertation offers such a design.

The chapter also shows how different parsing algorithms can manifest themselves in the target sentence. Following the psycholinguistic analysis in the previous chapter, Chapter 3 explains how the increase or decrease in processing load or the differences in sentence interpretation can be related to the implementation of the different parsing algorithms. The chapter also shows that sentence parsing cannot be performed in a unidirectional manner, either top-down or bottom-up. Chapter 3 focuses on the detailed analysis of mental structure building that shows how top-down parsing is not possible without intermediary bottom-up checks. Hypothetically, sentence parsing is a synthesized algorithm of top-down and bottom-up structure-building.

Besides, Chapter 4 brings together the general theoretical assumptions on human language processing overviewed in Chapter 2 and the linguistic theories on the target linguistic phenomena reviewed in Chapter 3. In other words, it brings together the theories reviewed in the previous chapter and makes a bridge to Chapters 4 and 5.

This chapter shows how processing research and linguistics studies complement each other to inform the research questions and predictions put forward in the dissertation. This chapter follows the analysis in Chapter 2 and argues that sentence parsing in native and non-native languages is fundamentally similar. This claim is based on the experimental evidence that the parser plays a decisive role in L2 acquisition, i.e. being governed by the UG, the parser spots the mismatches between the existing grammar and the newly processed input (see Chapter 2 for full revision). Any approach advocating fundamental differences in native and non-native parsing will have to put forward a theory of how a new language is acquired if the human brain never analyses it in the target-like manner. To the best of the author's knowledge, the proponents of shallow processing have not offered any theory of L2 acquisition through the shallow parse.

The dissertation argues that both native and non-native processing use the main functions of the human parser described in Chapter 2. Therefore, human language processing is incremental, it is performed in cycles and is based on mental structure-building. Mental structure-building is the initial stage of sentence parsing, it builds a structural description of the sentence (Phillips, 1996) and follows phrase structure. The current chapter is written in this framework.

3.2 Bidirectional Nature of Mental Structure-Building

This section describes the main parsing algorithms of top-down and bottom-up structure-building. It uses the target sentence, i.e. the three syntactic nodes at the beginning, to show how parsing unfolds. The theoretical analysis in this section shows that top-down and bottom-up parsing result in different amounts of processing load that occurs at different places in the sentence. The section also argues that sentence parsing cannot be cognitively efficient if only one of the parsing algorithms governs it. Therefore, the top-down and bottom-up structure-building necessarily complement each other (see Kazanina et al., 2007 for discussion).

The section is mainly built around the assumption that there may be one leading parsing algorithm that works either top-down by generating a structural prediction or bottom-up by assembling the accumulated categories into phrases. Let us consider how mental structure-building unfolds in each parsing algorithm, the top-down and the bottom-up.

To predict a structure in the top-down manner, the parser uses rules of grammar to compute possible structural continuations for an existing node. For example, a VP is likely to be followed by an NP or PP. A structure for an NP or a PP is generated after the VP is processed but before any new word is encountered.

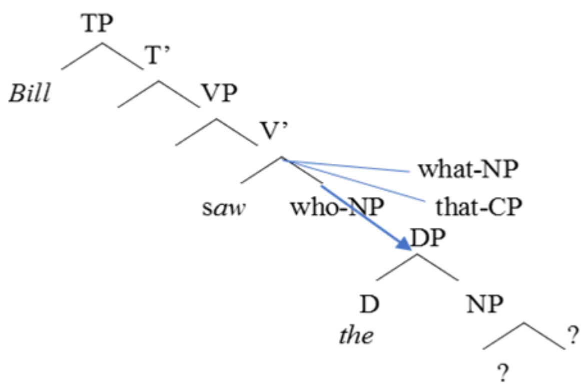
To parse bottom-up, the parser accumulates words and checks the rules of grammar for a possible structural fit. The processed words are accumulated in the "stack" (Crocker, 1999, p. 202). As soon as a sequence of words can be joined together by a grammar rule, these word chains are replaced by a phrase. For example, a determiner followed by a noun will be stored as a DP.

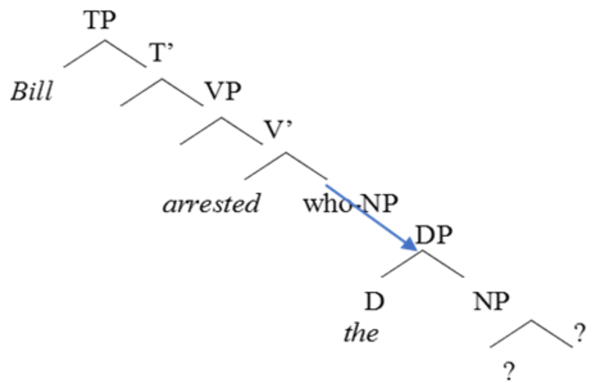
The description of each parsing algorithm above shows that they differ in when the parsing decision about phrase formation and placement is made. The top-down parser decides about a possible structural placement of the upcoming phrase before it is fully processed. The bottom-up parser waits till the upcoming phrase is complete and places it in the tree after the phrase is processed. Thus, the difference between how the two parsing algorithms work means that different spots of a sentence can be processed more easily or with more difficulty depending on the implemented parsing algorithm. This assumption is illustrated through the example of the target sentences (3.1). The very beginning of sentence parsing, the matrix verb and its complement, is analysed from the perspective of top-down and bottom-up parsing.

The target sentences in the dissertation manipulate the matrix predicate between the perception and the non-perception type. Following the analysis by Grillo and Coast (2014) and Grillo et al. (2015) in Chapter 2, a perception verb would complicate sentence processing due to its linguistic nature. A perception verb can trigger multiple structural anticipations for different types of complements (3.1a), which is not possible after a non-perception verb (4.1b)

(3.1) a) Bill saw [NP the mother of the woman]. // b) Bill arrested [NP the mother of the woman].

(3.1a) *(3.1b)*





It is important to mention that the effect of a perception verb is based on triggering a structural anticipation for multiple ways to continue the sentence. In what follows, an increase in processing load after a perception verb is only compatible with top-down structure building. Following the rules of phrase structure, a perception verb in the matrix predicate, the verb *saw*, can be followed by an animate NP/DP (*who*-NP), an inanimate NP/DP (*what*-NP) or a declarative subordinate clause (*that*-CP). The top-down parsing unfolds in several steps after the matrix predicate has been parsed.

First, the VP rule, or step 1: VP = V → DP (CP). The following words confirm the continuation with the DP *[$_{DP}$ the mother]*, not the CP. The DP is processed like DP = D + NP = the + mother. At this point, the *who*-DP anticipation has been realized. The sentence can finish. Alternatively, an eventive complement to the matrix verb can still follow and the parser can still assume the structure of a Small Clause (SC): V → SC *[[$_{VP}$ [$_{V}$ saw] (what?) [$_{SC}$ the mother talking]*. The structural adjustment towards the SC enters a competition with the structural anticipations triggered by the DP, which is not related to the argument structure of the matrix verb. The DP can be followed by an RC, [$_{RC}$ that was talking], or, for example a PP *[$_{PP}$ in the shop]*, or a PP *[$_{PP}$ of the woman]*.

An overlap between the predictions generated by the DP alongside the eventive complement triggered by the VP creates an overlap of structural anticipations: *[$_{SC}$ the mother **talking**]*, or [$_{CP}$ ***that was talking***], or, for example, *[$_{PP}$ **in the shop**]* or *[$_{PP}$ **of the woman**]*. When the preposition *of* is encountered, the parser knows several things: 1) the sentence is not finished; 2) a PP will follow; 3) this is a complex DP, where the DP *[$_{DP}$ the mother]* is the head; 4) the entire complex NP is a complement of the matrix predicate. A projection for the PP *[$_{PP}$ of the woman]* is generated and successfully filled with the incoming words.

The situation is very different in the sentences with a non-perception verb *arrested*, the second sentence in example (3.1b). There is no structural prediction for an eventive complement triggered by the verb. Therefore, there is no overlap between the anticipated eventive projection of the V and the PP at the level of complex DP in the sentences with a non-perception verb. If processing of the DP is considered separately, its internal complexity does not depend on the type of the matrix verb. However, having no structural overlap between the complex DP and the anticipated eventive complement makes sentences with a non-perception verb easier for processing. In other words, a non-perception verb is not expected to create additional processing complexity at the parsing of the complex DP.

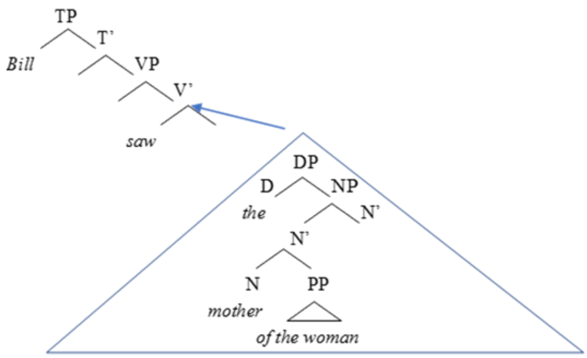
For both types of the matrix verb, the complex head DP *[$_{DP}$ the mother of the woman]* is not fully predicted after the parser has processed the VP, or after it encounters the first article *the* of the complex DP *[$_{DP}$ **the mother** of the woman]*. The need to generate a structure for the PP *[$_{PP}$ of the woman]*, and to place it within the complex DP *[$_{DP}$ the mother of the woman]*, and to make sure the complex DP modifies the matrix verb creates processing difficulties in top-down parsing. These difficulties are related to the nature of the complex DP and would be the same after the perception and the non-perception verb. However, a perception verb will add to the already existing processing complexity with the anticipated projections for the eventive complement.

In summary, the top-down algorithm predicts a different amount of the processing load at the second noun in the complex DP in the sentences with a perception as compared to the sentences with a non-perception verb. Unlike the non-perception verb *arrested*, the perception verb triggers an eventive projection alongside the internal complex projection of the DP complement *[$_{DP}$ the mother of the woman]*. After processing the first part of the DP *[$_{DP}$ the mother]*, the parser is ready to continue with the eventive complement. This should be withheld and add the PP *[$_{PP}$ of the woman]* should be added to the complex DP first. In other words, a perception condition adds a competing structural prediction for an eventive complement that can be realised in the form of the gerund after the first DP *[$_{DP}$ the mother]*.However, the real sentence requires to parse the PP first.

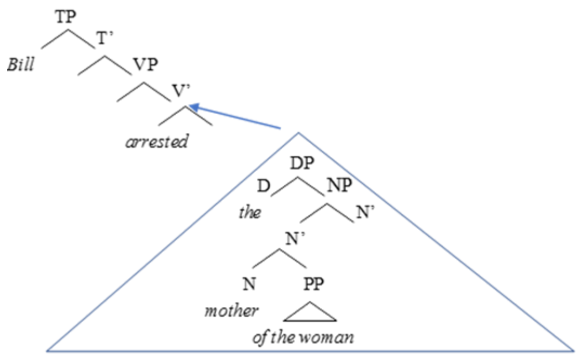
None of the predicted difficulties are expected to occur in bottom-up structure building (3.2).

(3.2) a) Bill saw [$_{NP}$ the mother of the woman] // b) Bill arrested [$_{NP}$ the mother of the woman]

(3.2a)



(3.2b)



The bottom-up parse is input-driven. The parser recognizes word categories and applies rules of grammar to join the words into certain phrases. Incoming words are stored in the stack. As soon as the parser can start implementing rules, it substitutes a string of words in the stack with phrases (Crocker 1999). Examples in (3.2) will have the following operations to parse the complex DP *[$_{DP}$ the mother of the woman]*: 1) D + N = DP; 2) DP + of + the + woman = NP + of + NP = NP + PP = complex NP *[$_{NP}$ the mother of the woman]*.

In bottom-up processing (3.2), the parser does not deal with either multiplicity of structural choices or with the incompleteness of the structural projection for the complex DP *[$_{DP}$ the mother of the woman]*. It waits for the entire phrase to be processed and parses it as a complex NP-complement that modifies the matrix predicate. At this point, the bottom-up parsing does not expect any increased processing load and the type of the matrix predicate does not make any parsing difference.

Following the analysis above, bottom-up parsing looks more efficient from the point of view of cognitive load. The bottom-up parser waits till the complex DP *[$_{DP}$ the mother of the woman]* is complete and assigns it to the matrix verb. For the same procedure, the top-down parser has to sort out the irrelevant structural predictions and adjust the structure of the DP-complement *[$_{DP}$ the mother]* to accommodate the PP *[$_{PP}$ of the woman]* as part of the complex DP-complement *[$_{DP}$ the mother of the woman]* that modifies the matrix verb.

In a processing experiment, the top-down parsing will show its complexity in increased reading times (RT) at the second noun *woman* in the PP *[$_{PP}$ of the woman]*. The effect will be measurable at the noun *woman* because the PP structure will be generated at the moment the preposition is encountered. The generated PP will require accommodation within the complex DP *[DP the mother of the woman]* before the parser could continue with the originally anticipated eventive complement, the SC. There will be a different processing scenario in the bottom-up algorithm. The bottom-up parsing will not have longer reading times at the second NP *[$_{NP}$ the woman]* as the parser will wait to receive enough information before it can beside on the modification of the PP within the complex DP.

Increased RTs of the second NP *[$_{NP}$ the woman]* can be suggestive evidence for top-down parsing. However, there are several questions that cannot be answered by the effect of slower RTs after a perception verb. First, the top-down parse can show longer RTs at the noun *woman* because of the general linguistic complexity of the complex DP. At this point, the effect of a perception verb overlaps with the effect of the DP complexity, even though both of them are evidence for top-down parsing. Besides, the capability of the parser to adjust the initially generated prediction towards the complex DP remains an open question. It is unclear how a unidirectional top-down parser decides whether the newly generated structure will modify the closest node, the DP *[$_{DP}$ the mother]* or be part of the complex DP *[$_{DP}$ the mother of the woman]* that modifies the matrix verb.

The limitations of the unidirectional parsing become obvious in the following example. To decide that the PP *[$_{PP}$ of the woman]* is part of the complex DP and not, for example, a PP-adjunct of the DP, the parser needs to look back and decide about the best grammatical fit for the PP *[$_{PP}$ of the woman]*. The same holds true when the parser adds a PP node to the existing DP and joins them together in a complex DP *[$_{DP}$ the mother of the woman]*, which becomes a complement of V. The accommodation of the PP inside the complex DP requires going up the built tree and doing a minor reanalysis. In other words, a top-down prediction is apparently maintained by bottom-up checks for grammatical fitness of the incoming constituents.

A combined algorithm of top-down and bottom-up parsing has been described in the literature. According to Crocker (1999), “the top-down and bottom-up algorithms represent two extremes of the vast range of possible parsing algorithms” (Crocker, 1999, p. 204). Crocker (1999) offers a combined top-down / bottom-up algorithm, where the algorithm uses “the “left corner” of a phrase structure rule <…> to project its mother category <…> and predict the remaining categories on the right, top-down" (Crocker, 1999, p. 205). Kazanina et al. (2007) claim that top-down structure-building is subject to bottom-up checks for well-formedness.

In the target sentence, an intermediary bottom-up check takes place at the preposition *of*. The preposition signals that the phrase is not finished, a PP is to follow and the DP *[$_{DP}$ the mother]* is part of a complex DP *[$_{DP}$ the mother of the woman]* (3.3).

(3.3) [V-saw [DP [D-the [NP-mother]]]] →

*[V-saw [DP [D-the [NP-mother]] [PP [P-**of** [DP [D-the [NP-woman]]]]]].*

The key structural amendment involves more than just linear adding of a PP *[$_{PP}$ of the woman]* to the existing DP *[$_{DP}$ the mother]*, the string is reanalysed and parsed as a complex DP-complement *[$_{DP}$ the mother of the woman]* that modifies the matrix verb. Therefore, a bottom-up check for grammatical fitness aids top-down structure-building at the level of the preposition *of*. This bottom-up structural double check allows for a minor structural adjustment, which, theoretically speaking, can work as a preventive measure to avoid bigger reanalysis later in the sentence. Therefore, top-down and bottom-up processing necessarily complement each other.

The analysis of the combinatorial use of the top-down and bottom-up algorithms through the examples in this section suggests that top-down parsing plays a leading role in structure-building and bottom-up checks provide timely amendments that could prevent a parsing crash. The effect of top-down parsing can be measured through prolonged reading times at the second noun *woman* in the complex DP *[$_{DP}$ the mother of the woman]* and used as evidence for structural adjustment.

However, the complex DP is not the most favourable linguistics environment to investigate parsing strategies. The end point in sentence comprehension is a complex DP *[$_{DP}$ the mother of the woman]* that modifies the matrix verb. It means that a successful parse will end up with the same structural projection independently of whether there is increased RT on the noun *woman*, or whether the parsing algorithms is unidirectional top-down or bottom-up, or whether it is a combination of both. For the analysed part of the sentence possible differences in the application of parsing algorithms do not influence sentence comprehension. It means, the *VP + complex DP* example leaves a possible variability of parsing strategies a merely theoretical matter that can be partly addressed through the measurement of RT at a certain region in the sentence. The situation is different if the entire sentence is considered, which is the main topic of the following section.

To summarize, the current section used the example of the complex DP *[$_{DP}$ the mother of the woman]* to shows how top-down and bottom-up structure building could unfold in real time. The section explained how the linguistics nature of a perception verb could increase processing complexity of the sentence when it was processed in the top-down manner. The sections also explained why there would be no processing effect of the matrix predicate in the bottom-up algorithm.

The section provided a step-by-step analysis of sentence parsing and showed that top-down parsing on its own could not account for the structural accommodation of the PP *[$_{PP}$ of the woman]* into the complex DP *[$_{DP}$ the mother of the woman]*. The section claims that top-down structural anticipation is accompanied by bottom-up checks for grammatical fitness as these two parsing strategies cannot work in isolation from each other.

3.3 Cyclicity in Sentence Parsing and its Implications on Sentence Interpretation

This section explains how the interpretation of complex syntactic strings may depend on the implementation of a certain processing algorithms, top-down or bottom-up. A full analysis of the target sentence shows that a top-down parsing follows a structural prediction triggered by a perception verb in the matrix clause and can shape sentence structure all the way down the syntactic tree. It means, the verb type influences both RC resolution and anaphora resolution. Secondly, the section shows that bottom-up parsing annuls the effect of the matrix verb and anaphora resolution has a language-specific pattern in the target sentence (3.4)

(3.4) Bill saw / arrested the mother of the woman [RC that was talking about herself / her in the yard].

As can be gathered from the previous chapters, structural parsing follows phrase structure and unfolds in a recursive pattern CP → TP → VP → NP / CP → TP → VP → NP, etc. The first theoretical assumption of this section claims that the top-down parse follows the structural prediction triggered at the level of VP. This structural prediction is supported throughout the sentence and shapes anaphora resolution at the lower processing cycle. In other words, the generated structural anticipation is triggered at the level of the higher VP and is maintained till the level of the lower DP in the chain CP → TP → VP → DP / CP → TP → VP → DP. The top-down directionality of structural parsing is described in Schneider and Phillips (2000). The authors argue that parsing decisions of the higher processing cycles define the parsing of lower cycles.

Building on the findings by Phillips and Schneider (2000) the target sentence can be divided into several processing cycles where each cycle contains a certain linguistic phenomenon. In the target sentence (3.4) cycle 1 is the level of the matrix verb which triggers a structural projection for its complement. In cycle 2, the structure triggered by the matrix verb is extended to accommodate the incoming RC. In cycle 3, the attachment of the RC shapes anaphora resolution.

This section explains that a structural prediction is created phrase by phrase, and the generated projection is maintained throughout the course of sentence processing. The description of the processing cycles is presented from the first word to last, which follows the natural unfolding of a sentence in real-life and shows how a new upcoming word may fit in or reshape the originally created structure. The analysis goes through the entire sentence from the matrix verb at the top of the tree to anaphora resolution at the bottom of it (3.5).

(3.5) Bill saw || ^{1} the mother of the woman || ^{2} that was talking about || ^{3} her / herself in the yard.

Word-for-word presentation of the sentence, as it occurs in real-life, creates a certain linguistic expectation which unfolds in three processing cycles marked as ^{1} || ^{2} and || ^{3} in (3.5). The highest processing cycle (1) is the level of the matrix clause. At this level, the perception verb creates a prediction for an eventive complement alongside the complex NP. The second cycle (2) is RC attachment resolution, which is preconditioned by the higher processing cycle, where the anticipated projection for an eventive complement favours HA. The lowest processing cycle (3) is anaphora resolution, which is syntactically constrained by the type of RC attachment chosen at the second cycle.

3.3.1 Cycle ([1]): The matrix verb and the complex noun phrase

This section only considers the first parsing cycle, i.e. the effect of a perception verb in the matrix clause. The previous section showed that a non-perception verb in the matrix clause triggers a structural prediction for a who-NP-complement (see section 4.2 above). A non-perception verb cannot have multiple complements that would be anticipated after it has been parsed. Therefore, with a non-perception verb in the matrix clause there are no competing structural projections that would make sentence processing particularly complex. If the perception and the non-perception processing conditions are compared to each other, the non-perception verb is a no-difficulty condition and is the processing baseline.

A perception verb in the matrix clause, on the contrary, triggers multiple structural predictions for a complement. The analysis in the previous chapters can be narrowed down to the two distinctive complements of a perception verb that influence subsequent sentence parsing, an event and an entity, or a set of entities, (3.6).

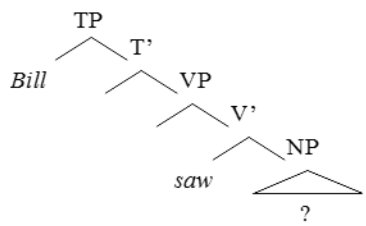
(3.6) Bill saw [NP…]

a. VP = V → NP

b. VP = saw → what-NP

or

VP = saw → who-NP



On reading the complex DP [DP the mother of the woman] the prediction for the who-NP is checked (3.7), (see also section 3.2).

(3.7) Bill [$_{VP}$ saw [$_{who\text{-}NP}$ the mother of the woman]].

However, the eventive complement, or the *what*-prediction has not been resolved at the level of the complex *who*-NP yet. There is no syntactic prompt to abandon the eventive structural anticipation. After the complex NP *[$_{NP}$ the mother of the woman]*, the *what*-complement may still appear. It will have a form of the SC: V → SC *[[VP[$_V$ saw] (what?) [$_{SC}$ [$_{NP}$ the mother of the woman] talking]]*. To satisfy the *what*-prediction, or a prediction for an eventive complement in English, the *who*-NP in (3.7) must be followed by verbal element. In Russian the *what*-complement must be a finite subordinate clause (CP), which will be described separately. Compare (3.8a) and (3.8b).

(3.8) a. Bill ***saw*** *[SC the mother of the woman talking (talk) about her / herself in the yard] (Eng).*

b. Bill ***saw*** *[CP that the mother of the woman was talking about her / herself in the yard] (Rus).*

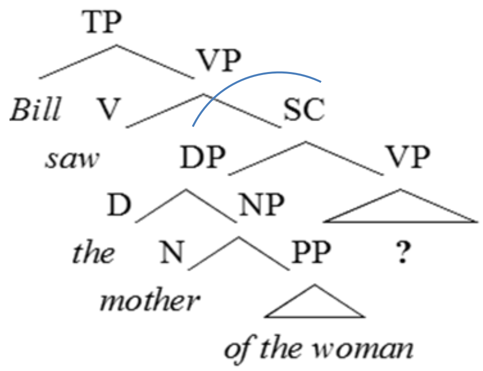
Bill ***saw*** *(what?) the event of talking about her / herself performed by the mother of the woman in the yard.*

In English the phrase structure of the *what*-prediction, or the eventive complement, is *VP = V → SC*, in Russian it is *VP = V → CP*. Notice that both realizations of the eventive complement make the first DP *[$_{DP}$ the mother]* of the complex DP *[$_{DP}$ the mother of the woman]* the only grammatically possible doer of the action of *talking* expressed by the embedded verb. In both languages a perception verb in the matrix clause triggers an anticipation for an eventive complement alongside the *who*-NP. The differences between Russian and English are in when and how the misleadingly generated eventive projections influence RC resolution.

In English, the parser expects a verbal element to follow the DP *[$_{DP}$ the mother of the woman]* to fulfill the eventive complement that is still possible in the form of a SC. At the same time, the complex DP *[$_{DP}$ the mother of the woman]* also triggers a structural prediction: NP = N → PP / RC. By the time the parser reaches the complementizer *that* (3.9), the eventive complement SC remains a strong structural prediction because it was generated at a higher processing cycle and nothing in the sentence signals that it would be ungrammatical. Besides, it is cognitively efficient for the parser to stick to the existing structure than to generate a new one or reanalyse the structural prediction.

(3.9) Bill ***saw*** *the mother of the woman || **that** was talking about her / herself in the yard.*

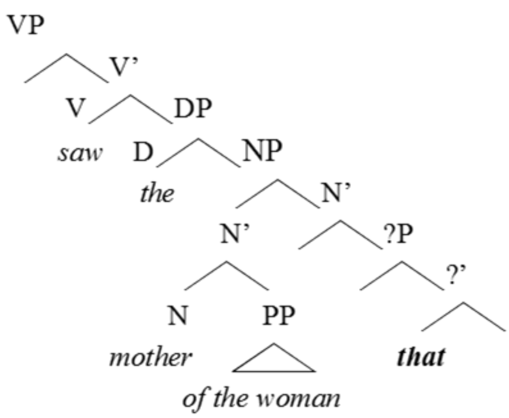
Bill ***saw*** *[SC [**NP** [PP]] [**VP**…]]*



The tree in (3.9) is a structural prediction triggered by a perception verb. At the beginning of the sentence it is a DP, that could be either a *what*-DP or a *who*-DP. After parsing the complex DP *[$_{DP}$ the mother of the woman]*, the parser structures it to modify the verb, but possibly as the subject of the SC that would contain a verbal element to fulfil the prediction for an eventive complement. The expected verbal element will modify the higher NP *mother* as a VP of the SC.

On encountering the complementizer *that*, the parser realizes that a restrictive RC will follow. It checks back to the complex NP *[$_{NP}$ the mother of the woman],* confirms that it is a *who*-NP complement of the matrix verb and abandons the event-oriented prediction. This is the first processing cycle. At the end of it, the parser has a structural projection that moves from a VP-expectation to a RC-expectation. The RC will be easily fit in the already generated node. It is a minimal and cognitively cheap adjustment. Meanwhile, the same as the potentially expected VP that didn't materialize, the incoming RC will have to modify the higher NP *[$_{NP}$ the mother]* in the tree (3.10).

*(3.10) Bill **saw** [NP [PP]] [?P…]*



In Russian, a structural prediction for the eventive complement (3.8b) is a finite subordinate clause. The same as in English, a perception verb *saw* in Russian can be followed by either a *who*-complement: *Bill **saw** (who?) → NP (Bill **videl** (kogo?) → NP)*, or an eventive complement: *Bill **saw** (what?) → CP [$_{CP}$ **that** the mother of the woman was talking about herself / her in the yard]*. Notice, that the eventive complement has the form of a full finite subordinate clause. Therefore, for the eventive complement in Russian, the parser is expecting to project a clause beginning with the complementizer *that*. In other words, an eventive complement in Russian will have *that* right after the matrix predicate. Alternatively, if the head position of the CP is empty and the verb is followed by another constituent, the parser abandons the anticipation for the eventive complement and carries on with the DP analysis which can be potentially followed by an RC.

Thus, compared to English, the eventive projection in Russian is ruled out earlier. In Russian, the absence of the complementizer *that* signals the *who*-NP continuation only. By the time the parser reaches the first DP *[$_{DP}$ the mother]* of the complex DP *[$_{DP}$ the mother of the woman]*, there is no competing structural predictions that would complicate sentence parsing. In Russian, the eventive projection triggered by a perception verb does not make parsing much more difficult that a sentence with a non-perception matrix verb, basically because the optionality is ruled out right after the matrix verb.

The situation is very different in English, where the anticipated eventive complement remains a valid structural anticipation till the complex DP is processed and the parser hits the complementizer of the RC. The beginning of the RC, i.e. the complementizer *that*, completely rules out the possibility for an eventive complement. Therefore, a perception verb in the matrix clause should leave a measurable increase in processing load in English. The parsing conflict is resolved at the beginning of the RC and the following constituents should be processed slower. This prediction only concerns the top-down parsing algorithm.

It is important to mention that English eventive complement can have a form of the finite CP too. This property patterns in Russian and English. However, the CP in English is one of the structural options to realize an eventive complement. It is ruled out at the beginning of the sentence, and it does not cancel a structural continuation in the form of a SC. For this reason, the CP eventive clause in English is not informative for the current processing experiment.

In summary, the top-down structure-building yields different processing effects in English and Russian. In English a perception verb triggers a structural anticipation for an eventive complement that can be completely ruled out only at the beginning of the RC. In Russian, the effect of a perception verb is not going to be very strong as the generated projection is annulled right after the matrix verb. The top-down parsing algorithm also expects to see processing differences between the sentences with a perception vs. a non-perception verb. The non-perception verb creates a minimal processing difficulty and can be the baseline for the measurement of the processing load in the sentences with a perception verb.

The bottom-up parsing, on the contrary, does not expect any effect of the matrix predicate on the processing of the following constituents. In other words, the subcategory of the matrix predicate is not going to have an immediate effect on sentence parsing. Consider now the bottom-up parsing algorithm. If the target sentence in (3.9) is parsed bottom-up, a perception verb in the matrix clause does not make sentence processing more complex than when the matrix predicate is a non-perception verb. As explained in 3.2., the bottom-up parser accumulates words in the stack to group them in phrases as soon as a relevant grammar rule becomes applicable. In the target sentence, the string *Bill saw the mother of the woman that…* will be parsed in the following way:

1) Bill + saw = NP + VP;

2) NP + VP + the;

3) NP + VP +the + woman = NP + VP + NP(DP);

4) NP + VP + NP + of;

5) NP + VP + NP + of + the;

6) NP + VP + NP + of +the + woman = NP + VP + NP + of + NP(DP) = NP + VP + NP + PP = NP + VP + complex NP = Bill saw the mother of the woman;

7) NP + VP + complex NP + that.

The stages 1-7 in bottom-up parsing show no difference in phrase formation and structural modification in a sentence with a perception vs. with a non-perception verb. In the first processing cycle, bottom-up structure building does not create any additional processing difficulty associated with a perception verb in the matrix clause in either English or Russian.

Alternatively, top-down parsing influences English and Russian sentences differently and the effect is related to the type of the matrix predicate. In English, unlike in Russian, a perception verb creates a measurable processing difficulty in sentences with a perception verb. Besides, if top-down parsing is maintained till the end of the sentence, the attachment of the RC is preconditioned by a structural prediction for the SC. This projection has the complex DP in place and keeps the node for the verbal element within the SC open. This node modifies the entire DP *[$_{DP}$ the mother of the woman]* which patterns with HA in RC resolution (see Chapter 4 for detail).

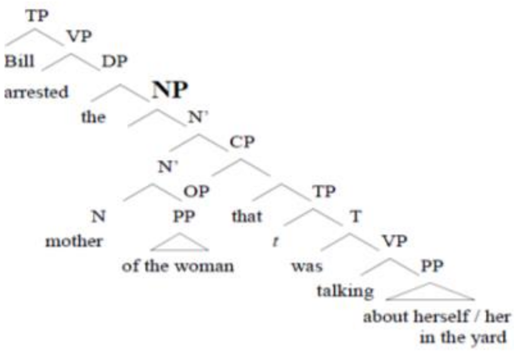
3.3.2 Cycle (^{2}): RC resolution

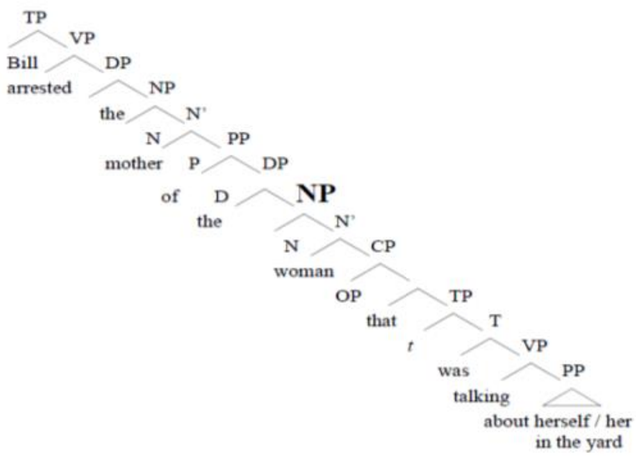
Despite syntactic equivalence between English and Russian, the ambiguous RC in the target sentence reveals cross linguistic variation in its attachment resolution (see Chapter 4). The optionality for two interpretations shows in the answer to a comprehension question in (3.11). The grammaticality of both answers (3.11a) and (3.11b) is shown in syntactic trees (3.12) and (3.13), respectively.

(3.11) Bill saw the mother of the woman that was talking about herself / her in the yard.

Who was talking about her / herself?

a) the mother (HA) b) the woman (LA)





As explained in Chapter 3, the parser attaches the RC higher in the tree (HA) for answer (3.11a), [$_{DP}$ *the mother of the woman*]. Tree (3.12) shows LA resolution of the RC that corresponds to answer (3.11b), [$_{DP}$ *the woman].* There is an established cross-linguistic variation in RC resolution, so that native speakers of Russian prefer the HA in tree (3.12) but native speakers of English prefer LA in the RC, (3.13) (see Chapter 4 for detail). Chapter 4 also shows that a preferred type of RC resolution yields a certain pattern of anaphora resolution. Therefore, (3.12) is a Russian-like pattern of sentence parsing and (3.13) is the English-like one.

The preferred pattern of RC resolution can be subject to change due to an external influence, or, in other words, due an influence of a constituent from outside the clause. As explained in 3.3.1, the top-down parsing at the previous processing cycle expects the oncoming syntactic string to modify the higher DP *[$_{DP}$ the mother of the woman]* in sentences with a perception verb. The effect is expected to be noticeable in English.

In English, a structural prediction for an eventive complement generated at the first processing cycle patterns with the tree structure in (3.12). The complex DP complement *[$_{DP}$ the mother of the woman]* modifies the matrix verb and has an open node for the upcoming verbal element within the SC. A potential for the SC to continue through structural modification of the entire DP *[$_{DP}$ the mother of the woman]* favours HA of the RC. The anticipated VP within the SC can be easily substituted by the RC that would start from the same node.

It is worth mentioning that an effect of a perception verb contradicts the default English preference for LA in the RC, (3.13). At this point, a perception verb creates an incongruent processing condition for RC attachment in English. To maintain the top-down projection, English parsing should abandon the naturally preferred LA (3.13) in sentences with a perception verb in the matrix clause.

In Russian, a structural projection for an eventive complement is ruled out before the complex NP *[$_{NP}$ the mother of the woman]* is encountered. Moreover, native speakers of Russian prefer HA (3.12) in the RC even in sentences without a perception verb. In the case of Russian, a perception verb creates a congruent processing condition, i.e. the naturally preferred HA is supported by a temporary expectation of the eventive complement. Top-down parsing in Russian is expected to benefit from a perception verb in the higher processing cycle, i.e. sentences with a perception verb may be processed faster than sentences with a non-perception matrix verb.

To sum up, top-down parsing is expected to lead to HA preference in both Russian and English, when the main verb is a perception verb: in Russian, because a perception verb does not contradict the preferred HA pattern, and in English, because a structural prediction generated by a perception verb favours HA of the RC. The latter overrides the original preference for LA attested in may studies with NSs of English (see Fodor 2002, Grillo et al. 2015). All in all, an experimental study should demonstrate overall preference for HA in both Russian and English in sentences with a perception verb (see Sokolova in press, Sokolova and Slabakova 2019 for detail).

Alternatively, bottom-up structure building is immune to the effect of a perception verb in the matrix clause (see 3.2, 3.3.1). The parser adds the complex DP to the V in the matrix clause and starts working on the RC. By the time the parser reaches the complementizer *that* there is no structural condition that would constrain RC resolution. Besides, the bottom-up algorithm does not create any parsing difficulty online. The same as for any other constituent, the parser waits till the end of the RC to decide about its attachment. Adding elements to the stack word by word, the parser keeps organizing them in phrases within the RC till the moment that RC *[$_{RC}$ that was talking about herself / her in the yard]* is complete. Nothing in the bottom-up parsing forces the comprehender to override the RC resolution pattern generally preferred in her language. The complete RC is attached high in Russian and low in English.

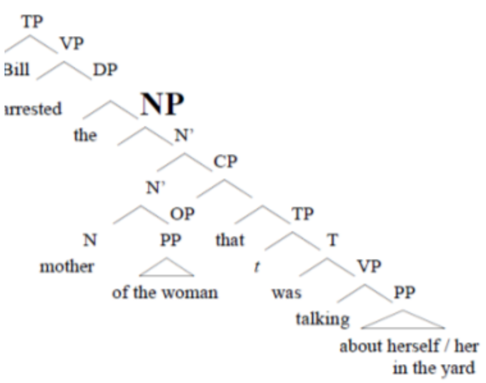
At the end of the second processing cycle, the parser has performed RC attachment. In top-down parsing, there is an overall preference for HA in both Russian and English. In bottom-up parsing, RC attachment preserves a language-specific pattern, LA in English and HA in Russian. With the target sentences like in (3.9) a preferred pattern of RC resolution shapes anaphora resolution further down in the tree. The anaphora is a prepositional object of the embedded verb and anaphora resolution is the third processing cycle of our analysis.

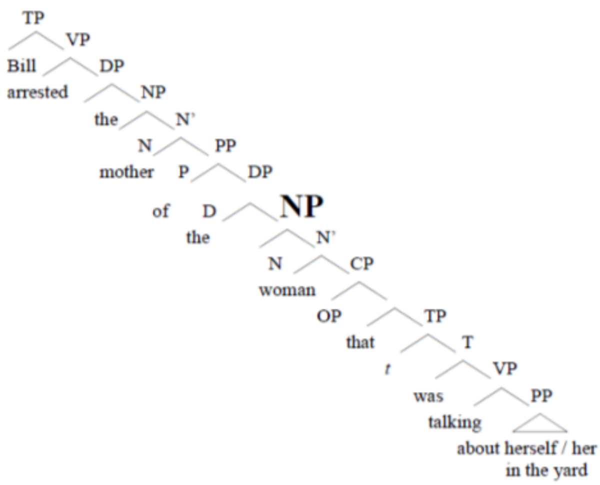
3.3.3 Cycle (^{3}): Anaphora resolution

In order to find out if there is a direct top-down structural prediction in human sentence parsing, the study uses anaphora resolution at the end of the sentence, or at the bottom of the syntactic tree. The anaphoric elements are the reflexive (Eng herself / Rus sebe) and the pronoun (Eng her / Rus nej). Both types of the anaphora appear as the prepositional object to the embedded verb, [VP talking [PP about Pron her / Refl herself]]. The anaphora is in the lowest processing cycle and its co-reference is pre-conditioned by the parsing at higher cycles. In both top-down and bottom-up processing anaphora resolution depends on the preferred type of RC attachment.

In accordance with the basic Binding Principles (Chomsky, 1981), anaphora resolution is performed through co-reference and c-command. In the target sentence, both nouns in the complex head DP *[DP the mother of the woman]* match the anaphoric elements her / herself in gender number and person. Both DPs, the higher DP *[DP the mother of the woman]* and the lower DP *[DP the woman]* can potentially c-command the anaphora in either HA (3.14) or LA (3.15) (see also Chapter 4 below).

(3.14) (3.15)





The antecedent of the anaphor is the trace of OP, in Spec TP. The OP and the head DPs are coindexed and the DPs serve as antecedents for the OP (see section 2.2.2 and Sauerland, 2000 for discussion). In other words, with HA the antecedent of OP is the complex DP *[$_{DP}$ the mother of the woman]* (3.14), with LA, the antecedent of OP is the lower DP *[$_{DP}$ the woman]* (3.15).

In accordance with the Binding Principles (Chomsky, 1981), the reflexive is bound within the binding domain (Principle A), or to the nearest c-commanding antecedent. HA of the RC in (3.14) leaves the OP coindexed with the DP *[$_{DP}$ the mother of the woman]* and *herself* must be co-referent with it and *her* cannot be co-referent with it in HA of the RC. In the tree in (3.15), the OP is co-indexed with the lower DP *[$_{DP}$ the woman]*, in LA of the RC, *the woman* is co-referent with the reflexive but not with the pronoun.

At this point, one can see that a preferred type of RC resolution puts a constraint on anaphora resolution, i.e. RC resolution chosen at a higher processing cycle defines the nearest c-commanding element for anaphora resolution. Comparing the trees (3.12) and (3.13) to (3.14) and (3.15), one can also see that (3.14) is what was previously called Russian-like RC resolution preference and (3.15) is the English-like one. Since anaphora resolution totally depends on the preferred type of RC attachment, a processing study can expect a variability of anaphora resolution depending on the processing algorithm used for sentence parsing.

In bottom-up parsing, there will be two language-specific types of reflexive resolution, the Russian-like and the English-like. Anaphora resolution will follow RC resolution and the reflexive will have the pattern: *herself = the mother* in Russian and *herself = the woman* in English.

In top-down parsing, the eventive projection of the first processing cycle is expected to be maintained till the end of the sentence. Therefore, an RC will have an overall preference for HA in both Russian and English. The overall preference for HA in RC yields an overall preference for the reflexive resolution, like *herself = the mother*.

Pronoun resolution also follows the general Binding Principles: the pronoun must be free within its binding domain (Principle B, Chomsky, 1981). In the current framework, the binding domain is defined by the nearest accessible subject, for our purposes the TP (see Chapter 4 for the definition of the binding domain). By its definition, the pronoun is not bound by the nearest c-commanding DP and can have several options for co-reference. Meanwhile, the comprehension check in the experiment forces the pronoun to have an antecedent within the head NP (3.16).

(3.16) Bill saw the mother of the woman that was talking about herself / her in the yard.

This person was talking about:

(a) the mother   *(b) the woman*

The design of the study excludes long-distance binding for the pronoun. There is a gender mismatch with the matrix subject. Besides, a comprehension check locks binding choices within the head NPs. To observe Principle B, the pronoun must be free within the domain, however, it can be co-referent with the non-c-commanding DP, in Russian. It is the lower DP *[$_{NP}$ the woman]* (3.14) and in English it is the DP *[$_{DP}$ the mother]*, which is not the nearest c-commanding DP (3.15). It is important to notice that the pronoun always remains ambiguous because an extra sentence referent is always possible. The context of the experiment does not support the ambiguity of pronoun resolution. However, its processing may be more complex than the processing of the reflexive.

To sum up, both Russian and English observe the Binding Principles for anaphora resolution. However, these languages have different binding patterns when the anaphora is placed within the RC. From a bottom-up parsing perspective, the difference is a result of language-specific RC resolution, which changes the distance between the c-commanding NP and the anaphora. Consequently, the pronoun in Russian (3.14) must be bound by the lower NP *[$_{NP}$ the woman]*, which is outside its binding domain. In English (3.15), the pronoun is bound higher in the tree to the NP *[$_{NP}$ the mother]*, which is located above its nearest c-commanding element. According to bottom-up parsing, then, there will be two language-specific patterns of anaphora resolution, independent of the matrix verb, if Binding Principles are observed:

Russian-like: ‘*herself = the mother // her = the woman*’

and

English-like: ‘*herself = the woman // her = the mother*’

On the other hand, if parsing is performed in a top-down manner and follows the hierarchy of processing cycles, a perception verb in the matrix clause favours HA of the RC at the highest processing cycle. At the second processing cycle, the RC is attached higher in the tree. Consequently, in HA (3.14) the higher noun binds the reflexive and the lower noun binds the pronoun: ‘*herself = the mother // her = the woman*’ in both languages.

Thus, a preferred pattern of anaphora resolution can become evidence for either top-down or bottom-up sentence parsing. Moreover, potential processing difficulties created by a perception verb can be measured. Altogether, the dissertation experiment will provide a detailed description of the mechanisms of human parsing of the sentences with a perception verb in the matrix clause and an RC that contains the anaphora.

3.4 Summary

This chapter approaches the linguistic target of the dissertation from a psycholinguistic perspective. It explains how the assumptions of the general processing theories can manifest themselves in online sentence processing. The latter is innovative in the field of processing studies.

To begin with, human sentence processing is incremental and is based on mental structure building, i.e. it is based on the parser’s ability to recognize the syntactic category of the incoming word and assemble several categories into phrases and phrases into sentences. The incrementality of parsing means that the parser deals with sentence chunks and decides what structure should be assigned to the string of words step by step as the words appear in online sentence presentation.

Sentence parsing follows phrase structure and builds a mental syntactic tree. It means, parsing can be performed from either top to bottom or from bottom to top incrementally. This hierarchical organization of the incoming linguistic information should agree with the order in which words appear in the sentence. In the target languages, English and Russian, the parser moves from left to right as the sentence unfolds. The parser takes in the linear string of words and puts out a hierarchical structure built either top-down or bottom-up.

The directionality of the parsing algorithms influences the final interpretation of the sentence. Therefore, a preferred interpretation pattern can be understood as a surface manifestation of the parsing algorithm that underlie linguistic decision making. The linguistic target has a perception verb in the matrix clause, an ambiguous RC in the middle and the anaphora at the end of the sentence.

Structurally flexible RC can be influenced by a perception verb from outside the clause. A perception verb favours HA preference in the RC if sentence is parsed top-down. The preferred type of RC resolution shapes the anaphora resolution at the end of the RC. As a result of top-down structure building the reflexive will be co-referent with the noun *the mother* and the pronoun with the noun *the woman* in both languages of the experiment (Table 3.1).

Bottom-up parsing does not allow any structural anticipation, and the matrix verb has no processing effect other than its capability to have a complement. With no influence from the matrix predicate, the bottom-up parsing strategy that assigns structure retrospectively, i.e. to the processed constituents, will result in language specific attachment resolution of the RC. The RC resolution will yield a language-specific pattern of anaphora resolution '*herself = the mother // her = the woman*' in Russian and '*herself = the woman // her = the mother*' in English (Table 3.1).

Table 3.1. Effect of parsing algorithm on sentence interpretation

	Matrix predicate	***RC attachment***	***Anaphora resolution***
Top-down parsing	Structural projection for an eventive complement favours HA of the RC	HA of the RC in both English and Russian	'herself = the mother // her = the woman' in both English and Russian
Bottom-up parsing	No effect of the matrix predicate	HA of the RC in Russian LA of the RC in English	'herself = the mother // her = the woman' in Russian 'herself = the woman // her = the mother' in English

In summary, the preferred pattern of anaphora resolution works as evidence for the usage of a certain parsing algorithm in sentence processing. However, there is experimental evidence that top-down and bottom-up parsing may complement each other (see Kazanina et al., 2007). On top of that, section 3.2. in this chapter uses the matrix predicate and its complement to show that unidirectionality of sentence parsing is not possible in real life. The dissertation argues that both parsing algorithms complement each other and form a combined top-down + bottom-up parsing mechanism. To be more specific, sentence comprehension starts with a structural anticipation which undergoes a bottom-up check for grammatical fitness. For example, the complex DP *[*$_{DP}$ *the mother of the woman]* at the beginning of the sentence must undergo minor structural reanalysis.

There are several parsing operations that ensure the assembly and proper attachment of the complex DP *[*$_{DP}$ *the mother of the woman]*. Right after the matrix verb has been processed, the parser creates a structural projection for the possible coming DP node which is the complement of the verb. The anticipated DP appears and gets parsed closing the DP *[*$_{DP}$ *the mother]*. However, the DP is followed by the preposition of. On encountering the preposition, the parser must extend the anticipated projection to accommodate the PP *[*$_{PP}$ *of the woman]* and join all the phrases into the complex DP *[*$_{DP}$ *the mother of the woman]*.

Even though integration of the PP is a relatively easy operation, it cannot be performed without going back up the tree and reopening the phrase. Going up the tree even one step means the parser is performing a bottom-up operation. In our example the purpose of this bottom-up operation is to check whether the PP would be grammatically attached to the existing DP. This bottom-up check allows for a quick amendment of the generated projection to the complex DP *[*$_{DP}$ *the mother of the woman]* which remains the complement of the matrix predicate.

This chapter is not limited to the analysis of the complex DP. It implemented the known theoretical assumptions and analysed the possible parsing operations in the entire sentence. Even though the chapter explains how top-down and bottom-up parsing is expected to result in different interpretation decisions, the dissertation argues that the entire nature of human language processing cannot use one unidirectional parsing algorithm. Sentence processing is based on a combinatorial algorithm of top-down + bottom-up parsing. The latter opens a question of how the combination of top-down and bottom-up parsing can manifest itself in real life sentence processing.

Chapter 4 Theoretical Predictions on Contexts under Investigation

4.1 Introduction

The dissertation uses syntactically complex sentences to investigate parsing algorithms in human sentence processing. There are several linguistic environments that fall within the scope of the dissertation. They are the matrix predicate, the ambiguous relative clause (RC) and the anaphora at the end of the sentence. The cornerstone element in the sentence under analysis is the ambiguous RC. Its structural flexibility to attach higher or lower in the tree allows checking for several linguistic factors that can shape sentence parsing.

Another factor is a perception verb in the matrix clause. A certain type of verb can influence the parsing preference for attachment resolution from outside the RC, or from the position higher in the tree. The preferred type of RC attachment influences anaphora resolution, when the anaphora is placed at the end of the RC, or at the bottom of the tree. The linguistic effect of a perception verb works from the top of the tree towards the bottom. Meanwhile, anaphora resolution triggers a search for its antecedent among the constituents that have already been parsed, or in the bottom-up manner. For anaphora resolution, the parser needs to go up the tree and find the antecedent among the head nouns of the ambiguous RC.

This section considers RC attachment resolution, anaphora resolution and the linguistic nature of a perception verb in the matrix clause and describes the linguistic nature of the phenomena under investigation. The analysis explains how certain linguistic properties of the target constituents may prompt the use of certain parsing algorithms in sentence processing.

The chapter shows that the target linguistic phenomena are of a universal nature. The selectional properties of a perception verb, the two types of RC ambiguity resolution and anaphora resolution follow the same linguistic constraints in English and Russian. However, the same grammatical properties, for example, a potential of a perception verb to have a certain type of complement, entail different processing difficulties in Russian and English. The potential processing differences can have a linguistic explanation, which is given in this chapter.

4.2 Ambiguous Relative Clause: Attachment Resolution Cross-referencing

This section provides a linguistic account for RC resolution in English and Russian. It also explains how linguistic approaches to cross-linguistic variation in RC attachment inform the experiment design in the dissertation. In other words, this section reviews the linguistic factors that may prompt a certain type of RC resolution. The dissertation wants to avoid these linguistic influences and it keeps the experimental sentences balanced between Russian and English.

The target sentence of the experiment is a complex sentence with an ambiguous restrictive RC in (4.1). Its Russian equivalent is (4.2).

(4.1) Bill saw the mother of the woman [$_{RC}$ that was talking about herself / her in the yard].

(4.2) Bill videl mamu zhenshchiny, [$_{RC}$ kotoraya govorila o sebe / nej vo dvore].

Bill saw mother-ACC woman-GEN that-COMP talk-PAST. FEM about herself-REFL / her-PRON in yard.

The target sentence (3.1) contains an RC [$_{RC}$ that was talking about herself / her in the yard]. In the structural analysis of the RC, the dissertation follows the Matching Hypothesis that claims no transformational relationship between the head DP [$_{DP}$ the mother of the woman] and the trace *(t)* within the RC (see Sauerland, 2000 for detail, see Bianchi, 2000 for discussion). The dissertation assumes the existence of the Operator (OP) that raises to the initial position of the RC (4.3).

(4.3) Bill saw the mother of the woman [$_{RC}$ OP that $_{t}$ was talking about herself / her in the yard].

The Operator is a silent element that can be co-reference with either of the head nouns in the complex head DP *[$_{DP}$ the mother of the woman]*. First, the OP can be co-referent with the higher NP *[$_{NP}$ the mother]*. The second option is the co-reference of the OP with the lower NP [$_{NP}$ the woman] in the complex DP *[$_{DP}$ the mother of the woman]*. The optionality in co-reference of the OP explains the ambiguity of the interpretations of the sentences in (3.1) and (3.2). In syntactic terms the sentences in (3.1) and (3.2), will be referred to as structurally ambiguous.

Structural ambiguity means that a sentence can have more than one grammatically correct interpretation and every interpretation has its own syntactic structure. The RC in (4.1) and (4.2) can be interpreted in two ways and yield two grammatically correct answers to a comprehension question in (4.4):

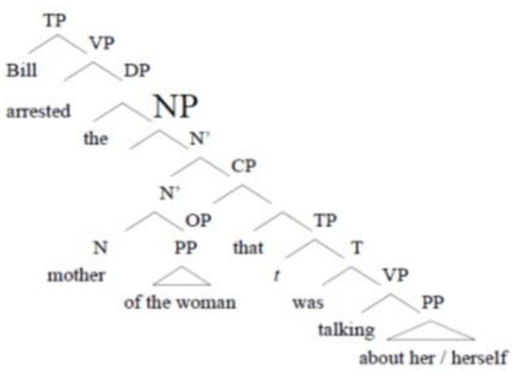
(4.4) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

Who was talking in the yard?

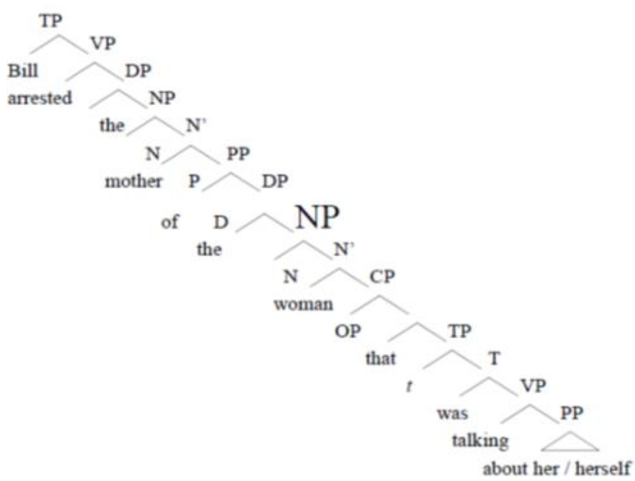
a) the mother of the woman   *b) the woman*

The grammaticality of (4.4a) and (4.4b) is shown in trees (4.5) and (4.6).

(4.5)



(4.6)



The tree in (4.5) illustrates the answer choices (4.4a), where the RC modifies the entire complex DP [DP mother of the woman] and the doer of the action of talking becomes the mother. The tree in (4.6) illustrates the answer choice (4.4b). The RC [RC that was talking about herself / her in the yard] modifies the lower DP [DP the woman]. The placement of RC attachment in the tree in (4.5) is higher than in the tree in (4.6). Therefore, (4.5) is high attachment resolution (HA) of the RC and (4.6) is low attachment resolution (LA) of the RC.

There is experimental evidence that all syntactic properties being balanced, native speakers of Russian, French, Dutch, German, Greek, and Italian prefer HA (4.5) (Cuetos & Mitchel, 1988;

Hemforth, Konieczny, Scheepers, Strube,1998; Zagar, Pynte, Rativeau, 1997). At the same time, native speakers of English, Norwegian, Romanian, and Swedish prefer LA (4.6) (Fernandez, 1999; Fodor, 2002). In the dissertation experiment, the target languages are English and Russian. Following the experimental results on RC resolution given here, Russian is a HA language and English is a LA language.

The literature on cross-linguistic variation in RC attachment provides several explanations of the interpretation variability of the RC. First, languages with flexible word orders are most often HA languages. This is applicable for both English and Russian in the study. Even though both English and Russian are SVO languages, Russian allows a lot of scrambling. Therefore, the word order in Russian is more flexible than in English and Russian is a HA language.

Hemforth et al. (1998) suggest that RC attachment depends on how the RC is introduced. If the RC is introduced by a relative pronoun (*who / which* in English), native speakers of a given language prefer HA. Meanwhile, in languages, where the RC is introduced by a complementizer (*that* in English), LA is preferred (Hemforth et al., 1998). In English and Russian, both a relative pronoun and a complementizer can introduce the RC, *the mother of the woman who / that [was talking…]*. In Russian, sentences like in (4.7) are grammatical but normally preferred by native speakers much less often than the RCs with the relative pronoun.

(4.7) Bill videl mamu zhenshchiny, [RC chto govorila o sebe / nej vo dvore].

Bill saw mother-ACC woman-GEN that-COMP talk-PAST. FEM about herself / her in yard.

Bill saw the mother of the woman that was talking about herself / her in the yard.

Following the assumption by Hemforth et al. (1988), the use of the complementizer in Russian would prompt LA preference. It may create an incongruent processing condition since Russian is a HA language. The same is true about English. The incongruent condition will be created by the relative pronoun that would favour HA resolution in a LA language.

The dissertation is not focused on solving the problem of ambiguity resolution of the RC. The RC and its structural flexibility create a favourable linguistic environment to study processing mechanisms in native and non-native languages. Therefore, incongruent processing conditions in RC resolution could potentially obscure the results of the dissertation experiment as it could become unclear what linguistic cue guides RC parsing decisions.

To avoid having uninterpretable results, the dissertation observes the theoretical assumptions by Hemforth et al. (1988) in the experimental design. English RCs are introduced by the complementizer that and Russian RCs are introduced by the relative pronoun *kotoraya* as in (4.2). In accordance with Hemforth et al. (1988), the natural preference for LA in English is supported by the complementizer. In Russian the relative pronoun ensures the naturally preferred HA.

The assumptions by Hemforth et al. (1998) were taken into consideration even though the usage of the relative pronoun *kotoraya* may not be crucially important for Russian. There are no special studies measuring whether the use of *kotoraya* vs. *chto* in RCs would influence its attachment resolution preference in Russian. Meanwhile, there are studies showing that Russian preserves a very strong preference for the Early Closure, or HA, in sentences like (4.2) even in the linguistic contexts where other languages would switch to the Late Closure parsing.

A linguistic experiment by Sekerina (1997) investigated parsing preferences in native speakers of Russian. The study expected to see the Early Closure preference in the sentences with preposition-less genitives, and Late Closure in the sentences with lexical prepositions. Native speakers of Russian preferred Early Closure in both conditions. The part of the study that used RCs got HA preferences. Thus, Russian was established to be a very strong HA language with potentially minimal sensitivity to the usage of the complementizer *chto* in the RC.

Another condition that can influence a change in RC resolution preference is the preposition between the head nouns in the complex DP [$_{DP}$ the mother of / with the woman]. The previous chapter reviewed the debate about the linguistic nature of the preposition with and concluded that it prompted a change of syntactic modification from a DP to a coordination phrase (CoordP) [$_{CoordP}$ [$_{NP}$ the mother] with [$_{NP}$ the woman]. The latter entails a preference for LA of the RC that follows the CoordP.

There is experimental evidence of the effect of the preposition with across languages. In all known studies, the head DP in (4.1) and (4.2) is grammatical with either the preposition with or the preposition of within the complex NP [$_{NP}$ the mother of / with the woman]. The effect of the preposition with is reported to be very strong. When the second DP is introduced by the preposition <u>*with*</u> in French, LA is preferred even though French is a HA language (Frenck-Mestre and Pynte, 2000; see also Gilboy et al, 1995; Traxler, Pickering, and Clifton, 1998).

Unlike the preposition with, the preposition of seems to create zero-biased processing conditions for RC resolution. There are no studies that would report any special effect of the preposition of. On the contrary, in sentences with the of-PP for the second noun RC resolution shows cross-linguistic variation (Fodor 2002b). The dissertation takes a possible effect of the preposition into account. The target sentences use of-PPs in English and preposition-less genitives in Russian (see Sekerina 1997 for detail). Thus, no switch of RC attachment preference can be implicitly prompted by the DP structure.

The last theory of RC attachment that could potentially have an impact on RC processing of the target sentences is the Implicit Prosody Hypothesis (Fodor, 2002a, 2002b). The theory claims that cross-linguistic variation in RC resolution depends on the default prosodic structure of a language. In languages like in French, German or Russian, the RC and the head DP form different prosodic units, i.e. the complex DP is followed by a prosodic pause. In this linguistic condition, the RC is attached to the entire head DP [$_{DP}$ the mother of the woman], which means the attachment is higher in the tree, or HA.

In languages like English, there is a prosodic break within the head DP [$_{DP}$ the mother || of the woman]. The prosodic pause in the middle of the head DP breaks the head DP and the RC into prosodic units differently from Russian, French or German. The DP [the mother] forms a separate prosodic unit, prosodic unit 1, and [of the woman that was talking…] forms prosodic unit 2. In other words, the RC forms a single prosodic unit with the lower DP. In this case, the language prefers LA. The Implicit Prosody Hypothesis provides a possible explanation for cross-linguistic variation in RC resolution between Russian and English. However, there are no implications of this theory that should be taken into account and inform the design of the current experiment.

The assumptions of the Implicit Prosody Hypothesis were further investigated by Dekydtspotter et al. (2008). The study claimed that longer RCs formed a separate prosodic unit in any language. The formation of a separate prosodic unit entailed the HA of the RC. At the same time, shorter RCs had a tendency to be prosodically joined to the lower DP, which favoured LA-resolution across languages (Dekydspotter et al., 2008). Following the findings by Dekydtspotter et al. (2008) this study controls for the length of the RC in the target sentences (see section 5.3.3).

To sum up, the dissertation experiment uses syntactically complex sentences with ambiguous RCs. RC ambiguity is not syntactically constrained towards the HA in Russian or LA in English. Both structural options are grammatical and equally available in both languages. However, there are linguistic factors that may favour either HA or LA across languages. For example, flexibility of word order may result in HA or the use of the complemetizer may favour LA, etc.

This section reviewed the linguistic environments that may favour a certain preference in the RC attachment. None of the reviewed factors are grammatical constraints that would make either HA or LA impossible in either English or Russian. Therefore, the dissertation follows the scholarly findings and classifies Russian to have a general preference for HA, whereas English is a LA language. All the linguistic factors analysed in this section were taken into account in the design of the dissertation study.

The flexibility of RC resolution is a linguistic environment that allows investigating how attachment ambiguity of the RC can be influenced by the matrix predicate and how a preferred type of RC attachment influences anaphora resolution, when the anaphora is placed within the RC.

4.3 Linguistic Principles of Anaphora Resolution in English and Russian

Anaphora resolution is a linguistic target of the dissertation. It is placed at the end of the RC and will be processed when the main chunk of the sentence has already been parsed. The placement of the anaphora allows to check whether its resolution is influenced by any parsing decision made earlier, at the level of the matrix predicate or at the level of the RC. In other words, the dissertation traces structural parse from the top of the tree to the bottom, where the anaphora is located. This section explains the linguistics of anaphora resolution (4.3.1) and shows how RC attachment shapes it (4.3.2)

4.3.1 Binding Principles and Anaphora Resolution

This sub-section reviews the linguistic studies on anaphora resolution. It evaluates the linguistic conditions of anaphora resolution in English and Russian and shows that the target sentences in the dissertation are balanced across these languages.

The target sentence has the anaphora within an RC and at the end of the sentence in both English (4.8) and Russian (4.9).

(4.8) Bill saw the mother of the woman that was talking about herself / her in the yard.

(4.9) Bill vide-l mam-u zhenshchin-y,

Bill.-NOM.MASC see-PAST.MASC mother-ACC.FEM woman-GEN.FEM

kotor-aya govori-la o seb-e / ne-j vo dvore.

who/that-COMP/FEM talk-PAST.FEM about herself-REFL / her-FEM in yard-PREP.CASE

‘Bill saw the mother of the woman that was talking about herself / her in the yard.’

Anaphora resolution is a search for a potential antecedent placed before or after the anaphora in the sentence, which is guided by the Binding Principles of Chomsky (1981).[2] The Binding Principles are summarized in (4.10).[3]

(4.10) Binding principles A and B

Principle A: A reflexive must be bound within its binding domain.

Principle B: A pronoun must be free within its binding domain.

Principle C: An R-expression must be free.

The dissertation studies two types of anaphora, the reflexive *herself / sebe* and the pronoun *her / nej*.[4] Therefore, Principle C is not applicable to the analysis. Following Principles A and B, the reflexive and the pronoun behave differently in their search for an antecedent: the reflexive is bound within the binding domain, the pronoun is bound outside the domain. When people are asked to answer a comprehension check, like in (4.11), they need to interpret the anaphora. Thus, the parser follows the grammatical constraints for anaphora resolution to pick either of the required answers.

(4.11a) The mother of the woman was talking about herself in the yard.

This person was talking about:

a) the mother of the woman b) the woman

(4.11b) The mother of the woman was talking about her in the yard.

This person was talking about:

a) the mother of the woman b) the woman

---

[2] The dissertation considers the discourse independent anaphora only.
[3] The dissertation uses only the canonical examples, so the basic Binding Principles stated in (3) suffice.
[4] see White, 1998; Felser, 2009; Felser & Cunnings, 2012; Slabakova, White, & Brambatti Guzzo, 2017 for acquisition and application of Principles A and B in L2

In (4.11a), the grammatical answer is herself = the mother of the woman. In (4.11b) the grammatical answer in her = the woman. The pronoun can have an antecedent outside the sentence. Since the external interpretation is not supported by any context, it is disregarded in the rest of the dissertation. However, one must keep in mind that the pronoun is always ambiguous while the reflexive is not.

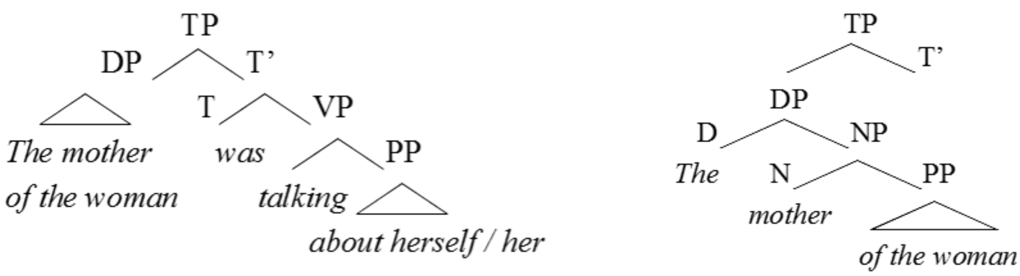
To make an interpretation decision in (4.11a) and (4.11b), the human parser needs to apply grammatical constraints of anaphora resolution. They are three. The parser checks whether a potential antecedent and the anaphora are co-referent, whether the antecedent c-commands the anaphora and whether the antecedent is within or outside the binding domain.

The subject of the sentence in (4.11) is a complex NP [NP the mother of the woman]. The complex NP [NP the mother of the woman] contains the NP [NP the woman]. Both NPs can be co-referenced with the anaphora: They have the same gender and number features. At this point, neither of the NPs can be selected as the only possible antecedent.

(4.12) The mother (sg., fem.) of the woman (sg., fem.) was talking about herself (sg., fem.) / her (sg., fem.)

To decide about anaphora resolution, the parser needs to check for the second binding condition, the configuration of c-command. C-command is a relationship of sisterhood between syntactic nodes. A node c-commands its sister node together with all her daughter nodes. (3.13) is a syntactic tree for the sentence in (3.12).

(4.13)



The syntactic tree in (4.13) shows that the complex DP *[$_{NP}$ the mother of the woman]* is a sister node to T'. A full tree structure of the subject DP *[$_{NP}$ the mother of the woman]* shows that even though the entire DP *[$_{NP}$ the mother of the woman]* c-commands the T', the PP *[of the woman]* does not. The PP *[of the woman]* is a constituent within the DP *[the mother of the woman]*. The complex structure of the DP *[the mother of the woman]* shows that the DP *[the woman]* cannot c-command the anaphora from inside the PP *[of the woman]* (4.13). In summary, both the complex DP and the lower DP within its structure are co-referenced with the anaphora but only the entire DP *[$_{DP}$ the mother of the woman]* c-commands the anaphora.

To make the final decision about anaphora resolution and to answer a comprehension task in either (4.11a) or (4.11b), the parser checks whether the antecedent for the anaphora is within the binding domain or not. The definition of the binding domain in English and Russian requires an extended explanation. Compare the sentences in (4.14a) and (4.14b).

(4.14a) The woman$_1$ was talking about her$_1$ mother.

(4.14b) Zhenshchina$_1$ govorila o jeje$_{*1}$ mame.

Woman-Nom.Fem talked-PAST about her-PRON.POSS mother

The woman$_1$ was talking about her$_{*1}$ mother.

Examples in (4.14) are grammatical in English but are ungrammatical in Russian. The subject DP *[$_{DP}$ the woman]* and the possessive pronoun *her* are co-referent and the DP c-commands the pronoun. In accordance with Principle B, the pronoun must be free, i.e. unbound, within its binding domain. In Russian (4.14b), the ungrammaticality of the binding *'her = the woman'* means that the antecedent for the pronoun is inside the binding domain. The latter prompts the conclusion that a clause containing a potential antecedent is the binding domain in Russian (Timberlake, 1979, Rappaport, 1986, Baylin, 2007). The ungrammaticality of the Russian example (3.14b) is ruled out by Principle B.

In English, the possessive pronoun *her* in (4.14a) can be bound by the DP *[$_{DP}$ the woman]*, it is grammatical. The inconsistency between (4.14a) and (4.14b) means that either Principle B is violated in English or the binding domain for the pronoun is the DP *[$_{DP}$ her mother]*. Further theoretical discussion of this question would go beyond the scope of the dissertation. The experimental study took the contradictions in the definition of the binding domain into account and excluded sentences like (4.14) from the experiment. In other words, the pronoun cannot be part of a possessive phrase in English. A mismatch in pronoun resolution between (4.14a) and (4.14b) would create an undesirable processing conflict in the experiment and obscure the results of the study.

To accommodate both Russian and English, the dissertation study excluded possessive pronouns and unified the binding domains in the two languages to be a simple clause. To be more specific, the binding domain is a finite clause that contains a potential antecedent for the anaphora. With this unified definition, the dissertation aims at keeping the experimental items balanced between Russian and English. It does not question the existing linguistic approaches to binding in English.

Following the explanation of the binding domain above, the sentence in (4.12) has two DPs within the binding domain, the DP *[$_{DP}$ the mother]* and the *[$_{DP}$ the woman]*. However, only the higher DP *[$_{DP}$ the mother of the woman]* c-commands the anaphora. In (4.11a), the reflexive must have the antecedent within the binding domain, i.e. within the clause (Principle A). Therefore, the reflexive is bound by the subject [$_{DP}$ the mother of the woman] and a comprehension check in (4.11a) receives the answer in (a) *the mother*. (4.15) shows the proper co-reference of (4.12).

*(4.15) The mother $_j$ of the woman $_i$ was talking about **herself** $_j$ / **her** $_{*j/i}$.*

The example in (4.15) shows that the pronoun can be bound by the lower NP, which requires an extended explanation. The search for an antecedent for the pronoun is guided by Principle B. Principle B claims that the pronoun must be free within the binding domain. Principle B rules the subject DP *[$_{DP}$ the mother of the woman]* out as an impossible antecedent for the pronoun. At this point, the pronoun can be bound by any entity outside the clause. However, the comprehension task in (4.11b) locks the search for a potential antecedent within the clause. There are only two answer choices in (4.11b), the DP *[$_{DP}$ the mother of the woman]* and the DP *[$_{DP}$ the woman]*, where the lower DP does not c-command the anaphora. Therefore, the pronoun can be bound by the non-c-commanding DP within the domain and still respect Principle B. Consequently, there can be only one grammatically possible antecedent for the pronoun within the domain, the non-c-commanding DP *[$_{DP}$ the woman]* (see, 4.13). A comprehension check, like the one in (4.11b) would receive the answer choice (b) *the woman*.

In accordance with the Binding Principles, the reflexive is bound by the higher DP *[$_{DP}$ the mother of the woman]*, while the pronoun may be co-referent with the lower DP *[$_{DP}$ the woman]* and cannot be co-referent with the higher DP *[$_{DP}$ the mother of the woman]*. The dissertation adopts the assumption that the binding domain is a minimal finite clause that contains the antecedent and the anaphora – it is a simplification of a very complex problem but sufficient for our purposes. In both Russian and English, anaphora resolution is constrained by the Binding Principles of Chomsky (1981). In both languages, anaphora resolution depends on RC attachment resolution, i.e. is influenced by a constituent higher in the tree.

4.3.2 Anaphora resolution and RC attachment

As has been shown above, the reflexive can have subject antecedents in both English and Russian, and the pronoun can be bound by the non-c-commanding DP within the domain without violating the Binding Principles. This sub-section develops the linguistic application of the Binding Principles and shows that anaphora resolution depends on the preferred type of RC resolution in the target sentence.

In the experimental sentences, the anaphora is placed within an ambiguous RC, repeated here as (4.16) and (4.17).

(4.16) Bill saw the mother of the woman that was talking about herself / her in the yard.

(4.17) Bill videl mamu zhenshchiny, kotoraya govorila o sebe / nej vo dvore.

The same as in the examples in the previous section, the results of the mental process of anaphora resolution manifest themselves through a comprehension check (4.18).

(4.18) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

This person was talking about:

a) the mother　　*b) the woman*

Anaphora resolution follows the main linguistic constraints. It must be co-referent with the antecedent and be bound in c-command. The matrix subject in (4.16) and (4.17) is a masculine noun Bill. There is no gender agreement between the anaphora and the noun Bill, they cannot be co-referent and the possibility for long distance binding to the matrix subject is ruled out.

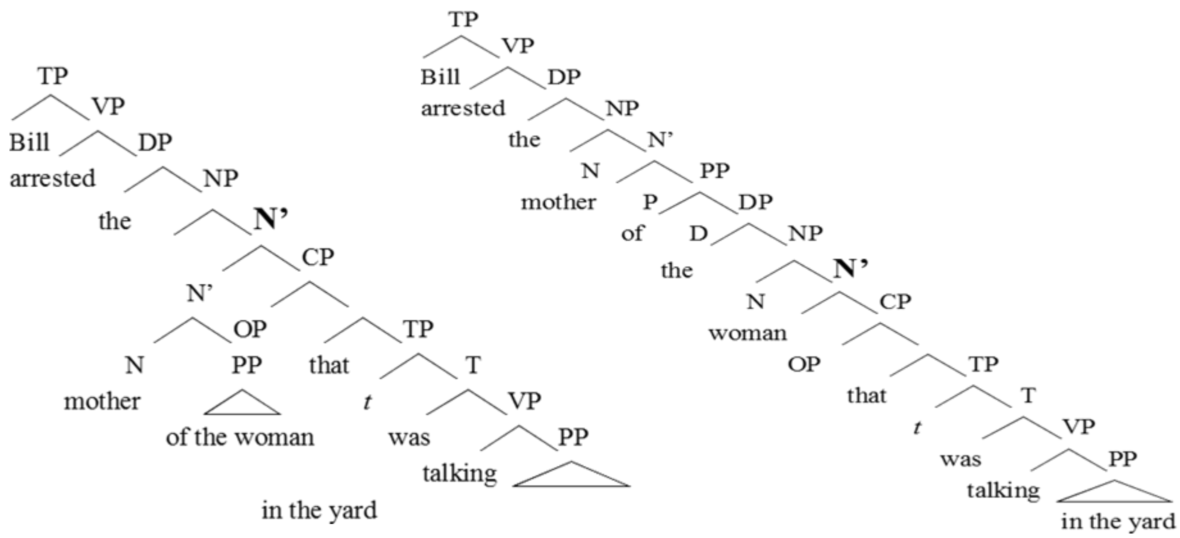
The comprehension task in (4.18) offers only two answer choices. It is always one of the DPs, the DP [DP the mother of the woman] or the DP *[DP the woman]*. Therefore, any potential antecedents from outside the clause are excluded by the comprehension task. The offered answer choices lock anaphora resolution within the limits of the clause in (4.18).

Following the explanation in the previous section, both the reflexive and the pronoun can find antecedents within the binding domain, or in the RC clause. To obey Principle A, the reflexive must be bound by the c-commanding antecedent within the clause. The pronoun can have a non-c-commanding antecedent within its domain and still respect Principle B.

A grammatical search for a c-commanding antecedent in (4.16) and (4.17) is going to be more complex than in examples in the previous section. The complexity is caused by the syntactic ambiguity of the RC in 4.16) and (4.17), repeated here as (4.19).

(4.19) Bill saw the mother of the woman that was talking about herself / her in the yard.

(4.20) (4.21)



Syntactic trees in (4.20) and (4.21) show two possibilities for attachment resolution of the RC. The tree in (4.20) is HA of the RC, where the OP (operator) in the Spec CP is co-indexed with the higher DP *[$_{DP}$ the mother of the woman]*. The tree in (4.21) is LA of the RC, where the OP is co-indexed with the lower DP *[$_{DP}$ the woman]* (see the Matching Hypothesis in Sauerland 2000).

The study adopts the principle that X c-commands Y, iff every branching node that dominates X dominates Y. In the tree in (4.20) this node is the N' in bold type. The N' dominates both the DP *[$_{DP}$ the mother of the woman]* and the RC that contains the anaphora. Therefore, the DP *[$_{DP}$ mother]* c-commands the anaphora. In accordance with Principle A, the reflexive is bound by the c-commanding DP *[$_{DP}$ the mother of the woman]* within the TP (4.22).

*(4.22) Bill saw the mother of the woman [$_{RC}$ **OP** that [$_{TP}$ **t** was talking about herself / her in the yard]].*

In (4.20), reflexive resolution is *'herself = the mother'* and a comprehension task (4.18) will receive the answer choice (a) *the mother* because of the HA of the RC. The pronoun in (4.20) must be free within the domain. To observe Principle B, the antecedent for the pronoun can be placed within the binding domain but it cannot c-command the pronoun. In the case of HA of the RC in (4.20), the pronoun is bound by the lower DP *[$_{DP}$ the woman]*, which does not c-command the anaphora. In (4.20), pronoun resolution results in *'her = the woman'* and the comprehension task in (4.18) receives answer (b) *the woman* in the condition of HA of the RC.

In the case of HA of the RC, the OP is co-indexed with the higher DP *[$_{DP}$ the mother of the woman]*. The attachment preference in the RC defines the nearest c-commanding node for anaphora resolution. Therefore, HA of the RC yields the pattern of anaphora resolution *'herself = the mother // her = the woman'*.

The tree in (4.21) is LA of the RC, where the OP is co-indexed with the lower DP *[$_{DP}$ the woman]*. Following the principle of c-command where X c-commands Y, iff every branching node that dominates X dominates Y, the branching node that dominates the DP *[$_{DP}$ the woman]* and the anaphora is the N' in bold type. Thus, the lower DP *[$_{DP}$ the woman]* is the nearest c-commanding node to the anaphora in (4.21).

In accordance with Principle A, the reflexive is bound by the nearest c-commanding DP *[$_{DP}$ the woman]* in LA of the RC in the tree in (4.21). To observe Principle B, the pronoun must be bound by the non-c-commanding element within a clause. In the context of LA of the RC (4.21), the higher DP *[$_{DP}$ the mother]* is outside the clause, or the binding domain. Even though the DP *[$_{DP}$ the mother]* c-commands the pronoun, it is not the nearest c-commanding element or a grammatical antecedent for the pronoun. In the case of LA of the RC (4.21), the comprehension task in (4.18) receives the answer choice (b) for the reflexive, *'herself = the woman'* and the answer choice (a) for the pronoun, *'her = the mother'*. The pattern of anaphora resolution in the sentences with LA of the RC is '*herself = the woman // her = the mother*'.

To summarize, the two different types of RC attachment resolution result in two different options for anaphora resolution. In the case of HA (4.20), the OP is co-indexed with the higher DP *[$_{DP}$ the mother]* and it becomes the nearest c-commanding element to the anaphora. In the case of LA of the RC (4.21), the OP is co-indexed with the lower DP *[$_{DP}$ the woman]* and it becomes the nearest c-commanding element for the anaphora. In other words, the HA of the RC results in the following pattern of anaphora resolution *'herself = the mother // her = the woman'* (4.20). The LA of the RC yields the opposite pattern of anaphora resolution: '*herself = the woman // her = the mother'* (4.21). Anaphora interpretation is used in this experimental study as a proxy for RC attachment preference.

The section on RC resolution (4.2) states that there are preferred patterns of RC resolution in each language of the experiment. Native speakers of Russian generally prefer HA, whereas native speakers of English prefer LA. Putting together a language-specific preference in RC attachment and the linguistic constraints on anaphora resolution, the dissertation claims that anaphora resolution depends on RC attachment and has two language-specific patterns: *'herself = the mother // her = the woman'* in Russian and '*herself = the woman // her = the mother'* in English.

4.4 Universal Effect of a Perception Verb in the Matrix Clause

A perception verb in the matrix predicate on its own is not a linguistic target of the dissertation. However, its linguistic nature influences sentence parsing significantly. The selectional properties of a perception verb allow for two possible complements, an entity complement and an event complement. Therefore, the parser can expect several variants of sentence continuation after encountering a perception verb. This optionality can make sentences with a perception verb difficult to process.

This section describes some linguistic properties of a perception verb. It also focuses on the universal ability of a perception verb to favour HA of the ambiguous RC when this verb is placed in the matrix clause. This parsing preference is further compared to the universal effects of prosody found in non-native processing. The section finishes with an overview of the effects of a perception verb in non-native processing of restrictive RCs that motivated the experiment in the dissertation. The studies reviewed here allow for certain expectations in non-native speakers' behaviour that lay the foundation for the theoretical predictions of the dissertation.

4.4.1 Selectional properties of a perception verb

This sub-section argues that the matrix predicate is a factor that can influence attachment resolution of the RC. The matrix verb is a factor external to the RC and its influence comes from a position higher in the syntactic tree. The role of the matrix predicate in RC resolution was discussed in Chapter 2. Frazier and Clifton (1997) tried to explain a preference for HA in many languages by a processing preference to attach adjuncts as close to the main predicate as possible (see also Pritchett, 1999).

The critique of this approach is based on the preference for LA in several languages, including English, where the RC is an adjunct that is attached far from the matrix verb. A cross-linguistic variation to attach similar type of adjuncts closer to the matrix verb in some languages (Russian) and farther in other (English) is not explained by the theory Predicate Proximity (Frazier and Clifton 1997). However, the role of the matrix predicate cannot be completely disregarded in linguistic approaches to language parsing.

This section reviews the studies that returned scholarly attention to the matrix predicate and its role in RC resolution (Grillo, 2014; Grillo et al., 2015). These studies go further than the scholars of 20 years ago (Frazier & Clifton, 1997; Pritchett, 1999) and try to explain why and how the selectional properties of the matrix verb may shape RC resolution towards the HA preference.

According to Grillo and Costa (2014), the matrix verb is a constituent outside the RC that favours HA. The analysis of anaphora resolution in the previous section shows that if the RC is attached higher, the pattern of anaphora resolution like ‘herself = the mother // her = the woman’ is preferred. Therefore, a potential of the perception verb to favour HA is a potential to shape anaphora resolution as well. Thus, the effect of a matrix verb can shape sentence parsing all the way down the syntactic tree and yield the pattern for anaphora resolution like ‘herself = the mother // her = the woman’. This effect of the matrix predicate would be a clear case of top-down sentence parsing (Philips & Schneider, 2000; Kazanina et al., 2007).

The current analysis focuses on the linguistic nature of the perception verb and explains its potential to shape sentence RC parsing towards HA. The linguistic targets of the dissertation have either a perception or a non-perception verb in the matrix clause. Compare (4.23) and (4.24):

(4.23) Bill saw the mother of the woman that was talking about herself / her in the yard.

(4.24) Bill arrested the mother of the woman that was talking about herself / her in the yard.

In (4.23), the matrix predicate is a perception verb saw. In (4.24), it is a non-perception verb arrested. There is no structural difference between the two predicates if the matrix clause is followed by a restrictive RC (4.25), (4.26).

(4.25) Bill saw (who?) [DP the mother of the woman] [RC that was talking about herself / her in the yard].

(4.26) Bill arrested (who?) [DP the mother of the woman] [RC that was talking about herself / her in the yard].

In both (4.25) and (4.26), the matrix predicate is followed by a complex DP-complement with an adjunct RC. For the non-perception verb in the matrix clause (4.26), no other complements are possible. However, a perception verb in the matrix clause can be followed by several complements: an animate complement, an inanimate complement or a declarative clause complement. The possible complements of a perception matrix predicate are given in (4.27-4.29):

(4.27) Bill saw [DP the mother of the woman that was talking…] (animate complement)

(4.28) Bill saw [DP a conversation of the mother of the woman] (inanimate complement)

(4.29) Bill saw [CP that the mother of the woman was talking…] (subordinate clause)

The sentence in (4.27) has a perception verb and an animate complement, (4.28) shows a perception verb with an inanimate complement, which could be an event, (4.29) shows that a perception verb can be followed by a subordinate clause. Summarizing the complement options for a perception verb (4.27-3.29), one can notice that the complement in (4.27) answers a comprehension question *who?*, whereas both complements in (4.28) and (4.29) answer a comprehension question what?, as in (4.30-4.32).

(4.30) Bill saw (who?) [DP the mother of the woman that was talking…] (animate complement)

(4.31) Bill saw (what?) [DP a conversation of the mother of the woman] (inanimate complement)

(4.32) Bill saw (what?) [CP that the mother of the woman was talking] (subordinate clause)

In what follows from examples (4.30-4.32), a perception verb can have an entity-complement and an event-complement. The entity-complement is a DP, and the event-complement can either be a DP or a CP-clause.

The phenomenon of a perception verb and its complements was analysed by Grillo and Costa (2014). They studied how the potential of a perception verb to have several complements influences attachment resolution of an ambiguous RC. Their analysis focused on Romance languages like French, Spanish and Italian. The sentence in (4.33) is the Spanish equivalent of the example in (4.23).

(4.33) María vio a [DP la madre de la mujer] [RC que estaba hablando de…].

Maria saw [DP the mother of the woman] [RC that was talking about …].

According to Grillo and Costa (2014), languages like Spanish, French and Italian can have a higher number of “default” interpretations of the RC than either English or Russian. It means that Romance languages can infer one or more interpretation from the string of words identical to (4.33 and 4.34). Therefore, Romance languages will have interpretation #3 (this additional interpretation is explained later in examples 4.37 and 4.38 in this section), on top of the two universally possible readings of an ambiguous RC in (4.34).

The two interpretations for (4.34) are equally available in both Romance languages and in English or Russian (4.34).

(4.34) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

Who was talking in the yard?

a) the mother of the woman *b) the woman*

From the perspective of RC resolution, the subordinate clause can either modify the higher *DP [$_{DP}$ the mother of the woman*] or the lower DP *[$_{DP}$ the woman]* in (4.34) (see section 4.2 above).

The situation is different when the subordinate is analysed from the perspective of the matrix verb, which can have either the entity-complement or the event-complement. In the given sentence, the perception verb saw in (4.34) is followed by the who-complement, which is an entity-complement (4.35).

(4.35) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

Who did Bill see?

a) the mother of the woman that was talking *b) the woman that was talking*

Compare (4.34) and (4.35). In the case of a restrictive relative, the RC head answers both comprehension questions, in (4.34) and in (4.35). The complex DP is the attachment site for the RC and the entity-complement of the matrix predicate.

Let us focus on the matrix predicate. Alongside the entity-complement, a perception verb can also have an event-complement (4.32), or the what-complement, that would be structurally different from either (4.34) or (4.35). An event-complement is prompted by a comprehension question <u>*what?*</u> in (4.36), which is answered in (4.36a).

(4.36) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

What did Bill see?

a) the talking / a conversation *b) ?*

Comparing the examples in (4.35) and (4.36) one can see that both an entity-complement and an event-complement are possible in English. They are prompted by two different comprehension questions and (who? and what (event)?) and are realized through two different types of subordinate clauses. The latter makes English very different from the languages analysed by Grillo and Costa (2014). However, it does not undermine the similarity of the effect of a perception verb.

The experiments by Grillo and Costa (2014) investigated Romance languages, like French, Spanish or Italian. In these languages the same string of words can have various syntactic modifications, the entity-complement and the event-complement, both alongside the ambiguous RC. In other words, both the *who?* question in (4.35) and the *what?* question in (4.36) can be answered by the exact same sentence (4.37).

(4.37) María vio a (who?) [DP la madre de la mujer] [RC que estaba hablando de…]. (RC)

María vio a (what?) [SC [DP la madre de la mujer] [CP que estaba hablando de…]. (event-complement, PR)

Maria saw the mother of the woman that was talking about….

Grillo and Costa (2014) called the structural modification in (4.37) a Pseudo-Relative (PR) for its surface similarity to the restrictive RC. Being a surface-identical string of words, a restrictive RC and the Pseudo-Relative (the eventive complement) are very different syntactically. The RC modifies the head nouns, the PR is a unit of the head DP and the subordinate CP that modify the matrix verb (4.38).

(4.38) María vio a [SC [DP la madre de la mujer] [CP que estaba hablando de cosméticos]]. (Sp.)

An eventive complement in English also modifies the matrix verb and includes the head DP and the subordinate. Compare the eventive complements in Spanish (4.39a) and in English (4.39b).

(4.39a) María vio a [SC [DP la madre de la mujer] [CP que estaba hablando de cosméticos]]. (Sp.)

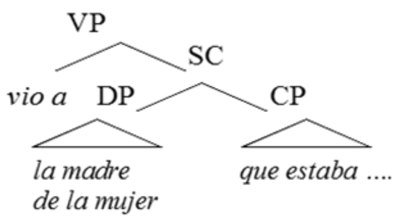
(4.39b) Maria saw [SC [DP the mother of the woman] [VP talking about the cosmetics]. (Eng.)

Maria saw (what?) the talking by the mother of the woman.

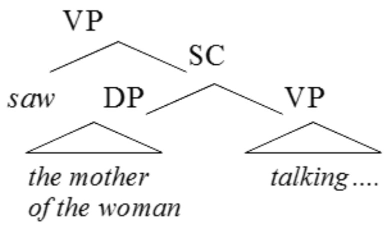
The example in (4.39a) is a Spanish sentence with an eventive complement, or what-complement, of the matrix predicate. In its structure, the subordinate CP together with the head DP modify the matrix verb. The sentence in (4.39b) is an English sentence, also an eventive complement, where the VP together with the head DP modify the matrix verb. In English, the eventive complement takes the form of a Small Clause (SC). In both sentences, the subordinate clause modifies the matrix verb. However, Spanish has a finite subordinate clause (4.39a) but in English it is a SC (4.39b).

Despite the differences in the form of the subordinate clause of the eventive complement in Spanish and English, the embedded verb in both languages modifies the complex DP in the same way. It becomes obvious by the tree structure in (4.40a) and (4.40b)

(4.40a) Spanish: Finite CP, Pseudo-Relative



(4.40b) English: Small Clause



The tree in (4.40a) is an eventive complement in Spanish. The modification in (4.40a) leaves only the first noun *the mother* as a potential doer of the action of *talking* in the following CP. This structural elimination of the lower DP from being the doer of the activity expressed by the embedded verb explains HA preference in Romance languages (Grillo & Costa, 2014).

Even though the eventive interpretation in (4.40a) may not be the preferred parsing option for a native speaker of Spanish, the modification in (4.40a) is a grammatical alternative to the sentence in (4.33). Grillo and Costa (2014) claim that optionality of structural modifications of the target sentences shown in (4.37) is part of the grammar of the speakers of Spanish, French or Italian. Therefore, a potential for a covert structural modification that would have the higher DP as the only possible doer of the action of the embedded verb explains HA preference in RC resolution in Romance languages (Grillo & Costa, 2014).

The tree structure of the English SC in (3.40b) shows that only the higher DP *(the mother)* can be the doer of the action of *talking* in this syntactic modification. It is the same as in Spanish (4.40a). With the eventive complement, structurally different subordinates in Spanish (4.40a) and English (4.40b) have the same higher noun as the doer of the action expressed by the embedded verb.

Grillo et al. (2015) claim that a potential to have an eventive complement is enough for a matrix perception verb to favour HA of the RC across languages.

Taking together the analysis of Grillo and Costa (2014), a follow-up study by Grillo et al. (2015) and the structural analysis in this section, the dissertation argues that the effect of a perception verb to favour HA is universal. There is experimental evidence that HA is preferred in sentences with a perception verb in a LA-language – English (Grillo et al., 2015). The effect is explained by a potential of a perception verb to have an eventive complement even if the overt syntactic structure of this complement is very different from the structure of the RC (Grillo et al., 2015).

4.4.2 Eventive Complement in English and Russian

The previous section shows that structural realization of an eventive complement varies from language to language. However, a perception verb in the matrix clause may affect RC attachment resolution in a similar way across languages. A perception verb favours HA of the RC. The preference for HA is achieved through a specific structural modification, where the higher NP becomes the only possible doer of the activity expressed by the embedded verb.

This section analyses structural differences in the eventive complement of a perception verb in English and Russian. Following the analysis in the previous section, English and Russian are very different from Romance languages. Neither English nor Russian allows Pseudo-Relatives. This means that an eventive interpretation cannot be inferred from a string identical to the surface word order of the RC, like in Spanish in (4.37). However, a perception verb can be followed by an eventive complement in both languages. An event-related interpretation is prompted by a comprehension question *what?* (4.41) and has different structural realizations.

(4.41) Bill saw the mother of the woman that was talking about herself / her in the yard.

What did Bill see?

The comprehension question in (4.41) cannot receive a grammatical answer with the string of words identical to the RC in either English or Russian (4.42). Previous section shows that it is possible in Romance languages, for example, in Spanish (4.37, 4.39a, 4.40a)

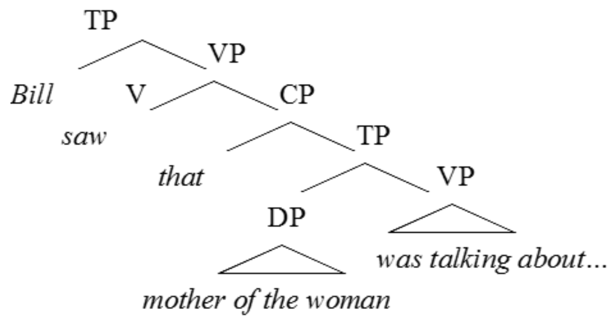
*(4.41) *Bill saw (what?) the mother of the woman that was talking about herself / her in the yard.*

An entity-complement followed by a restrictive RC in (4.41) answers a who-question, not a what-question. The what-interpretation, or the event-oriented interpretation, presupposes that Bill saw some event, or Bill became a witness of a certain action. In our example in (4.41), Bill witnessed the act of talking by the mother of the woman.

There are various structural options to realize an eventive complement, i.e. the eventive complement can be worded in different ways in English and Russian. In English, there are two structural options for an eventive complement, the finite subordinate clause (CP) and the small clause (SC). The example in (4.42) is an eventive CP complement in English. A syntactic tree for a CP subordinate is given in (4.43)

(4.42) Bill saw [CP that the mother of the woman was talking about herself / her in the yard].

(4.43)

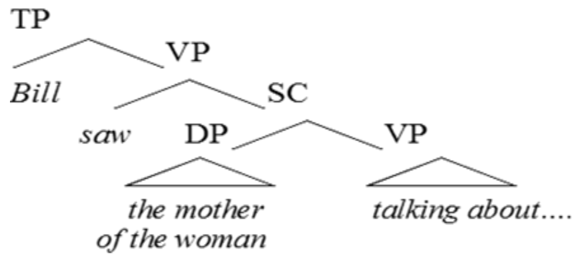


Notice that the complementizer appears in the head CP position. The grammatical subject of the subordinate clause is the DP *[$_{DP}$ the mother of the woman]*. The VP in the subordinate clause modifies the subject. There is no structural option where the VP would modify the lower DP *[$_{DP}$ the woman]*. The structure in (4.43) is an eventive complement of the matrix verb, where the head DP is modified by the VP. Consequently, only *the mother* can be the doer of the action of *talking*, not *the woman*.

The second option for an eventive complement in English is a SC (4.44) that was briefly mentioned in the previous section. The syntactic tree in (4.45) shows that the SC modifies the perception verb as its eventive complement. Within the SC, the complex DP is modified by the VP. The same as in the finite clause, only *the mother* can be the doer of *talking* in the SC modification.

(4.44) Bill ***saw*** *[$_{SC}$ [$_{DP}$ the mother of the woman] [$_{VP}$ talking about the herself / her in the yard].*

(4.45)



These are two structural options for an eventive complement in English, a finite clause or a SC. The analysis shows that in the CP, the same as in the SC, the entire complex *DP [$_{DP}$ the mother of the woman]* is modified by the VP constituent. There is no structural ambiguity and no optionality to modify the VP to either the higher DP *[$_{DP}$ the mother of the woman]* or the lower DP [$_{DP}$ the woman]. Therefore, if the parser triggers a structural anticipation for an eventive complement after it encounters a perception verb the higher DP may be favoured for further modifications within the subordinate clause. If the sentence does not continue as an eventive complement, the anticipated projection for the SC would favour HA of the following RC in English. The latter is predicted by Grillo et al. (2015, see also Grillo & Costa, 2014). They claim that even in LA languages like English, a perception verb favours HA of the RC because of the possibility that an eventive clause might follow.

Let us now focus on the structural options for an eventive complement in Russian. The same as English, Russian does not allow a Pseudo-Relative reading of the RC, even though, Russian is a HA-language. The same as in English, there are several options to realize an eventive complement in Russian. First, it can be a finite clause (4.46)

(4.46) Bill videl [$_{CP}$ chto mama zhenshchiny govorila o ***sebe / nej*** *vo dvore].*

Bill saw that-COMP mother-NOM woman-GEN talked about herself / her in yard.

Bill saw that the mother of the woman was talking about herself / her in the yard.

Just like English (4.42), the complementizer takes the spec CP, the VP in the subordinate clause modifies the complex DP *[$_{DP}$ the mother of the woman]* and the entire CP is a complement of the matrix predicate. There is no structural option to modify the VP to the lower DP, which would preserve syntactic ambiguity.

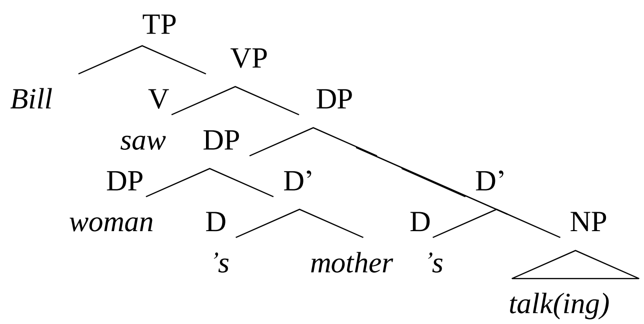
The second option for an eventive complement is a complex NP (4.47). The structure of the eventive complement NP [$_{NP}$ mamy zhenshchiny govornye] is provided in (4.48).

(4.47) Bill videl (what?) mamy zhenshchiny govornye o sebe / nej vo dvore.

Bill saw mamy-GEN woman-GEN talk-NOM about herself / her in yard.

Bill saw the mother of the woman's talk(ing) about herself / her in the yard.

(4.48)



The eventive complement in (4.47) and (4.48) is strongly dispreferred by native speakers of Russian, even though it is grammatical. It is normally rated low, 10 out of 10 adult native speakers give the sentence the rating of 2-3 out of 9. The complex NP in (4.47) is part of the grammar of native speakers of Russian and can be anticipated as a structural option for an eventive complement of a perception verb.

Putting together all the options for overt realizations of the eventive complement in English and Russian, the first structural option for a complement shared by both languages is a finite CP. The finite CP has a similar structure and would be processed similarly in Russian and English. In both languages, if the head CP in the target sentence is empty (4.49), i.e. there is no complementiser *that* after the matrix verb, the parser disregards the possible finite CP-complement.

*(4.49) Bill saw_______ the mother of the woman **that** was talking about herself / her in the yard.*

When the parser gets to the complex DP *[DP the mother of the woman]*, nothing looks worrisome in English. However, the Russian DP *[DP mam**y** zhenshchiny govornye]* is case marked. A structurally complex eventive NP-complement has the first noun *mam**y** (mother-Gen)* in the genitive case. Any other form of a complement would have the accusative case. Thus, in Russian, all possible structural anticipations for an eventive complement are ruled out by the third word in the sentence. As soon as the parser hits the case-marked ending of the noun *the mother*, it knows that only a direct object entity-complement can follow.

In English, the CP eventive complement is ruled out in the same manner as in Russian. When the verb is not followed by the complementizer, the head position in the CP is empty. This empty slot after the matrix verb dismisses the anticipated eventive CP. However, the eventive complement in the form of the SC remains a valid structural prediction till the parser hits the complementizer *that* at the beginning of the RC (4.49). It is much later than the head CP position in the finite clause, or the first head noun in Russian. Therefore, the processing complexity of a sentence with a perception verb in the matrix clause is going to be much higher in English than in Russian.

If sentences with a perception verb (4.23) are compared to sentences with a non-perception matrix predicate (4.24), they would be more difficult to parse in both English and Russian. As explained in section 4.4.1, the target sentences can have two types of the matrix predicate, a perception verb *(saw)* and a non-perception verb *(arrested)*.

When a non-perception verb is placed in the matrix clause, it does not create any processing difficulty for the following restrictive RC. After a non-perception verb, only the DP-complement is possible. According to the GP theory, a simple DP analysis for complements is always preferred in mental structure building. Therefore, when the DP appears after a non-perception verb, the parsing goes smoothly. Moreover, a non-perception verb does not generate any alternative complements that would overlap with the RC coming right afterwards. The non-perception matrix predicate selects a DP-complement which can either finish the sentence or be followed by the RC. The absence of structural anticipations makes sentences with non-perception predicates easier to process than sentences with perception matrix verbs.

A perception verb can be followed by an eventive complement alongside the entity-complement with a restrictive RC. The optionality between the two complements is possible due to the linguistic nature of the matrix verb, i.e. verb semantics – perception – broadens the scope of structural choices after the matrix verb. On top of a simple DP for the entity-complement, the SC for the eventive complement, becomes possible. The eventive complement does not have the same overt realization as the entity-complement. If the parser originally prefers the eventive complement over the DP analysis, it will generate a projection where the complex DP is modified by the gerund within the subordinate SC. The SC analysis on its own is already more complex than a simple DP projection. Besides, if the SC analysis is originally preferred, the parser will encounter a structural problem on processing the complementizer *that* in the target RC (4.41).

A preference for the SC eventive complement after a perception verb is problematic for the GP theory (Fodor 1978, among others). In its original form, the GP theory claims that the simplest analysis should always be preferred. Therefore, if a perception verb selects an eventive complement over the DP analysis, the SC structure is the simplest analysis for the complement of a perception matrix predicate. This assumption can be better explained by the unrestricted race model (van Gompel et al. 2000).

The unrestricted race model advocate serial parse which unfolds step-by-step. This model clearly explains the optionality of initial parsing choices claiming that the parser initially adopts the structure which is supported by several sources of information. In our case, the semantic information of the verb adds +1 selectional property for the complement of the matrix verb and the SC is generated. Then, the upcoming DP *[$_{DP}$ the mother of the woman]* supports the SC analysis. The model also explains a possible processing conflict at the level of complementizer *that* in the RC (4.41). As the parser "encounters each word, it checks whether the syntactic structure built so far is consistent with the new information provided by the word" (van Gompel et al. 2000, p. 5). If the parser makes use of the information from all possible sources, structural adjustments mid-sentence become totally possible and will show in the increased reading times at the places of reanalysis.

As predicted by serial processing models, i.e. by the unrestricted race model, the anticipated eventive complement makes sentence processing more complex. It allows for a prediction that when the target sentences (4. 41) have a perception verb, they will be processed much slower than sentences with a non-perception matrix predicate. Following the variability of overt realizations of the eventive complement in English and Russian, the increase in processing load is predicted to occur at different places in the sentence in English or Russian.

The analysis in this section shows that a perception verb has a universal potential to trigger an eventive complement. This type of complement may have different structural realizations across languages but there is no analysis in which the embedded VP can modify the lower DP. Therefore, a perception verb can have a universal effect in changing RC resolution towards HA across-languages. The dissertation extends the findings of Grillo et al. (2015) to the realm of non-native language processing and checks whether the effect of a perception verb is preserved and implemented in the top-down parse from the matrix predicate all the way down the tree to anaphora resolution.

4.5 Universal Cues in Relative Clause Parsing

This section continues the analysis of the linguistic nature of the constituents within a complex sentence containing the RC. The overview of the experimental studies in this section explains how sensitivity to the universal cues for sentence parsing speaks for domain specific processing in non-native languages, which means similarity of parsing algorithms in native and non-native processing.

The studies reviewed in this section use ambiguous RC to measure second language (L2) speakers' sensitivity to the prosodic cues in sentence parsing (Dekydtspotter et al., 2008, see also Jun & Koike, 2003; Jun 2004, 2008) and the effect of a perception verb (Sokolova & Slabakova, 2019; Sokolova in press)

The first study by Dekydtspotter et al. (2008) checked the prediction of the Implicit Prosody Hypothesis (IPH, Fodor, 2002) with the population of L2 learners of French at low-intermediate level of proficiency. The IPH was reviewed earlier in this chapter. Its main claim is that prosodic information is implicitly used in sentence processing even in silent reading tasks. In what concerns ambiguous RCs, the IPH claimed that a prosodic pause before the RC favours HA resolution, whereas, a prosodic pause before the second head noun favours LA of the RC.

Following the assumptions of the IPH, the default prosody in French has a pause before the RC making French a HA-language. At the same time, English is a LA with the corresponding prosodic structure, i.e. the pause between the head nouns explains LA preference in English. Dekydtspotter el al. (2008) argued that a switch to HA preferences in RC resolution in French meant that L2 speakers of French, whose native language was English, were sensitive to the default prosody of the target language and parsed the sentences accordingly.

At the second stage of the experiment, the study by Dekydtspotter el al. (2008) manipulated the length of the RC. This also followed the assumptions of the IPH, which claimed that longer RCs formed a separate prosodic unit and had a prosodic pause before them. At the same time, shorter RCs were joined to the lower DP and had no prosodic break between the DP and the RC. Therefore, there was a universal processing preference to attach longer RCs to the higher DP and shorter RCs to the lower DP.

Both native and non-native speakers in the study by Dekydtspotter et al. (2008) attached shorter RCs to the lower noun in the tree, whereas, the longer RC were attached to the higher noun of the complex noun head. Dekydtspotter et al. (2008) showed that both monolinguals and L2 learners were equally sensitive to a universal processing cue – the length of the RC. The RC length influenced the prosodic structure of the target sentenced. The prosodic structure, in its turn, proved to be a linguistic universal underlying sentence parsing.

The main findings of Dekydtspotter et al. (2008) provide experimental evidence in favour of domain-specific language processing governed by the *supergrammar* in non-native languages. To develop the idea further, the study showed that native and non-native speakers used the same structural parse in sentence processing. Therefore, the authors argued that human language processing was governed by universal linguistic constraints equally available for native speakers and language learners.

A similar argument in favour of the universality of certain linguistic properties and their influence on sentence processing was made by Grillo and Costa (2014) in the studies reviewed earlier in this chapter. The main claim concerned the effect of a matrix perception verb to favour HA of the ambiguous RC. A preference for HA was triggered by the structural anticipation for an eventive complement triggered by a perception verb. The structural realizations of the eventive complement left the higher DP as the only possible doer of the action of the embedded verb (see section 3.4 for detail). This preference was transferred to RC parsing.

The effect of the matrix verb is very likely to be universal, i.e. to influence attachment resolution of the RC across languages. Grillo et al. (2015) tested monolingual speakers of English. The study established that adult English monolinguals showed a tendency to switch their RC resolution preference to HA resolution after a perception verb. HA was preferred around 60% of the time in the sentences where a perception verb was followed by a reduced RC and in around 50% of the full RCs with overt complementizers vs. 10 - 20 % of HA after a non-perception verb. These results prompted a conclusion that a perception verb activated an event-related interpretation, whose syntactic structure favoured HA preference in a LA-language – English.

The studies by Sokolova and Slabakova (2019) and Sokolova (in press) tested the universal parsing effects of a perception verb with (low) intermediate speakers of English and Russian as either L2 or L3. The studies used ambiguous RC like in (4.50):

(4.50) Maria saw the mother of the boy [RC that was talking about cosmetics].

a) the mother was talking about cosmetics *b) the boy was talking about cosmetics*

At the first level of analysis, the study checked for the relevance of non-structural information for RC resolution. There is a social convention that the talking about cosmetics is more likely to be performed by the mother than by the boy. The conventional information was expected to favour HA of the RC in (3.50). The results by Sokolova and Slabakova (2019) and Sokolova (in press) did not confirm any effect of social conventions in RC resolution. Neither L2/L3 speakers of Russian or English, nor native speakers of these languages, relied on social conventions to decide about the attachment of the RC. These results go against the assumption of the SSH, reviewed in Chapter 2, but support the findings by Dekydtspotter et al. (2008).

As becomes evident from the example in (4.50), the sentences in Sokolova and Slabakova (2019) and Sokolova (in press) had a perception verb in the matrix clause. The results showed that L2/L3 speakers of English were sensitive to its effect, i.e. there was a change in RC attachment in sentences with a perception verb in the matrix clause. Sokolova and Slabakova (2019) and Sokolova (in press) showed that non-native processing was sensitive to the universal processing cues predicted by Grillo and Costa (2014). These findings supported the results by Dekydtspotter et al. (2008) who argued for linguistically governed non-native processing.

The studies by Sokolova and Slabakova (2019) and Sokolova (in press) have significant implications for processing research in non-native language, i.e. they made the first step in the investigation of parsing algorithms in non-native processing. The studies tested the predictions of the SSH, a bottom-up processing model (Felser 2018, personal communication) and found no support for its claims. The experiments reported a strong effect of a perception verb on RC resolution. These findings mean that the eventive structural projection takes the upper hand over the restrictive RC reading. The results obtained in those studies for the perception verb can only be explained by the top-down structural prediction and can assume it plays a leading role in human language parsing.

The effect of a perception verb can be explained in terms of Phillips and Schneider (2000), who claim that parsing decisions of the higher processing cycles shape the parsing of lower levels (see Chapter 2 for detail). In the case of a perception verb, the matrix verb triggers an eventive projection that favours HA resolution of the incoming ambiguous RC. The parser sticks to this initial commitment and attaches the RC higher in the tree. An effect of the perception verb on RC resolution speaks in favour of top-down structure building in human language parsing.

The results by Sokolova and Slabakova (2019) and Sokolova (in press) motivated the dissertation experiment. The current study extends the target sentences adding the anaphora at the end of the RC. With this design, the dissertation continues to investigate the effect of a perception verb in the matrix clause on the processing of lower levels.

4.6 Summary

Chapter 4 provided an overview of the studies that investigated linguistic properties of a perception verb, described linguistic mechanisms of attachment resolution of the ambiguous RC, and examined the constraints on anaphora resolution in English and Russian. The chapter shows that there are three points within a sentence where the linguistic characteristics of the target phenomena prompt a certain path of sentence parsing.

First, there is a perception verb in the matrix clause. A perception verb is placed at the beginning of the sentence or at the top of the syntactic tree. Its linguistic properties facilitate HA resolution of the ambiguous RC in Romance language and in English. A perception verb supports HA of the RC in Russian but does not exhaustively explain its original preference for HA.

A perception verb triggers a structural anticipation for an eventive complement across languages. The structural realization of the eventive complement varies from language to language. Meanwhile, one structural characteristic remains unchanged in all languages. The verbal constituents in the embedded clause never modify the lower DP in the complex head DP. This linguistic property favours HA of the RC.

When a perception verb is placed in the matrix clause of a sentence with the restrictive RC, it preserves its potential to have an eventive complement. The structure of the eventive complement implicitly reduces a parsing preference to favour LA. A perception verb has been shown to favour HA of the RC in native English and non-native French, Russian and English. The effect of the matrix predicate can be easily explained by top-down mental structure-building which is explained in the next chapter.

The effect of a perception verb becomes noticeable due to the linguistic nature of the ambiguous RC. It is a central component of the analysis for several reasons. The RC is central because it is in the middle of the target sentence and forms the second level or processing. The following chapters will describe this level as the second processing cycle. The RC is also central because the entire study is built around its structural flexibility to attach higher or lower in the tree. The latter creates a favourable linguistic environment where parsing algorithms can be studied. Third, the RC is central because its attachment can be influenced by the matrix verb but the RC itself can influence anaphora resolution. In other words, the RC receives influence from the top of the syntactic tree and transmits this influence onto the lower structural levels.

The third constituent analysed in this chapter is the anaphora at the end of the RC. Anaphora resolution is the target of the experimental study, which manifests the linguistic influences on its interpretation. Anaphora resolution follows the main Binding Principles for the reflexive and the pronoun. In accordance with the Binding Principles, the reflexive must be bound within the domain, and the pronoun must be free within the domain.

The dissertation adopts the definition of the binding domain as a clause that contains both the anaphora and its potential antecedent. There is a mismatch in pronoun resolution between English and Russian. In English, the possessive phrase can form a binding domain. In Russian, the equivalent sentences would be ungrammatical. Therefore, the dissertation excluded sentences with possessive phrases from its design and extended the definition of the domain to account for anaphora resolution in both English and Russian.

Following the main Binding Principles, the reflexive needs to be bound by the nearest c-commanding noun, which is one of the head nouns of the RC. In the target sentence, RC attachment defines which of the nouns in the complex DP is the nearest c-commanding element to the anaphora. Therefore, the reflexive is bound by the DP [DP the mother] in the case of HA and by the DP [DP the woman] in the LA of the RC.

The pronoun must be free within the domain. However, the comprehension tasks lock the choices for anaphora resolution within the two options: the mother or the woman. Both constituents are within the RC. In this case, the pronoun can be bound by either the non-c-commanding noun or by the non-nearest co-commanding noun. The former occurs in HA, the latter in LA. Neither of the binding options for the pronoun violate Principle B and confirm that the comprehension task is grammatical.

The linguistic nature of anaphora resolution shows its correlation with RC resolution. In accordance with the Binding Principles, the HA of the RC entails the preference for anaphora resolution like ‘herself = the mother // her = the woman’. It is the Russian-like pattern of anaphora resolution. In English, where LA of the RC is preferred anaphora resolution returns the pattern ‘herself = the woman // her = the mother’.

The linguistic analysis of the perception verb, the RC ambiguity and the options for anaphora resolution allow for a study of the processing algorithms of sentence parsing, i.e. the effect of the matrix predicate can influence anaphora resolution only if sentence parsing is performed in the top-down manner. The psycholinguistic assumption for the processing of the target sentences are summarized in the next chapter.

Chapter 5 Experimental Study of Parsing Mechanisms in Native and Non-Native speakers of Russian and English

5.1 Introduction

This chapter begins with the two main research questions the dissertation addresses: (1) the analysis of parsing mechanisms in native and non-native sentence processing and (2) the description of the influence of another learnt language on human sentence processing. As can be gathered from the theoretical chapters, human language processing begins with mental structure-building, which follows the rules of grammar. There is some experimental evidence that sentence parsing combines the top-down and the bottom-up algorithms. Meanwhile, this question has been understudied in the field. The dissertation bridges this gap.

The second research question investigates L2 development through the analysis of the participants' parsing behavior. The theories of L2 acquisition and L2 processing predict gradual development of the L2 and its integration in the grammar of an individual. The dissertation is aimed at capturing the earliest stage of L2 acquisition, where L2 processing is L1-guided but the speakers start developing some sensitivity to L2-specific parsing cues.

The two main research questions are specified by a set of subordinate questions. This section is followed by the predictions of possible type of processing behavior in monolingual and bilingual groups. Further, the experimental method is described. The methods section describes the participants, the materials and the procedure of testing. Special attention is paid to the ethics procedure in the experiment.

The chapter finishes with a detailed description the method of data collection and data analysis. The final section explains how the data were coded and why a certain method of analysis was selected. This section also provides the list of acronyms used in coding and statistical analysis which will be used in the Results chapters.

5.2 Research Questions, Hypotheses, Predictions

5.2.1 Research Questions and Theoretical Hypotheses

The main research questions (RQ 1 and RQ 2) are informed by the theoretical analysis in Chapters 1-3 and address the two main objectives of the study: 1) to describe the human parser in as much detail as possible; and 2) to investigate the developmental stage of intermediate L2 proficiency through the analysis of parsing strategies.

(5.1) Main research questions:

RQ 1: Do top-down and bottom-up parsing algorithms complement each other in sentence parsing?

RQ 2: Does knowledge of another language at the intermediate level of proficiency have an effect on sentence parsing? (for the bilingual experiment)

RQ 1 checks whether there is a hierarchy of processing cycles in sentence parsing or whether the bottom-up parsing interferes with the structural prediction initiated from the beginning of the sentence or the top of the syntactic tree. In other words, RQ 1 is aimed at the investigation of the parsing algorithms that underlie sentence processing.

The processing theories reviewed in the previous chapters provide a general description of the human parser and suggest that two algorithms that may govern sentence processing, the top-down or the bottom-up one (see Chapters 1-3 for detail). However, there are studies showing that top-down structure building is supported by bottom-up checks for grammatical fitness (Kazanina et al., 2007).

Kazanina et al. (2007) show that top-down and bottom-up parsing complement each other. However, it remains unclear whether there is one leading parsing algorithm or whether top-down and bottom-up algorithms take turns to check how the structure is being built. The current experiment attempts to address this issue and argues that structural prediction is the driving force of sentence parsing. The top-down prediction triggers the mechanism and generates a structure that gets verified through bottom-up checks at every processing cycle. The dissertation puts forward the first theoretical hypothesis to RQ 1 (5.2).

(5.2) Hypothesis 1 to RQ 1

Top-down and bottom-up algorithms complement each other in sentence processing: parsing starts with a top-down structural prediction that undergoes bottom-up checks for grammatical fitness at every processing cycle.

Both RQs investigate the implication of parsing algorithms. However, RQ 2 approaches it from the developmental perspective. RQ 2 is aimed at establishing any effect of the developing L2 proficiency on sentence processing. For example, the linguistic nature of a perception verb creates processing difficulties in English, but not in Russian (See Chapters 3-4 for detail). Therefore, there can be a facilitative effect of Russian in processing sentences with a perception verb by L2 speakers. Alternatively, L2 speakers can show sensitivity to the language specific effect of a perception verb in English.

The second question (RQ 2) is focused on registering the effects of L1 and L2 at the intermediate stage of language L2 acquisition. Following Fodor (1998, among others), the parser needs time to accumulate enough L2 input to start upgrading the existing grammar to accommodate L2-specific set of parameters. While waiting, the parser uses the L1 as the initial parsing hypothesis in L2 processing.

In general, the intermediate level of L2 proficiency is quite an early stage of L2 acquisition, where strong influence of L1 is still highly expected. On the other hand, intermediate learners of an L2 may have accumulated enough L2 specific knowledge to process some salient L2 phenomena in the TL-like manner. The possible instances of L2-like behavior will be specified in the following section. For the sake of putting forward a hypothesis, the dissertation assumes that intermediate level of L2 proficiency is too early to show any evidence of sensitivity to L2-specific processing cues (5.3):

(5.3) Hypothesis 2 to RQ 2

L2 processing at the intermediate level of proficiency is L1-governed and shows no evidence of L2 processing in the TL-like manner.

The hypotheses stated here are theory-driven and follow the main RQs. However, the main RQs cannot be informative without a detailed analysis of the participants' parsing behavior. For this purpose, the dissertation offers a set of subordinate questions that specify the main RQs.

The following section provides a set of predictions of how the subordinate RQs will be answered and how the answers obtained will inform the main RQs.

5.2.2 Predictions for processing behavior

This section predicts the answers to the subordinate questions and explains how they go in line or might contradict the theoretical hypothesis in the previous section. First, the set of questions targeting the combinatorial nature of the human parser in the RQ 1 (5.4).

(5.4) Subordinate questions to RQ 1:

RQ 1.1: Is there an overall preference for the pattern of anaphora resolution 'herself = the mother / her = the woman'?

RQ 1.2: Is there a language-specific pattern of anaphora resolution 'herself = the mother / her = the woman' in Russian and 'herself = the woman / her = the mother' in English?

RQ 1.3: Does a perception verb in the matrix clause increase sentence complexity at the embedded verb?

RQ 1.4: Does a perception verb in the matrix clause increase general sentence complexity?

RQ 1.5: Are there any other factors that increase sentence complexity?

The first four RQs are focused on the direct investigation of how top-down and bottom-up paring manifest itself in the measured processing load and the final interpretation decision. The last RQ, RQ 1.5, seeks additional information on the processing complexity of the sentence, i.e. whether the parser considers other linguistically complex phenomena or whether a perception verb is such a salient processing cue that it overrides other linguistic prompts. For these reasons, RQs 1.1-1.4 are considered together and the predictions for RQ 1.5 will follow. Meanwhile, all the five subordinate RQs in the set address the main RQ 1 and provide valuable information on how human sentence parsing works.

The questions in RQ 1.1-1.4 are yes/no questions and their hypothetical answers can be mutually exclusive if each question is studied separately. For example, if RQ 1.1 and RQ 1.2 were both answered yes, the study would not make sense and the results would not show any consistency. For this reason, the predictions are provided as the four mainly possible combinations of answers to the subordinate questions RQ 1.1-1.4 (5.5).

(5.5) Four main combinations of possible answers to RQ 11-1.4

RQ 1.1 – yes; RQ 1.2 – no; RQ 1.3 – yes; RQ 1.4 – yes

RQ 1.1 – no; RQ 1.2 – yes; RQ 1.3 – no; RQ 1.4 – no

RQ 1.1 – no; RQ 1.2 – yes; RQ 1.3 – yes; RQ 1.4 – yes

RQ 1.1 – yes; RQ 1.2 – no; RQ 1.3 – no; RQ 1.4 – no

The first combination is RQ 1.1 – yes; RQ 1.2 – no; RQ 1.3 – yes; RQ 1.4 – yes. It means that the overall preference for anaphora resolution is 'herself = the mother / her = the woman', not the language-specific one, a perception verb increases RTs at the embedded verb and the sentences with a perception verb are read slower than the sentence with a non-perception verb. This combination of answers has an effect of a perception verb, which can only occur in top-down parsing. This set of answers supports a clear case of top-down parsing offered by Phillips and Schneider (2000).

The second answer option is RQ 11. – no; RQ 1.2 – yes; RQ 1.3 – no; RQ 1.4 – no. It shows a language specific pattern of anaphora resolution 'herself = the mother / her = the woman' in Russian and 'herself = the woman / her = the mother' in English, and no effect of a perception verb either on sentence processing or on anaphora resolution. This would be a solid example of unidirectional bottom-up parsing, described in Chapter 3.

The third combination has a set of answers like RQ 1.1 – no; RQ 1.2 – yes; RQ 1.3 – yes; RQ 1.4 – yes. It means, that a perception verb does not shape anaphora resolution. However, it increases the processing load of the sentence where anaphora resolution has a language-specific pattern. This set of answers would speak for the combination of parsing algorithms in sentence processing and will serve as direct evidence supporting Hypothesis 1 as the effect of a perception verb appears at the beginning of the sentence, but it is annulled by the time of anaphora resolution. Hypothetically, a projection for the eventive complement was checked and amended in the middle of the sentence.

The last set of answers could be problematic to explain: RQ 1.1 – yes; RQ 1.2 – no; RQ 1.3 – no; RQ 1.4 – no. There is only one effect – a perception verb influences anaphora resolution but does not influence processing load. This is a very unlikely scenario. However, its theoretical explanation can be that the top-down algorithms is the easiest parsing strategy which imposes a parsing decision from the top of the tree and shapes sentence parsing all the way down. In the absence of any grammatical conflict at lower stages top-down processing does not face or causes any parsing difficulties.

The four possible sets of answers provided above are the four most likely scenarios of how the sentence parsing of the anaphora after a perception verb might unfold. However, there could be additional processing evidence in favor of either top-down or bottom-up, or top-down / bottom-up parsing, if other linguistic prompts were considered. RQ 1.5 prompts a general analysis of sentence processing complexity and establishes what factors may be as relevant as a perception verb.

RQ 1.5 is also a yes or a no answer. The yes answer would mean that there are linguistic cues other than a perception verb that shape sentence parsing. For example, pronouns should be processed more slowly than reflexives due to their linguistic nature. Pronouns preserve their potential to be bound outside the sentence, even though the context of the experimental task does not support it (see Chapter 3).

The feminine pronoun her can increase processing load in English due to its homonymy with the possessive pronoun her and its potential to initiate a possessive phrase, like [her daughter]. There is no such homonymy in Russian or with masculine pronouns in English. The effect of the feminine her is a unique English-specific phenomenon. An increase in processing load after her would mean the parser generates a structural prediction for a possessive phrase and had to reject it after no NP followed further down the tree.

Possible processing effects of other linguistic phenomena, especially of the pronoun her, would provide additional evidence for the leading role of the top-down prediction in sentence parsing. Besides, the placement of a pronoun is at the bottom of the syntactic tree. Evidence for structural prediction at the end of the sentence, after the prediction of a perception verb was fulfilled or ruled out. The latter is indirect evidence for the existence of more than one processing cycle within a sentence.

The last option to consider is a negative answer to RQ 1.5. It will mean that there are no factors other than a perception verb that increase sentence complexity. Even though it is an unlikely outcome, it will mean that having a constituent that can prompt top-down structural prediction overrides any other processing clues and dominates mental structure-building.

The second set of RQs specify and support the second main RQ 2 (5.6). They are aimed at looking for effects of either L1 or L2 on sentence processing and would interpret the answers as developmental characteristics of the intermediate level of L2 proficiency.

(5.6) Subordinate questions to RQ 2:

RQ 2.1: Is sentence parsing at the intermediate level of L2 proficiency influenced by the L1 parsing hypothesis?

RQ 2.2: Is there evidence for L2-like sentence parsing in intermediate L2 speakers of Russian and English?

The subset of subordinate RQs or RQ 2 are also yes/no questions and their predicted answers can be organized in four sets (5.7).

(5.7) Four combinations of possible answers to RQ 2.1-2.2

RQ 2.1 – yes; RQ 2.2 – yes

RQ 2.1 – yes; RQ 2.2 – no

RQ 2.1 – no; RQ 2.2 – yes

RQ 2.1 – no; RQ 2.2 – no

The first set RQ 2.1 – yes; RQ 2.2 – yes means that L2 parsing is L1-like. However, L2 speakers may start showing sensitivity to L2-specific clues. Evidence for L1-like parsing can be, for example, final interpretation decision of anaphora resolution if they show L1-like pattern in the L2. L2-like parsing may show itself in the L2 participants' sensitivity to such salient English-specific phenomena, as, for example, the feminine pronoun her in English.

The second set of answers, RQ 2.1 – yes; RQ 2.2 – no, rejects any evidence for L2 like parsing. It would mean that the intermediate level of L2 proficiency does not provide enough input to start the grammar upgrade. It will support the main hypothesis to RQ 2 and show that intermediate level of L2 proficiency is too early to show any instances of L2-like parsing behavior.

The third set of answers provides quite an unlikely combination of answers for the intermediate level of L2 proficiency, RQ 2.1 – no; RQ 2.2 – yes. However, it can have a theoretical explanation.

Such a result would mean that the I-language has fully accommodated the L2-specific parameters and L1 is successfully inhibited when it is needed.

The last set of answers is RQ 2.1 – no; RQ 2.2 – no. It is the most unlikely outcome that would be extremely problematic for the main hypothesis. The two *no*s would mean there is no system in how the participants process the target sentences. Linguistic decision making is performed at random, without any consistency with the rules of grammar.

In summary, the section puts forward the main research questions and provides hypotheses for them. It also generates predictions for the behavior targeted by the subordinate questions. If the main hypotheses of the study are correct, the summary of results will provide a certain set of answers to RQs.

For RQ 1, the answers will be RQ 1.1 – no; RQ 1.2 – yes; RQ 1.3 – yes; RQ 1.4 – yes and RQ 1.5 would be answered yes and provide evidence of the parsing algorithms for other linguistics phenomena.

For RQ 2, the answers will be RQ 2.1 – yes; RQ 2.2 – no to confirm that intermediate level of L2 proficiency is too early to override the default preference for L1-like parsing.

The research questions and hypotheses are answered in the experiment described in the following sections.

5.3 Method

5.3.1 Ethics Procedure

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the University of Southampton, UK, Project identification code 41713.

Before conducting the experiment, an ethics approval was obtained from the University of Southampton Ethics Committee (see Appendix 1). All the participants were given the information sheets that described the study in the participant's native language. The description did not disclose that the focus of the study was anaphora resolution. All informants were asked to sign the informed consent form for inclusion in the study. Participation in the study was voluntary and people had a chance to quit at any stage of the experiment if they wanted to.

5.3.2 Participants

To participate in the study, the informants had to be 18 or older. The participants were recruited among college students and young professionals in the USA and Russia. There were two groups of monolingual speakers of English and Russian and two bigger groups of adult learners of Russian or English as an L2. L2 learners of Russian had English as their native language. L2 learners of English were native speakers of Russian. The L2 speaker groups were divided into two subgroups. One subgroup was tested in the L1, another subgroup in the L2.

5.3.2.1 Monolingual participants

The monolingual participants of the study formed two groups. Each group had 20 people, around 50% male and 50 % female. The two monolingual groups were:

- native speakers of English (NE)
- native speakers of Russian (NR)

None of the participants learned a foreign language for more than a basic language requirement of an educational institution. All the participants reported not remembering anything of the learnt language.

The participants were matched by age and social status. The mean age in the English group was 34 years, and the mean age in the Russian group was 34 years. All the participants of the study were professionals with a college degree, either a BA, MA, or specialist diploma, which is an MA equivalent in Russia.

5.3.2.2 Bilingual Participants

The participants of the bilingual experiment were L2 speakers of Russian and English. In total there were four bilingual groups, two in each L2, English and Russian. L2 speakers of each language were subdivided into two groups to be tested in either their respective L1s or L2s. This approach provides a clear picture of the role of L1-parser in L2 language processing at the (low) intermediate level of proficiency. Besides, comparisons between the L2 speakers’ performance in their L1s and L2s clearly show possible manifestations of L2-specific algorithms in sentence parsing. Finally, processing patterns shown by L2 speakers in their L1s form a baseline for the data analysis in L2 processing.

L2 speakers of English formed 2 groups: RER and REE. The abbreviation for the group RER means Russian-English bilinguals tested in Russian (their L1). The group REE were Russian-English bilinguals tested in English (their L2).

L2 speakers of Russian formed 2 groups: ERE and ERR, where the group ERE were English-Russian bilinguals tested in English (their L1); and the group ERR were English-Russian bilinguals tested in Russian (their L2).

The bilingual participants were matched by age, L2 proficiency and the length of exposure to the language. Table 5.1 below summarizes the background information on the L2 speaking participants — in the experiment. The first line shows their score in the proficiency measure, C-test. The C-test was only offered to the bilingual participants. It was a pen-and-paper test where the participants had to fill in the gaps. A detailed explanation of the C-test design is provided in Section 5.3.4.1 below. A full version of the C-test and the background questionnaires can be found in the appendix.

Even the groups that were tested in their respective L1s (ERE and RER) took the proficiency test in L2. All the four target groups did around 50% correct in the test on average. This result qualifies them as intermediate speakers of their respective L2.

Table 5.1 Background information: L2 speakers of Russian and English

	ERE N = 20	ERR N = 20	RER N = 20	REE N = 20
C-test: proficiency measure score	53% Range 30-80	48% Range 30-57	47% Range 30-57	46% Range 30-55
Length of exposure the L2	2-4 years in college	2-4 years in college	3-8 years in college and at school	3-8 years in college and at school
Mean age of the participants	25	26	26	24
<u>Example of group label reading:</u> **ERE** = native speakers of **E**nglish with L2-**R**ussian *(**ER** – the first two letters of the acronym)*, tested in their L1-**E**nglish *(**E** – the last letter of the acronym)*				

All the participants of the study were young adults. Around half of the participants were college students in the last years of college or at the beginning of graduate school. Another half of the participants were young professionals with a college degree, again either a BA or MA, or a specialist diploma, an MA equivalent in Russia.

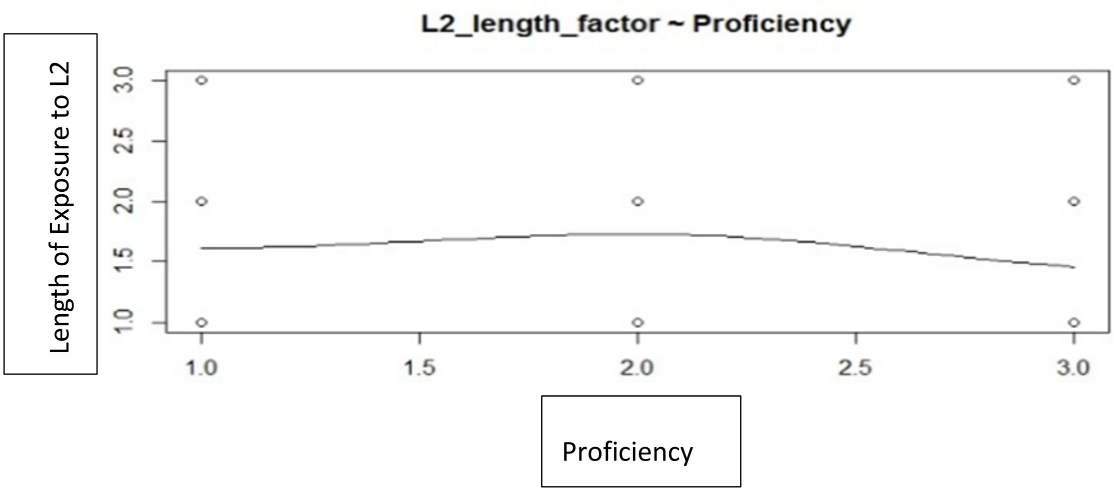
All the participants started learning L2 in a classroom setting. They reported that most of their language learning occurred in college. All the participants achieved the desired (low) intermediate level of proficiency in the C-test. Meanwhile, a detailed analysis of the learners' background questionnaires reveals a lot of differences in how their level of language proficiency was achieved and maintained.

In the background questionnaires of 80 participants, there was some variability in the number of years of language learning at school, different current exposure to the target language, different number of other languages the participants had been exposed to and different self-ratings in reading and auditory comprehension in the target languages.

To make sure the enumerated factors only mean different paths in L2 acquisition and do not obscure the results of the study, a statistical analysis of the background data was performed. The entire population of L2 speakers of both English and Russian were divided into three levels by L2 proficiency. A C-test score of 30-40 % correct grouped the participants as "Low-Intermediate", a score of 41-60 % correct as "Intermediate", and a score of 61-70 % correct meant "High-Intermediate". The statistical analysis with R software used regression models with the factors L2_length (of exposure), Current_Exposure, Other_Languages, Self_Ass(essment)_Reading and Self_Ass(essment)_Comprehension. Proficiency was the dependent variable.

First, the results show that longer does not mean better (Figures 5.1-2).

Figure 5.1 Correlation: Proficiency by length of exposure to the L2, p < .01

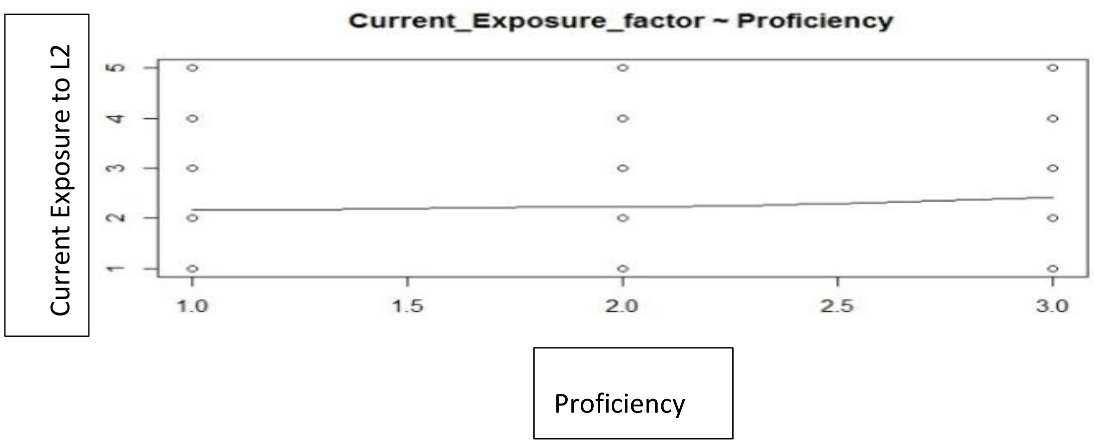


As can be gathered from Figure 1, the level of L2 proficiency and the length of exposure are almost in reverse correlation. The analysis summarized all the years of a participants' exposure to the L2. It included classroom studies, L2 language use in everyday life outside the classroom and experience abroad. The number of years of L2 exposure was coded as "1" for less than 6 years of total experience in the L2, and as "2" for more than 6 years of total experience in the L2.

Figure 1 shows that the most proficient participants with the level of proficiency "3 – High Intermediate" have been exposed to the L2 for less than 6 years. The length of exposure shows a little rise from "1" to "2", or from Low Intermediate to Intermediate, in proficiency. There is a correlation between learning a language longer and moving from Low Intermediate to solid Intermediate. In other words, more years with the language move you from low- to solid intermediate, but this correlation is lost at the high-intermediate level of L2 proficiency.

The second factor that formed L2 proficiency was the amount of time the participants use the L2 in their current everyday lives, or "current exposure" (Figure 2).

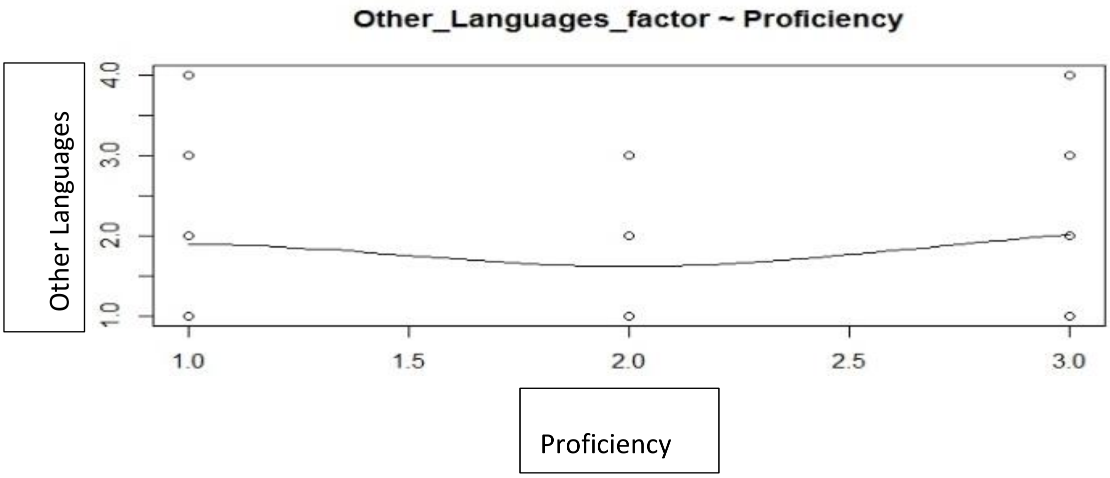
Figure 5.2 Correlation: Proficiency by Current exposure the L2, p < .001



The graph in Figure 2 shows a correlation between current exposure to L2 and L2 proficiency. In other words, a higher level of proficiency is achieved due to intensive current exposure to the L2, that includes experiences in the country of the target language.

The next factor that could form L2 proficiency was linguistic background, or other previously learnt languages, Figure 5.3.

Figure 5.3 Correlation: Proficiency by previous linguistic experience, p < .01



None of the participants learnt another language for more than 2 years in high school. In the correlation of linguistic experience in other languages with L2 proficiency, Low- and High-Intermediate learners studied other languages in high school, but Intermediate learners did not. Thus, richer linguistic background is not a predictor of higher proficiency in the L2.

The last measurements were participants' self-assessments in reading and auditory comprehension. There is a common notion that classroom language learning is mainly reading-based. The analyses checked that the participants who had limited experience in naturalistic language use and learnt their L2s in their home countries were not in an advantageous position as more experienced readers in the non-native language. Figures 5.4 and 5.5 show correlations between the participants' level of proficiency and their self-assessments in reading and auditory comprehension, p < .001.

Figure 5.4 Correlation: Proficiency by and self-assessments in reading comprehension

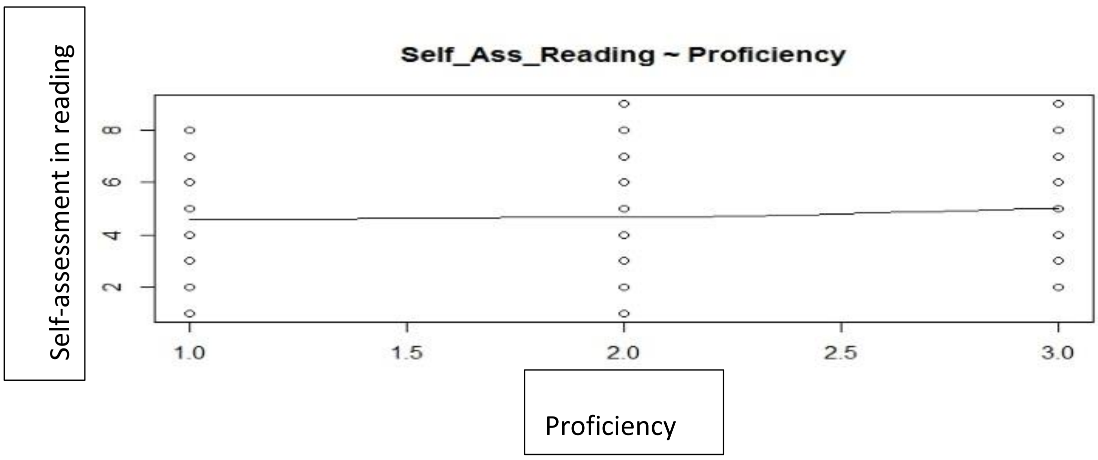
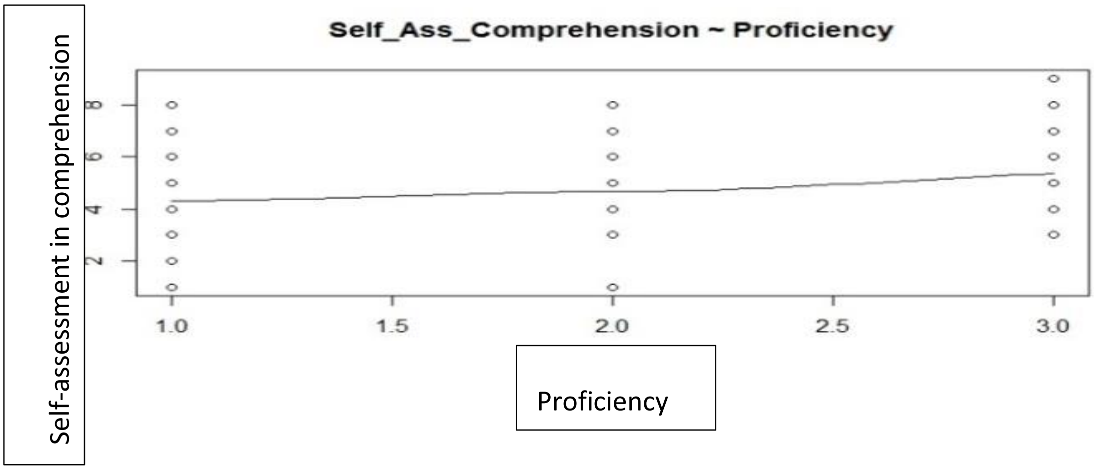


Figure 5.5 Correlations between proficiency and self-ratings in auditory comprehension



According to Figures 4 and 5, the level of confidence in both reading and auditory comprehension is in direct correlation with the growth of proficiency: The better the participants know a language, the more comfortable they feel in both reading and listening. This finding goes against the stereotypical belief that classroom learning is reading-based and does not provide enough auditory practice. As for the current study, it means that classroom-based L2 learners with lower levels of proficiency are not in any advantageous position in a self-paced reading study than L2 learners who learnt the L2 through intensive study abroad programs.

In summary, the analyses of individual differences show that Intermediate level of L2 knowledge can be achieved either through prolonged (more than 6 years) exposure to the language in and outside the classroom in the home country or through a shorter (less than 6 years) but more intensive training that includes visits to the country of the target language. Classroom-based learning mainly occurred in the Russian groups, who were learners of English as the L2. These participants learnt the L2 longer than American participants. Native speakers of American English started learning Russian in college and travelled to Russian-speaking countries frequently.

The findings of the current analysis reveal country-specific approaches to language learning. In Russia, it is earlier exposure and short and infrequent trips abroad; in the USA, learning starts later but the training is more intensive and includes study abroad programmes.

Participants' self-assessments fully reflect their growing confidence in the L2 and show no preference for reading modes in the sub-groups that are lower in proficiency or learnt their L2 mainly in the classroom.

Even though L2 learners acquired their non-native languages in different ways, they all reached at least low-intermediate level of L2 proficiency and the differences analyzed in this section do not obscure the main results of the dissertation experiment. A specific analysis of the correlations between L2 proficiency and the results of the main experiments revealed a slight tendency for L2-like processing in the High-Intermediate subgroups. This correlation will be commented on in the next Chapter under Results.

5.3.3 Materials

A full experimental designed contained 32 target sentences and 64 distractors. The 32 target sentences were organized in 8 quadruples. Each quadruple had a "two-by-two" design in both languages, Russian and English. The bilingual participants were randomly assigned to be tested either in their respective L1 or L2. Each participant did the experimental task only once, in either their native or non-native language. Monolingual participants were tested in their respective native languages. Each participant only saw one version of the experiment, either the Russian or the English one. Altogether, the design was "two-by-two-by-two" manipulating the following conditions:

a) type of anaphora: pronoun vs. reflexive;

b) type of the matrix verb: perception vs. non-perception;

c) the language of testing: Russian vs. English.

Table 2 provides a sample stimulus set in English. The examples of Russian were equivalent translations (a full list of the experimental items can be found in the Appendix).

Table. 5.2 Sample stimuli set

Stimuli quadruple:
1) Bill saw [the mother of the woman] that was speaking about her *in the yard*. 2) Bill saw [the mother of the woman] that was speaking about herself *in the yard*. 3) Bill arrested [the mother of the woman] that was speaking about her *in the yard*. 4) Bill arrested [the mother of the woman] that was speaking about herself *in the yard*.
Comprehension check:
This person was speaking about: a) the mother b) the woman

The 4 sample sentences in Table 5.2 are numbered 1, 2, 3 and 4. They form a quadruple, where sentences 1 and 3 use the pronoun. They are counter-balanced by the sentences with the reflexive (2 and 4). Sentences 1 and 2 use a perception matrix verb and sentences 3 and 4 a non-perception one. All the target sentences are balanced across quadruples for the order of the head NPs (ex., the mother of the woman / the daughter of the woman) and the biological and grammatical gender (ex., the mother of the woman / the father of the man) of the head NPs and the matrix subject (ex., Bill / Mary saw).

Every target sentence was followed by a comprehension check with two answer choices. The order of answer choices was controlled for. Half of the comprehension checks had the higher NP as the first answer choice (ex., a) the mother, b) the woman). Half of the comprehension checks had the lower NP as the first answer choice (ex., a) the woman, b) the mother). and the order of head nouns.

The target sentences were controlled for the total length and for the length of the RC. On average, an experimental sentence contained 15 words. The RC was 8 words long, which is half the sentence on average. There were no RCs longer than 12 syllables in English and 14 syllables in Russian in the experiment.

The distractors were complex sentences with subordinate clauses. The distractors did not contain ambiguous RCs or any other structural ambiguities. The distractors were not shorter than the target sentences in lengths (5.8).

(5.8) I see the wife of the neighbor in the park that was open near my house.

What was open:

a) park   b) house

Every participant had a unique order of sentence presentation. All the target sentences and the distractors were randomized by the program Linger.

5.3.4 Experimental Procedure

Before participating, the participants signed an informed consent form, filled in a linguistic background questionnaire and did a proficiency measure test (all the forms can be found in the appendix). This stage was followed by the experiment itself, where the participants were asked to read sentences on the computer screen and select the answer to a comprehension question after every sentence. After the self-paced reading task, the participants who did the experiment in their L2 were offered a post-test assignment which checked their knowledge of anaphora resolution.

5.3.4.1 C-test

The C-test was designed following the standards for C-test design of Iowa State University available online.

The C-test contained 3 independent texts. Each text had 20 gaps. The second half of every other word was deleted. The first sentence and the final paragraph of each test were kept in full. The sentences in every text were 7-10 words long. The task was to restore as much of the text as possible, i.e. to fill in as many gaps as possible.

The C-tests in both Russian and English were validated with adult native speakers of these languages. 10 native speakers of each language were asked to do the C-test. In both languages the results were the same. Nine out of ten validators completed 100% of the C-test. One person in each language, Russian and English, completed 98% of the C-test. The missing 2% came from one gap that was left blank.

The C-test had 60 gaps in total. The acceptance score was 30% and above. The lowest cut-off score was calculated from the baseline score that could be obtained by, for example, guessing a repeated word, or a copula in English. Random guessing can result in the maximum of 20% correct in the C-test. The minimum acceptance score was the baseline of 20% + 10% margin = 30% correct in the C-test.

The second condition of the inclusion criteria required filling in the gap in both function and notional words. For example, a C-test of 30% correct, where only prepositions, articles and the copular were filled in would not be accepted.

The third inclusion condition required filling in the gaps in all the three texts. It does not mean that all the gaps in every text should be filled in. However, a C-test of 30% correct, where text 1 is fully completed, but texts 2 and 3 are left blank, would not be accepted.

The inclusion criteria had a ceiling level of proficiency, 70% correct in the C-test. The inclusion criteria between 30% and 70% allows to single out the target groups of (low) intermediate speakers of Russian or English as the L2.

The consent form and the background questionnaire took 5 minutes to fill in, on average. The linguistic measure (C-test) took around 10 minutes to complete. The L2 proficiency measure, the C-test, was only offered to bilingual participants. The pre-testing session lasted 10-15 minutes.

5.3.4.2 Self-paced reading experiment

The main experiment was a self-paced reading task administered through free software for linguistics experiments called Linger. The experiment required reading a set of sentences on the computer screen and answering a comprehension check after every sentence. Each participant completed the testing only once and saw only one version of the experiment, either in English or in Russian. The main experiment consisted of two parts: a pre-sessional training and the experimental task.

The pre-sessional training was used to let participants familiarize themselves with the experiment interface. In accordance with the main procedure, the pre-training session gave participants written instructions on the computer screen. The instructions prompted the participants to use all the keys that they would need to be using throughout the experiment.

The training session had 6 practice sentences followed by 6 questions. All practice sentences were unambiguous. The sentences gradually increased in length from sentence 1 to sentence 6, beginning from short sentences of about 5 words in length and ending up with 15-word long sentences that matched the target sentences in length.

The practice sentences were followed by comprehension questions. Each comprehension question had two answer choices. To choose answer 1, the participants had to press the key F, and for answer choice 2, they had to press the key J. The comprehension questions prompted the participants to use both keys, F and J, equal number of times.

The pre-sessional training took about 5 minutes to complete. During the practice session, the experimenter stood next to a participant and helped, if needed. When the pre-sessional training was over, a notification appeared on the screen. At this point, the participants had a chance to ask clarification questions. To proceed to the main stage of the experiment, the participants had to press Enter key. The experimenter stepped aside but remained in the room to make sure the participant would not be distracted.

The main experiment had 32 target sentences and 64 distractors. All the sentences of the main experiment were randomized by the programme and the sequence of sentences did not repeat from one participant to another. The experimental items were introduced word-by-word. The participants could see only one word on the screen at a time. To retrieve the next word, they had to press the SPACE key.

At the end of the main experiment a notification "Thank you very much!" appeared on the screen. The experimenter thanked the participant and answered all the questions the participant had. The main experimental task took the participants 20-30 minutes to complete.

5.3.4.3 Post-test

The main test was followed by a post-test that checked whether the participants had acquired anaphora resolution in their non-native language. The post-test was only offered to the participants who did the experiment in the L2 after they completed the main part of the experiment. The full version of the post-test is provided in the appendix.

The post-test was an acceptability judgement task conducted in a form of a pen-and-paper test. The participants were asked to read a set of sentences their L2 that were followed by the equivalent interpretations in the native language. For example, a test item, like *Bill looks at himself in the mirror*, was given in the L2. It was followed by a sentence, like *Bill looks at a different person in the mirror*, provided in the native language of the participant.

The participants were instructed to decide whether the reflexive pronoun (or the plain pronoun, in other items) in the L2 sentence was explained correctly in the following L1 sentence. They had to accept or decline the interpretations selecting: "Yes", "No" or "Cannot decide". The choice of "Yes" meant the interpretation in the native language matched the meaning of task sentence in the L2. The choice of "No" meant the interpretation in the native language was not correct. The option "Cannot decide" meant the participant was confused about the match in meaning between the target sentence and the task sentence. The participants' choices of "Cannot decide" were less than 10 % in total.

The task sentences contained the anaphora. Every sentence was followed by its interpretation in the participants' native language. In total, there were 20 post-test items, 10 per each type of the pronoun. The test provided an equal number of the sentences with local and long-distance binding for both the reflexive and the pronoun. The test items required an equal number of acceptances and rejections. This design provided a clear picture of whether an error in acceptance or rejection was a single time error, or whether a certain type of binding was systematically rejected by a participant. The latter meant the main principles of anaphora resolution had not been acquired and the data of the participant had to be discarded.

The inclusion criterion was 85% correct, which meant 2 mistakes in 20 sentences. The results of the participants who did not meet the 85% threshold in the post-test were excluded. There were only 2 participants who scored lower than 85% in the post-test. The post-test took the participants 5-7 minutes to complete.

All the participants were tested in a quiet room. The (bilingual) participants were randomly assigned an experimental group: 'L2 speakers tested in the L2' or 'L2 speakers tested in the L1.' Each participant was only tested once. Total time of testing was around 25-30 minutes for the monolinguals, 40-45 minutes for the bilinguals tested in the L1, and 45-55 minutes for the bilinguals tested in the L2. The participants could quit the experiment at any point of time without any consequences. After completing all the assignments in the experiment, the participants had an opportunity to ask detailed questions about the study.

The post-test. The results of the participants who did not pass the post-test criteria were excluded from the future analysis.

5.4 Data Analysis

The experiments in the dissertation investigate the implementation of top-down and bottom-up parsing in native and non-native languages. A top-down parsing algorithm based on structural prediction expects an overall preference for the pattern of anaphora resolution 'herself = the mother // her = the woman'. Bottom-up parsing will result in a language-specific pattern of anaphora resolution 'herself = the mother // her = the woman' in Russian and 'herself = the woman // her = the mother' in English. This result is obtained through noun choices picked in the comprehension task.

To provide a pattern of sentence parsing, the experiments measure reading times and check whether a perception verb causes any slowdowns in the course of sentence processing. The measurement is verb type effect.

For a well-rounded description of sentence parsing, the study also checks which factors other than the effect of verb type influence sentence processing. The focus is to establish what factors make parsing more complicated. The analysis checks the reading times for an effect of all main factors, like the type of anaphora resolution, or language of testing, etc. On top of the reading time measurements, general complexity of the sentence is measured through response time, or the time taken by the participants to answer a comprehension question.

The study tested 6 groups of participants, 2 monolingual groups and 4 bilingual groups. The dissertation uses acronyms to label the target groups. The names of the main variables that are used in the analysis were also abbreviated. A list of acronyms is provided in the table below.

Table 5.3 Table of Acronyms Used in Data Coding and Data Analysis

Acronym	Explanation
NE	Native English speakers
NR	Native Russian speakers
ER-R	Bilinguals: L1-English, L2-Russian, tested in Russian (L2)
ER-E	Bilinguals: L1-English, L2-Russian, tested in English (L1)
RE-E	Bilinguals: L1-Russian, L2- English, tested in English (L2)
RE-R	Bilinguals: L1-Russian, L2- English, tested in Russian (L1)

Data Analysis	
Group	Belonging to either of the experimental groups above.
Nchoice	Noun chosen as a referent of the anaphora: 1 = the mother; 2 = the woman
Verbtype	The type of verb in the matrix sentence: 0 = perception verb; 1 = non-perception verb
AnaType	The type of anaphora: 0 = the reflexive; 1 = the pronoun
Group NL	Native language of the speakers of an experimental group
Language	Language of testing (different from native language in ERR and REE)
AnaPred	The feminine pronoun her that triggers a structural anticipation for a possessive phrase
RT	Reading time taken to read a certain word in the target sentence
RespTime	Response time, or the time taken to answer a comprehension task

The target sentence of the experiment contains a perception verb in the matrix clause, the matrix clause is followed by an ambiguous RC with an anaphoric element at the end of it, repeated here as (5.9).

*(5.9) Bill **saw** the mother of the woman [$_{RC}$ that was talking about herself / her in the yard].*

This person was talking about:

a) the mother *b) the woman*

The dependent variables include a preferred noun choice for anaphora resolution (Nchoice), reading times (RT) of every segment of the sentence and the time taken to answer a comprehension question, or response time (RespTime).

Nchoice is the preferred answer to a comprehension check. It shows whether the anaphora is co-referenced with the higher or the lower NP. Following the Binding Principles (Chomsky 1981), the reflexive and the pronoun are expected to have different head noun antecedents. The first stage of the analysis establishes whether Nchoice depends on the type of anaphora: the reflexive or the pronoun (AnaType). AnaType is the first factor that is measured in fixed effects.

The AnaType factor can be realized in two ways: 1) an overall preference for '*herself = the mother // her = the woman'*, 2) language-specific patterns '*herself = the mother // her = the woman'* in Russian and '*herself = the woman // her = the mother'* in English.

The first option, an overall preference for '*herself = the mother // her = the woman'*, is suggestive evidence for top-down parsing, where the pattern of anaphora resolution is predicted by the matrix predicate at the highest processing cycle. If this is true, Nchoice depends on the type of the perception matrix verb (VerbType). VerbType is the second independent variable in the analysis. Because the effect of VerbType can only be measured through a preferred pattern of anaphora resolution, the analysis of fixed effects should have a significant interaction VerbType*AnaType.

The second option for anaphora resolution is a language-specific pattern '*herself = the mother // her = the woman'* in Russian and '*herself = the woman // her = the mother'* in English. This should suggest that different types of anaphora seek antecedents differently across the two languages of the experiment. Language effect is measured through an independent variable language of testing (Language). The difference between the patterns of anaphora resolution by Language can only be measured through an interaction of fixed effects AnaType*Language.

The factor Group is only used for descriptive purposes because it overlaps with factors Language and Group NL. For example, an overlap between the factors Language and Group occurs in Experiment 1, where the two monolingual groups are compared to each other, Group NE by default means that Language (of testing) of the participants is English and Group NR means Russian is the language of testing for the Russian speaking monolinguals. Group and Language also overlap in the parts of Experiment 2, where two groups of L2 speakers tested in their respective L1 or in their respective L2 are compared to each other.

In the analysis, the Language (of testing) factor groups the respondents tested in a certain language, Russian or English, together. It means that English monolinguals and L2 speakers of English are grouped together, and Russian monolinguals and L2 speakers of Russian are grouped together too. Language (of testing) effect means that native and non-native speakers perform similarly. Having Language (of testing) among fixed effects provides a better analysis of the effects of the L1 or L2 on processing than a Group effect would.

Another variable that specifies the group effect is the variable Native Language of the Group (Group NL). GroupNL gathers together the participants with the same native language, both monolingual and bilingual. For example, native speakers of English (NE) will be grouped together with native speakers of English who know Russian and were tested in their L1 English (ERE) and with native speakers of English who know Russian and were tested in their L2 Russian (ERR). These three groups are compared to the three mirror-image groups of native speakers of Russian, both monolingual and bilingual.

The factor GroupNL checks for an effect of the native language in bilingual sentence processing. Having a significant GroupNL effect means that L2 speakers of either English or Russian show L1-like behaviour in their L2. The same as with other variables, such as VerbType effect and Language effect, the Group NL effect is measured in interaction with AnaType, which means a possible fixed effect of AnaType*GroupNL.

All the enumerated analyses of the factors that influence answer choice (Nchoice) provide an answer to RQ 1A-B and investigate whether there is an effect of top-down or bottom-up parsing. To specify the obtained results, the dissertation puts forward RQ 1C-D which study the effect of the VerbType on the RT at the embedded verb and on the general complexity of sentence processing. RQ 1E establishes whether there are other factors that influence sentence complexity, one of which could be the feminine pronoun *her*. The pronoun can trigger a structural anticipation for a possessive phrase due to its homonymy to the possessive pronoun in English.

The role of a perception verb in general processing complexity of the sentence is measured though the reading time (RT) of the embedded verb *talking* (RTverb2), the last word of the sentence *yard* (RTspill), and the time taken by a participant to answer a comprehension question (RespTime). The independent variable is the type of the matrix verb, or VerbType. If the VerbType makes a sentence more difficult, the analysis of fixed effects will show the VerbType as a predictor for longer RTverb2, RTspill or RespTime.

To test whether the feminine pronoun *her* creates a temporary garden path effect and makes processing more difficult, the analysis checks whether the RTspill, or reading of the last word *yard*, is longer after the feminine pronoun *her*. The pronoun *her* is an independent variable (AnaPred_amb) in the analysis. If the pronoun *her* in *talking about her in the yard* triggers a structural prediction for a possessive phrase, like *[her daughter]*, the preposition of the following PP *[$_{PP}$ in the yard]* forces the parser to abandon the structure for a possessive phrase and parse the sentence where the pronoun *her* is followed by the PP. The effect of structural adjustment will show in prolonged RTs at the spill-over region, the last word *yard*. The analysis will return significant effect of AnaPred-amb.

The second main question RQ 2 checks for the effect of the knowledge of more than 2 languages on sentence parsing. The analysis of non-native processing uses only the four groups of L2 speakers. Since some of the L2 participants are tested in the L1, they form a baseline for the analysis of the results of the L2 participants tested in the L2. The dissertation also compares English and Russian monolinguals to the L2-speaking participants who were tested in their respective native languages. This allows for highlighting the effect of bilingualism on processing in the L1. The data coding and data analysis uses the same variables that were described above for the main experiments.

All the analyses use mixed effect models with random cross effects for participants using “package: lme4” for R version 3.4.3. The analysis of the preferred noun choices uses a generalized mixed effects model with a binomial distribution using packages 'afex', 'lmerTest', 'emmeans', 'r2glmm', and 'pivottabler' for R version 3.4.3. The analysis included contrast coded fixed effects for the type of matrix predicate (VerbType: -.5 = non-perception, .5 = perception), for the type of anaphora (AnaType: -.5 = reflexive, .5 = pronoun) in a 2x2 factorial design for each language of testing, English and Russian. Additionally, the analysis checks for the effect of the language of testing (Language: -.5 = English, .5 = Russian), of the native languages of the participants (GroupNL: -.5 = English, .5 = Russian), and for the predictive effect of the pronoun *her* (AnaPred: -.5 = ambiguous; .5 = non-ambiguous) as additional inferential statistics. Random effects are fit using random intercepts for participants and items. Models are fit using “maximum likelihood” technique. A fixed effect was considered significant if the absolute value of *t* statistics was greater than or equal to 2.0 (or less than -2.0) / *p* value was smaller than .05, confidence interval .95.

Chapter 6 Results of Experiment 1: Monolingual Speakers of English and Russian

6.1 Introduction

This chapter presents the results of the first self-paced reading experiment conducted with adult monolingual speakers of English and Russian. The results address the main RQ and provide a detailed analysis of how sentence parsing in English may differ from Russian. The presentation of results follows the order of RQs 1A-E (see Chapter 5). The main RQ 2 concerns the effect of another language on sentence processing. Therefore, it is not applicable for this experiment, where the target group is monolingual adult speakers of English and Russian.

First the results address the question of a possible combinatorial use of top-down and bottom-up parsing. The results check for the overall pattern of anaphora resolution (RQ 1A-B) and for the effect of a perception verb on the RT at the embedded verb and on general complexity of the sentence (RQ 1C-D). The presentation of results finishes with RQ 1E which checks for other factors that could increase processing complexity of a sentence. Besides, the role of other linguistic factors in sentence processing can provide additional evidence for the hypothesized algorithm of top-down + bottom-up parsing.

The chapter sums up all the results to answer RQ 1 and shows whether there is evidence for combinatorial use of top-down and bottom-up algorithms in monolingual sentence processing. Only significant findings are presented in the chapter. The non-significant results for all testing conditions are provided in the appendix.

6.2 Parsing Algorithms in Sentence Processing

6.2.1 General Pattern of Anaphora Resolution

This section begins with the analysis of the general patterns of anaphora resolution in the two monolingual groups of speakers of English and Russian and addresses RQ 1A-B. In other words, the section presents the results for Nchoice which are expected to come as a certain pattern. There can be an overall preference for the pattern herself = the mother // her = the woman in both groups. This would be evidence for top-down structural parse. Another option is a language specific pattern herself = the mother // her = the woman in Russian and herself = the woman //

her = the mother in English. Therefore, Nchoice in response to a comprehension question provides the first information of what parsing algorithms may govern sentence processing.

Table 6.1 shows R statistics for the noun choice by the factors Group, VerbType and AnaType. All the results are presented with the reference category – the higher NP choice.

Table 6.1 R statistics for Nchoice

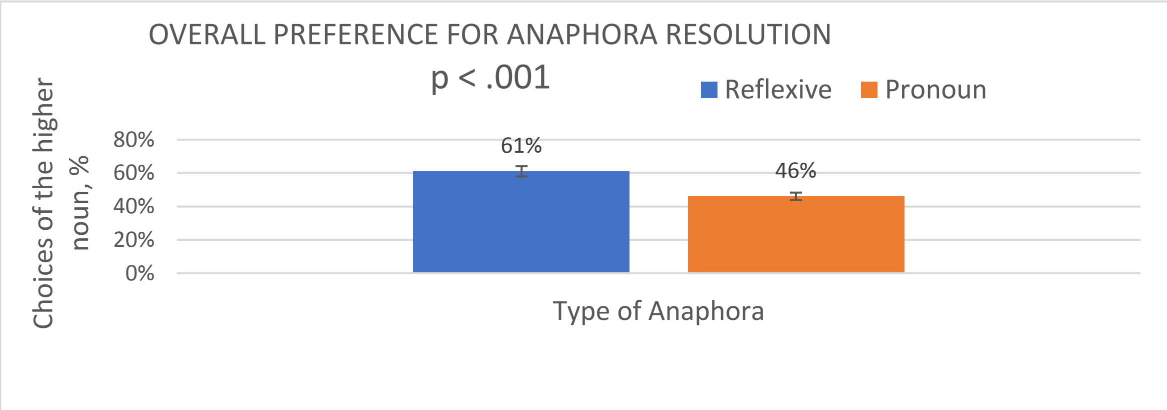
<table>
<tr><td>Linear Mixed Model:
model.english = lmer(PctNoun1 ~ VerbType_factor*AnaType_factor*Language_factor + (1 | Participant) + (1 | Item), data = monolinguals, REML = FALSE)
> summary(model.english)</td><td>Estimate</td><td>Std Error</td><td>df</td><td>t-value</td><td>Pr(>|t|)</td></tr>
<tr><td>(Intercept)
VerbType_factor1
AnaType_factor1
Language_factor1
AnaType_factor1:Language_factor1</td><td>0.53853
0.05422
-0.15406
1.047e-01
1.047e-01</td><td>0.02533
0.02550
0.02550
5.076e-02
5.076e-02</td><td>40.00782
1239.02328
1239.02328
3.999e+01
1.209e+03</td><td>21.262
2.126
-6.041
2.062
-8.448</td><td>< 2e-16 ***
0.0337 *
2.02e-09 **
0.0457 *
< 2e-16 ***</td></tr>
<tr><td colspan="6">Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1</td></tr>
<tr><td>Binomial Distribution:
model.english = glmer(PctNoun1 ~ VerbType_factor*AnaType_factor*Language_factor + (1 |Participant) + (1|Item), data = monolinguals, family = "binomial")
> summary(model.english)</td><td>Estimate</td><td>Std. Error</td><td colspan="2">z-value</td><td>Pr(>|t|)</td></tr>
<tr><td>VerbType_factor1</td><td>0.25265</td><td>0.14760</td><td colspan="2">1.712</td><td>0.0869 .</td></tr>
<tr><td>AnaType_factor1</td><td>-0.72305</td><td>0.14810</td><td colspan="2">-4.882</td><td>1.05e-06 ***</td></tr>
<tr><td>Language_factor1</td><td>0.51615</td><td>0.24654</td><td colspan="2">2.094</td><td>0.0363 *</td></tr>
<tr><td>AnaType_factor1: Language_factor1</td><td>-1.99513</td><td>0.25025</td><td colspan="2">-7.972</td><td>1.56e-15 ***</td></tr>
<tr><td colspan="6">Random Effects</td></tr>
<tr><td>Groups</td><td>Name</td><td>Variance</td><td colspan="3">Std.Dev.</td></tr>
<tr><td>Participant</td><td>(Intercept)</td><td>0.019347</td><td colspan="3">0.1391</td></tr>
<tr><td>Item</td><td>(Intercept)</td><td>0.002313</td><td colspan="3">0.0481</td></tr>
<tr><td>Residual</td><td></td><td>0.2054540</td><td colspan="3">4533</td></tr>
<tr><td colspan="6">Number of obs: 1280, groups: Participant, 40; Item, 32</td></tr>
</table>

Table 6.1 shows that Nchoice depends on the AnaType and VerbType and Group. The effect is also significant in the interaction AnaType*Language.

The first fixed effect is the VerbType effect ($p < .05$), which favors the choice of the higher NP. Meanwhile, the VerbType as a simple effect is not informative for the current experiment. An expected effect of top-down hierarchy of processing cycles should manifest itself through a facilitative effect of the VerbType for the pattern of anaphora resolution *herself = the mother // her = the woman*. In terms of statistical analysis, it means there should be a significant interaction of the factors AnaType*VerbType. The data analysis disregards a simple effect of the VerbType as non-informative.

The second simple effect is AnaType effect, or the overall preference for the type of anaphora resolution *herself = the mother // her = the woman* (SD = 11). Overall preference means the statistical analysis considered all the participants together, i.e. the monolingual speakers of English + the monolingual speakers of Russian. In what was obtained, monolingual speakers of Russian and English mostly prefer to answer the comprehension question like *herself = the mother // her = the woman*. This pattern of anaphora resolution is expected in the top-down parsing algorithms. Figure 6.1 shows the percentage of the higher NP choices.

Figure 6.1 Overall preference for the higher NP

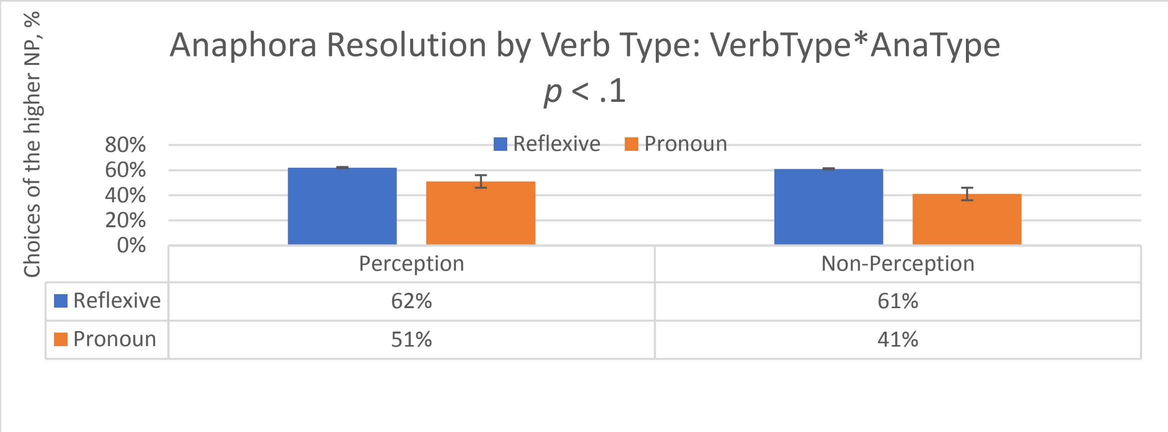


In Figure 6.1, the reflexive is co-referent with the higher NP *(herself = the mother)* in 61% of the cases. The pronoun is co-referent with the higher NP in 46% of the cases, which means that the pronoun is co-referent with the lower NP *(her = the woman)* more often (100% – 46% = 54%) than with the higher NP. The results show a general preference for the pattern *'herself = the mother // her = the woman'* in anaphora resolution when both groups are analyzed together.

Before the results on anaphora resolution can be interpreted as serious evidence in favor of top-down parsing algorithms, the analysis should show that these Nchoices occur due to the effect of a perception verb, i.e. in the interaction AnaType*VerbType (see Chapter 5).

Table 6.1 shows marginally significant interaction AnaType*VerbType. It is marked as ('.') in R, which means $p < .1$. Figure 6.2 shows VerbType impact on the preferred pattern of anaphora resolution.

Figure 6.2 Anaphora resolution: Effect of Verb Type



Even though both monolingual groups show the top-down-like preference for *'herself = the mother // her = the woman'* in anaphora resolution, the effect of the VerbType reaches significance because it influences the pronoun only, reflexive resolution remains the same with both verb types. At this point, it is not possible to say that an overall preference for the pattern *'herself = the mother // her = the woman'* in anaphora resolution is caused by a perception verb in the matrix clause.

The next factor that influences Nchoice in the analysis of fixed effects is Group factor. For the monolingual population, the Group factor means being either a native speaker of English (NE) or a native speaker of Russian (NR). The two languages of the experiment are expected to show different patterns of anaphora resolution: *herself = the mother // her = the woman* in Russian and *herself = the woman // her = the mother* in English.

The Group factor comes out as a significant simple effect, Group, $p < .05$. It also shows in a significant interaction with the type of anaphora resolution, AnaType*Group, $p < .001$. For the reasons stated above for the VerbType factor, the Group factor is not informative as a simple effect, it does not give a clear picture of how each type of the anaphora is influenced by the Group. However, the interaction of AnaType*Group shows a preferred pattern of anaphora resolution in every group of participants, NE and NR. Figure 6.3 shows the percentage of Nchoice by Group.

Figure 6.3 Choice for higher NP in interaction with Group

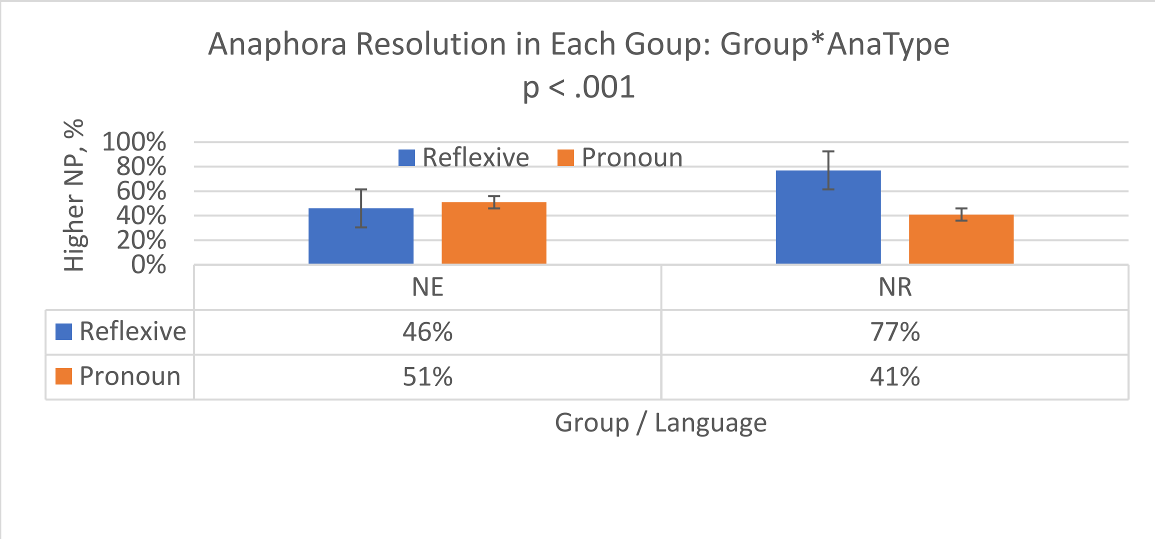


Figure 6.3 shows that the higher NP is preferred less than in 50% of the cases in English and in more than 70% of the sentences in Russian. The pronoun shows the opposite pattern, i.e. most often the reflexive is co-referent with the lower NP and the pronoun is co-referent with the higher NP in English. In Russian the most frequent pattern is the opposite; the reflexive is co-referent with the higher NP and the pronoun – with the lower one.

In the general overview, there is a preference for a language-specific pattern for anaphora resolution *herself = the mother // her = the woman* in Russian and *herself = the woman // her = the mother* in English (SD = 16). This pattern is predicted by bottom-up parsing, where a perception verb in the matrix clause does not have influence on sentence parsing. It is noticeable that the percent of Nchoice in NE is around 50%. Even though the difference between the higher and the lower noun reaches significance, their results could potentially be interpreted as zero-preference, or preference around chance. In this context it is important to notice that there is a marginally significant effect of a perception verb on anaphora resolution. A perception verb does not change much in the final sentence interpretation, but it prompts a closer look at the VerbType effect on sentence processing performed in the next section.

There is another point of concern. The current results in NE have a 44% preference in choosing the higher NP in the sentences with reflexives. Knowing that reflexive resolution patterns with LA preference in RC attachment (Chapter 4), this percentage is much higher than what native speakers of English most often show (see Sokolova and Slabakova, 2019, Sokolova in press). This mismatch and the marginally significant interaction of VerbType*Nchoice motivates further analysis of whether a perception verb in the matrix clause may influence NE in any special way.

6.2.2 Reading Times at the Embedded Verb

This section studies the effect of the embedded verb on sentence processing in the two monolingual groups of adult speakers of English and Russian. The manifestation of top-down structure-building is first analyzed through the effect of a perception verb on the embedded verb (RQ 1C). It is measured through prolonged RTs at the embedded verb in English. Longer RTs is evidence for the processing conflict between the eventive complement and the restrictive RC triggered by a perception verb (see Chapter 4). The triggered prediction for an eventive complement must be abandoned after the complementizer that (in English) which increases processing load at the spill-over region, the embedded verb. This effect is not expected in Russian (see Chapter 3) Table 6.2 shows the effect of a perception verb on the RT at the embedded verb.

Table 6.2 R statistics for the effect of a perception verb on the embedded verb

RT of the embedded verb *talking*					
	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	512.030	24.159	40.006	21.194	< 2e-16***
VerbType_factor1	54.273	16.750	1239.013	3.240	0.00123**
VerbType_factor1:Group_factor1	-66.256	33.500	1239.013	-1.978	0.04817*
Signif. codes: 0 ‘*’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1**					

As becomes evident from Table 6.2, a perception verb (*saw* vs. *arrested*) influences the RTs at the embedded verb *(talking)* and there is a significant interaction with Group effect. Longer RTs indicate that a linguistic phenomenon causes a processing difficulty. In this case, VerbType slows down RTs of the embedded verb, $p < .01$. Besides, the VerbType influences the two groups of monolingual participants differently, which becomes evident from the significant interaction VerbType*Group, $p < .05$. Figures 6.4 and 6.5 show VerbType effect on the RT of the embedded verb in the entire monolingual population (Figure 6.4) and by group (Figure 6.5).

Figure 6.4 RT of the embedded verb: Effect of VerbType

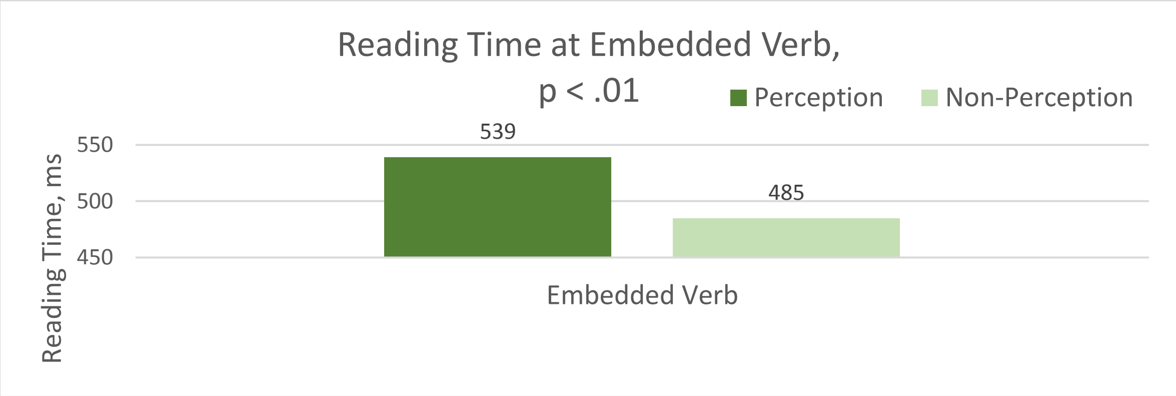
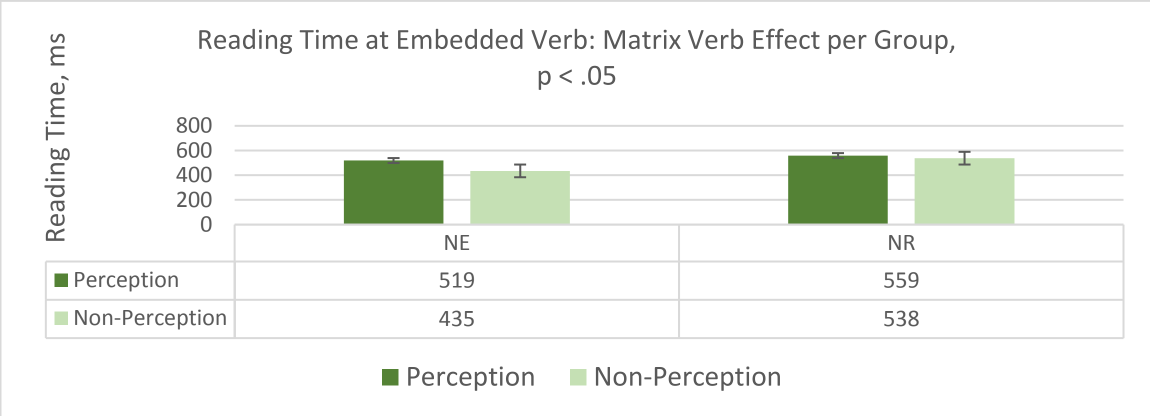


Figure 6.5 RT of the embedded verb: effect of VerbType by Group



Comparing Figure 6.4 to Figure 6.5, one can notice that the overall significance of the VerbType in the entire monolingual population of the informants (Figure 6.4) is actually a generalization of the the effect of the VerbType on the group NE (Figure 6.5). NR slow down their reading time for 20 ms. after a perception verb, whereas NE for 85 ms, on average. Figure 6.5 shows that the effect of a perception verb is stronger in English than in Russian. This result patterns with linguistic theories explained in Chapters 3-4. A perception verb is expected to have stronger effect in English where it prompts a change of the preferred pattern of RC resolution.

The results of the RTs at the embedding verb are coherent with the theoretical predictions of its effects in top-down parsing in both English and Russian. Therefore, they are interpreted as evidence for top-down sentence parsing that occurs at the beginning of the sentence.

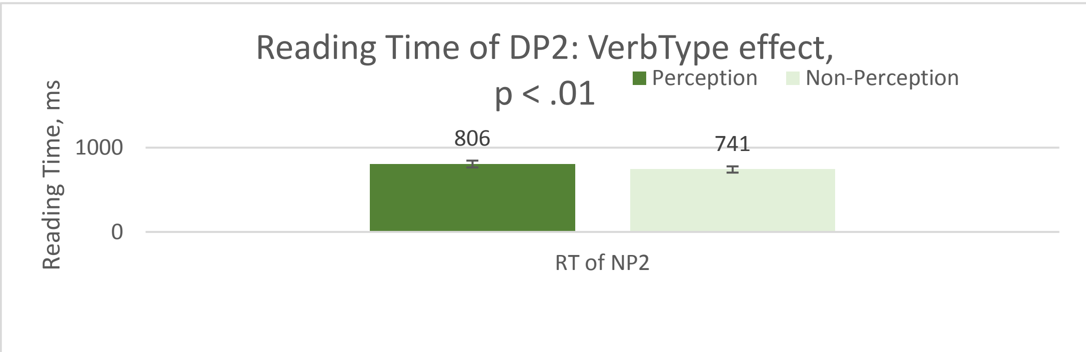
There is another piece of evidence that supports the assumption for top-down structural prediction at the beginning of the sentence. A perception verb causes a processing difficulty of the second DP *[$_{DP}$ the woman]* in the complex DP *[$_{DP}$ the mother of the woman]*. The example of the complex DP was used in Chapter 4 to show that sentence parsing could not be performed by a single unidirectional algorithm even within one complex phrase. The results obtained in the current analysis extend the explanation in Chapter 4.

The statistical significance of the VerbType on the RT of NP2 is shown in Table 6.3. It is followed by Figure 6.6 showing the effect of a perception verb on the RT of the second DP *[$_{DP}$ the woman]*.

Table 6.3 R statistics for the significant effect of a perception verb the embedded verb

RT of NP2 *[$_{NP}$ the woman*					
	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	773.384	65.900	40.000	11.736	1.57e-14***
VerbType_factor1	65.011	20.579	40.000	3.159	0.00301**
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Figure 6.6 RT of the second NP [$_{NP}$ the woman]. Effect of a perception verb



The second DP *[$_{DP}$ the woman]* is read 60 ms slower after a perception verb in both monolingual groups, $p < .01$. There is no Group*VerbType interaction which means, a perception verb affects native speakers of Russian and English in the same way. This effect was predicted in the theoretical chapter (Chapter 4) where the first argument in favor of a combination of top-down and bottom-up parsing was offered.

Longer RTs might be evidence for the structural accommodation of the incoming PP inside the complex DP *[$_{DP}$ the mother of the woman]*. The initial DP projection needs to be extended to the complex DP that also contains the PP *[$_{PP}$ of the woman]*. As explained in Chapter 4, this cannot be achieved by top-down parsing only and involves bottom-up revisions of the generated structure. Therefore, any processing difficulty at the complex DP is suggestive for a bottom-up check of the originally projected DP *[$_{DP}$ the mother]*.

Current results point to the role of the perception verb in the increased RTs at the second DP. In other words, a perception verb *saw* has a different effect on the subsequent sentence processing than a non-perception verb *arrested*. Slower RTs at the second noun can result from the multiple structural anticipations triggered by a perception verb. For example, an eventive complement may anticipate a verbal element right after the first DP.

The anticipation of multiple complements after a perception verb can account for the increased processing load in the sentences with a perception verb as compared to the sentences with a non-perception one. In the non-perception condition, the parser needs to realize one thing – that the phrase is not over. Then it will extend it to the complex DP *[$_{DP}$ the mother of the woman]*. In the perception condition, the parser needs to begin with the same thing – to realize that the phrase is not over. However, the further stages are more complex. The parser needs to select whether the eventive or the entity complement is being supported by the incoming linguistics information and only afterwards it will extend the projection accordingly.

To sum up, this section provided evidence for top-down parsing at the beginning of the sentence. First, a perception verb causes longer RTs of the embedded verb *talking* with $p < .01$. This goes in line with theoretical assumptions of the effect of a perception verb on sentence processing. Second, a perception verb increases the RT at the second DP *[$_{DP}$ the woman]* in the complex NP *[NP the mother of the woman]* with p < 01. Because, the RT is different between the VerbType condition, this effect cannot be explained by the complexity of the DP *[$_{DP}$ the mother of the woman]* which stays the same in both experimental conditions. Therefore, prolonged RTs at the second DP *[$_{DP}$ the woman]* is evidence of the already generated multiple structural anticipation.

6.2.3 General Processing Complexity: Effect of a Perception Verb

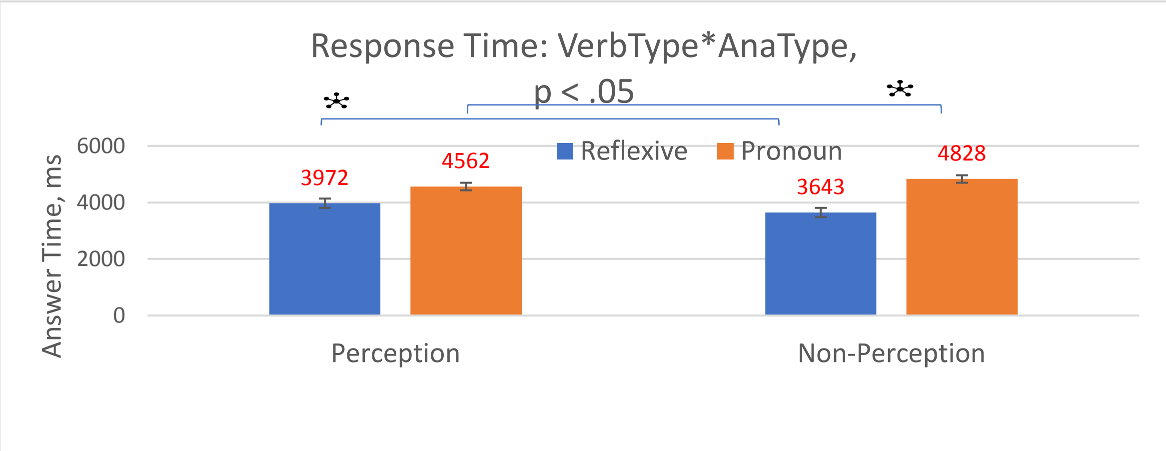
This section reports the analysis of the RT at the wrap-up region (yard) which is the last word in the sentence and the response time (RespTime), or the time taken to answer a comprehension check. The results in the two monolinguals groups of native speakers of English and Russian show whether the sentences with a perception verb are generally more complex for processing than the sentences with a non-perception matrix predicate (RQ 1D).

A perception verb has no effect on the RT at the wrap-up region. It increases general processing complexity of the sentence only at RespTime. The effect is shown in Table 6.4. This VerbType effect is significant in an interaction with AnaType, which is shown in Figure 7.

Table 6.4 R statistics for the effect of a perception verb on sentence processing

Response Time					
	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	4251.27	40.00	227.91	18.653	< 2e-16***
AnaType_factor1	887.45	133.13	120.00	6.666	8.46e-10***
VerbType_factor1:AnaType_factor1	-594.30	266.26	120.00	-2.232	0.0275*
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Figure 6.7 Response Time: Effect of VerbType*AnaType



In Figure 6.7 a perception verb has a stronger effect of the final interpretation of the reflexive than on the pronoun, $p < .05$. In sentences with a perception verb, the reflexive is processed slower than in sentences with a non-perception matrix verb. At the same time, the interpretation of the pronoun is faster when the sentence has a perception verb in the matrix predicate.

In summary, a perception verb negatively influences the application of Principle A, but has a facilitative effect on the application of Principle B. A perception verb is a confusing factor in sentence processing which affects processing complexity even at the end of the sentence, at the stage of interpretation decision-making.

A perception verb affects the type of anaphora whose linguistic properties are a direct manifestation of the preferred type of RC resolution. Making the interpretation of the reflexive more difficult can be interpreted as evidence that VerbType favors HA which needs to be suppressed in English. However, the results are not supported by the interaction with the Group factor which would mean a language-specific effect of a perception verb.

6.2.4 General Processing Complexity: Other Linguistic Factors

This section addresses the question of whether there are factors other than the matrix verb that influence processing complexity of the target sentence, RQ 1E. The analysis of the two monolingual groups of adult speakers of English and Russian also checks whether any of the processing results can be interpreted as evidence for either the top-down or bottom-up parsing, or for their combinatorial use. Table 6.5 summarizes the factors that influence the RT at the very end of the sentence, the wrap-up region (yard).

Table 6.5 R statistics for the RT of the wrap-up region (yard)

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	810.28	59.89	40.00	13.530	< 2e-16***
VerbType_factor1	20.84	42.50	120.00	0.490	0.625
AnaType_factor1	191.02	42.50	120.00	4.494	1.62e-05***
Group_factor1	110.99	119.77	40.00	0.927	0.360
VerbType_factor1:AnaType_factor1	23.77	85.00	120.00	0.280	0.780
VerbType_factor1:Group_factor1	44.81	85.00	120.00	0.527	0.599
AnaType_factor1:Group_factor1	-32.61	85.00	120.00	-0.384	0.702
VerbType_factor1:AnaType_factor1:Group_factor1	-238.09	170.01	120.00	-1.400	0.164
Signif. codes: 0 ‘*’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1**					

Table 6.5 shows a significant effect of AnaType which reminds us of the complex effect of AnaType and VerbType reported in the previous section. However, in this analysis AnaType appears as a significant simple effect, $p < .001$. Figure 6.9. shows effect of AnaType on the reading time at the wrap-up region (yard) in milliseconds. The simple effect of AnaType is given in Figure 6.8. It allows for several observations.

Figure 6.9 RT of the wrap-up region (yard): Effect of AnaType

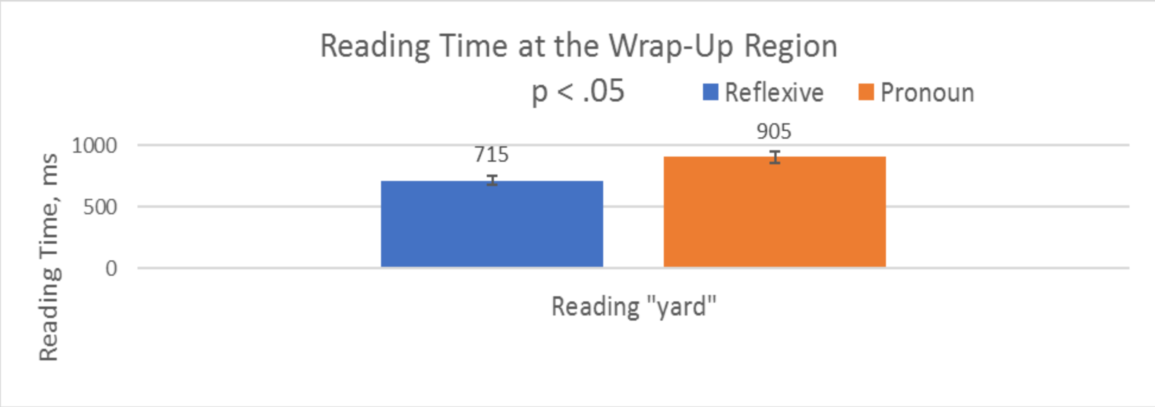
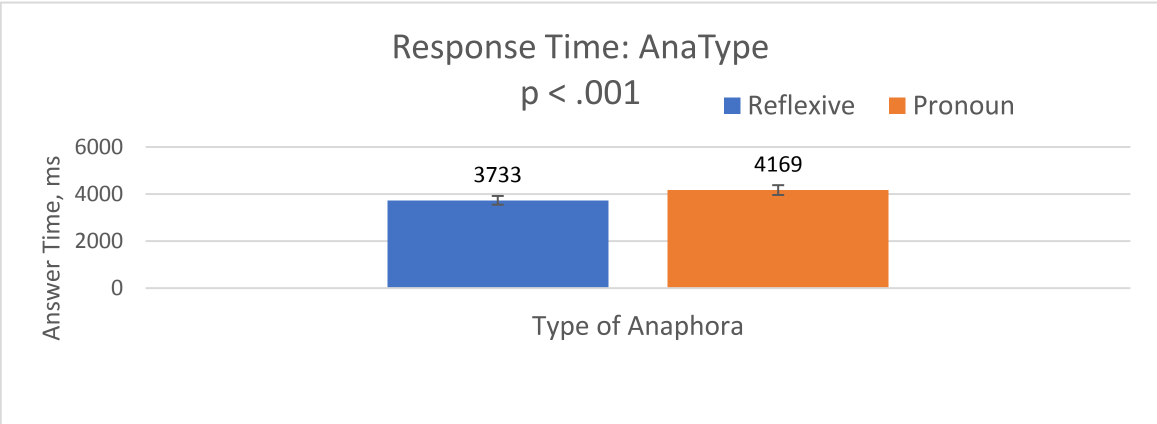


Figure 6.9 shows that the reflexive is processed much easier than the pronoun, $p < .05$. This effect is exhaustively explained by the binding complexity of the pronoun and its potential to look for an antecedent outside the target sentence (Chapter 3). The effect of the pronoun stays significant at the RespTime as well, $p < .001$ (Figure 6.10).

Figure 6.10 Response Time: Effect of AnaType



In both the RT at the wrap-up region *(yard)* (Figure 6.9) and in RespTime (Figure 6.10), pronouns are more difficult to process than reflexives. The processing effect of the pronoun becomes more interesting if we recall Figure 7 from the previous section.

Under the influence of a perception verb the processing effect becomes exactly the opposite, where the reflexive is difficult to process, and the pronoun is easy to process. In other words, a perception verb interferes with the natural effect of the AnaType. The linguistic complexity of the pronoun that is supposed to make it difficult to process is overridden by the effect of a perception verb. After a perception verb, native speakers of both English and Russian struggle with the resolution of the reflexive which is direct evidence of their confusion about RC attachment after a perception verb (Figure 6.7).

The variability in the RTs at the two types of the anaphora is influenced by a perception verb. The effect of the VerbType can only be explained by the application of the top-down algorithm in sentence parsing. The existence of structural anticipation in the target sentence is supported by the effect of the feminine pronoun *her* on sentence processing.

The analysis measures the RT of the region *(yard)* and the RespTime to check whether the longer RTs of this segment are caused by the feminine pronoun *her* in English. Longer RTs after the feminine pronoun *her* is an English-specific effect which supports the existence of a structural prediction in sentence processing.

The feminine pronoun *her* can trigger a structural anticipation for a possessive phrase *(talking about her______in the yard)* and slow down sentence processing at the level of the wrap-up region *(yard)*. Table 6.6 provides R statistics for the effect of the pronoun *her* (AnaPred) on the RT at the wrap-up region *(yard)*. Table 6.7 shows the effect of AnaPred on RespTime.

Table 6.6 R statistics of the RT of the wrap-up (yard): Effect of the feminine pronoun (her)

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	818.03	68.15	39.31	12.004	1.01e-14 ***
VerbType_factor1	18.43	50.73	81.74	0.363	0.7173
Group_factor1	150.36	135.14	46.66	1.113	0.2716
AnaPred_factor1	157.48	62.13	81.74	2.535	0.0132*
VerbType_factor1:Group_factor1	52.39	124.25	81.74	0.422	0.6744
VerbType_factor1:AnaPred_factor1	30.33	124.25	81.74	0.244	0.8078
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Table 6.7 R statistics for the response time: Effect of the feminine pronoun (her)

Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	4401.23	259.77	40.05	16.943	< 2e-16 ***
VerbType_factor1	149.05	159.60	81.76	0.934	0.353113
Group_factor1	77.68	508.14	45.09	0.153	0.879181
AnaPred_factor1	777.00	195.47	81.76	3.975	0.000151 ***
VerbType_factor1:Group_factor1	-198.09	390.95	81.76	-0.507	0.613730
VerbType_factor1:AnaPred_factor1	415.23	390.95	81.76	1.062	0.291320
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Both tables show that the effect of the feminine pronoun *her* is significant and makes sentence processing more difficult at the level of the wrap-up region, p <.05, and RespTime, p <.001. Figure

6.11 illustrates the RT of the wrap-up region *(yard)* after the feminine pronoun *her*. Figure 6.12 shows the effect of the feminine pronoun *her* on the RespTime

Figure 6.11 RT of the wrap-up region (yard): Effect of feminine pronoun (her)

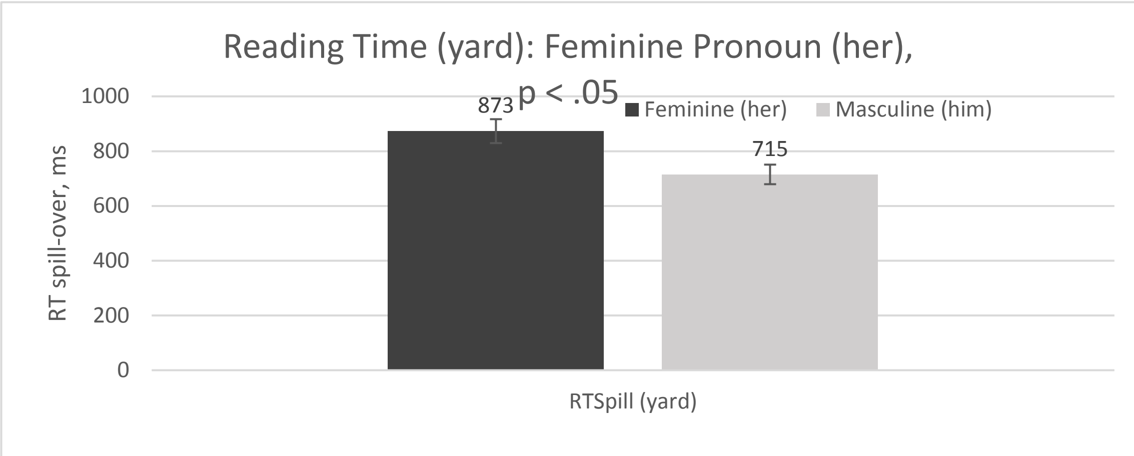
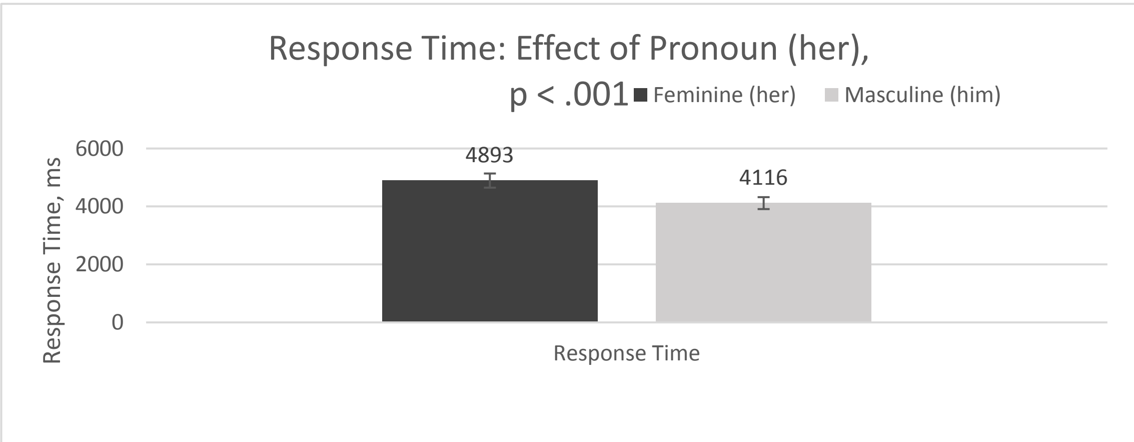


Figure 6.12 Response time: Effect of feminine pronoun (her)



Comparing the results in Figures 6.11-12, the feminine pronoun *her* slows down the RT at the wrap-up region for more than 150 ms. It means that the preposition *in* annuls the anticipated projection for a possessive phrase and the processing effect shows at the following word. At the wrap-up region *(yard)* the anticipated structure is fully rejected, and processing complexity increases.

On top of that, the effect of AnaPred does not die out when the sentence finishes. The feminine pronoun *her* makes sentence interpretation longer, (see the RespTime in Figure 6.12). The sentences with the feminine pronoun *her* require longer time for the participants to interpret than the sentences with the masculine pronoun *him*, $p < .001$. Summarizing the results in Figures 6.11 and 6.12, the feminine pronoun *her* creates additional processing difficulties that show in the increased RTs of the wrap-up region *(yard)* and prolonged RespTime.

The effect of the feminine pronoun supports the existence of the structural prediction in sentence parsing. Besides, it shows that structural prediction occurs at different levels of the syntactic tree, not just at the beginning of the sentence. The latter means that the parser is eager to generate a new structural anticipation as soon as it is done with the current one. In other words, there are stages in sentence parsing when the parser is done with one projection and triggers another one. These stages can be called processing cycles. To be ready to start a new projection the parser needs to close the previous one. This closure must be a bottom-up check for the complete grammatical fitness of the processed constituents.

6.3 Summary

The results in the previous section show that monolingual sentence processing follows all the linguistics assumptions for structural parse. Additionally, we find that top-down and bottom-up parsing algorithms complement each other. First, the top-down parsing creates a structural anticipation for the eventive and the entity complement to the matrix verb. The complex DP *[DP the mother of the woman]* is processed slower in English, where the parser closes the phrase for the entity complement, but the structural prediction for a SC-eventive complement has not been ruled out yet.

Second, the generated top-down structural prediction increases the processing load mid-sentence, where the parser abandons the SC anticipation in English in favor of the RC. The bottom-up check amends the erroneously generated projection and, as a result, the RC is attached high in Russian and low in English. A new top-down structural projection is the RC that ensures the pattern of anaphora resolution like herself = the mother // her = the woman in Russian and herself = the woman // her = the mother in English.

Putting together the results of the monolingual experiment, the dissertation argues for cyclicity in sentence parsing. A structural prediction generated top-down at the higher level in the syntactic tree is annulled in the middle of the sentence through a bottom-up check. After the structure has been amended the parser is ready to generate a new projection. The potential for a new structure-building shows in the effect of the feminine pronoun her at the end of the sentence in English.

Chapter 7 Results of Experiment 2: Intermediate L2 Speakers of English and Russian

7.1 Introduction

This chapter reports the results of the second experiment in the study. The experiment used the same methodology as Experiment 1 but investigated adult L2 speakers of English and Russian. There were two populations of L2 speakers: Russian-English and English-Russian. Every L2 speaking group was divided into two subgroups to be tested in their respective L2s and L1s (see section 5.3.2 for detail). All the participants did a self-paced reading study and were exposed to the same stimuli sentences as monolingual speakers of English and Russian in Experiment 1.

This chapter is organized in the following order. First, it reports the results addressing RQ 1 and analyses how sentence parsing is performed. The results are presented in two sets. First, all the L2 speakers are compared to each other, i.e. the participants' performance in the L1 is compared to their performance in the L2. In other words, the processing behavior of L2 participants in the L1 becomes a control condition for the processing behavior in the L2. Second, the results of L2 speakers tested in their L1s are compared to the monolingual results from the previous experiment. This comparison allows for establishing possible effects of the L2 on sentence processing in the native language.

The results of L2 speakers (section 7.2) are presented separately from the data comparing L2 speakers' performance to the monolingual groups (section 7.3). However, both sections follow the order of the subordinate questions (see Chapter 5). First, the results of anaphora resolution are reported (RQ 1.1-1.2 in sections 7.2.1. and 7.3.1 respectively). Then, both sections report the effect of VerbType on the RT at the embedded verb (RQ 1.3, sections 7.2.2 and 7.3.2) and the effect of a perception verb on the general complexity of the sentence (RQ 1.4, sections 7.2.3 and 7.3.3). Both sections finish with the general analysis of the processing complexity of the sentence (RQ 1.5, sections 7.2.4 and 7.3.4)

Even though processing results will provide some information on how the two languages in the mind of an intermediate L2 speaker may influence each other, the question is too big and requires a separate consideration. Therefore, RQ 2 is considered in a separate section in this chapter (section 7.4). RQ 2 addresses the question of the role of the L1 in L2 processing. Besides, it checks for any instances of L2-like behaviour in the intermediate speakers of English and Russian (7.3).

The presentation of results follows the order of the subordinate questions to RQ 2 (7.4). It begins with the general overview of the L1 instances in L2 processing and explains them as an expected reflection of a certain developmental stage in L2 proficiency (RQ 2.1). Then the section analyses the instances of L2-like behaviour in the L2 as well as possible beneficial effects on the knowledge of another language on processing in the L1 (RQ 2.2). The results are explained from the perspective of the developing L2 within the existing grammar.

The chapter finishes with a brief summary of results and describes how non-native sentence parsing unfolds. In conclusion, the instances of the L1- and L2-like instances of the participants' processing behavior are discussed. Please, notice that only significant findings are presented in the chapter. The non-significant results for all testing conditions are provided in the appendix.

7.2 Parsing algorithms in sentence processing

7.2.1 General pattern of anaphora resolution

This section addresses RQ 1.1-1.2 and reports the data on the preferred pattern of anaphora resolution in L2 speakers. The question under analysis differentiates between the two possible outcomes of the comprehension task. Anaphora resolution of the type *herself = the mother // her = the woma*n can be interpreted as evidence for top-down parsing if two conditions are observed. First, this pattern should be statistically significant in the analysis of the entire population of L2 speakers. Second, the preferred type of anaphora resolution should be caused by a perception verb, i.e. there should be statistical significance of the interaction VerbType*AnaType.

An alternative option for anaphora resolution is a language-specific pattern like *herself = the mother // her = the woman* in Russian and *herself = the woman // her = the mother* in English. There are two explanations for this type of anaphora resolution. First, a language-specific pattern speaks for bottom-up parsing, where the matrix predicate has no effect on sentence processing. Second, a Russian-like pattern of anaphora resolution in the L2-Russian and an English-like pattern in the L2-English would mean processing the non-native sentences is performed in the TL-like manner.

The analysis establishes the preferred pattern of anaphora resolution through the answer choices (Nchoice) to comprehension tasks that were recorded in Linger. Table 7.1 shows R-statistics of the significant factors that influence Nchoice. The data are analyzed and presented with **higher NP choice as the reference category**.

Table 7.1 R-statistics for Nchoices: AnaType, VerbType, Group, Language and GroupNL

Mixed Linear Model: model.english = lmer(PctNoun1 ~ GroupNL_factor*VerbType_factor*AnaType_factor*Language_factor + (1 | Participant) + (1|Item), data = Biling_only, REML = FALSE)	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	0.509245	0.015773	80.000000	32.285	< 2e-16 ***
Language_factor1	0.180208	0.044613	80.000000	4.039	0.000122***
GroupNL_factor1	-0.087760	0.031546	80.000000	-2.782	0.006737**
AnaType_factor1:Language_factor1	-0.461706	0.063827	240.000000	-7.234	6.28e-12 ***
AnaType_factor1:Group_factor1	-0.430853	0.071360	240.000000	-6.038	5.90e-09***
AnaType_factor1:Group_factor2	0.317956	0.063827	240.000000	4.982	1.21e-06 ***
GroupNL_factor1:AnaType_factor1	0.294916	0.045132	240.000000	6.534	3.79e-10***
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Binomial Distribution: model.english = glmer(Interpretation ~ VerbType_factor*AnaType_factor*Lang_factor*NL_factor + (1 |Participant) + (1|Item), data = Biling_only, family = "binomial")	Estimate	Std Error	z-value	Pr(>|t|)
Lang_factor1	0.42137	0.14112	2.986	0.00283 **
NL_factor1	-0.40308	0.14113	-2.856	0.00429 **
AnaType_factor1:Lang_factor1	-0.77048	0.16841	-4.575	4.77e-06***
AnaType_factor1:Lang_factor1	-0.77048	0.16841	7.846	4.30e-15***
Lang_factor1:NL_factor1	0.61357	0.28227	2.174	0.02973*
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**				
Random effects:				

Groups	Name	Variance	Std.Dev
Participant	(Intercept)	0.0128905	0.11354
Item	(Intercept)	0.0009092	0.03015
Residual		0.2232596	0.47250
Number of obs: 2558, groups: Participant, 80; Item, 32			

In the statistical analysis in Table 7.1, the Nchoice is influenced by the Language of testing and the native language of the participants. There is no significant effect of the VerbType on anaphora resolution in the population of L2 speakers. The latter means anaphora resolution does not depend on the type of the matrix predicate. The analysis comments on the statistically significant factors.

Table 7.1. shows several simple effects that influence Nchoice in a significant way. For the reasons stated in section 6.2 in the monolingual analysis, simple effects may not be informative for the study, even when they reach statistical significance. The analysis should take into account the complex nature of the anaphora itself. It is not enough to get general information of whether the higher or the lower DP is preferred more often. The analysis should make it clear whether both types of anaphora are co-referent with the same DP or whether the reflexive and the pronoun are co-referent with different DPs in accordance with the type of RC resolution (Chapter 3).

The information confirming that anaphora resolution is not performed at random but follows linguistic constraints and presents a certain pattern comes from a significant effect of AnaType. AnaType means the reflexive is interpreted differently from the pronoun. In the current analysis, AnaType is only significant in interactions with other factors such as GroupNL or Language. The absence of an overall pattern of anaphora resolution like *herself = the mother // her = the woman* together with the absence of any effect of the VerbType on Nchoice speak against top-down parsing in the population of L2 speakers of Russian and English.

Summarizing the argument above, a clear understanding of how participants that know more than one language interpret the anaphora can be obtained from the analysis of significant interactions of the main factors with the factor AnaType. These factors are Language, Group or GroupNL. These three factors add to each other and provide a detailed analysis of anaphora resolution in the bilingual groups.

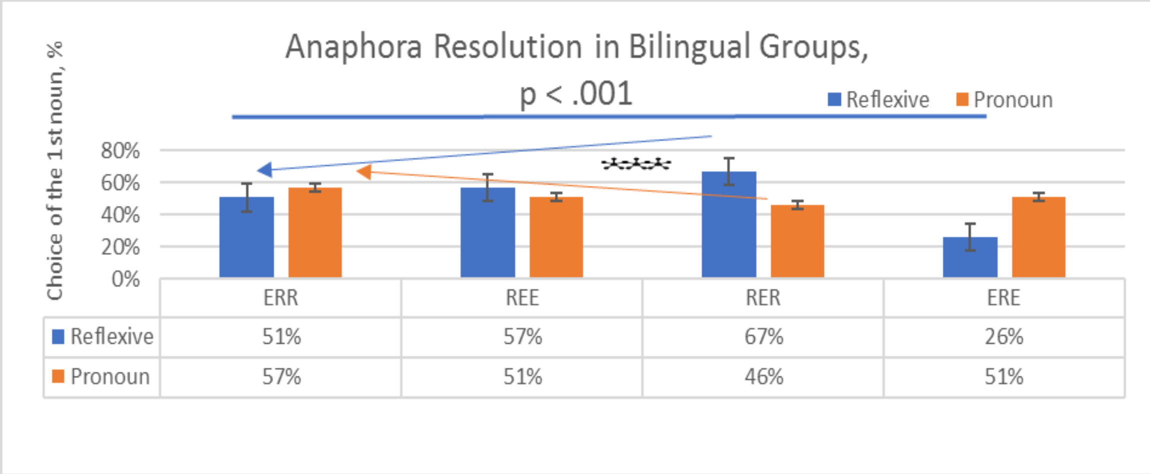
In the current analysis, a multilevel Group factor can be difficult to interpret as the model runs the following comparisons: 1) ERE vs ERR+REE+RER; 2) ERE+ERR vs REE+RER; 3) ERE+ERR+REE vs. RER. For a clearer analysis and for the sake of accuracy, two main factors Language (of testing) and GroupNL (native language of the participants) will replace the traditional analysis by Group.

The factor Language compares the participants by the language they were tested in. For example, L2 speakers of Russian tested in Russian (ERR) are joined together with the bilingual participants tested in their native language – Russian (RER). These two groups are then compared to the other two groups: L2 speakers of English tested in English (REE) and native speakers of English tested in their L1 (ERE). The Language factor joins together L2 and L1 speakers of a given language.

The factor GroupNL compares the participants by their native language. ERR and ERE are grouped together, because they share the same L1 – English. They are compared to the groups RER and REE, whose native language is Russian. An overview of the main factors above explains how they complement each other and co-inform the general conclusion on the preferred type of anaphora resolution.

The significant interactions in Table 7.1 above (AnaType*Group, AnaType*GroupNL and AnaType*Language) means that the two types of anaphora are interpreted differently by different groups of participants, $p < .001$. Consequently, the two types of anaphora are interpreted differently in English and Russian. Figure 1 shows the Group effect for anaphora resolution.

Figure 7.1 Anaphora resolution: effect of AnaType*Group



The differences in anaphora resolution are significant, p < .001, despite the fact that the overall pattern in ERR and ERE is similar, the purple bar is lower than the orange bar. The patterns in REE and RER are similar too, the orange bar is lower than the purple bar. This effect requires an extended explanation.

To begin with, the combination *'purple bar higher, orange bar lower'* corresponds to the pattern *herself = the mother // her = the woman* which is a Russian-like pattern of anaphora resolution (see section 6.2 for clarifications). The combination of *'orange bar higher, purple bar lower'* corresponds to the type of anaphora resolution *herself = the woman // her = the mother* which was defined as the English-like one in Chapter 3. Therefore, Figure 7.1 shows two language-specific types of anaphora resolution in L2 speakers.

The two groups on the left in Figure 7.1 are the bilingual groups tasted in their non-native languages, L2s. The two groups on the right are the L2 speakers' groups tested in their respective L1s. Groups **E**R**E** and **R**E**R** are native speakers of English and Russian, who were tested in their native languages. Groups E**RR** and R**EE** are the L2 speakers of English and Russian who were tested in their non-native languages.

The difference between the groups tested in the L1s and the groups tested in the L2s is significant. Statistical significance between the performance in the L1 and the L2 is normally understood as the case where the two groups tested in the L1s would show their respective language-specific patterns of anaphora resolution, and the two groups tested in the L2 would interpret the anaphora in the manner of their respective L2s. However, anaphora resolution in REE patterns with the results in RER and shows a Russian-like interpretation preference. In the same fashion, the results in ERR pattern with the comprehension choices in ERE and show the

English-like pattern of anaphora resolution. In other words, the participants with the same L1s show the same L1-like general patterns of anaphora resolution in either their respective L1 or L2.

In what follows, L2 speakers at the intermediate level of L2 proficiency show native language (NL) patterns of anaphora resolution. It explains the significance of the Group effect and the GroupNL (native language of the group) effect in the interactions with the AnaType. All the participants whose native language is English prefer English-like pattern of anaphora resolution. All the participants whose L1 is Russian interpret the anaphora in a Russian-like pattern. There is no difference whether L2 speakers are tested in the L1 or the L2. However, the difference between the participants tested in the L1s and the L2s remains significant. Let's consider the results of anaphora resolution in detail.

The group ERE shows a very low preference for the higher DP in reflexive resolution (26%) but a high preference for it in pronoun resolution (51%). It means the lower DP is preferred for reflexives (100% – 26% = 74%) and the higher DP – for pronouns in this group. The group RER shows a mirror image pattern, where the reflexive is bound by the higher DP (67%) and the pronoun by the lower DP (100% – 46% = 54%). In other words, the RER participants prefer the pattern *'herself = the mother // her = the woman'* in their native language – Russian, and the ERE participants prefer the pattern *'herself = the woman // her = the mother'* in their native language – English. The two groups of L2 speakers (L2ers) tested in their respective L1s (ERE and RER) form a baseline for the analysis of the results in the two bilingual groups tested in their L2s (ERR and REE).

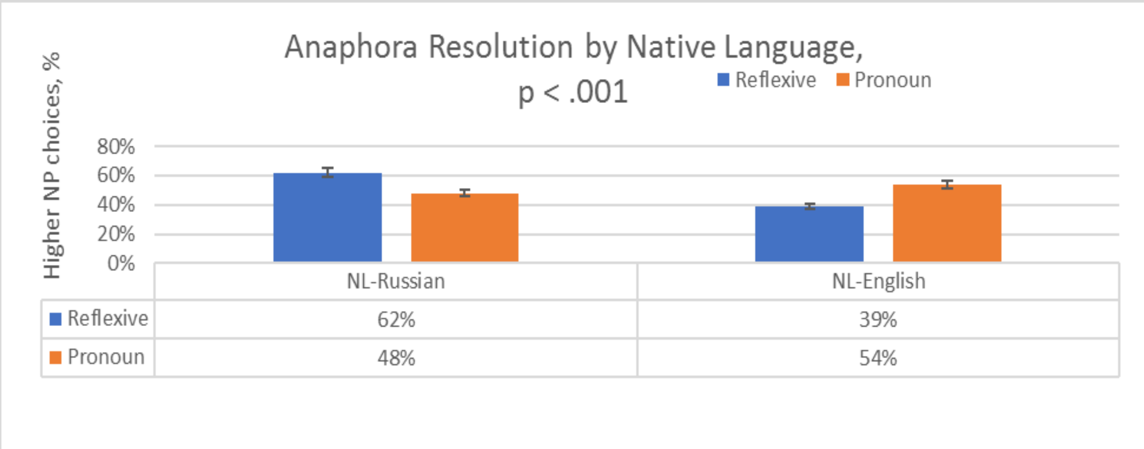
The L2ers who are tested in their respective L2s (ERR and REE) stay within their L1-like preference. Neither ERR nor REE switch to the L2-like pattern of anaphora resolution. On the contrary, the REE group preserves their L1-like pattern of anaphora resolution and chooses the higher DP 57% of time for reflexives and 51% of the time for pronouns. The ERR group also stays within the L1-like pattern for anaphora resolution, the higher DP is preferred less for the reflexive (51%) and more for the pronoun (57%).

The statistical difference between the L2ers tested in the L1 and the L2 comes from the change in the amount of preferred DP choices in every condition. For example, if the REE group is compared to the RER group, the preference for the higher DP in reflexives is going down, whereas the preference for the higher DP in pronouns is going up. This change demonstrates a tendency to switch to the English-like pattern of anaphora resolution in English. The tendency is marked by the arrows on Figure 7.1. There is a similar tendency in the ERR group, the DP preference is noticeably changing in the reflexive condition.

To sum up, L2 speakers show a Group effect in anaphora resolution. The interaction Group*AnaType means different types of anaphora are interpreted differently *'reflexive ≠ pronoun'* and the preference for a certain patterns of anaphora resolution depends on the native language of the participants. There are two language-specific patterns of anaphora resolution *'herself = the mother // her = the woman'* in Russian and *'herself = the woman // her = the mother'* in English. The L2ers tested in the L2 do not overcome the L1-like threshold in anaphora resolution but there is a tendency to switch to the TL-like preferences in anaphora resolution in the L2. Hypothetically, this can happen with growth in L2 proficiency.

The obtained results are specified by the analysis of the factors Language (of testing) and GroupNL. Figure 7.2 shows the effect of GroupNL of anaphora resolution and Figure 7.3 illustrates the effect of the Language (of testing).

Figure 7.2 Anaphora resolution: effect of AnaType*GroupNL



The significance of the Group NL factor confirms the results above. There is an L1-like pattern of anaphora resolution at (low) intermediate level of proficiency in the L2. However, the Language (of testing) in Figure 7.3 is also a significant factor for anaphora resolution. It is important to notice that the factor Language groups the participants by the language of testing, not by their native language, i.e. English as an L1 or L2 are one group for this statistical analysis and L1- or L2-Russian is another group in the analysis by Language.

Figure 7.3 Anaphora resolution: effect of AnaType*Language

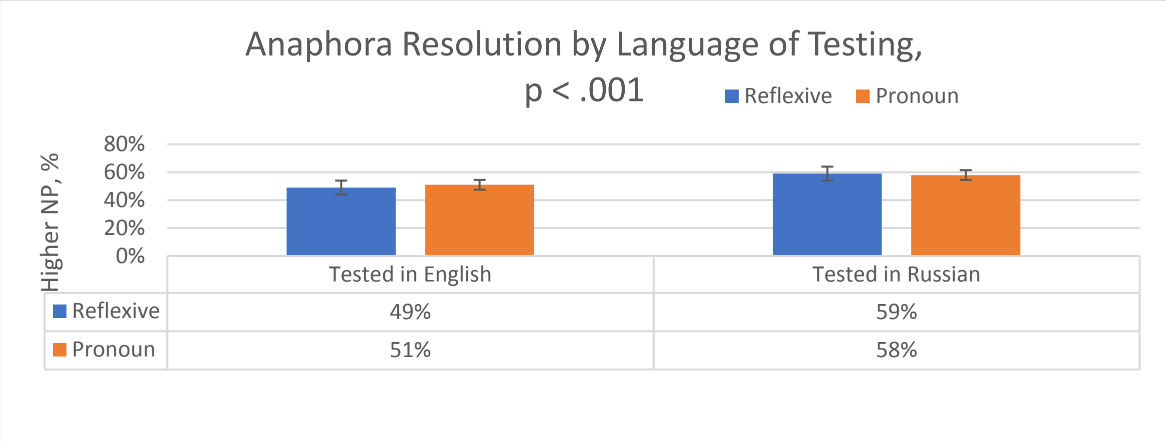


Figure 7.3 shows the results of L2 speakers as "Tested in English" and "Tested in Russian". It is very noticeable that DP choices in the graphs are very close to each other, 49% vs. 51% for "Tested in English" and 59% vs 58% for "Tested in Russian". The data clearly show that the significance of the contrast is based on the reverse pattern on the preferred choices, *'purple lower than orange'* in "Tested in English" and *'purple higher than orange'* in "tested in Russian". However, both graphs include L2 speakers tested in the L2 and this inclusion shows overall TL-like preference in anaphora resolution. In other words, in the analysis by Language (of testing) L2 speakers of Russian and English cross the L1-like threshold, though with a tiny margin.

The findings in this section show that L2 speakers preserve their L1-like preference for anaphora resolution in the L2. However, there is a difference between how L2ers perform in their L1s and in their L2s. This difference is always towards the target-like pattern in the L2. Even though the threshold of L1-like performance has not been overridden yet, there is a potential for L2 speakers to show TL-like preferences for anaphora resolution the growth of L2 proficiency (a more detailed analysis is provided in Section 7.3.1.1 below).

The results of L1-like parsing in the L2 make an implication to the section where the influences of the knowledge of another language on sentence parsing will be discussed. The current analysis is focused on the investigation of parsing algorithms that underlie sentence processing. The hypothesis for a top-down structural prediction expected to see an overall preference for anaphora resolution like *her = the mother // herself = the woman* that would result from the effect of the matrix predicate. This assumption is not confirmed by the results in anaphora resolution reported in this section.

Irrespective of what language-specific pattern of anaphora resolution the L2ers prefer, their answers manifest development towards either English-like or Russian-like preference. Following our theoretical predictions, a language-specific preference in the comprehension task is a manifestation of bottom-up parsing. A perception verb does not shape anaphora resolution because it had no predictive power in the bottom-up algorithm. The analysis of anaphora resolution shows no evidence of unidirectional top-down structure building in the population of L2ers.

7.2.2 Reading times at the embedded verb

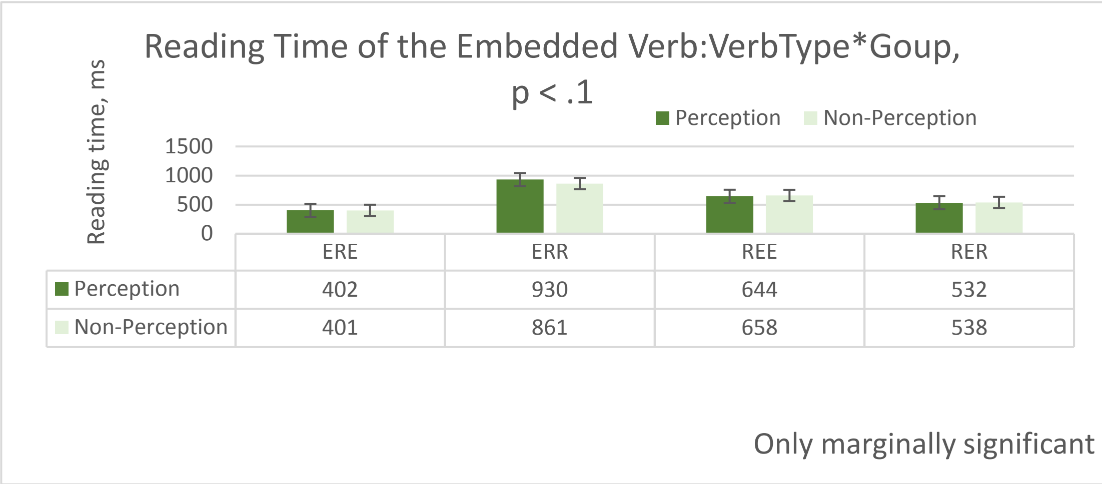
This section addresses RQ 1C and checks for the effect of a perception verb on the RT at the embedded verb in English. Having the effect of the VerbType is an expected evidence for the top-down structural prediction for an eventive complement. The increased RT means the top-down prediction was generated after the parser encountered the matrix verb. However, it entered structural competition with the restrictive RC after the complementizer was encountered. The structural need to amend the eventive projection to the RC increases processing load a bit later than the critical region that, so the RT slowdown occurs at the embedded verb talking in English. In Russian the structural anticipation for an eventive complement is not expected to influence sentence processing much (see Chapter 5). Table 7.2 shows VerbType effect on the regions around the embedded verb talking.

Table 7.2 R statistics for the significant effects of the VerbType

RT of the complementizer *that*					
Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	706.12	25.06	80.00	28.180	< 2e-16***
VerbType_factor1	-53.52	24.55	80.00	-2.180	0.03222*
VerbType_factor1:Group_factor1	239.01	98.21	80.00	2.434	0.01717*
RT of the embedded verb *talking*					
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	621.752	17.051	80.000	36.464	< 2e-16***
VerbType_factor1:Group_factor1	-76.138	46.034	240.000	-1.654	0.0994 **.**
Signif. codes: 0 ‘*’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1**					

As can be gathered from Table 7.2, a perception verb in the matrix clause influences the embedded verb *talking* as well as the complementizer *that* before the verb. The effect of a perception verb is a significant simple effect for the RT at the complementizer. It also comes out significant in the interaction with Group NL, $p < .05$, which affects the RT at the complementizer. VerbType effect appears in a marginally significant interaction VerbType*Group, $p < .1$, for the RT at the embedded verb. Figure 7.4 shows the VerbType effect on the RT at the embedded verb.

Figure 7.4 RT of the embedded verb: effect of VerbType*Group



A perception verb in the matrix clause is expected to slow down the RT at the embedded verb in English (Chapter 4). This effect shows in a group of native speakers of English, ERR. However, they slow down at the embedded verb in their non-native Russian, the language whose parsing is not supposed to be influenced by a perception verb.

The strongest effect of a perception verb is supposed to show in the group ERE. However, Figure 10 shows the same RTs at the embedded verb in the perception and the non-perception condition. This unexpected result will be explained later in this section through a comparison of the RT at the complementizer and at the embedded verb.

The results in groups REE and RER goes in line with the linguistic predictions for sentence parsing (Chapters 4 and 5). Native speakers of Russian do not slow down at the level of the embedded verb. In Russian, the complementizer is not the point of a structural conflict. The eventive projection is disregarded much earlier in the sentence (Chapter 4). Therefore, a perception verb is not expected to make sentence processing more complex at the embedded verb.

A slowdown at the embedded verb is a characteristic of English-like parsing behavior. The fact that native speakers of English show it in their L2-Russian is interpreted as evidence for the L1-governed processing in the L2. The fact that native speakers of Russian do not slow down at the embedded verb in their L2-English also demonstrates their L1-like parsing behavior in the L2. A strong L1 effect in the L2 is typical for this stage of L2 acquisition.

The picture of sentence parsing becomes more complete when the analysis of the VerbType effect on the RT at the complementizer is added. The significance of a perception verb is shown in

Table 7.2. Figure 7.5 shows a simple effect of the VerbType, $p < .05$. Figure 7.6 shows VerbType effect in interaction with Group, $p < .05$.

Figure 7.5 RT at the complementizer: effect of VerbType

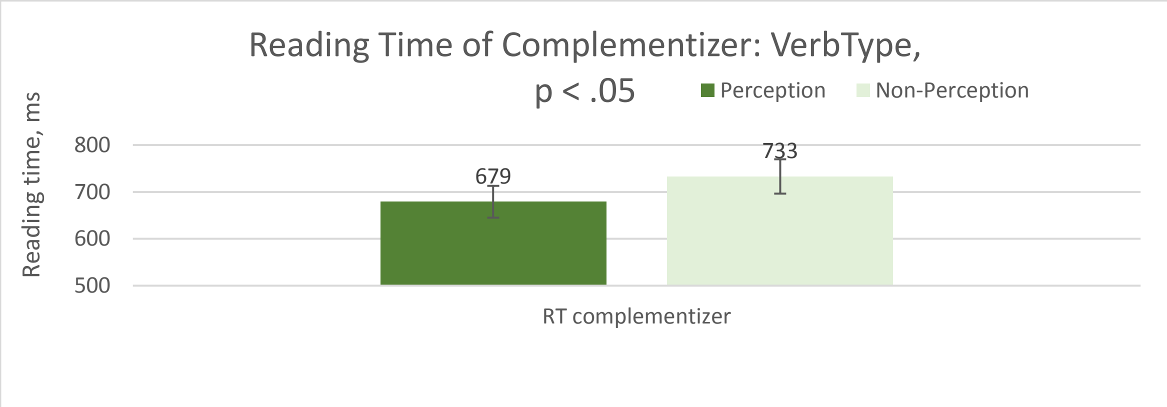
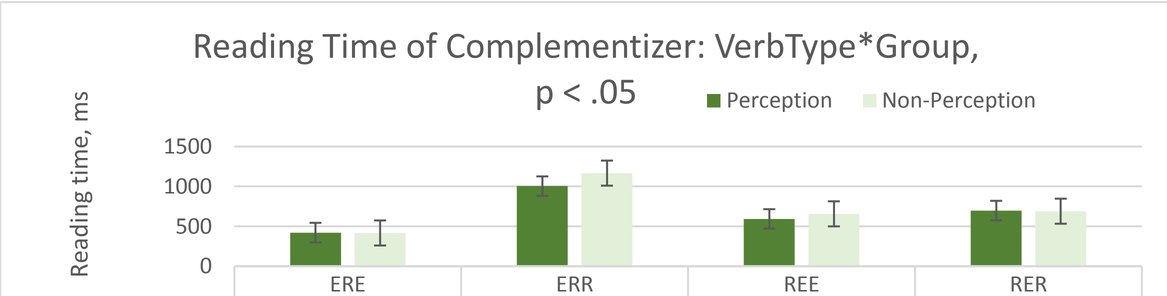


Figure 7.6 RT at the complementizer effect of VerbType*Group



	ERE	ERR	REE	RER
Perception	422	1004	593	698
Non-Perception	417	1167	657	690

Figure 7.5 shows a general facilitative effect of a perception verb on the RT at the complementizer. The complementizer *that* is read faster after a perception verb. This effect suggests that L2 speakers do not struggle with sentence processing up to the moment they are reading the complementizer. Therefore, if a perception verb triggers any structural prediction at the beginning of the sentence, it is very easy to parse, and the participants are not hindered at any point.

The effect of a perception verb at the complementizer is presented in detail in Figure 7.6. The interaction VerbType*Group means a perception verb influences the four experimental groups differently. In Figure 7.6, L2 speakers tested in their L2s (ERR and REE) benefit from the effect of a perception verb more than the groups tested in their L1s (ERE and RER). The participants tested in the L2 read the complementizer faster after a perception verb. This means a perception verb neutralizes processing complexity across the two languages of the L2 speakers. This effect can mean co-activation of both languages when the L2ers are tested in their non-native language.

It is important to mention that group ERE do not benefit from the effect of a perception verb. On the contrary, a perception verb increases processing load in their native language English, and they react to the effect of the VerbType right away. The group ERE slow down to 422 ms. at the complementizer (Figure 7.6) and regain their reading speed to the 402 ms. at the embedded verb (Figure 7.4). In other words, they change from *slower after a perception verb* at the complementizer to *equally fast in both experimental conditions* at the embedded verb.

The effect of a perception verb on group ERE is comparable to its effect on group ERR in the way predicted by Dekydtspotter et al. (2006) (Chapter 2). The paper warned against direct comparisons between native and non-native processing as native speakers may show sensitivity to a linguistic condition earlier than non-native speakers. In this case, a segment by segment comparison between native and non-native processing would fall into the trap of comparative fallacy. At this point, our analysis shows slower reading times at the complementizer and the embedded verb after a perception verb in the groups of native speakers of English. However, a perception verb influences the participants tested in their L1-English earlier – at the complementizer – than the native speakers of English tested in the L2. The latter show L1-like sensitivity to a perception verb later and slow down their RT at the embedded verb.

In summary, a perception verb facilitates faster RTs at the complementizer, and the effect is more pronounced in non-native processing than in the L1. As predicted by the top-down structure-building, the complementizer signals the up-coming RC and creates a structural conflict with the existing eventive projection. In English, a previously generated projection for an eventive complement is abandoned and in English-like parsing the complementizer *that* causes a processing difficulty, or an increase in the RT at the embedded verb.

The results of the RT at the embedded verb in Figure 7.4 are marginally significant. However, if compared to the results in Figures 7.5 and 7.6, they allow for a clear observation of how different groups of participants cope with the processing complexity of the sentence. Native speakers of English tested in their L1 show sensitivity to the effect of a perception verb at the complementizer. Native speakers of English tested in their L2 read the complementizer faster after a perception verb, but the sentence regains its processing complexity at the level of the embedded verb. Native speakers of English show L1-like sensitivity to a perception verb in their L2-Russian.

A perception verb affects native speakers of English in the way predicted by the main linguistic approaches (Chapters 3 and 4). It increases processing load around the embedded verb (Figure 7.6 – group ERE; Figure 7.4 – group ERR). This increase in processing load signals top-down structural prediction that is disregarded after the parser encounters the complementizer *that* in English. A perception verb is not expected to influence processing in Russian much.

The results provided in this section show that there is an effect of a perception verb on sentence processing at the level of the embedded verb. A perception verb influences native speakers of English who preserve this effect in their L1 and L2. Native speakers of Russian, on the contrary are not sensitive to the effect of a perception verb in either of their languages. The latter is interpreted as evidence for L1-governed parsing in the L2.

7.2.3 7.2.3 General processing complexity: effect of a perception verb

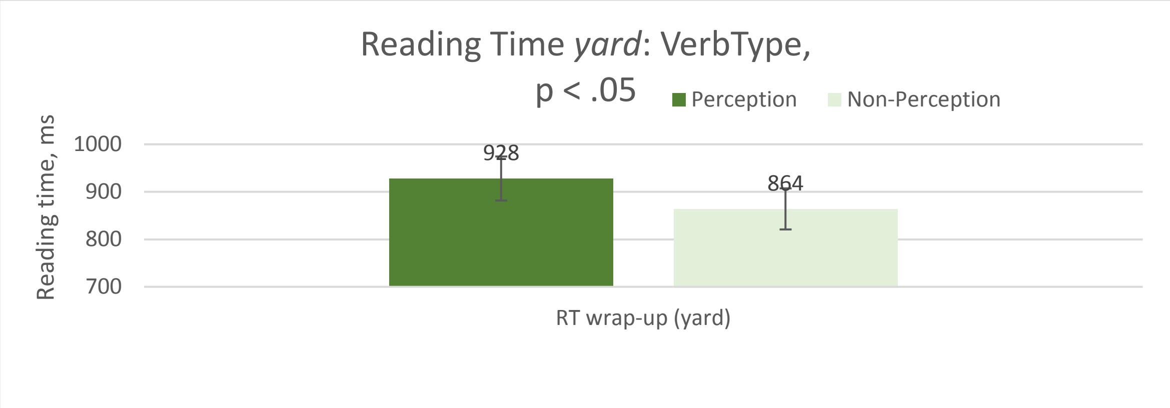
This section examines the effect of a perception verb on general processing complexity of the target sentence (RQ 1D). The main processing assumption expects sentences with a perception verb to be more difficult to process in English than in Russian. The accumulated effect of the overridden structural anticipation in the middle of the sentence can last till the end of the sentence. The analysis expects to see effects of the VerbType at the wrap-up region (yard) and in RespTime. Table 7.3 shows VerbType effect on the wrap-up region. There is no effect of the matrix verb on RespTime, or the time taken to answer a comprehension question.

Table 7.3 R statistics effect of VerbType on general processing complexity.

RT of the wrap-up region *yard*					
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	889.280	62.903	79.390	14.137	<2e-16***
VerbType_factor1	77.480	39.287	320.096	1.972	0.0495*
VerbType_factor1:Language_factor1	-295.44	105.48	240.00	-2.801	0.00551**
VerbType_factor1:GroupNL_factor1	204.21	101.15	320.10	2.019	0.0443*
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

The R-statistics in Table 7.3 above shows that VerbType significantly influences the RT of the wrap-up region *yard*. The effect of the matrix verb also shows in interaction with the factors Language and GroupNL. Figure 7.7 provides a chart for the effect of a perception verb on the reading time of the wrap-up region *yard*.

Figure 7.7 RT of the wrap-up (yard): effect of VerbType

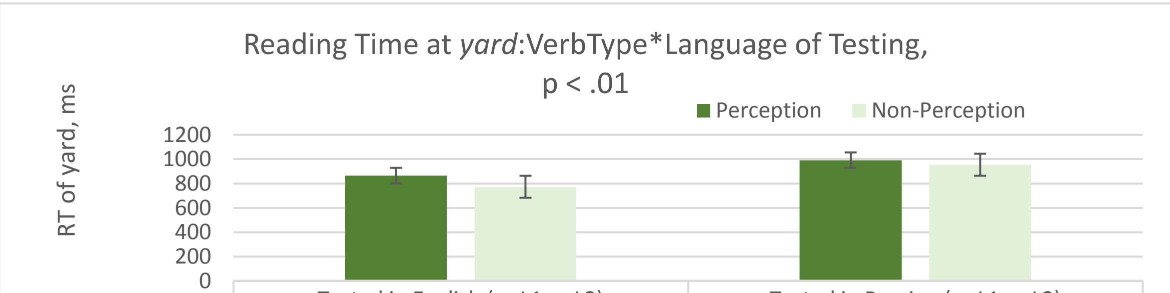


In Figure 7.7, the last word in the sentence is read slower in the sentences with a perception verb in the matrix predicate, $p < .05$. A processing effect of the matrix verb is a sign of top-down prediction which manifests itself differently in English and Russian. The effect of the matrix verb is not supported by the interaction with the Group factor. However, the significant interactions VerbType*Language, $p < .01$, and VerbType*GroupNL, $p < .05$, are worth considering.

The significance of the interactions VerbType*Language and VerbType*GroupNL indicates that a perception verb can have a different effect on sentence parsing depending on the language of testing and the native language of the participants.

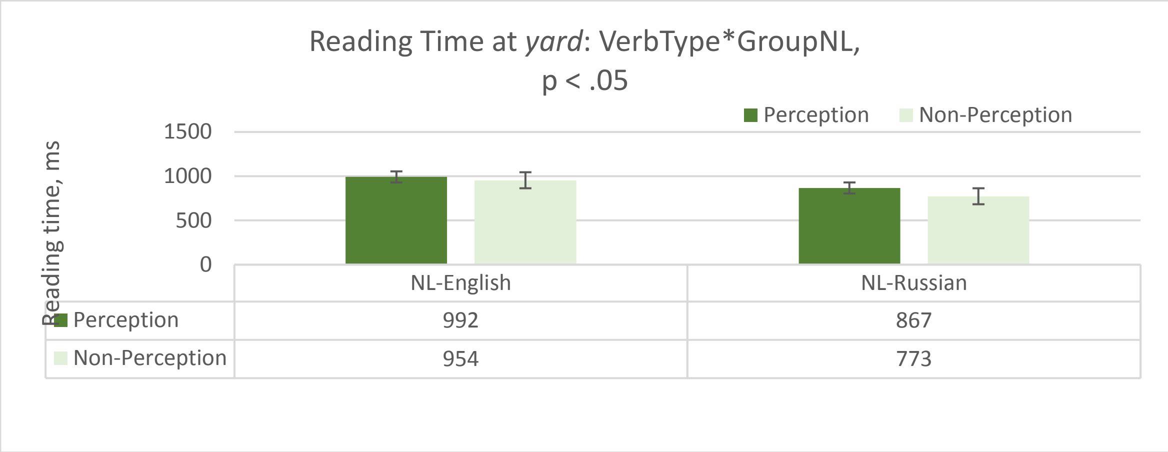
Figures 7.8 and 7.9 below show the effect of the VerbType on the reading time of the wrap-up region *yard* by the language of testing (Figure 7.8) and by the native language (Figure 7.9).

Figure 7.8 RT of the wrap-up region: effect of VerbType*Language.



	Tested in English (as L1 or L2)	Tested in Russian (as L1 or L2)
Perception	865	992
Non-Perception	773	954

Figure 7.9 RT of the spill-over (yard): effect of VerbType*GroupNL



At first glance, Figures 7.8 and 7.9 are mirror images of each other. However, is it also noticeable that effect of a perception verb is stronger in “Tested in English” (Figure 7.8) and in “NL-Russian” (Figure 7.9) than in their respective second subgroups. To have an effect of a perception verb in English goes in line with the linguistic predictions for sentence parsing, whereas, having the same effect in Russian goes against the predictions of the dissertation. Meanwhile, Figure 7.9 shows that native speakers of Russian struggle with the effect of a perception verb more than native speakers of English. The explanation can be obtained from the comparative analyses of the results in Figure 7.8 and Figure 7.9.

The graphs for “Tested in English” in Figure 7.8 show the results of L2 speakers of English (REE) together with the speakers of English as the L1 (ERE). Both native and non-native speakers of English are sensitive to the effect of a perception verb at the end of the sentence. Then the same sensitivity is transferred to the subgroup “NL-Russian” in Figure 7.9. At a closer look, non-native speakers of English, group REE, are native speakers of Russian as well. So, the same participants are included into the subgroup “Tested in English” in Figure 7.8 and the subgroup “NL-Russian” in Figure 7.9. Therefore, the effect of a perception verb that influences the group REE (Figure 7.8) is transferred to the grouping “NL-Russian” in the analysis by GroupNL in Figure 7.9.

The effect of a perception verb in the population tested in English speaks for the learners’ sensitivity to the English-specific phenomenon in their L2. The fact that this effect is transferred into the analysis by native language serves as additional evidence that the L2ers are developing their parsing towards processing in the TL-like manner.

To summarize the effects of a perception verb on sentence complexity, a slight increase in the processing time at the embedded verb in English is followed by significantly longer RTs at the wrap-up region *yard*. Such results support the findings that L2ers are sensitive to the language specific effects in their L2s. Unlike previous findings, the L2 speakers of English behave English-like in processing of the wrap-up region *yard*, which shows in their sensitivity to the language-specific linguistic phenomena in their non-native language.

Moreover, the effect of a perception verb is stronger in English than in Russian which is explained by the linguistic nature of the target phenomenon (Chapter 5). Sensitivity to the effect of a perception verb is anticipated behavior in a top-down parsing algorithm

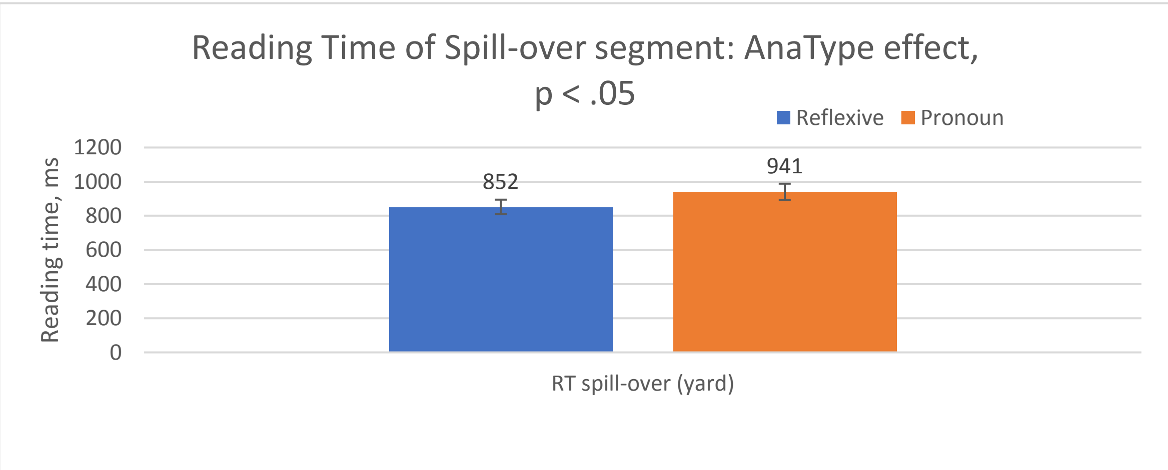
7.2.4 General processing complexity: other factors

To provide a full account of sentence processing, the analysis checks what factors other than a perception verb may influence general complexity of sentence processing (RQ 1E). The statistical analysis measures the effect of AnaType, AnaPred, Group, Language and GroupNL on the RTs at the wrap-up region (yard) and the RespTime. Table 7.4 shows R-statistics for the effect of the AnaType factor on the RT at the wrap-up region (yard). It is the only significant factor. Figure 7.10 provides a graph for the AnaType effect.

Table 7.4. R-statistics for the RT of the spill-over (yard): AnaType effect.

Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	889.280	62.903	79.390	14.137	< 2e-16 ***
AnaType_factor1	100.642	44.094	320.096	2.282	0.0231*
Signif. codes: 0 ‘*’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1**					

Figure 7.10 RT of the spill-over (yard): AnaType effect



As becomes evident from Table 7.4 and Figure 7.10, pronouns are more difficult to process than reflexives for the entire population of L2 speakers. This processing difficulty is caused by the linguistic complexity of the pronoun that influences the entire sentence. The analysis does not show any significant interaction AnaType*Group, which means the pronoun has the same effect in English and Russian, irrespectively of whether it is a native and a non-native language of the participants.

The pronoun is read slower at the wrap-up region *(yard)* than the reflexive (Figure 7.10). The pronoun preserves its effect on the later region, i.e. on the time of the final sentence interpretation. In Table 7.5, the Resp Time is influenced by two factors AnaType and AnaPred. Besides, there is a significant interaction between AnaType and Group (Table 7.5). This effect was not observed at the earlier region *(yard)*.

Table 7.5 R-statistics for RespTime by factors AnaType and AnaPred

Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	3953.66	155.61	80.00	25.407	< 2e-16 ***
AnaType_factor1	439.57	99.01	240.00	4.440	1.38e-05***
AnaPred_factor1	602.28	164.98	160.78	3.651	0.000353***
AnaType_factor1:Group_factor1	1581.51	396.05	240.00	3.993	8.67e-05***
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

The statistical analysis shows that there is a difference between the processing of the pronoun and the reflexive and, within the category pronoun, between the feminine and the masculine pronoun in English. These effects are presented one after another.

Figure 7.11 shows the effect of the AnaType on RespTime. Figure 7.12 shows the interaction AnaType*Group.

Figure 7.11 Response Time: effect of AnaType

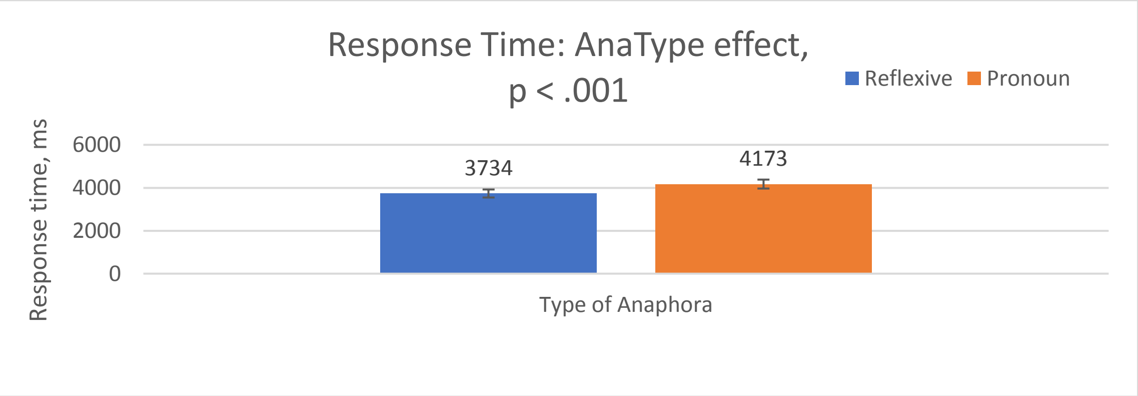
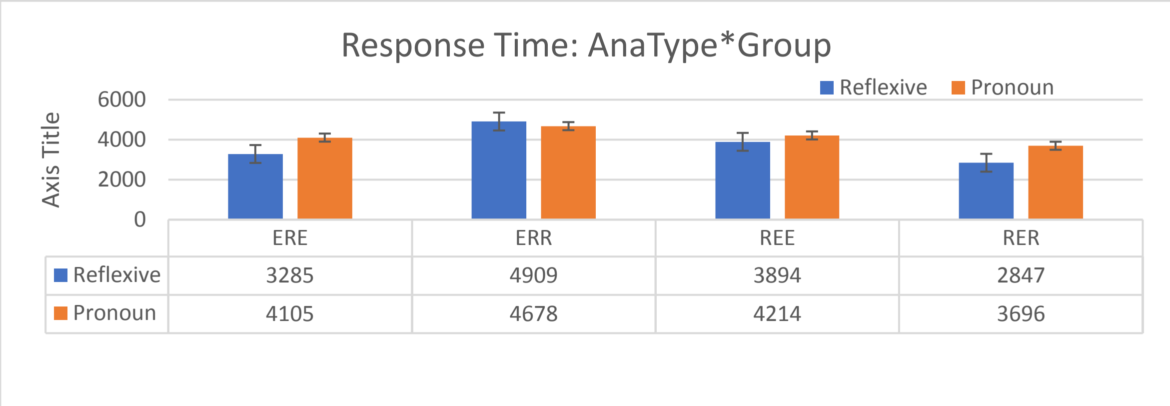


Figure 7.12 Response Time: effect of AnaType*Group



The general pattern of the RespTime at the anaphora in Figure 7.11 corresponds to the results in Figure 7.10 for the RT at the wrap-up region. Sentences with pronouns require more time when the participants answer a comprehension question than the sentences with the reflexive.

The general complexity of the pronoun can be explained by its ability have multiple antecedents within a sentence and its potential to be co-reference with the matrix subject (Kenninson 2003). Besides, the pronoun can have discourse antecedents outside a given sentence, so it is potentially ambiguous while the reflexive is not. In the experimental task, a comprehension check restricts all the co-reference options for the pronoun to a certain DP because it only offers two answer choices (see Chapters 3 and 4). To process the pronominal element, the parser may performan co-reference checks with, for example, the matrix subject and the following need to disregard the irrelevant antecedents explains longer RespTime in pronoun interpretation than in answering comprehension questions for the reflexive. In other words, the pronoun is more difficult to process in both Russian and English, be they native or non-native languages of the participants. However, there is an exception that requires additional explanation.

Figure 7.12 shows that native speakers of English tested in their L2-Russian (ERR) struggle with the reflexive more than with the pronoun and their RespTime is longer in the reflexive condition. These results are strikingly different from the processing behavior of all the other participants, both L2ers and monolinguals. The fact that the ERR group has more difficulties with the type of anaphora that is a direct reflection of the preferred type of RC resolution. This could be interpreted at a delayed effect of a perception verb that favors HA of the RC, i.e. a switch to the Russian-like pattern of anaphora resolution.

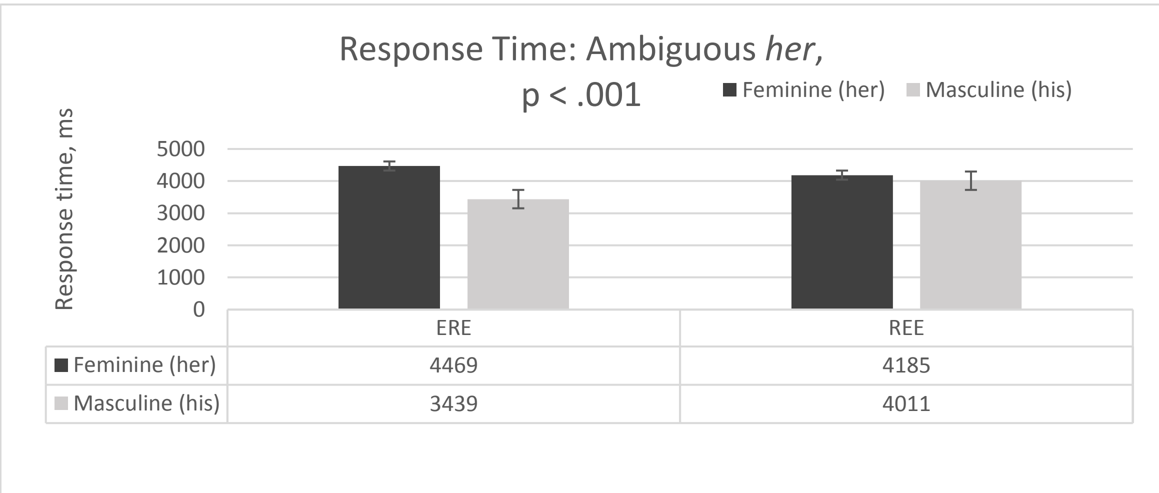
It is important to notice that ERR participants are intermediate speakers of Russian who are on their way to switching from their L1-like preference in anaphora resolution to the TL-like pattern. The tendency was shown in the analysis of the Nchoice at the beginning of this chapter. The data of the RespTime together with the data on anaphora resolution in group ERR show that the participants are struggling to decide whether to choose the higher or the lower DP. At the same time, they are successful with all non-target sentences and do the comprehension tasks correctly.

Even though the participants in group ERR do not overcome the threshold of their L1-like pattern in anaphora resolution, they need more time to pick an answer to a comprehension check in the condition directly influenced by a perception verb. The latter shows L2ers' sensitivity to the linguistic prompts for sentence parsing even in the situation when the first analysis of the general sentence interpretation may not show it.

Another factor that prolongs RespTime in the population of L2 speakers is the AnaPred factor. AnaPred is the factor that check for an effect of the feminine pronoun *her*. In English, the pronoun *her* in the prepositional complement *[$_{PP}$ about her]* is homonymous with the possessive pronoun *her* and triggers a structural projection for a possessive phrase, like, for example, *[her daughter]*. A processing necessity to suppress the possessive phrase increases the RespTime in the sentence with the feminine pronoun *her*.

Table 7.5 above provides the R-statistics for the AnaPred effect. Figure 7.13 shows the effect of AnaPred on RespTime in milliseconds. Notice, that AnaPred effect is only relevant for English and only for the feminine gender of the pronoun. The masculine pronoun in English and both gender pronouns in Russian are not homonymous with the corresponding possessive pronouns. The AnaPred effect is additional evidence for top-down structural prediction in human sentence parsing.

Figure 7.13 Response Time: effect of AnaPred



The analysis includes only the participants tested in English, the native speakers of English tested in their L1 (ERE) and the non-native speakers of English tested in their L2 (REE). Both groups are sensitive to the effect of the feminine pronoun *her*.

In top-down structural prediction a projection for the possessive phrase (ex., *[her daughter]*) triggered by the feminine pronoun *her* is dismissed by the following PP *[$_{PP}$ in the yard]*. The very end of the sentence is the area of a processing conflict, which shows after the sentence has been fully processed, in RespTime.

In summary, the AnaPred effect shows L2 speakers' sensitivity to the language-specific phenomena in their non-native languages. These results feed the claim that the participants of the experiment are at the stage of L2 acquisition when they are abandoning their L1-like parsing hypothesis in the L2 and are switching to the TL-like manner of L2 processing.

When the effect of AnaPred is considered together with the effects of the VerbType, they show that top-down structure building takes place at various levels of sentence parsing. Together with the information on the general preference in anaphora resolution, the results show that sentence parsing goes in cycles and top-down and bottom-up algorithms complement each other.

A top-down structural prediction triggered by a perception verb is already cancelled by the time of anaphora resolution. However, a new structural prediction is generated as soon as the parser is ready for it. The ability of the parser to generate a new projection in a new processing stage is revealed by the feminine pronoun *her* that creates a favorable linguistic environment for another structural prediction.

7.3 7.3 Knowledge of another language in sentence parsing

The purpose of this section is to estimate the current stage of the participants' L2 development through the analyses of their processing behavior. This section addresses the second main research question (RQ 2) that concerns the role of the two languages in the L2 speakers' sentence processing and follows the main Hypothesis 2 of the dissertation.

Hypothesis 2 is informed by the studies claiming that L2 acquisition in adulthood begins with the full transfer of L1 grammar (Schwartz and Sprouse 1996), which becomes the first parsing hypothesis in the L2. L1 parsing guides L2 processing till the parser accumulates enough input to specify L2-like parameters (Fodor 1998). Putting together the amount of L2 experience and the participants results in the C-test, Hypothesis 2 argues that the intermediate level is a very early post-initial state of L2 acquisition where L2 processing is still governed by the L1 parsing hypothesis.

The analysis in the previous section has already mentioned that there is evidence for L1-like parsing in both the L1 and the L2. However, processing in the L2 has shown sensitivity to such salient phenomena as the predictive power of the feminine pronoun *her*. For example, the patterns of anaphora resolution and sensitivity to the verb type effect were L1-like in L2 processing. At the same time, a potential to switch to the TL-like pattern of anaphora resolution in the L2, shown in the previous section, and L2ers' sensitivity to an English-specific cue, the feminine pronoun *her*, in L2-English is evidence of development towards the processing in the TL-like manner in the L2.

Even though the previous analysis was focused on the investigation of parsing algorithms, some data allowed for primary conclusions about the role of both languages in sentence processing. Taken together the results from the previous section cast doubt on the main Hypothesis 2 that expects purely L1-like behavior at the intermediate level of L2 proficiency.

To fully address RQ2, this section runs additional analyses comparing the L2ers tested in their L1s to the monolingual speakers of English and Russian. For additional clarity and to make sure there is a certain tendency to use both languages in sentence parsing, the statistical analysis sometimes includes all the six groups of participants. The section is guided by the two subordinate research questions. RQ 2.1 summarizes the effect of the L1 in non-native processing. RQ 2.2 checks for L2-specific effects and claims the potential for switching to processing in the TL-like manner with the growth of L2 proficiency.

7.3.1 L1 effect in L2 processing

The analysis in this section addresses the first subordinate questions RQ 2.1 and investigates to what extent L1 guides L2 parsing. The analysis also considers some evidence from the previous section that show possible influences of L2 on native processing. For example, there is some effect of bilingualism on the RT at the embedded verb which suggests the knowledge of Russian may have a facilitative effect on sentence parsing in English. This section runs additional analysis and provides a detailed description of how the L1 influences and is influenced in L2 processing.

The section follows the same key questions of the statistical analysis as the previous sections but moves the focus of the analysis from the investigation of parsing algorithms to the role of L1 in parsing. First, the analysis checks the role of L1 effects in anaphora resolution (RQ 1.1-1.2). Second, it analyses the effect of a perception verb on the RT at the embedded verb (RQ 1.3) and checks whether L1 affects L2 processing or is being affected by it. The section finishes with an analysis of the L1 effect at the level of the entire sentence and examines its general processing complexity (RQ 1.4-1.5).

7.3.1.1 General pattern of anaphora resolution

This section starts with the analysis of anaphora resolution that has already revealed L1-like patterns in the participants' respective L2s. The analysis also claimed a potential to switch to the TL-like pattern of anaphora resolution with the participants' growth in L2 proficiency. The latter is supported by the detailed analysis of individual difference on anaphora resolution.

The analysis of individual differences subdivided the entire population of L2 speakers into three categories by L2 proficiency: high intermediate, intermediate and low intermediate. A statistical analysis in each group does not return any significant effect of L2 proficiency on anaphora resolution. It means that the differences in proficiency between the participants are so tiny that the level of L2 proficiency does not change the overall pattern of anaphora resolution. However, some marginally significant interactions revealed in the analysis deserve additional comments. Table 7.6 shows R-statistics for the factor Proficiency in anaphora resolution.

Table 7.6 R-statistics: Proficiency and Anaphora resolution.

Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	5.149e-01	1.460e-02	8.000e+01	35.260	< 2e-16 ***
Group_factor1:AnaType_factor1:Proficiency_factor1	-6.972e-02	1.031e-01	2.400e+02	-1.659	0.098453 .
Group_factor2:AnaType_factor1:Proficiency_factor1	2.914e-03	1.035e-01	2.400e+02	-1.656	0.098968 .
Group_factor3:AnaType_factor1:Proficiency_factor1	3.708e-02	1.201e-01	2.400e+02	-5.225	3.78e-07 ***
Group_factor3:AnaType_factor1:Proficiency_factor2	-2.969e-01	1.609e-01	2.400e+02	-1.846	0.066196 .
Descriptive statistics: Proficiency as a continuous variable					
Proficiency	-1.433e-03	1.128e-03	8.002e+01	-1.270	0.207739
Proficiency:VerbType_factor1	-8.020e-04	1.285e-03	2.447e+03	-0.624	0.532619
Proficiency:AnaType_factor1	9.945e-04	1.285e-03	2.446e+03	0.774	0.439042
Proficiency:Language_factor1	3.145e-03	2.257e-03	8.002e+01	1.394	0.167259
Proficiency:VerbType:AnaType	-4.949e-03	2.570e-03	2.446e+03	-1.926	0.054281 .
Proficiency:VerbType:Language	7.061e-04	2.570e-03	2.447e+03	0.275	0.783531
Proficiency:AnaType:Language	-1.272e-02	2.570e-03	2.446e+03	-4.950	7.92e-07 ***
Proficiency:VerbType:AnaType:Language	-3.892e-03	5.140e-03	2.446e+03	-0.757	0.448969
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

The factor Proficiency appears significant when it is coded as a categorical or a continuous variable. Proficiency is significant in with anaphora resolution. A clearer explanation of the proficiency effect is provided by the categorical analysis. Proficiency is coded as a 3-level independent variable.

Proficiency comes out significant in multiple interactions that involve different levels of different variables. For example, the interaction "*Group_factor3:AnaType_factor1:Proficiency_factor1"* with p < .001 singles out *the interpretations of reflexives by the participants of Group RER with low-intermediate level in the L2* from the rest of the tested population as significantly different. The current analysis does not benefit from such a detailed data presentation. For the purposes of the current study, the analysis just needs general information about proficiency effect on anaphora resolution. If all the data from Table 7.6 are considered together, they show marginally significant interactions of all levels of proficiency with all the levels of the Group factor and the preferred types of anaphora resolution. The Group factor in this analysis differentiates between the bilingual groups tested in their L1s and the bilingual groups tested in their L2s.

The results of all interactions are given in Figures 7.14-7.17 below. Each figure shows the interaction AnaType*Proficiency in each group. Proficiency means proficiency in the L2 for the entire bilingual population. Even the participants who were tested in their respective L1s took an L2-proficiency test. The analysis checks for effects of L2 proficiency in each group for whether it may influence anaphora resolution in either L1 or L2. First effects of L2 proficiency may start showing in native language processing, that would be evidence for cross-linguistic influence in L2 language acquisition. Figure 7.14 shows the results for group ERE, Figure 7.15 for group ERR, Figure 7.16 for group REE and Figure 7.17 for the Group RER.

Figure 7.14 Group ERE: Proficiency and preference in anaphora resolution

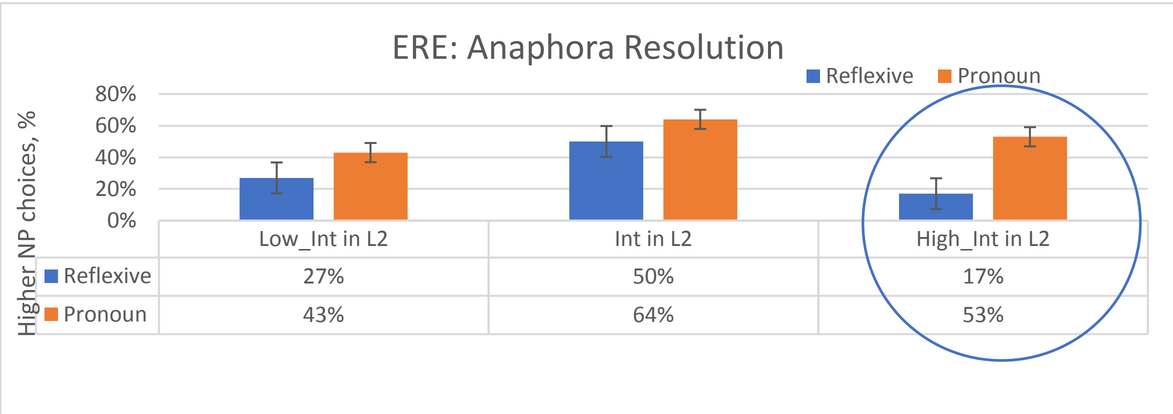


Figure 7.15 Group ERR: Proficiency and preference in anaphora resolution

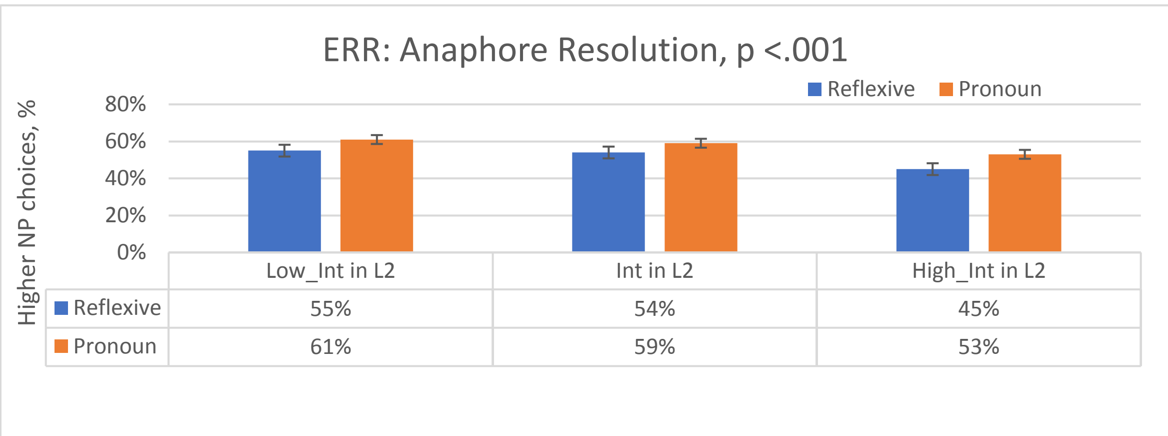


Figure 7.16 Group REE: Proficiency and preference in anaphora resolution

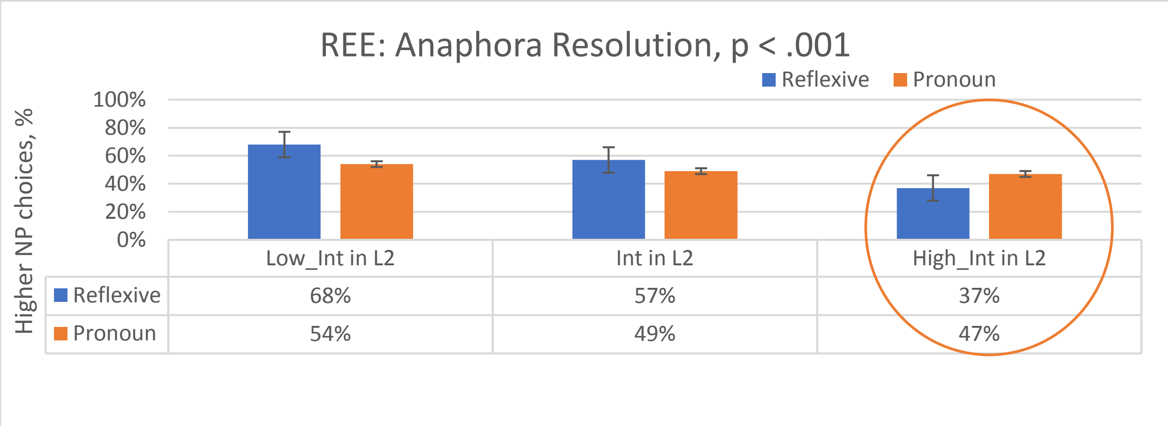
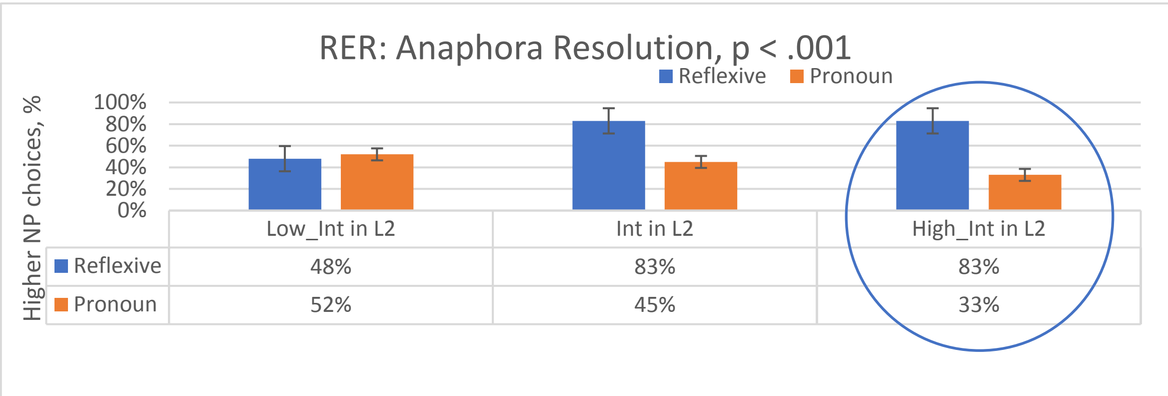


Figure 7.17 Group RER: Proficiency and preference in anaphora resolution



There are noticeable changes in anaphora resolution in three experimental groups at the highest levels of proficiency. Figures 7.14 and 7.17 show L2 speakers tested in their respective L1s. In both ERE and RER, the L2 speakers with higher-intermediate level of L2 proficiency show a very clear pattern of anaphora resolution typical for their native language, English-like in English and Russian-like in Russian (see blue circles on Figures 7.14 and 7.17). These are more clear-cut patterns of L1-like anaphora resolution than the patterns of the participants in the groups ERE or RER with lower levels of L2 proficiency. The English-like pattern of anaphora resolution in group ERE is much more distinct than the pattern shown by English monolinguals (see Chapter 6, Section 6.2), which suggests that with the development of the L2 proficiency, L2ers are also developing a skill to keep their two languages separate.

Figures 7.15 and 7.16 show L2 speakers tested in their L2s. Higher intermediate speakers of English in group REE overcome the L1-like threshold and show English-like preference for anaphora resolution in their L2 English. Group ERR preserves the L1-like preference in anaphora resolution even at high-intermediate levels of proficiency.

When all the participants are split into three proficiency groups, the results show that low intermediate and intermediate speakers preserve their L1-like preference in L2 anaphora resolution. However, high intermediate speakers show a clear tendency to overcome the L1-like threshold in DP choices and perform in the TL-like manner in their L2s. Besides, high intermediate L2 speakers show a clear differentiation between the languages they have acquired. When L2 speakers of either Russian or English are tested in their respective L1s they show a clear preference for the pattern of anaphora resolution typical for this language.

Putting the data from Figures 7.14-7.17 together, there is a preserved pattern for L1-like anaphora resolution in the L2 and there is a clear tendency to switch to the TL-like patterns in anaphora resolution in the L2. This potential will most likely develop with the participants' growth in L2 proficiency.

The analysis of individual differences in L2 proficiency supports the main findings in a language-specific pattern of anaphora resolution. It confirms the overall L1-like preference in anaphora resolution and points to the evidence of the developing L2. Besides, the analysis of individual differences highlights the fact that L2ers may become better at inhibiting one of their languages with the growth of L2 proficiency. This potential shows in clearer native-like patterns of anaphora resolution when high intermediate L2ers are tested in their respective L1s.

Alternatively, a clear L1-like pattern of anaphora resolution can be explained by the low proficiency in the L2. When the participants are tested in their L1s their knowledge of the L2 is not enough to activate the second language.

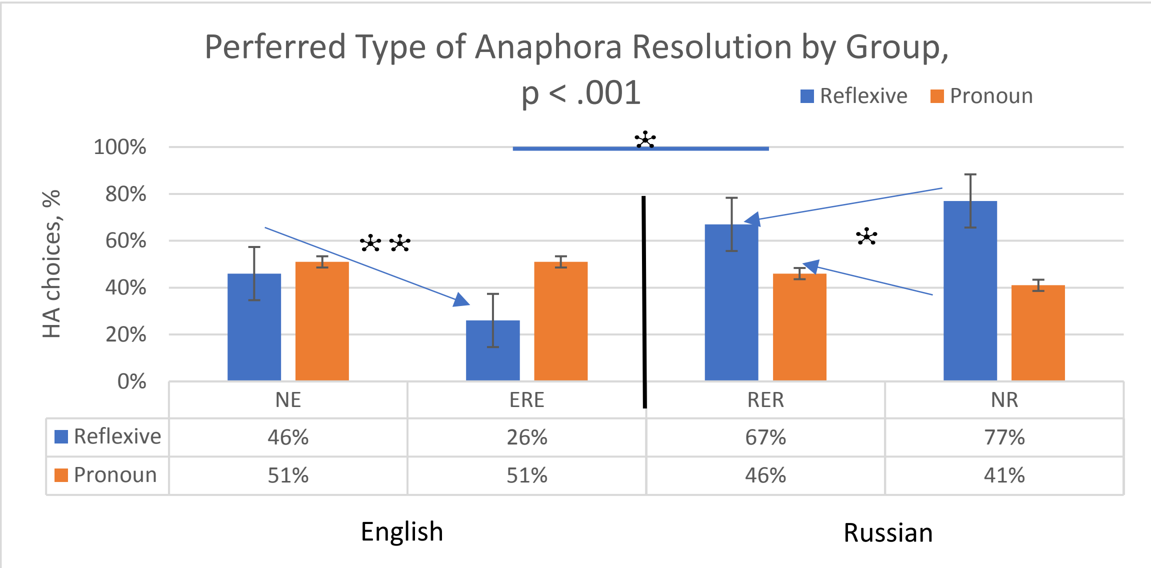
To clarify this question the study runs a comparative analysis of the L2ers tested in the L1s and the monolinguals from the first experiment. Table 7.7 provides R statistics for this analysis. Figure 7.18 illustrates the interaction AnaType*Group.

Table 7.7 R statistics for Nchoice (ERE and RER vs. NE and NR)

Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	0.50703	0.01683	80.00000	30.130	< 2e-16 ***
AnaType_factor1	-0.06808	0.02442	240.00000	-2.787	0.00574 **
Language_factor1:AnaType_factor1	-0.54018	0.05983	240.00000	-9.029	< 2e-16 ***
AnaType_factor1:Group_factor1	0.19018	0.06908	240.00000	2.753	0.00636 **
AnaType_factor1:Group_factor3	0.15625	0.06908	240.00000	2.262	0.02460 *
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

The analysis ignores the significant interaction AnaType*Language that was commented on in the previous section. Comparing L2ers tested in their L1s to monolinguals does reveal something new: NE and ERE prefer the English-like pattern of anaphora resolution and NR and RER prefer the Russian-like pattern in their sentence interpretation. However, the comparison between NE and ERE in the analysis of the Group effect addresses the question above.

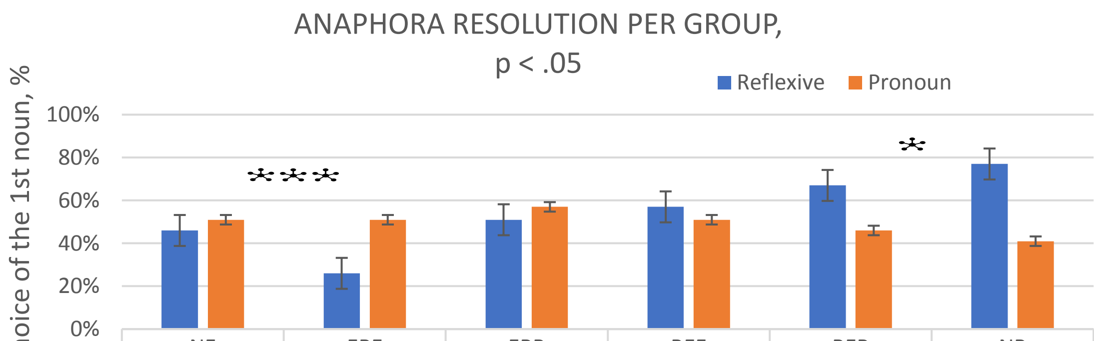
Figure7.18 Anaphora resolution: Group effect



To begin with, NE demonstrate a fuzzy preference for English-like anaphora resolution. They prefer a higher DP for the reflexive more often than native speakers of English who also know Russian as the L2 (ERE). As established in the analysis in Experiment 1, anaphora resolution in the NE is influenced by a perception verb. The analysis in Experiment 2 shows no effect of a perception verb on anaphora resolution. The difference between groups NE and ERE in Figure 7.18 means that the participants who know Russian show a clearer English-like patterns of anaphora resolution in their L1-English than English monolinguals. They must be immune to the confusing effect of a perception verb on anaphora resolution that was found in Experiment 1 for English monolinguals. This must be the first significant effect of bilingualism on anaphora resolution.

The effect of bilingualism shows a bit differently in Russian. Unlike for ERE, knowledge of the L2-English provides the learners with exposure to an LA language where a perception verb may have an effect. Besides, L2 learners of English have been learning their L2 longer than the mirror image group of Russian learners. Native speakers of Russian show a change in the percentage of the preferred answers towards English-like pattern of anaphora resolution when NR is compared to RER in Figure 7.18. RER tend to prefer the higher DP for the reflexive a bit less and for the pronoun a bit more than NR. The difference is statistically significant and is interpreted as the first instances of L2 effect in the L1. This observation becomes more obvious if all the participants in two studies are compared to each other, see Figure 7.19. The analysis performed in all the experimental groups, monolinguals and bilinguals together, reveals statistical significance between NSs of either English and Russian and the equivalent groups of L2ers tested in their L1s. It supports the approach of the thesis to use L2ers tested in the L1s as control groups for the target groups tested in the L2s. For the current section, the analysis provides a statistically significant illustration of the effect investigated.

Figure 7.19 Anaphora resolution in all the experimental groups: Group effect



	NE	ERE	ERR	REE	RER	NR
Reflexive	46%	26%	51%	57%	67%	77%
Pronoun	51%	51%	57%	51%	46%	41%

The three groups of the native speakers of Russian on the right in Figure 7.19, the NR to the RER and to the REE, show a gradual change towards English-like pattern of anaphora resolution in both the reflexive and the pronoun. The preference for the higher DP in reflexives gradually declines. At the same time, the tendency to assign the pronoun to the higher DP is growing. Group RER shows an intermediary pattern of anaphora resolution between NR and RER. Therefore, knowledge of the L2 influences L1 processing in native speakers of Russian as well as in native speakers of English, even though the influence of the L2 manifests itself in different ways.

The analysis of this section specifies the general assumption of the L1-like pattern of anaphora resolution. First, the analysis of individual differences shows a tendency to switch to the TL-like pattern of anaphora resolution with the participants' growth in L2 proficiency. Besides, L2ers differentiate between their two languages much better if their proficiency in the L2 is higher. Group ERE is not confused by the effect of a perception verb in anaphora resolution in their native language English. Therefore, the L2-Russian facilitates their L1 processing. L2-English also influences L1 processing in native speakers of Russian. Their longer exposure to the TL than in L2 speakers of Russian facilitates their soft change towards the English-like pattern of anaphora resolution in their L1.

The detailed analysis of anaphora resolution shows that L2 acquisition is a process of mutual influence of the languages on each other from the very early stage of L2. The general pattern of anaphora resolution per group returns L1-like preference in the participants' L2, which is expected at their level of L2 proficiency. However, a detailed analysis shows that L1-English benefits from the knowledge of L2-Russian and becomes less confused by the effect of a perception verb. L1-Russian is susceptible to English-like preferences in sentence parsing and shows a soft cline towards L2-like pattern of anaphora resolution in the L1.

To sum up, the analysis of anaphora resolution at the intermediate level of L2 development already offers evidence that the L1 influences the L2 and, at the same time, the L1 is being influenced by the L2. In other words, the parser readjusts to accommodate the norms of the L2 into the existing L1 grammar.

7.3.1.2 Reading times at the embedded verb

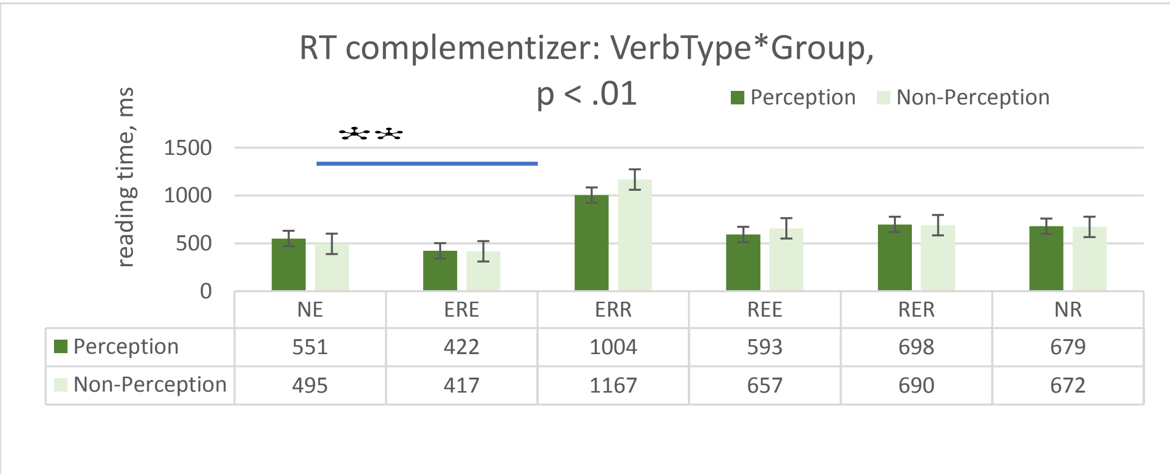
The RT at the embedded verb is a manifestation of the effect of a perception verb on sentence parsing. Increased RTs in English is evidence for a top-down structural anticipation that gets reconsidered after the parser encounters the complementizer that. The effect is not expected in Russian. This mismatch between the expected increase in RTs in English and no processing difficulty in Russian allows for comparisons in parsing behaviour between Russian-like and English-like. For respective groups it means the comparisons of whether the participants show L1-like or L2-like parsing behavior in L2 processing.

The previous analysis shows that native speakers of Russian show Russian-like behavior and do not slow down the RT in either their L1 or their L2. Alternatively, native speakers of English show English-like behavior and slow their RT down in the L2-Russian. These results prompt a conclusion that the L2ers show the parsing behaviour typical for their L1s when they are processing their non-native languages. This claim is specified by the analysis of parsing behavior between monolinguals and the L2ers tested in the L1. Notice, that the data of monolingual participants are used here for clearer illustration. The thesis sticks to the point that monolinguals and bilinguals should not be compared directly and only general tendencies in processing patterns should be discussed here.

Section 7.2.2 shows that L2 speakers of Russian tested in their L1 English show sensitivity to a perception verb earlier than a similar group tested in the L2. Group ERE slow the RTs down at the complementizer (Figure 7.6, section 7.2.2) but group ERR show slower RTs at the embedded verb (Figure 7.4, section7.2.3).

When native language processing by L2ers is compared to monolinguals, there are certain similarities. Figure 7.20 shows RTs at the complementizer by all the groups of participants. For illustrative purposes, a full statistical analysis was performed for the entire pool of six groups. Notice that the contrast between NE and ERE and the contrast between NE / ERE and ERR are significant. Therefore, the three groups of native speakers of English behave differently. The observed difference between the groups NE and ERE supports the exclusion of monolingual groups from the bilingual analysis, i.e. from being used as the control group for the analysis of the bilingual behavior.

Figure 7.20 RT of complementizer (that): effect of VerbType*Group




```
> lsmeans::lsmeans(model.english, pairwise ~ VerbType_factor*GroupNL_factor)
lsmeans
VerbType GroupNL          lsmean        SE       df         lower.CL          upper.CL
 NonPerc  NLE            556.7311     31.73684   173.7      494.0916          619.3706
 Perc     NLE            540.0320     31.73684   173.7      477.3926          602.6715
 NonPerc  NLR            924.2086     31.73684   173.7      861.5691          986.8481
 Perc     NLR            846.3852     31.73684   173.7      783.7457          909.0246
contrast                              estimate         SE          df    t.ratio   p.value
 NonPerception,NLE - Perception,NLE     16.69905     27.74817    120.0    0.602     0.9313
 NonPerception,NLE - NonPerception,NLR -367.47752    44.88267    173.7   -8.188     <.0001
 NonPerception,NLE - Perception,NLR   -289.65408    44.88267    173.7   -6.454     <.0001
 Perception,NLE - NonPerception,NLR   -384.17656    44.88267    173.7   -8.560     <.0001
 Perception,NLE - Perception,NLR      -306.35312    44.88267    173.7   -6.826     <.0001
 NonPerception,NLR - Perception,NLR     77.82344     27.74817    120.0    2.805     0.0296
```

Table 7.8 show R-statistics of the effect of a perception verb on the RT in all the groups of participants, bilingual and monolingual. The analysis is used here for illustrative purposes.

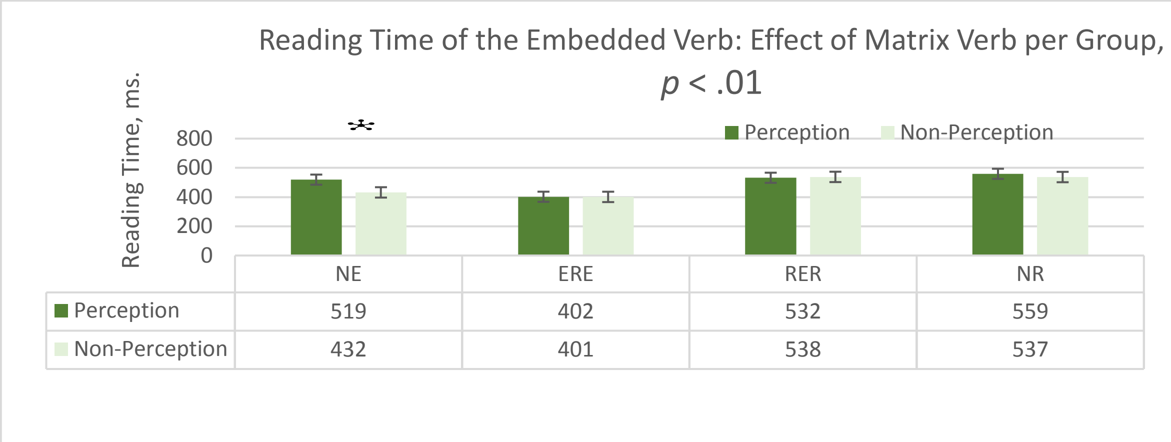
Table 7.8 R-statistics: effect of VerbType on the RT at the complementizer and embedded verb

RT of the complementizer *that*					
Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	670.564	19.029	120.000	35.239	< 2e-16***
VerbType_factor1:Group_factor1	-170.559	62.047	120.000	-2.749	0.00690**
VerbType_factor1:Group_factor2	-238.326	84.772	120.000	-2.811	0.00576**
RT of the embedded verb *talking*					
(Intercept)	621.752	17.051	80.000	36.464	< 2e-16 ***
VerbType_factor1	25.37	13.63	120.00	1.862	0.0650.**.**
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Putting together the information in the statistics table and the graphs in Figure 7.20, one can notice that group ERE slightly slow their RTs down at the complementizer. It is at the same constituent as NE. Therefore, the participants tested in English, NE and ERE, show earlier sensitivity to the effect of a perception verb than group ERR, even though group ERE behave English-like in their L2 Russian. This explains the statistical difference between NE / ERE and ERR. There is significant difference between NE and ERE: NE show longer RTs at the embedded verb than in ERE. The latter can suggest that knowledge of Russian, the language where no difficulty at this area is expected, starts having a facilitative effect on processing in the L1 and reduces the processing conflict that the complementizer and the embedded verb.

To answer the question above, the analysis zooms into the differences in RTs at the embedded verb between the monolinguals and the L2ers tested in their L1s. Figure 7.21 shows the graphs for RTs at the embedded verb by the four target groups, NE, ERE, RER, NR. These are the four groups of native speakers of Russian and English tested in their respective L1s. The only difference in that two of the groups have knowledge of another language at the intermediate level.

Figure 7.21 RT at the embedded verb: VerbType*Group effect



Comparing Figure 7.20 and 7.21, one can notice that both NE and ERE slow down at the complementizer (Figure 7.20), thus showing sensitivity to a perception verb. However, only group NE preserves the effect of the matrix verb at the embedded verb (Figure 7.21). It is important to notice that a slowdown of the RT at the region of the complementizer and the embedded verb is evidence of a recovery from the generated structural projection for an eventive complement. Therefore, group ERE deals with this processing complexity much faster than monolingual speakers of English. The latter can be attributed to the early effects of bilingualism, i.e. the knowledge of Russian, which is easier at this sentence fragment.

The effects of bilingualism also show in the RTs of group ERR reported in the previous section (see section 7.2.2, Figures 7.4.and 7.6). The analysis in section 7.2.2 shows that L2 speakers of Russian slow down their RTs at the embedded verb only. This means group ERR preserve the native-like effect of a perception verb, even when they are tested in their L2, but react to it later than NE or ERE.

Putting the data of the three groups of English-speaking participants together, they all are sensitive to the effect of a perception verb and slow the RTs down. However, English speakers show sensitivity to a perception verb earlier if they are tested in their native language than in the L2. The latter goes in line with the warning by Dekydtspotter et el. (2006) claiming that processing effects in non-native processing may show later than in native languages. Using the L2ers tested in their respective L1s as control groups for the L2ers tested in their L2s and providing illustrative comparisons between L2ers and the monolingual groups, the thesis avoids the comparative fallacy that could obscure the results of the experiment.

To be more specific, there is an effect of bilingualism revealed in the analysis. Speakers of two languages (ERE) deal with the processing challenge faster than monolinguals (NE). Group ERE slow down at the complementizer to amend the erroneously generated structure. At the same time, group NE read both the complementizer and the embedded verb slower when they need to deal with the processing complexity caused by the embedded verb. Group ERE recovers from the wrong parsing hypothesis faster than group NE. Group ERR show L1-processing effect at the spillover region only.

In summary, sentence processing at the level of the embedded verb is L1-like in all the bilingual groups of participants, irrespectively of whether they are tested in the L1 or the L2. Native speakers of Russian do not show any effect of a perception verb in either their L1-Russian or their L2-English. Native speakers of English slow down the RT after a perception verb in both their L1 and their L2.

However, knowledge of the second language facilitates sentence processing. Native speakers of English who also know Russian recover from a parsing conflict faster than English monolinguals. This can be an effect of Russian, where a perception verb does not create a processing conflict at the complementizer. In this case, the knowledge of Russian that is being acquired at the moment have a facilitative effect on sentence processing. In other words, a possibility of different structure building in Russian is added to the existing structural options in English. Thus, at the level of "unconscious representational knowledge" (Hicks & Dominguez 2019, p.1), English is influenced by the newly formed knowledge of Russian. The psycholinguistic mechanisms of this influence are studied in the field of L1 grammatical attrition (see Hicks & Dominguez 2019 for a review). The current results show that structural anticipation for a SC eventive complement in L1-English can be reduced due to the effect of L2-Russian. In the current experiment it results in faster processing time and looks as a facilitative effect of bilingualism.

Alternatively, bilinguals do not make as many predictions as English monolinguals. However, both English monolinguals and English-Russian bilinguals were tested in their first or most dominant language (for L2ers) – English. It is very unlikely that native parsing competence would not be possible in the bilingual group. In this context, even hypothetically reduced prediction in the native language is most likely an effect of the developing knowledge of the L2 - Russian.

This analysis is another good example of how direct comparisons between native and non-native processing can be misleading. Native speakers of English react to a perception verb earlier when they are tested in their L1 than when they are tested in their L2 and recover from the misanalysis faster than monolinguals.

7.3.1.3 General processing complexity: effect of a perception verb

This section checks whether sentences with a perception verb are more difficult to process than sentences with a non-perception matrix predicate. A perception verb is a linguistic phenomenon that creates processing difficulties in English. However, the same effect in Russian creates a congruent processing condition as a perception verb favors HA of the RC, which is naturally preferred in Russian.

Having a perception verb as an English-specific effect allows for cross linguistic comparisons between the mechanisms of native and non-native processing. This section analyses general complexity of a sentence and the effect of a perception verb on it.

General complexity of the sentence is measured through increased RTs at the wrap-up region (yard) and at the RespTime. The statistical analysis presented in Table 7.9 returns a significant effect of a perception verb on the wrap-up region, but not on RespTime.

Table 7.9 R-statistics for VerbType effect on the wrap-up region

RT of the wrap-up region *yard*					
(Intercept)	866.13	47.48	119.35	18.243	< 2e-16 ***
VerbType_factor1:Language_factor1	77.480	39.287	320.096	1.972	0.0587 **.**
VerbType_factor1:GroupNL_factor1	-206.81	102.65	480.56	-2.015	0.0445*
Signif. codes: 0 ‘*’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1**					

The results of the statistical analysis in Table 7.9 are illustrated by Figures 7.22 and 7.23. Figure 7.22. shows the effect of a perception verb by Language (of testing) and Figure 7.23 by GroupNL.

Figure 7.22 RT at the wrap-up region: effect VerbType*Language

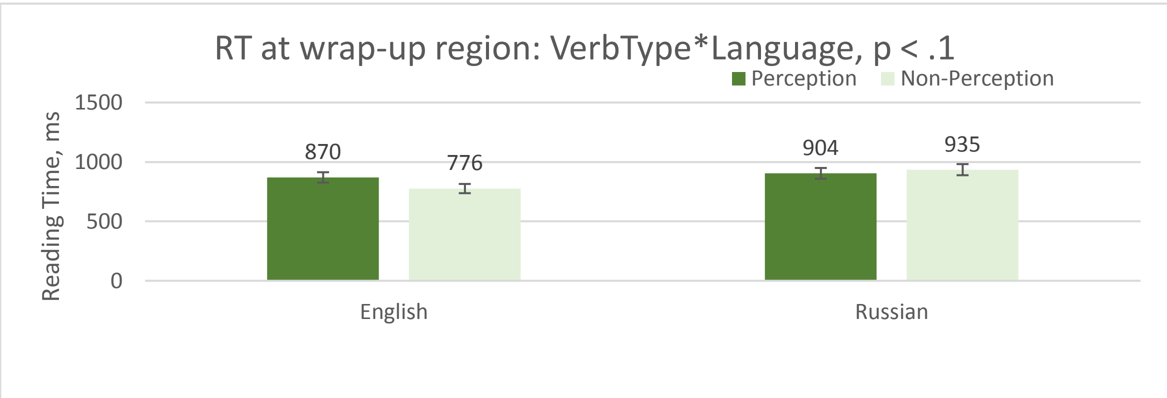
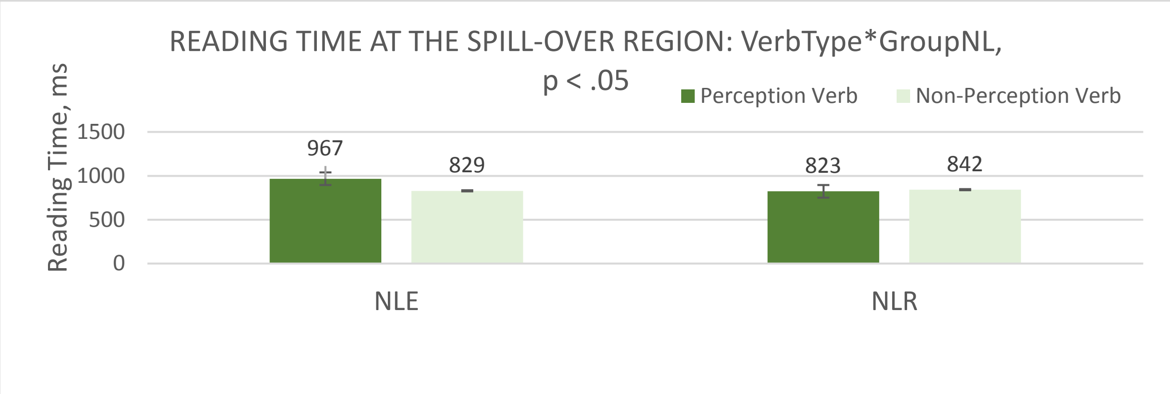


Figure 7.23 RT of the wrap-up region (yard): effect of VerbType*GroupNL



If Figures 7.22 and 7.23 are considered together, the results show that a perception verb makes the entire sentence more complex for native speakers of English as well as for the participants tested in English. The latter includes L2 speakers of English.

A perception verb has exactly the opposite effect in Russian. It facilitates sentence processing, as expected in the theoretical analysis in Chapters 3-5. Neither participants whose native language is Russian, nor the participants who are tested in Russian, struggle with a perception verb effect at the end of the sentence. The latter includes non-native speakers of Russian.

The GroupNL effect in Figure 7.23 is much stronger than the effect of the Language (of testing) shown in Figure 7.22. The effect of Language is only marginally significant. This mismatch between the GroupNL and the Language (of testing) shows that sentence processing is mostly L1-like at the wrap-up region. However, there is a potential for L2 speakers to develop processing in a TL-manner which shows in the marginally significant effect of the Language.

The results in this section go in line with the previous findings on L1 effect in sentence processing. Non-native processing at the intermediate level is mostly L1-guided. However, there is evidence of the L2 developing towards processing in a TL-like manner.

7.3.1.4 General processing complexity: other factors

This section is expected to check for language specific effects in sentence processing and measure the participants' sensitivity to the factors other than a perception verb that may be difficult to process. The previous analysis shows that these factors are AnaType, the pronoun vs. the reflexive, and AnaPred, or the feminine pronoun her that increases sentence processing in English.

The factor AnaType does not have a language-specific nature. The pronoun has a universal effect to increase processing load of a sentence. This effect occurs due to the ambiguous nature of the pronoun that preserves its potential to be bound outside the sentence even when the context does not support it. The linguistic nature of the pronoun makes it very different from the reflexive which shows in sentence processing.

As can be gathered from the analysis in previous sections all the participants, native and non-native speakers of English and Russian, are universally sensitive to the effect the pronoun. All the target groups process sentences with the pronoun slower than sentences with the reflexive. The effect shows in both the RT at the wrap-up region and the RespTime.

The results of R-statistics given in Table 7.10 shows that AnaType is a significant predictor of the processing complexity at the end of the sentence. However, there are no significant interactions between AnaType and other factors. It means AnaType influences the entire population of the participants in the same way. Therefore, it cannot be informative for the investigation of cross-linguistic influences on sentence processing.

Table 7.10 R-statistics for the RT of the wrap-up (yard) and the RespTime

Reading time of the wrap-up region *yard*:					
Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	866.13	47.48	119.35	18.243	< 2e-16 ***
AnaType_factor1	125.71	31.11	480.56	4.040	6.21e-05***
Response Time					
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	4111.913	136.417	120.825	30.142	< 2e-16***
AnaType_factor1	556.307	101.291	480.915	5.492	6.44e-08***
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

The second factor that shaped sentence processing in Experiment 1 and Experiment 2 is AnaPred_factor. It is an English-specific effect triggered by the feminine pronoun *her* which creates a temporary garden path effect and makes the parser anticipate a possessive phrase. This effect is possible due to the homonymy between the personal pronoun and its possessive form in the feminine gender. This effect is not possible in the other experimental conditions.

The statistical analysis returns a strong effect of the AnaPred factor on sentence processing. However, this effect shows only among the participants tested in English, which includes speakers of English as the L2. It is evidence for L2-like processing in the L1 and is discussed in detail in the next section.

7.3.2 Evidence for processing sensitivity to L2-specific cues

The purpose of this section is to specify the findings of the role of the L1 in non-native sentence processing and to provide a well-rounded description of the intermediate stage of L2 proficiency through the analysis of native and non-native sentence parsing. This section addresses the main RQ 2 and focuses on the instances of L2-specific behavior in non-native sentence processing.

As can be gathered from the previous sections in this chapter, there is plenty of experimental evidence that L2 parsing at the intermediate level of L2 proficiency is not guided by the L1 solely. There are instances of L2 effect on L1 processing too. First, such evidence prompts a conclusion that L2 acquisition occurs through mutual influence of the two languages on each other. Second, the intermediate level of L2 proficiency already shows a potential for L2-like processing which means a certain amount of the L2 has been acquired.

This section checks for the instances of processing in the TL-like manner at the intermediate level of proficiency. The data presentation in the section is built around the main processing questions of the dissertation. The questions check for a certain pattern of anaphora resolution, the effects of a perception verb on sentence processing and the participants' sensitivity to the factors other than a perception verb in sentence processing. The analysis summarizes the findings in the previous sections and describes the effect of AnaPred, the only clear instance of TL-like behavior in the L2.

7.3.2.1 Feminine Pronoun *her* in Native and Non-Native Parsing

The analysis in the previous section shows that the main Hypothesis 2 may be too strong in its definition of the intermediate level of L2 proficiency. There is no doubt, that L2 processing at this level is strongly influenced by L1. The L1 effect shows in the general preferences for anaphora resolution where non-native speakers preserve their L1-like patterns. It also shows in the lack of sensitivity to the effect of a perception verb in L2 English. Besides, native speakers of Russian process sentences with a perception verb faster than with a non-perception verb. They also preserve this Russian-specific facilitative effect in their L2 English.

However, Hypothesis 2 is too strong in rejecting any instances of the developing L2 in sentence processing at the intermediate level of L2 proficiency. A detailed statistical analysis shows that there is a tendency to switch to the TL-like pattern of anaphora resolution in high intermediate participants. Besides, knowledge of Russian, or the early effect of bilingualism, facilitates sentence processing in English and reduces learners' sensitivity to the effect of a perception verb.

All the observed effects of L2 influences on the L1 in sentence processing speak for the existence of some L2-specific capabilities that develop very early and might shape further L2 acquisition. However, none of the evidence above shows a clear example of L2-like behavior in the L2. This section bridges this gap and analyses an English-specific effect of the feminine pronoun that increases processing load at the end of the sentence.

The effect of the feminine pronoun is coded AnaPred the same as in the previous analysis. The AnaPred effect occurs due to the homonymy of the feminine pronoun her with the possessive pronoun her in English. The feminine pronoun her triggers a projection for a possessive phrase, like [her daughter] which no other experimental conditions can have. A possible possessive projection is not confirmed further on in the sentence and the generated structure needs to be disregarded. The latter creates a processing conflict and increases the RespTime, Table 7.11.

The homonymy of the personal and possessive pronouns does not occur in Russian or in the masculine pronoun in English. Therefore, a structural prediction can only be significant for the participants tested in English, NE, ERE and REE. The NE and the ERE are native speakers of English. The REE are L2 speakers of English. Table 7.11 shows R-statistics for processing load at the end of the sentence. Figure 7.24 shows the effect of AnaPred by Group.

Table 7.11 R-statistics for the RT of the wrap-up (yard) and the RespTime

Reading time of the wrap-up region *(yard)*:					
Fixed effects:	Estimate	Std Error	df	t-value	Pr(>|t|)
(Intercept)	866.13	47.48	119.35	18.243	< 2e-16 ***
AnaType_factor1	125.71	31.11	480.56	4.040	6.21e-05***
Response Time					
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	4111.913	136.417	120.825	30.142	< 2e-16***
AnaType_factor1	556.307	101.291	480.915	5.492	6.44e-08***
AnaPred_factor1:Group_factor 1	694.446	344.069	480.915	2.018	0.044111*
Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					

Table 7.11 shows that the feminine pronoun *her* affects the response time only and this effect is only relevant for some groups of the participants, NE, ERE and REE. The interaction AnaPred*Group_factor1 is a significant with $p < .05$.

Figure 7.24 Response Time: effect of AnaPred*Group

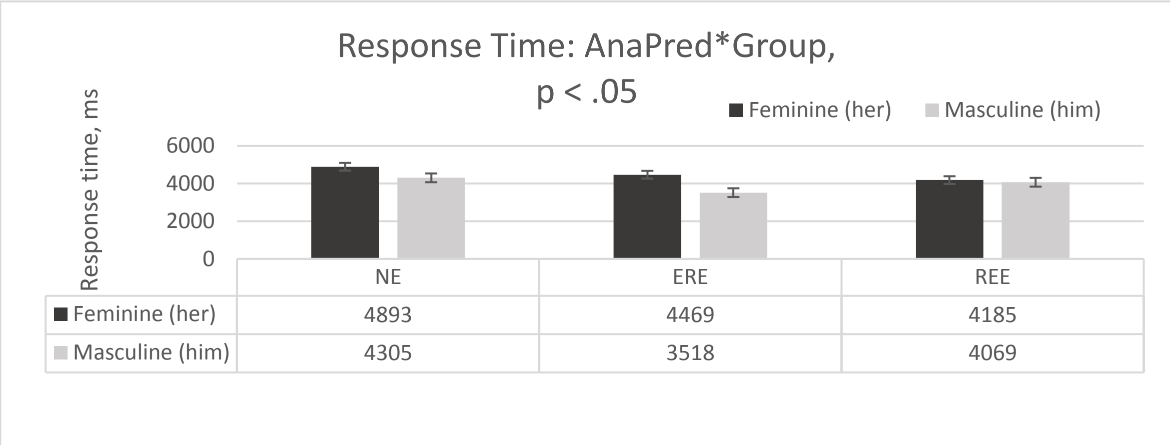


Figure 7.11 shows that both native (NE, ERE) and non-native (REE) speakers of English slow down their RespTime after the feminine pronoun *her*. Sensitivity to the effect caused by the feminine pronoun provides evidence that L2 speakers are capable of parsing sentences with the pronoun *her* in the TL-like manner. However, a strong effect of Group_factor1 shows that English-speaking monolinguals are more sensitive to the AnaPred effect than L2 speakers. The latter is expected for the intermediate level of L2 proficiency.

The analysis provided in this section shows that L2 speakers of English are sensitive to such a salient feature of their L2 as the feminine pronoun *her*. The same as in the native language, non-native parsing anticipates a noun that would follow the pronoun *her* and complete the possessive phrase. When the anticipated structure proves to be erroneous, the non-native parser needs time to amend it, which is again the same as in the native language.

7.4 Summary

This chapter presents the results of Experiment 2, which investigates sentence processing by L2 speakers of English and Russian. The participants were native speakers of either English or Russian with intermediate level of proficiency in their L2, Russian or English respectively. Some of the L2ers were tested in their respective L1s, the others in their respective L2s. Therefore, the groups of L2 speakers tested in their respective L1s create a base-line processing condition for the analysis of the parsing performance of the L2ers tested in their non-native languages.

The results analyzed in this chapter support all the theoretical predictions of grammar-governed parsing. Non-native speakers generate a top-down structural projection that needs to be reconsidered and dismissed after the parser encounters the complementizer that. The structural amendment towards a restrictive RC is performed bottom-up. It results in the generation of a new language-specific projection for the RC that ensures a language-specific pattern of anaphora resolution.

Non-native sentence processing at the intermediate level of L2 proficiency is L1-guided. However, the participants show a tendency to switch to the TL-like pattern of anaphora resolution in the L2. This becomes evident in the analysis of individual performance within the target groups tested in their L2s. L2 speakers of English whose proficiency is a bit higher than of the rest of the participants demonstrate the English-like preference in anaphora resolution. Besides, they are sensitive to salient language specific processing cues, such as the feminine pronoun her in English. All the evidence taken together shows that L2 speakers of English and Russian show a potential to process their non-native languages in a target-like manner when they become more proficient in their respective L2s.

Chapter 8 Discussion, Implications and Conclusion

8.1 Summary of findings

The dissertation investigated human sentence processing through the analysis of parsing behavior of native and non-native speakers of English and Russian. The main findings allow for the conclusion that human sentence parsing starts with a top-down structural prediction which is subject to bottom-up checks and amendments at every processing cycle. The second line of research established that L2 acquisition is a process where the existing grammar undergoes changing to accommodate the norms of the language being acquired. In the process of L2 acquisition, the two languages start influencing each other as early as intermediate level of L2 proficiency.

The main findings of the investigation of parsing mechanisms in a self-paced reading experiment are summarized in (8.1), (8.2) and (8.3) below. The summary of the results follows the order of the main research questions. First, the preferred type of anaphora resolution is provided. An overall preference for the pattern *'herself = the mother // her = the woman'* is expected to be evidence for a top-down structural parse. A language-specific type of anaphora resolution is evidence for the bottom-up parsing strategy. Second, the processing effects of a perception verb on the critical area mid-sentence are reported. Third, the results showing whether a perception verb increases general complexity of a sentence are given. Forth, the participants sensitivity to the effect of the feminine pronoun <u>*her*</u> is reported. The latter is evidence for predictive top-down structure building at the end of the sentence.

(8.1) Experiment 1. Monolinguals

1. Type of anaphora resolution: language-specific

2. RT at the embedded verb region: slowdowns in English, no effect in Russian

3. Verb type effect on processing complexity: slowdowns at the wrap-up region in English

4. Sensitivity to the pronoun her: slowdowns at the wrap-up region and in response time in English

(8.2) Experiment 2. Bilingual speakers tested in the L1

1. Type of anaphora resolution: language-specific

2. RT at the embedded verb region: slowdowns in English, no effect in Russian

3. Verb type effect on processing complexity: slowdowns at the wrap-up region in English

4. Sensitivity to the pronoun her: slowdowns in response time in English

(8.3) Experiment 2. Bilingual speakers tested in the L2

1. Type of anaphora resolution: language-specific

2. RT at the embedded verb region: slowdowns in L2-Russian (English-like behavior),

no effect in L2-English (Russian-like behavior)

3. Verb type effect on processing complexity: increases at the wrap-up region in English

4. Sensitivity to the pronoun her: slowdowns in response time in L2 English

Overall, the processing behaviour of the participants in both experiments shows evidence for the implementation of both top-down and bottom-up parsing algorithms. Increased reading times at the region of the embedded verb (number 2 in the summaries) are the results of the structural prediction ruled out at a later stage of sentence parsing. Besides, it is evidence that a perception verb at the beginning of the sentence triggers a structural prediction that remains valid till the parser encounters the complementizer. Therefore, sentence processing begins with a top-down structural prediction.

Increased reading time in the middle of the sentence (reported under number 3 in the summary) is evidence for a parsing conflict between a generated structural anticipation triggered by a perception verb and the restrictive RC. The conflict results in the amended RC structure that yields a language-specific preference for RC attachment and a language-specific pattern of anaphora resolution (reported as 1 in the summaries).

The participants' sensitivity to the effect of the feminine pronoun *her* (number 4 in the summary) is evidence for the parser's capability of generating several serial structural predictions throughout the course on a single sentence.

The second line of research is aimed at describing the developmental stage of intermediate level of L2 proficiency through the analysis of the participants' processing behaviour. The main findings in the analysis of the effect of another language on sentence processing are given in (8.4), (8.5) and (8.6) below. They summarize and enumerate the sets of results supporting the expected effects of crocc-linguistic influence in bilingual processing.

(8.4) evidence for L1 in L2 parsing:

anaphora resolution

reading time at the embedded verb

(8.5) evidence for TL-like parsing in L2:

sensitivity to the feminine pronoun her

(8.6) facilitative effects of L2 (Russian):

lower sensitivity to a perception verb in L1 English than in a monolingual group

faster recovery of the effect of a perception verb mid-sentence than in a monolingual group

The study shows effects suggesting that there is influence of the developing L2 in native language processing beginning from the intermediate level of L2 proficiency. However, L2 processing is mainly governed by L1 parsing strategies.

8.2 Parsing algorithms in sentence processing

The study used a self-paced reading experiment to investigate parsing algorithms in native and non-native sentence processing. The study consisted of two experiments that investigated adult monolingual speakers of English and Russian and adult L2 speakers of English and Russian whose proficiency in the L2 is much lower than in the L1.

Generative approaches to language processing established that human parsing is incremental and follows phrase structure. Mental structure-building can be performed in a top-down or a bottom-up manner. There is evidence that a structure generated as a top-down projection undergoes a bottom-up check for grammatical fitness (see Kazanina et al. 2007 for suggestive evidence of the combination of top-down and bottom-up algorithms). Besides, sentence processing observes a certain hierarchy of processing cycles because parsing decisions of the higher processing cycle shape the parsing of lower processing cycles if there is no grammatical conflict (Phillips & Schneider 2000).

The existing processing studies suggest that human parsing uses a combination of the two parsing algorithms: the top-down and the bottom-up one (Crocker 1999). However, the question of how exactly this combinatorial algorithm is implemented in online sentence parsing has not been studied systematically so far. The dissertation attempted to address this issue through the following set of research questions.

(8.7) The main research question of the dissertation, RQ 1

RQ 1: *Do top-down and bottom-up parsing algorithms complement each other in sentence parsing?*

(8.8) Subordinate research question to RQ 1

RQ 1.1: *Is there an overall preference for the pattern of anaphora resolution 'herself = the mother / her = the woman'?*

RQ 1.2: *Is there a language-specific pattern of anaphora resolution 'herself = the mother / her = the woman' in Russian and 'herself = the woman / her = the mother' in English?*

RQ 1.3: *Does a perception verb in the matrix clause increase sentence complexity at the embedded verb?*

RQ 1.4: *Does a perception verb in the matrix clause increase general sentence complexity?*

RQ 1.5: *Are there any factors rather than a perception verb that increase sentence complexity?*

The anticipated outcome of the processing experiment motivated the first hypothesis of the dissertation.

(8.9) Hypothesis 1 to RQ 1

Top-down and bottom-up algorithms complement each other in sentence processing: parsing starts with a top-down structural prediction that undergoes bottom-up checks for grammatical fitness at every processing cycle.

This section discusses the main processing results and follows the order prompted by the word-for-word sequence in online sentence presentation. The dissertation analyzed processing mechanisms through the examples of the sentence like in (8.10).

(8.10) Bill saw the mother of the woman [RC that was talking about herself / her in the yard].

This person was talking about:

(a) the mother *(b) the woman*

The linguistic organization of the sentence creates a favourable environment to test the main hypotheses of the dissertation. In the target sentence (8.10), a perception verb triggers a structural anticipation for either an eventive complement or an entity complement. The prospective complement can appear as a that-CP (eventive) or a DP (event / entity). In the CP complement, the matrix verb should be followed by the complementizer *that*. The absence of the complementizer signals a DP structural continuation. At this point, the eventive CP complement is ruled out in Russian.

After processing the DP complement *[$_{DP}$ the mother of the woman]*, the parser may anticipate the sentence to finish. If the sentence continues, Russian does not anticipate any linguistically motivated processing complexity after the complex DP is processed. However, English is different. On encountering the complex DP, the parser does not desregard the eventive complement as it can still be realized through the SC. The English parser anticipates a verbal constituent at the time it encounters the complementizer *that*. The complementizer is a point of structural conflict in English because it signals the upcoming RC. The RC means the prediction for an eventive complement should be abandoned. As a result, the English-like parser slows down at the next word, the embedded verb *talking*.

8.2.1 Processing effect of a perception verb

The dissertation establishes that a perception verb in the matrix clause causes longer reading times in English monolinguals at the embedded region. Bilingual participants, whose native language is English, are also sensitive to the effect of a perception verb and read the complementizer slower after a perception verb. When native speakers of English are tested in the L2 Russian they slow down at the embedded verb. The effect is different in Russian. Russian monolinguals and L2 speakers of English, whose native language is Russian, do not slow down their reading time at the embedded verb because a perception verb does not influence Russian sentence parsing much.

At the first processing cycle the linguistically motivated processing difficulty manifests itself in the region of the embedded verb. All native speakers of English slow down their reading time as they need to recover from the irrelevant structural prediction.

On top of showing processing effects at the critical area, the complementizer and the embedded verb, a perception verb slows down reading time at the wrap-up region in native speakers of English. Monolingual participants preserve the processing effect of a perception verb in the response time. Thus, a perception verb generates a structural projection for an eventive complement that competes with the restrictive RC and makes sentence parsing in English difficult.

8.2.2 Structural prediction at the end of the sentence

The dissertation also provides evidence that human sentence parsing is a multitask structure-building mechanism. The human parser considers all the structural prompts a sentence provides and uses this information in mental structure-building. The target sentence provides evidence that top-down structural prediction does not occur at the beginning of the sentence only. At the end of the sentence, the feminine pronoun triggers a structural prediction for a possessive phrase, ex., *[her daughter]*, that needs to be discarded after the parser encounters the preposition *in* (*in the yard)*.

In English, both native and non-native speakers slow down their response time to interpret the pronoun her. English monolinguals show the effect of the feminine pronoun a bit earlier that bilinguals. They slow down their reading pace at the last word of the sentence *yard*. L2 speakers of English, as well as, native speakers of English whose L2 is Russian, read the last word *(yard)* at their normal speed, but they show slower response time after the feminine pronoun *her*.

Both native and non-native speakers are sensitive to the effect of the feminine pronoun *her*. Therefore, both native and non-native speakers generate a structural projection at the end of the sentence and need time to recover from this misleading structure.

The effect of the feminine pronoun *her* pinpoints the fact that top-down structural projection occurs at any place in the sentence. So, the assumption that top-down structural prediction is the first step in sentence parsing is not enough to explain how mental structure-building is performed. Most likely, a new parsing prediction is generated after the current prediction is amended.

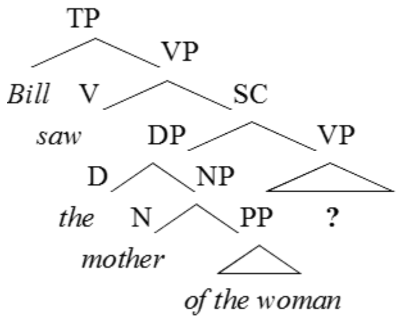
8.2.3 The role of bottom-up algorithm is sentence parsing

The main evidence for bottom-up parsing in the target sentence comes from the results on sentence interpretation, i.e. in the preferred pattern of anaphora resolution in English and Russian. To begin with, there are two possible outcomes of the comprehension task. The top-down parsing predicts an overall preference for anaphora resolution to be '*herself = the mother // her = the woman'* because a perception verb in the matrix clause triggers an eventive projection that favours HA of the following RC, i.e. the RC modifies the entire complex DP *[$_{DP}$ the mother of the woman]*.

An alternative pattern of anaphora resolution is predicted by the bottom-up parsing strategy. There would be no effect of a perception verb for the matrix clause, there would be no linguistic prompt to override a language-specific pattern of RC resolution in any language of the study, and the RC would show HA in Russian and LA in English. A language-specific preference for RC resolution yields a language-specific preference for anaphora resolution: *herself = the mother // her = the woman* in Russian and herself – *the woman // her = the mother* in English.

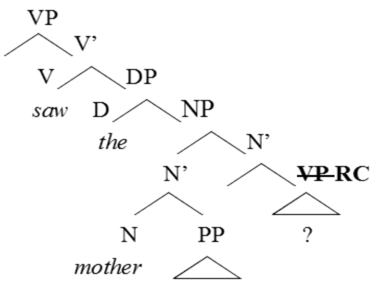
The results show preference for the pattern *herself = the mother // her = the woman* in Russian and *herself = the woman // her = the mother* in English, i.e. a language-specific pattern of anaphora resolution in all groups of participants. These results are evidence for bottom-up sentence processing. They also mean that the structural prediction triggered by a perception verb does not define sentence parsing all the way down the sentence but gets amended towards a language-specific pattern of RC resolution that yields a language-specific pattern of anaphora resolution. The process of structural correction unfolds in the following way (8.11), (8.12-8.13).

(8.11) A structural effect of a perception verb to favour HA of the RC

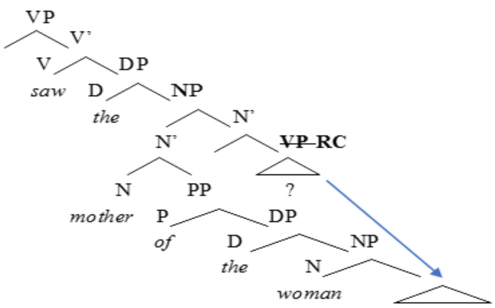


The tree structure in (8.11) shows that after processing the complex DP the English-like parser can still anticipate the verbal element. However, the complementizer follows. After processing the complementizer, the parser knows the up-coming constituent is the RC. At this point, the parser makes a bottom-up check and establishes a structural conflict between the expected VP and the up-coming RC. Consequently, the structure is amended.

(8.12) RC amendment in Russian



(8.13) RC amendment in English



A structural change results in the RC being attached low in English and high in Russian. This change ensures a language-specific pattern of anaphora resolution, that was obtained in the comprehension tack. Native speakers of Russian prefer the pattern *herself = the mother // her = the woman*, and native speakers of English prefer the pattern *herself = the woman // her = the mother*. L1 effect of anaphora resolution is discussed later in this section.

In summary, the effect of a top-down structural prediction shows in increased reading times at the critical regions throughout the sentence. However, the effect of a perception verb is not strong enough to shape the interpretation decision at the end of the sentence. Having evidence of both top-down and bottom-up parsing, the dissertation argues that structural amendment is fulfilled through bottom-up reanalysis of the erroneously generated structural projection. However, sentence parsing starts with a top-down structural prediction which governs sentence processing. In other words, structural prediction is the beginning of every processing cycle. Even in the middle of a sentence the amended structure triggers a new structural prediction that shapes the following processing cycle.

8.3 Knowledge of another language in sentence processing

The second aim of the study is to evaluate the participants' current developmental stage in the L2 through the investigation of their parsing mechanisms. This goal motivated the second research question of the study (RQ 2) and the two subordinate RQs that specify it (8.14).

(8.14) The main RQ2 and subordinate questions to RQ 2

RQ 2: *Does knowledge of another language at the intermediate level of proficiency have an effect on sentence parsing?*

RQ 2.1: *Is sentence parsing at the intermediate level of L2 proficiency influenced by L1 parsing hypothesis?*

RQ 2.2: *Is there evidence for L2-like sentence parsing in intermediate L2 speakers of Russian and English?*

The dissertation predicted a strong influence of the L1 in intermediate speakers of Russian and English. L2 acquisition begins with a full transfer of the L1 (Schwartz and Sprouse 1996) and the parser uses L1 parsing assumptions while it is waiting to get enough L2 input to re-assemble the current set of functional features to accommodate the norms of the L2 (Prévost & White 2000, Lardiere 2009, Slabakova 2014). Bearing in mind the amount of exposure to the TL, the dissertation puts forward the following Hypothesis (8.15):

(8.15) Hypothesis 2 to RQ 2

L2 processing at the intermediate level of proficiency is L1-governed and shows no evidence of L2 processing in the TL-like manner.

The second RQ 2 is only addressed in Experiment 2 where the population of L2 speakers of English and Russian were investigated. The statistical analysis reveals the effects of cross-linguistic influence in sentence processing

8.3.1 Evidence for L1-like parsing

The bilingual participants show a strong influence of the L1 in their preferred pattern of anaphora resolution and in their parsing mechanisms. First, the general pattern of anaphora resolution is L1-like in both L2 groups: *herself = the mother // her = the woman* in native speakers of Russian and *herself = the woman // her = the mother* in native speakers of English. In other words, the participants tested in the L2s stick to their L1-like pattern of anaphora resolution and show L1-like preference in the L2.

The influence of L1 also shows in sentence processing, i.e. in reading times at the embedded verb. L2 speakers show L1-like sensitivity to the effect of a perception verb. Native speakers of Russian do not slow down their reading time at the embedded verb even when they are tested in their L2 English. Their L1 Russian does not expect any special processing difficulty at the embedded verb, and the participants preserve this ease of processing in their L2.

The effect is the same in English. Native speakers of English read the embedded verb slower in both their L1 English and their L2 Russian. English expects a processing difficulty at the embedded verb. The expected difficulty remains in the L2-Russian. The latter means that L2 speakers of Russian have not developed enough sensitivity to the TL, which rules out the structural anticipation for an eventive complement much earlier than English. This limited sensitivity to the L2 at the intermediate level of proficiency in Russian was also attested in Sokolova (2018). The participants noticed the overt feminine gender morphology only when it was double marked, i.e. the noun was followed by the verb in the past tense and they both were marked for gender. In the current study, the participants missed the linguistic signal at the beginning of the sentence and did not disregard the eventive complement in Russian. It is evidence for L1-like parsing at the intermediate level of proficiency in the L2.

The effect of a perception verb is a strong measure of language-specific sentence processing. Native speakers of English show sensitivity to the perception condition, but native speakers in Russian do not. This pattern of behaviour is predicted by the grammar of both languages. At this point, L2 speakers show L1-like parsing in their respective L2s.

8.3.2 Potential for L2-like Parsing

There is also suggestive evidence for developing L2-like processing. However, the statistically significant examples of TL-like processing are not numerous. The latter is normal for an early post-initial stage in L2 acquisition.

Frist, there is variation in percentage of answer choices in anaphora resolution in the bilingual groups. A detailed analysis shows that the preferred percentage of L1-like choices in the L2 is different from the percentage of the choices in the L1. The overall pattern of anaphora resolution is changing towards TL-like when the participants are tested in the L2.

The tendency to switch to the TL-like pattern in anaphora resolution is supported by the result from the analysis of individual differences. The subgroup of higher proficient speakers of L2 English overcome the L1-like threshold and show TL-like pattern of anaphora resolution. Meanwhile, the general group results stay within the threshold of L1-like pattern of anaphora resolution. This evidence suggests a tendency to overcome the L1-like threshold in the interpretation pattern of anaphora resolution with the growth in L2 proficiency.

The assumption that anaphora resolution is developing towards the TL-pattern is indirectly supported by the processing results in group ERR, native speakers of English tested in the L2-Russian. Normally, the linguistic nature of the pronoun makes it more difficult to process than the reflexive. As a result, both L2ers and monolinguals experience processing difficulties in the sentences with the pronoun. However, L2 speakers of Russian struggle with the reflexive in the sentence with a perception verb.

The interpretation of the reflexive is the first interpretation effect a perception verb can have. Remember that English monolinguals prefer the higher noun for reflexives more often after a perception verb. L2 speakers of Russian (ERR) struggle with the constituent targeted by a perception verb too. First, Russian is a HA-language and they are acquiring this preference, even though the results show that L2 speakers do not overcome the threshold of L1-like interpretation patterns in the L2. Second, a perception verb prompts a switch to the higher noun even in their L1-English. The established processing difficulty shows in increased response time to the comprehension questions targeting reflexive resolution. It is difficult for L2 speakers of Russian to decide whether the reflexive is bound by the higher or the lower noun. This point of doubt works as indirect supportive evidence in favour of the speakers' developing sensitivity to the potential of a perception verb to favour HA of the RC and to the preference for HA in their L2 Russian.

A strong evidence for TL-like processing in the L2 comes from the prolonged response time in the sentences with the feminine pronoun *her*. It is an English-specific effect based on the homonymy of form between the pronoun *her* in the prepositional object about *her* and the possessive pronoun in the possessive phrase, like *her daughter*. The predicted effect shows in English native speakers. Besides, L2 speakers of English are sensitive to the effect of the feminine pronoun too. All the participants tested in English show slower response time after the feminine pronoun *her*.

8.3.3 Effects of Bilingualism

The study established some facilitative effect of the L2-Russian on sentence processing in the L1-English. The effect concerns a perception verb. The effect of a perception verb is neutralized by the knowledge of Russian, a language where a perception verb creates a congruent processing condition, as it favors HA of the RC.

The participants who know Russian are less subject to the effect of a perception verb in their L1-English. First, the L2ers tested in their L1-English are less confused by a perception verb in anaphora resolution than monolingual speakers of English. Second, English monolinguals read both the complementizer and the embedded verb slower in the sentences with a perception verb. Native speakers of English who know Russian recover from the processing difficulty at the embedded verb faster, they only slow down at the complementizer.

If measured through faster reading times, L2-Russian has a facilitative effect on sentence processing in the participants' L1-English. It means that even though sentence parsing in the L2 at the intermediate level of proficiency is L1-governed, the first knowledge of L2 has started influencing the unconscious representational knowledge of the speakers' L1. The studies of L1 grammatical attrition (see Hicks & Dominguez 2019 for discussion) investigate how the grammar of L1 can be re-arranged under the influence of L2. The current results of faster processing in English when the participants know Russian as their L1 can be explained by the same psycholinguistic mechanism that underlie L1 attrition. However, here the result is in faster and easier processing in the L1.

Another important observation comes from the established differences in the place of reading slowdown in the groups of native speakers of English tested in their L1 and their L2. Both groups slow their reding time down in response to the effect of a perception verb. However, the effect shows later in the group tested in their L2-Russian. This result was predicted by Dekydtspotter et al. (2006) in the authors' warning against direct comparisons between native and non-native groups in processing experiments.

In summary, L2 processing at the intermediate level of L2 proficiency is L1-guided. L1 grammar sets the initial parsing hypothesis in the L2. In the nonnative languages, L2 speakers speed up or slow down their reading time in accordance with their L1 parsing hypothesis. The influence of L1 also shapes the overall pattern of anaphora resolution.

Suggestive evidence for TL-like sensitivity to linguistic phenomena comes from the effect of the feminine pronoun *her* in English. There also facilitative effects of the knowledge of Russian in sentence processing in the L1. Taken all the evidence together, the dissertation claims that both languages in the process of L2 acquisition influence each other from the very early levels of L2 proficiency. Therefore, L2 acquisition is a process of readjusting the existing grammar to accommodate the norms of the language being acquired.

8.4 Theoretical Implications of the dissertation

The dissertation approaches human sentence processing from two perspectives. It investigates the process of mental structure-building and analyses the established processing behavior to describe the intermediate level of L2 proficiency. In the investigation of parsing algorithms, the dissertation manages to show the combinatorial nature of the human parser that uses both top-down and bottom-up parsing algorithms. The nature of the human parser is described through a step-by-step analysis of sentence parsing that unfolds in real time.

The findings support the theories of grammatically constrained sentence parsing (Frazier & Fodor 1978, Gibson et al. 1996, van Gompel 2000, among others). All the processing effects observed in the study were originally predicted based on the linguistic analysis of the target sentences. All the processing difficulties observed occurred either at the places of a structural conflict or they were predicted by the linguistic nature of a constituent (for ex., the processing effect of the pronoun). However, the observed effects may have a different degree of salience depending on various experimental conditions. The best example of grammar-constrained processing in both native and non-native languages is anaphora resolution. It follows the Binding Principles (Chomsky 1986) and depends on the preferred type of RC resolution. The dissertation established the Russian-like and the English-like pattern of anaphora resolution. The former follows the high attachment preference for the RC in Russian. The latter is a result of low attachment, preferred in English.

Processing effects of a grammatically constrained parse are the increased reading times to process the pronoun, as compared to the reflexive; the prolonged reading times after the complementizer *that*; and the processing effect of the feminine pronoun *her*. The experiments demonstrate an effect of the pronoun to increase the reading time as compared to the processing of the reflexive in both English and Russian and in both native and non-native processing. As argued by Kenninson (2003), a pronoun is charged for a long-distance search for a potential antecedent. In the context of a complex sentence, the most salient antecedent for the pronoun is the grammatical subject. The current findings show that in both languages of the experiment and in all the target groups the pronoun is processed slower than the reflexive. Therefore, a potential to be co-referent with the matrix subject suggested by Kenninson (2003) may be the reason of the processing effect in the target sentences.

The evidence for structural prediction in sentence parsing supports the theoretical claims that the human parser is incremental (Gibson 1996, Frazier & Clifton 1997, Fodor 2002, Phillips & Schneider 2000). The dissertation traces mental structure-building from the beginning of the sentence to its end. It establishes the existence of processing cycles and shows how a top-down structural prediction is amended by a bottom-up check for grammatical fitness.

The results of the dissertation develop but do not fully support the predictions by Philips and Schneider (2000). The thesis shows that sentence processing is cyclic. However, the thesis does not show any evidence of hierarchy in processing cycles. A parsing decision made at the higher processing cycles does not shape the parsing at the lower levels. Thus, the claim put forward by Phillips & Schneider (2000) is not confirmed in the dissertation. The originally generated structure undergoes a bottom-up check and is amended within a cycle. The amended structure generates a new prediction and the cycle repeats.

Important evidence for structural prediction is the increased reading time after the complementizer _that_ in English. The processing effect of the feminine pronoun tells us that structural anticipations can be generated multiple times during sentence processing. The latter prompts a conclusion that there are certain processing cycles. At the end of a cycle, the generated structure can be amended, and a new projection will be immediately generated. These findings partly support the main processing assumptions in the field. First, the predictive nature of the human parser, where an anticipated structure is generated in the top-down manner is supported (Aoshima et al. 2004, Kazanina et al. 2007, Phillips 2013). Increased processing time after the complementizer evidences for the erroneous structural prediction built in the top-down manner. However, the top-down parser is not the only algorithm that governs sentence processing.

Kazanina et al (2007) suggested that the original search for an antecedent in cataphora resolution is performed in a top-down manner but the check for morphological fit of the potential antecedent is performed in a bottom-up fashion. Crocker (1999) offered a mechanism that combines both the top-down and the bottom-up algorithms, it was called the left-corner parser. The thesis supports the claim that top-down and bottom-up processing complement each other. Our findings add to the results of Kazanina et al (2007) and allow for a theoretical assumption that the originally generated structural prediction undergoes bottom-up checks mid-sentence. The findings that the generated projection can be amended is new. At the same time, the claim that the amendment of a structure results in a newly generated projection goes in line with Crocker (1999) in the part where the author assumes that the parser consults with the already processed information to generate a top-down structural prediction.

The dissertation brought up a question of prediction in sentence processing, which has been studied by several processing models. Multiple sources of information inform sentence processing in the models suggesting parallel processing, i.e. in constraint-based approaches to human language processing (Tannenhaus et al. 1994, 1995) and the Surprisal, a computerized model (Levy 2008). Multiple predictions are also considered by the race model (van Gompel et al. 2000), which is a model of serial parse. The fact that semantics of a perception verb influences sentence processing is compatible with constraint-based models (Tannenhaus et al. 1994). However, verb semantics does not play any disambiguating function in the target sentences as would be predicted by the strong version of the constraint-based models. The categorization 'perception – non-perception' explains the selectional properties of the matrix verb and clarifies how certain structural predictions are made. Therefore, the results of the thesis reflect mental structure building which is investigated separately of any influence from other sources of linguistic information, at least, in the current experimental design. Besides, the analysis is not compatible with the theories of parallel processing. It is true that the parser can generate multiple structural anticipations. However, only one structure takes the upper hand and is generated at a time. The erroneous projection causes a processing conflict mid-sentence where the structure is amended, and another single projection is generated. These findings support the theories of serial parse (Frazier & Fodor 1978, Gibson et al. 1996, among many others) and are mostly compatible with the predictions of the race model (van Gompel et al. 2000).

One of the theoretical assumptions of the study followed the analysis by Grillo and Costa (2014) and checked for the effect of a perception verb in sentence processing. Grillo et al. (2015) reported a switch to HA in RC resolution in English as an effect of a perception verb in the matrix clause. The findings by Grillo and collaborators (2014, 2015) are partly confirmed. There is an effect of a perception verb in English. Speakers of English tend to prefer HA more often after a perception verb and this verb increases processing load. However, the effect is not as strong as in Grillo et al. (2015).

The failure to replicate the results by Grillo et al. (2015) in full is difficult to explain. The thesis borrowed and developed the scholars' idea and investigated the effect of a perception verb from the processing perspectives. The study suggested that a perception verb has a universal potential to generate multiple structural anticipations, one of which is always an eventive complement. The eventive complement can have different structural realizations in different languages, which would result in different language-specific processing effects. The latter explains the processing results received for English and Russian in the dissertation.

The study performed in the dissertation covers the area of native and non-native sentence processing. It provides additional evidence supporting structural processing in non-native languages. The participants in Experiment 2 show either English-like or Russian-like patterns of processing behavior. No processing patterns that would suggest a special parsing behavior of non-native speakers were attested. The results of the study become problematic for the SSH (Clahsen & Felser, 2018) in non-native processing and support the proponents of the structural parse in the L2 (Dekydtspotter et al., 2008; Hopp, 2014a, 2014b, 2015, 2016a, 2016b; Sokolova and Slabakova 2019, among others).

On top of the analysis of non-native parsing behavior, the study characterizes the level of L2 proficiency through the analysis of the processing patterns demonstrated in the study. This approach supports the scholarly assumptions of the role of the parser in language acquisition.

The study shows a decisive role of L1 in L2 sentence parsing which characterizes the intermediate level of L2 proficiency as an early post-initial stage of L2 acquisition. There are also results showing the parser’s sensitivity to the L2-specific cues in non-native sentence processing. This is evidence that the L2 is being parsed for acquisition and is being acquired (Dekydtspotter et al. 2008, Lardiere 2009, Slabakova 2014, Sokolova & Slabakova 2019). Finally, there is evidence for facilitative effects of Russian in sentence processing in the L1-English which means L2 is being integrated into the existing grammar.

The dissertation adds to the literature in sentence processing. It provides a detailed analysis of how top-down and bottom-up algorithms complement each other in sentence parsing. The dissertation also adds to the studies in adult L2 acquisition and shows that L2 acquisition is an integrated process where the L1 and the L2 influence each other from very early stages of L2 development.

8.5 Limitation and suggestions for further research

The dissertation investigates the mechanisms of human sentence processing. It establishes that top-down and bottom-up algorithms complement each other in sentence parsing. The study shows that sentence parsing is performed in cycles, each of which starts with a top-down prediction that is verified and amended in the bottom-up manner within the cycle.

The dissertation operates the term cycle and understands it as a piece of linguistic structure where a linguistically motivated parsing operation is performed. However, the term cycle needs to be specified and defined properly. In further studies following linguistic approaches to sentence processing, the definition of *cycle* will depend on the phenomenon under investigation, for example, a movement cycle. In this case, a series of studies investigating different linguistic phenomena will need to show the same implementation of parsing algorithms within a given cycle.

The dissertation touches upon the problem of L2 development towards the behavior in the TL-like manner with the growth of L2 proficiency. This explanation is used to account for the pattern of L2 anaphora resolution which does not overcome the threshold L1-like preference. The anticipated development means the participants with a higher L2 proficiency will show TL-like results in anaphora resolution. A replication of the current study with advanced speakers of L2 English and Russian will either support or belie this developmental assumption.

If a follow-up study with more proficient L2 speakers returns the same results as in this thesis, the explanation will be different. The current pattern of anaphora resolution in L2 is around 50% choices. Similar results were interpreted as 'no preference' by Felser et al. (2003) and called 'performance at chance'. These results will mean no distinct preference for a certain interpretation pattern, but they may have a different explanation from the one offered by Felser et al. (2003). No distinct preference may result from co-activation of both languages of the participants in sentence processing (Cunnings 2019, personal communication). In this case, 'no preference' means, first, a certain developmental stage and second, a certain developmental path. The developmental stage means that beginning from the intermediate level and above, the L2 grammar is formed enough to inform online structure building in sentence processing. L2 is co-activated and optionality of ambiguity resolution influences interpretation decisions of L2 speakers. The developmental path means, that the parser may be learning a set of new parsing strategies that would satisfy both grammars, the L1 and the L2. In this case, recognizing the structural optionality of ambiguous sentences is enough for successful parsing. Therefore, even advanced L2 speakers can show what is called 'results around chance' in ambiguity resolution. The latter is indirect evident of a single grammar in the mind of a speaker. This grammar is being updated with the L2 input information to the level where it can satisfy the parsing need of both languages. In this case no linear development from the L1-like performance to the performance in the TL-like manner can be expected with the growth in L2 proficiency.

The facilitative effects of the knowledge of another language on sentence processing in L1 also suggest that L2 acquisition is an integrated process where the languages influence each other from the very beginning. Therefore, the L2 is being integrated into the existing grammar and becomes a part of it. If both languages form a single grammar that informs sentence parsing an experiment with code-switched sentences will highlight it. A code-switched stimulus set is, in a way, a 'unified' language that embraces both the L1 and the L2 and keeps them activated. This design will create a favourable platform for processing experiments.

8.6 Conclusion

The dissertation uses complex syntactic strings to investigate sentence processing in native and non-native languages. The main aim of the processing study is to describe the mechanism that organizes the words presented in a linear order into hierarchical structures that are parsed for comprehension. The dissertation also describes the developmental stage of intermediate L2 acquisition through the analysis of the participants' parsing behavior.

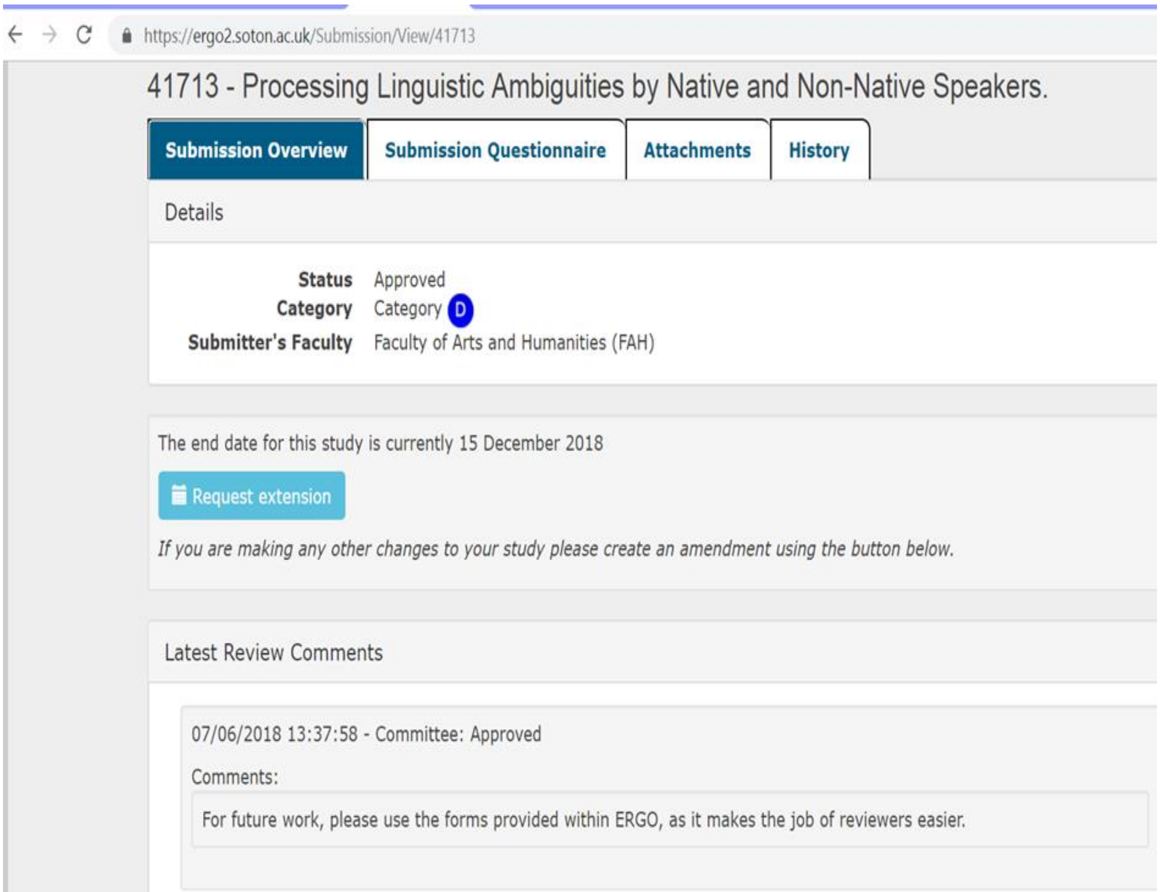
The findings support the scholarly claim that sentence parsing is structural and incremental (Frazier & Fodor, 1978; Phillips, 1996; Phillips, 2013, among others). The dissertation shows that a sentence can be parsed in several cycles (Phillips & Schneider, 2000) each of which would be operated through a combination of a top-down + bottom-up mechanism (Kazanina et al., 2007).

The dissertation supports the approaches to L2 acquisition where the ability of the human parser to establish the mismatches between the current state of grammar and the L2 input is a driving force for L2 acquisition (Fodor, 1998a, 1998b, 1998c; Dekydtspotter et al., 2006; Sprouse, 2011). The results of the non-native processing show that it is mainly governed by the L1. However, there are instances of TL-like sensitivity to the L2-specific phenomena in the L1. Furthermore, the limited amount of L2 knowledge already has a facilitative effect on L1 processing.

In addition, the dissertation is the first attempt to analyze non-native parsing and offer a description of the mechanism that governs processing of a certain type of sentence. The experiment in the dissertation opens the door for new research that would develop and specify its findings.

Appendix A Experiment: Procedure

A.1 Ethics Approval (ERGO II)



A.2 Information Flyer

INFORMATION FLYER 7

Hello!
We would like to invite you to participate in a research study on sentence processing and comprehension. We seek to document the manner in which people interpret sentences. We are looking for the people who speak English and know Russian up to the intermediate level.

If you agree to be in the study, the first step will be to make an appointment with the researcher, Marina Sokolova.

When we meet for the study,
you will first be asked to fill out a background questionnaire.
Then, Marina will have you read sentences on her laptop screen and respond to questions by pushing buttons on a standard keyboard.
While you are reading, the computer program records your answers and the time you take to read every word on the screen.
There will be around 90 sentences. You will have to read them at your normal pace. The entire study should last 30 - 35 minutes.

After you have participated, Marina will be glad to discuss the results with you.
If you are ineterested, please, contact.
Marina Sokolova (872)2322567
msokolopez@gmail.com; M.Sokolova@soton.ac.uk

A.3 Recruitment Email

Dear student,
A researcher from the University of Southampton, UK, is seeking current American students who are at least 18 years of age and know Russian at Intermediate level to participate in her study. The purpose of this study is to compare how people read and understand sentences in their native and non-native language.
Participation in the study involves:

- A time commitment of 30minutes
- Coming to campus to meet with the researcher
- A chocolate bar as a thank you for participation

For more information of this study, please, contact the investigator, Marina Sokolova, by phone at 872-232-2567 or via email at msokolopez@gmail.com or M.Sokolova@soton.ac.uk

Thank you,
Marina Sokolova, PhD
Principal Investigator
Study Title: Processing linguistic ambiguities in native and non-native speakers.

A.4 Consent Form

CONSENT FORM

Study title: Processing Linguistic Ambiguities by Native and Non-Native Speakers

Researcher name: Marina Sokolova, PhD research student
Prof. Roumyana Slabakova (supervisor)
Chair of Applied Linguistics
Modern Languages and Linguistics
The University of Southampton, UK
Research Professor (20%)
NTNU, Norway
Trondheim

ERGO number: 41713

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet *(07.11.2018____ /version no. of participant information sheet_7____)* and have had the opportunity to ask questions about the study.	
I agree to take part in this research project and agree for my data to be used for the purpose of this study.	
I understand my responses will be anonymised in reports of the research.	
I understand my participation is voluntary and I may withdraw (at any time) for any reason without my rights being affected.	

Name of participant (print name)……………………………………………………………

Signature of participant…………………………………………………………………….

Date…………07.11/18……………………………………………………………………….

Name of researcher (print name)…………Marina Sokolova…………………………

A.5 Background Questionnaire

BACKGROUND QUESTIONNAIRE

English Translation

Code number: _________________

Processing Linguistic Ambiguities by Native and Non-Native Speakers

Native Language(s): ____

Country of origin: ____

Education: ____

Gender: **M** / **F** Age: __________________

Are you dyslexic? **Yes** **/** **No**

Experience in Russian:

Please indicate the number of years you studied Russian at the following levels:

Elementary School	**1**	**2**	**3**	**4**	**5**	**6**	
Middle School		**1**	**2**	**3**	**4**	**5**	**6**
High School	**1**	**2**	**3**	**4**	**5**	**6**	

College ___ semesters / ___quarters / ___years

Experience in Russian-speaking countries:

How long have you spent (in months and years) in Russian-speaking countries (please indicate country), and in what capacity (were you studying, working, etc.)?

Which other languages have you studied? For how long?

1.

2.

3.

How would you rate your ability to read fluently in Russian?

0 1 2 3 4 5 6 7 8 9

very slow reader very fluent reader

How good are you sounding out Russian words?

0 1 2 3 4 5 6 7 8 9

Very poor very good

On a typical day, how much time do you spend:

watching television in Russian?

listening to the radio in Russian?

reading in Russian? *(including books, magazines, websites, etc.)*

speaking Russian with your friends?

Appendix B Experiment: Proficiency Measure.

B.1 C-test: L2 Proficiency

C-test

For Native Speakers of Russian

Assignment: Fill in the gaps where you feel necessary

Задание: Заполните пропуски, где Вам кажется уместным

Today is the best day of my life! I say this every day before I even get out of bed! Then I think___ what I am____ grateful for____ - a nice warm____ bed, here____ in my____ house, wonderful____ day, coffee____, running water____, a nice____ house, etc. Then____ I get____ up!

As I drove____ into town____ I saw a lady____ my grandma____ knew. I stopped____ and offered____ her a ride____, which she____ gladly accepted. I dropped her off at her destination, less than five minutes away.

That's an act of kindness in one trip to town, I thought. Now I will write it up for Help Others and maybe they will be contagious!

From https://www.kindspring.org/story/view.php?sid=31665, abridged version

There are many possible causes of insomnia. Sometimes th____ is o____ main ca____, but of____ several factors____ interacting together____ will cause____ a sleep disturbance____. The causes____ of insomnia____ include psychological____, physical or____ temporary factors____. A lack____ of a good____ night's sleep____ can lead____ to various____ problems and____ a vicious____ circle could____ develop. Professional counselling from a doctor, therapist or sleep specialist can help individuals cope with these conditions.

Based on the information from https://www.medicalnewstoday.com/articles/9155.php and https://sleepfoundation.org/insomnia/content/what-causes-insomnia

The American education system has varied structures which are set at state level. For most____ children, compulsory____ schooling starts____ at around____ the age____ of five____ to six____, and runs____ for twelve____ consecutive years____. Education is____ mandatory till____ the age____ of at____ least sixteen____ in all____ states, with____ some requiring____ students to____ stay in____ a formal education setting to eighteen.

Usually pre-school, known as pre-K or pre-kindergarten, is offered for children aged from around three to five years old. Kindergarten is the first year of compulsory education, which is typically taken at the age of five or six. Education then runs for twelve years.

From https://transferwise.com/us/blog/american-education-overview, abridged version

C-test

For Native Speakers of English

Задание: Заполните пропуски, где Вам кажется уместным

Task: Feel in the gaps where you feel appropriate

Исследователи из трех американских университетов и одного колледжа выяснили, что от вирусных инфекций страдают те, кто мало спит.

Для лю____, которые сп____ по 5-6 ча____ в су____, вероятность подхв____ инфекцию в чет____ раза вы____, чем дл___ тех, к____ спит более 7 ча___. Тот, к____ спит е____ меньше, подве____ себя е____ большему ри____. При продолжи____ ежесуточного с____ менее 5 ча____ статистика заболеваний увелич____.

Ка____ отметил ведущий автор исследования, доцент психиатрии Университета Калифорнии в Сан-Франциско Арик Пратер: «Сон выходит за рамки всех других факторов, которые были измерены. Не имеет значения, насколько люди стары, их уровень стресса, их раса, образовани или доход».

Based on the materials from https://subscribe.ru/catalog/socio.people.behealthy2/thread/?pos=125

Школьники в России учатся в средней школе 9 или 11 лет.

После окон____ девятого кла____ они мо____ учиться дал____ в професси____ училище и____ техникуме. А по____ окончания одинна____ класса школ____ получают атте____ о сре____ образовании и мо____ поступать в униве____ или инст____. Кто по____ одиннадцатого кла____ сдал в____ экзамены н____ пятерки, полу____ золотую мед____.

С четвертого класса школьники изучают один иностранный язык: английский, немецкий, французский или испанский. По интересам ребята могут выбирать факультативы.

Based on the materials from https://edunews.ru/education-abroad/sistema-obrazovaniya/shkolnoe.html

У нас очень дружная семья: я, мама, папа и бабушка. Каж____ год м____ празднуем д____ рождения вс____ членов на____ семьи, и хо____ есть мн____ других замеча____ праздников, де____ рождения – са____ любимый. В эт____ день м____ всегда стар____ порадовать имени____, приготовить сюр____, сделать эт____ день незабы____.

Когда м____ исполнилось се____ лет, м____ вместе с мамой и папой поехали в зоопарк. Мне давно хотелось там ещё раз побывать, но поездка всё время откладывалась, так как родители много работают. В этот день мама разбудила меня пораньше и сообщила радостную новость: у них выходной и мы все вместе едем в зоопарк! Это был самый замечательный день в моей жизни!

From https://nsportal.ru/ap/library/literaturnoe-tvorchestvo/2013/09/08/sochinenie-moy-luchshiy-den, abridged version

B.2 Post-test: Anaphora Resolution in the Non-Native Language (L2)

For L2-Russian / L1-English

Read Russian sentences in bold type. There are English explanations under each sentence. Decide whether the English interpretations are accurate and highlight "Yes / No / Cannot decide" according to your understanding

Вова думает, что Иван смотрит на него

The sentence means that Vova may look at Ivan

Yes / No / Cannot decide

Иван смотрит на себя

The sentence means that Ivan looks at Ivan

Yes / No / Cannot decide

Вова думает, что Иван смотрит на себя

The sentence means that Ivan may look at Vova

Yes / No / Cannot decide

Иван смотрит на него

The sentence means that Ivan looks at another male person

Yes / No / Cannot decide

Света думает, что Мария смотрит на нее

The sentence means that Maria looks at another female person

Yes / No / Cannot decide

Мария смотрит на себя

The sentence means that Maria looks at Maria

Yes / No / Cannot decide

Света думает, что Мария смотрит на себя

The sentence means that Maria may look at Sveta

Yes / No / Cannot decide

Мария смотрит на нее

The sentence means that Maria looks at another female person

Yes / No / Cannot decide

Иван думает, что Мария смотрит на себя

The sentence means that Maria may look at Maria, not at Ivan

Yes / No / Cannot decide

Иван думает, что Мария смотрит на него

The sentence means that Maria may look at Ivan

Yes / No / Cannot decide

Мария думает, что Иван смотрит на себя

The sentence means that Ivan may look at Ivan, not at Maria

Yes / No / Cannot decide

Мария думает, что Иван смотрит на нее

The sentence means that Ivan may look at Maria

Yes / No / Cannot decide

Мария смотрит на нее

The sentence means that Maria looks at Maria

Yes / No / Cannot decide

Света думает, что Мария смотрит на себя

The sentence means that Maria may look at Maria, not at Sveta

Yes / No / Cannot decide

Мария смотрит на себя

The sentence means that Maria looks at another female person

Yes / No / Cannot decide

Света думает, что Мария смотрит на нее

The sentence means that Maria may look at Sveta

Yes / No / Cannot decide

Иван смотрит на него

The sentence means that Ivan looks at Ivan

Yes / No / Cannot decide

Вова думает, что Иван смотрит на себя

The sentence means that Ivan may look at Ivan, not at Vova

Yes / No / Cannot decide

Иван смотрит на себя

The sentence means that Ivan looks at another man

Yes / No / Cannot decide

Вова думает, что Иван смотрит на него

The sentence means that Ivan may look at Vova

Yes / No / Cannot decide

For L2-English / L1-Russian

Прочитайте английские предложения и русские комментарии к ним. Решите соответствует ли комментарий смыслу английского предложения. Укажите «Да / Нет / Не могу решить» соответственно.

Vova thinks that Ivan looks at him

Предложение означает, что Вова, возможно, смотрит на Ивана

Да / Нет / Не могу решить

Ivan looks at himself

Предложение означает, что Иван смотрит на Ивана

Да / Нет / Не могу решить

Vova thinks that Ivan looks at himself

Предложение означает, что Иван, возможно, смотрит на Вову

Да / Нет / Не могу решить

Ivan looks at him

Предложение означает, что Иван смотрит на другого человека мужского пола

Да / Нет / Не могу решить

Sveta thinks that Maria looks at her

Предложение означает, что Мария смотрит на другого человека женского пола

Да / Нет / Не могу решить

Maria looks at herself

Предложение означает, что Мария смотрит на Марию

Да / Нет / Не могу решить

Sveta thinks that Maria looks at herself

Предложение означает, что Мария, возможно, смотрит на Свету

Да / Нет / Не могу решить

Maria looks at her

Предложение означает, что Мария смотрит на другого человека женского пола.

Да / Нет / Не могу решить

Ivan thinks that Maria looks at herself

Предложение означает, что Мария, возможно, смотрит на Марию, не на Ивана

Да / Нет / Не могу решить

Ivan thinks that Maria looks at him

Предложение означает, что Мария, возможно, смотрит на Ивана

Да / Нет / Не могу решить

Maria thinks that Ivan looks at himself

Предложение означает, что Иван, возможно, смотрит на Ивана, не на Марию.

Да / Нет / Не могу решить

Maria thinks that Ivan looks at her

Предложение означает, что Иван, возможно, смотрит на Марию

Да / Нет / Не могу решить

Maria looks at her

Предложение означает, что Мария смотрит на Марию.

Да / Нет / Не могу решить

Sveta thinks that Maria looks at herself

Предложение означает, что Мария, возможно, смотрит на Марию, не на Свету

Да / Нет / Не могу решить

Maria looks at herself

Предложение означает, что Мария смотрит на другого человека

Да / Нет / Не могу решить

Sveta thinks that Maria looks at her

Предложение означает, что Мария, возможно, смотрит на Свету.

Да / Нет / Не могу решить

Ivan looks at him

Предложение означает, что Иван смотрит на Ивана

Да / Нет / Не могу решить

Vova thinks that Ivan looks at himself

Предложение означает, что Иван, возможно, смотрит на Ивана, не на Вову.

Да / Нет / Не могу решить

Ivan looks at himself

Предложение означает, что Иван смотрит на другого человека

Да / Нет / Не могу решить

Vova thinks that Ivan looks at him

Предложение означает, что Иван, возможно, смотрит на Вову

Да / Нет / Не могу решить

Appendix C

C.1 Experiment: Stimuli Design

<u>Criterion 1:</u>

- the verb in the RC should accept the reflexive
- the embedded verb is not a reflexive verb, the reflexive is a prepositional object
- balanced between English and Russian

Possible embedded verbs:

<u>speak about</u> [herself / her] – говорила о [себе / ней] in the yard

<u>look at</u> [herself / her] – смотрела на [себя / нее] in the mirror

(in Russian there is a reflexive verb form *smotrelas*' but *smotrela na sebya* is equally frequent)

listen to – in Russian there will be no preposition

talk to – a synonym to *speak*

16 times with:

<u>speak about</u> [herself / her] – говорила о [себе / ней] in the yard

16 times with:

<u>look at</u> [herself / her] – смотрела на [себя / нее] in the mirror

<u>Criterion 2:</u>

- the head nouns must be of the same gender to keep the grammatical ambiguity in Russian
- the order of the head nouns is balanced
- the gender of the head nouns is balanced

16 manipulations for the verb <u>*speak about*</u>

8 feminine

mother x woman (in one quadruple = 4 times)

daughter x woman (in another quadruple = 4 times)

8 masculine

father x man (in one quadruple = 4 times)

son x man (in another quadruple = 4 times)

16 manipulations for the verb <u>*look at*</u>

8 feminine

niece x neighbour (in one quadruple = 4 times)

aunt x neghbour (in another quadruple = 4 times)

8 masculine

nephew x neighbor (in one quadruple = 4 times) uncle x neighbour (in another quadruple = 4 times)

Criterion 3:

- two perception and two non-perception verbs are balanced within a quadruple (experimental condition)

16 properly balanced sentences with the embedded verb *look at*

perception: see

non-perception: call

16 properly balanced sentences with the embedded verb *speak about*

perception: hear

non-perception: arrest

Criterion 4:

- two type of anaphora are balanced within a quadruple: the reflexive and the pronoun (experimental condition)
- both types of anaphora are balanced for gender

16 properly balanced sentences with the embedded verb *look at*

reflexive: herself

pronoun: her

16 properly balanced sentences with the embedded verb *speak about*

reflexive: himself

pronoun: him

Full stimuli set:

(4 = balanced across experimental conditions + feminine gender for the head nouns)

Bill heard the mother of the woman that was speaking about herself in the yard

Bill heard the mother of the woman that was speaking about her in the yard

Bill arrested the mother of the woman that was speaking about herself in the yard

Bill arrested the mother of the woman that was speaking about her in the yard

(the same 4 = balanced across the semantic weight/position of the noun)

Bill heard the daughter of the woman that was speaking about herself in the yard

Bill heard the daughter of the woman that was speaking about her in the yard

Bill arrested the daughter of the woman that was speaking about herself in the yard

Bill arrested the daughter of the woman that was speaking about her in the yard

8 in total for the feminine gender + the verb *speak about*

(4 = balanced across experimental conditions + masculine gender for the head nouns)

Ann heard the father of the man that was speaking about himself in the yard

Ann heard the father of the man that was speaking about him in the yard

Ann arrested the father of the man that was speaking about himself in the yard

Ann arrested the father of the man that was speaking about him in the yard

(the same 4 = balanced across the semantic weight/position of the noun)

Ann heard the son of the man that was speaking about himself in the yard

Ann heard the son of the man that was speaking about him in the yard

Ann arrested the son of the man that was speaking about himself in the yard

Ann arrested the son of the man that was speaking about him in the yard

8 in total for the masculine gender + the verb *speak about*

16 sentences with the verb *speak about*

(4 = balanced across experimental conditions + feminine gender of the head nouns)

John saw the niece of the actress that was looking at herself in the mirror.

John saw the niece of the actress that was looking at her in the mirror.

John called the niece of the actress that was looking at herself in the mirror.

John called the niece of the actress that was looking at her in the mirror.

(the same 4 = balanced across the position of the head nouns)

John saw the aunt of the actress that was looking at herself in the mirror.

John saw the aunt of the actress that was looking at her in the mirror.

John called the aunt of the actress that was looking at herself in the mirror.

John called the aunt of the actress that was looking at her in the mirror.

8 in total for the feminine gender + the verb *look at*

(4 = balanced across experimental conditions + masculine gender of the head nouns)

Mary saw the nephew of the actor that was looking at himself in the mirror.

Mary saw the nephew of the actor that was looking at him in the mirror.

Mary called the nephew of the actor that was looking at himself in the mirror.

Mary called the nephew of the actor that was looking at him in the mirror.

(the same 4 = balanced across the semantic weight/position of the noun)

Mary saw the uncle of the actor that was looking at himself in the mirror.

Mary saw the uncle of the actor that was looking at him in the mirror.

Mary called the uncle of the actor that was looking at himself in the mirror.

Mary called the uncle of the actor that was looking at him in the mirror.

8 in total for the masculine gender + the verb *look at*

16 sentences with the verb look at

Comprehension check for *speak about*:

This person was speaking about:

a) the mother b) the woman

This person was speaking about:

a) the father b) the man

Comprehension check for *look at*:

This person was looking at:

a) the niece b) the actress

This person was looking at:

a) the nephew b) the actor

Appendix D Statistics Report: Non-Significant Data

D.1 Monolingual Study

D.1.1 General pattern of anaphora resolution

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1:AnaType_factor1	0.09603	0.05100	1239.02331	1.883	0.0600 .

D.1.2 Reading time at the embedded verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1:AnaType_factor1	21.475	33.500	1239.013	0.641	0.52162
Group_factor1	73.35	48.31	40.00	1.518	0.1368

D.1.3 General processing complexity: effect of a perception verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
AnaType_factorpronoun	135.91	76.91	1239.01	1.767	0.0774 .
VerbType_factorPerception	-72.97	76.91	1239.01	-0.949	0.3429
VerbType_factor:AnaType_factor	142.82	108.76	1239.01	1.313	0.1894

D.1.4 General processing complexity: other linguistic factors

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	18.43	50.73	81.74	0.363	0.7173
Language_factor1	150.36	135.14	46.66	1.113	0.2716
Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1:Group_factor1	52.39	124.25	81.74	0.422	0.6744
VerbType_factor1:AnaPred_factor1	30.33	124.25	81.74	0.244	0.8078

D.2 Bilingual Study

D.2.1 General pattern of anaphora resolution

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	0.01406	0.02257	240.00000	0.623	0.533757
AnaType_factor1	0.00692	0.02257	240.00000	0.307	0.759380
VerbType_factor1:AnaType_factor1	-0.04821	0.04513	240.00000	-1.068	0.286454
VerbType_factor1:Language_factor1	0.05937	0.06383	240.00000	0.930	0.353165
VerbType:AnaType:Language	-0.01339	0.12765	240.00000	-0.105	0.916529

D.2.2 Reading time at the embedded verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	11.051	17.360	80.000	0.637	0.5262
VerbType_factor1:Language_factor1	8.509	49.102	80.000	0.173	0.8629
VerbType_factor1:GroupNL_factor1	14.395	49.102	80.000	0.293	0.7701
VerbType_factor1:Group_factor1	-54.545	69.441	80.000	-0.785	0.4345

D.2.3 General processing complexity: effect of a perception verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1:Language_factor1	-75.284	124.717	320.096	-0.604	0.5465
VerbType_factor1:GroupNL_factor1	204.21	101.15	320.10	2.019	0.0443*
VerbType_factor1:AnaType_factor1	36.339	88.188	320.096	0.412	0.6806

D.2.4 General processing complexity: other linguistic factors

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
Language_factor1	205.954	177.080	84.249	1.163	0.2481
GroupNL_factor1	129.849	173.668	77.954	0.748	0.4569
Language_factor1:AnaType_factor1	-7.456	122.295	320.096	-0.061	0.9514
GroupNL_factor1:AnaType_factor1	-107.536	122.295	320.096	-0.879	0.3799

Appendix E Reading Times by Segment

E.1 Monolingual Study

E.1.1 Reading time: NP1

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	0.4404	15.1095	120.0000	0.029	0.97680
Language_factor1	199.6596	69.0129	40.0000	2.893	0.00615**
AnaType_factor1	-12.8498	15.1095	120.0000	-0.850	0.39677
VerbType_factor1:Language_factor1	-33.9067	30.2190	120.0000	-1.122	0.26409
VerbType_factor1:AnaType_factor1	-17.0879	30.2190	120.0000	-0.565	0.57281
Language_factor1:AnaType_factor1	-50.0121	30.2190	120.0000	-1.655	0.10054
VerbType:Language:AnaType	-56.7759	60.4380	120.0000	-0.939	0.34941

E.1.2 Reading time: NP2

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	65.011	20.579	40.000	3.159	0.00301**
Language_factor1	392.111	131.800	40.000	2.975	0.00495**
VerbType_factor1:Language_factor1	7.046	41.158	40.000	0.171	0.86493

E.1.3 Reading time: complementizer

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	30.70	25.87	40.00	1.187	0.24237
Language_factor1	152.83	54.81	40.00	2.788	0.00807**
VerbType_factor1:Language_factor1	-51.24	51.74	40.00	-0.990	0.32796

E.1.4 Reading time: embedded verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	54.273	16.750	1239.013	3.240	0.00123**
AnaType_factor1	31.659	16.750	1239.013	1.890	0.05898*
Language_factor1	73.422	48.319	40.006	1.520	0.13649
VerbType_factor1:AnaType_factor1	21.475	33.500	1239.013	0.641	0.52162
VerbType_factor1:Language_factor1	-66.256	33.500	1239.013	-1.978	0.04817
AnaType_factor1:Language_factor1	-8.937	33.500	1239.013	-0.267	0.78968
VerbTypeAnaType:Language	-83.540	67.001	1239.013	-1.247	0.21269

E.1.5 Reading time: preposition

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	13.648	8.249	31.137	1.655	0.108
Language_factor1	17.202	31.501	39.997	0.546	0.588
AnaType_factor1	2.936	8.249	31.137	0.356	0.724
VerbType_factor1:Language_factor1	-5.222	16.308	1208.868	-0.320	0.749
VerbType_factor1:AnaType_factor1	-8.741	16.498	31.137	-0.530	0.600
Language_factor1:AnaType_factor1	6.778	16.308	1208.868	0.416	0.678
VerbType:Language:AnaType	-5.744	32.617	1208.868	-0.176	0.860

E.1.6 Reading time: anaphora

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	-2.183	22.476	1240.000	-0.097	0.92265
Language_factor1	98.214	71.984	40.000	1.364	0.18007
AnaType_factor1	29.467	22.476	1240.000	1.311	0.19008
VerbType_factor1:Language_factor1	-37.741	44.952	1240.000	-0.840	0.40131
VerbType_factor1:AnaType_factor1	-57.672	44.952	1240.000	-1.283	0.19974
Language_factor1:AnaType_factor1	119.709	44.952	1240.000	2.663	0.00784**

E.1.7 Reading time: wrap-up preposition

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	25.405	18.152	120.000	1.400	0.1642
Language_factor1	56.436	47.399	40.000	1.191	0.2408
AnaType_factor1	40.933	18.152	120.000	2.255	0.0259
VerbType_factor1:Language_factor1	-8.884	36.303	120.000	-0.245	0.8071
VerbType_factor1:AnaType_factor1	8.634	36.303	120.000	0.238	0.8124
Language_factor1:AnaType_factor1	57.159	36.303	120.000	1.574	0.1180
VerbType:Language:AnaType1	42.181	72.607	120.000	0.581	0.5624

E.1.8 Reading time: wrap-up region

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factorPerception	-72.97	76.91	1239.01	-0.949	0.3429
AnaType_factorpronoun	135.91	76.91	1239.01	1.767	0.0774 .
Language_factorNR	45.37	137.06	68.34	0.331	0.7416
VerbType_factor:AnaType_factor	142.82	108.76	1239.01	1.313	0.1894
VerbType_factor:Language_factorNR	163.85	108.76	1239.01	1.506	0.1322
AnaType_factor:Language_factorNR	85.51	108.85	1239.02	0.786	0.4323
VerbType:AnaType:Language	-237.16	153.88	1239.01	-1.541	0.1235

E.2 Bilingual Study

E.2.1 Reading time: NP1

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	-1.065	32.933	240.000	-0.032	0.9742
Language_factor1	1261.512	97.363	80.000	12.957	< 2e-16***
GroupNL_factor1	1025.680	97.363	80.000	10.535	< 2e-16***
VerbType_factor1:Language_factor1	102.489	65.866	240.000	1.556	0.1210
VerbType_factor1:GroupNL_factor1	66.091	65.866	240.000	1.003	0.3167

E.2.2 Reading time: NP2

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	-18.17	38.28	80.00	-0.475	0.6364
Language_factor1	28.74	226.21	80.00	0.127	0.8992
GroupNL_factor1	-438.56	226.21	80.00	-1.939	0.0561 .
VerbType_factor1:Language_factor1	-92.26	108.27	80.00	-0.852	0.3967
VerbType_factor1:GroupNL_factor1	-67.83	108.27	80.00	-0.626	0.5328

E.2.3 Reading time: complementizer

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	-53.52	24.55	80.00	-2.180	0.03222 *
Language_factor1	68.45	70.87	80.00	0.966	0.33704
GroupNL_factor1	-206.29	70.87	80.00	-2.911	0.00467**
Group_factor1	-598.16	100.23	80.00	-5.968	6.26e-08***
VerbType_factor1:Language_factor1	71.57	69.44	80.00	1.031	0.30583
VerbType_factor1:GroupNL_factor1	68.94	69.44	80.00	0.993	0.32386
VerbType_factor1:Group_factor1	239.01	98.21	80.00	2.434	0.01717*

E.2.4 Reading time: embedded verb

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	11.051	17.360	80.000	0.637	0.5262
Language_factor1	-116.123	48.228	80.000	-2.408	0.0184*
GroupNL_factor1	-249.623	48.228	80.000	-5.176	1.65e-06***
VerbType_factor1:Language_factor1	8.509	49.102	80.000	0.173	0.8629
VerbType_factor1:GroupNL_factor1	14.395	49.102	80.000	0.293	0.7701

E.2.5 Reading time: preposition

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	7.295	6.988	80.000	1.044	0.2997
Language_factor1	-78.231	40.352	80.000	-1.939	0.0561 .
GroupNL_factor1	-101.993	40.352	80.000	-2.528	0.0135*
VerbType_factor1:Language_factor1	18.362	19.765	80.000	0.929	0.3557
VerbType_factor1:GroupNL_factor1	12.937	19.765	80.000	0.655	0.5147

E.2.6 Reading time: anaphora

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	5.03	21.50	80.00	0.234	0.81563
Language_factor1	-142.07	75.68	80.00	-1.877	0.06412 .
GroupNL_factor1	-217.57	75.68	80.00	-2.875	0.00518**
VerbType_factor1:Language_factor1	64.78	60.81	80.00	1.065	0.28997
VerbType_factor1:GroupNL_factor1	56.51	60.81	80.00	0.929	0.35558

E.2.7 Reading time: wrap-up preposition

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	8.283	17.563	321.996	0.472	0.6375
Language_factor1	-61.691	58.014	90.272	-1.063	0.2904
GroupNL_factor1	-145.999	55.915	78.011	-2.611	0.0108*
AnaType_factor1	43.366	19.712	321.996	2.200	0.0285*
AnaPred_factor1	-12.933	27.336	321.996	-0.473	0.6364

VerbType_factor1:Language_factor1	-20.976	55.754	321.996	-0.376	0.7070
VerbType_factor1:GroupNL_factor1	-15.617	46.390	321.996	-0.337	0.7366
VerbType_factor1:AnaType_factor1	10.663	39.424	321.996	0.270	0.7870
Language_factor1:AnaType_factor1	21.234	54.671	321.996	0.388	0.6980
GroupNL_factor1:AnaType_factor1	-61.807	54.671	321.996	-1.131	0.2591
VerbType_factor1:AnaPred_factor1	9.554	54.671	321.996	0.175	0.8614
GroupNL_factor1:AnaPred_factor1	-52.066	54.671	321.996	-0.952	0.3416
VerbType_factor1:Language:AnaType	-29.481	109.343	321.996	-0.270	0.7876
VerbType_factor1:GroupNL:AnaType	-125.886	109.343	321.996	-1.151	0.2505
VerbType_factor1:GroupNL:AnaPred	-10.192	109.343	321.996	-0.093	0.9258

E.2.8 Reading time: wrap-up region

Fixed effects:	Estimate	Std. Error	df	t value	Pr(>|t|)
VerbType_factor1	77.480	39.287	320.096	1.972	0.0495*
Language_factor1	205.954	177.080	84.249	1.163	0.2481
GroupNL_factor1	129.849	173.668	77.954	0.748	0.4569
AnaType_factor1	100.642	44.094	320.096	2.282	0.0231*
AnaPred_factor1	-30.701	61.147	320.096	-0.502	0.6160
VerbType_factor1:Language	-75.284	124.717	320.096	-0.604	0.5465
VerbType_factor1:GroupNL	204.21	101.15	320.10	2.019	0.0443*
VerbType_factor1:AnaType_factor1	36.339	88.188	320.096	0.412	0.6806
Language_factor1:AnaType_factor1	-7.456	122.295	320.096	-0.061	0.9514
GroupNL_factor1:AnaType_factor1	-107.536	122.295	320.096	-0.879	0.3799
VerbType_factor1:AnaPred_factor1	77.664	122.295	320.096	0.635	0.5258
GroupNL_factor1:AnaPred_factor1	104.011	122.295	320.096	0.850	0.3957
VerbType_factor1:Language:AnaType	266.288	244.589	320.096	1.089	0.2771
VerbType_factor1:GroupNL:AnaType	-15.953	244.589	320.096	-0.065	0.9480
VerbType_factor1:GroupNL:AnaPred	183.303	244.589	320.096	0.749	0.4541

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