UNIVERSITY OF CALIFORNIA
Los Angeles

Processing information structure: A case study of Contrastive Topics in Estonian

A dissertation submitted in partial satisfaction
of the requirements for the degree
Doctor of Philosophy in Linguistics

by

Marju Kaps

2020

ABSTRACT OF THE DISSERTATION

Processing information structure: A case study of Contrastive Topics in Estonian

by

Marju Kaps
Doctor of Philosophy in Linguistics
University of California, Los Angeles, 2020
Professor Jesse A. Harris, Chair

This dissertation looks at the processing of information structure – more specifically Contrastive Topics (CTs) – in Estonian. Estonian is a flexible word order language meaning that information-structural relations like topicality and focus can be optionally expressed through syntactic means, by deviating from its canonical Subject-Verb-Adverb-Object word order. The syntactic encoding of information structure in Estonian raises interesting questions for language processing at the syntax-pragmatics interface. In this dissertation, I touch on the time course of contrast assignment in non-canonical clauses and whether contrast resolution (or pairing a contrastive constituent with a grammatically licensed contrastive alternative) is active and predictive in nature. Further implications for the processing of discourse-configurational languages are discussed throughout this work.

In the theoretical portion of this dissertation, I lay out a working hypothesis for the syntactic structure of the left periphery of Estonian V3+ clauses (where the verb occurs in the third or later linear position), presenting grammaticality judgment data in information-structurally controlled contexts.

The experimental portion of this dissertation utilizes psycholinguistic research methods – eye tracking during reading, a speeded acceptability task with rapid serial visual presentation and a sentence completion task. The dissertation includes two experimental chapters. In

Chapter 4, I use the principle of information-structural parallelism to disambiguate the information structure of V3+ clauses by following them with contrastive ellipsis. Looking at the processing of ellipsis remnants (which have previously been shown to exhibit a bias towards the most local correlate in the antecedent clause) reveals that the language processor rapidly computes contrast during the incremental processing of non-canonical V3+ structures and uses information-structural representations for processing clausal ellipsis. I also show evidence that information-structural representations may be temporarily underspecified in the absence of biasing context.

In Chapter 5, I explore the processing of temporary DP Object / Clausal coordination ambiguity in Estonian, showing that information-structural representations (whether computed based on the preceding discourse context or syntactic marking) lead the processor to anticipate upcoming contrast, which leads to the language processing system's independent preference for syntactically simpler structures (a.k.a. Minimal Attachment) being overridden. In contexts conveying a CT structure, DP Object coordination is penalized compared to the more complex Clausal coordination, as the former leads to a delay in meeting the presupposition for the existence of a salient CT alternative to a previously CT-marked constituent.

The experimental work presented here highlights the close connection between syntactic and information-structural processing. Syntactic marking of information structure (i.e. non-canonical word order) feeds the computation of discourse representations, and conversely, information-structural representations influence parsing decisions during incremental processing. The present work raises interesting questions for future research, particularly pertaining to the relative contribution of syntactic and discourse factors in computing information-structural relations, the effects of (implicit) prosody on information-structural processing, and the extent to which information-structural representations can remain underspecified during incremental comprehension, across constructions and across languages.

The dissertation of Marju Kaps is approved.

Elsi Kaiser

Hilda Koopman

Timothy Hunter

Jesse A. Harris, Committee Chair

University of California, Los Angeles

2020

Dedicated to my grandparents Kadri, Enn, Juta and Tiit,

who were academics in Soviet Estonia

Table of Contents

List of Figures

List of Tables

Acknowledgments

I owe a debt of gratitude to my advisor Jesse Harris – this dissertation wouldn't have come to be if it wasn't for his continued support, guidance, advice, patience and encouragement. Everything I've learned from him has shaped me as an academic, scholar and educator and I can only begin to hope this dissertation does justice to his mentorship. The dissertation has also greatly benefitted from the thoughtful input and insights of my committee members – Tim Hunter, Hilda Koopman and Elsi Kaiser. All mistakes remain my own.

This work would not have been possible if it wasn't for the generous welcome I received at the Institute of Estonian and General Linguistics at the University of Tartu (Estonia) as a visiting researcher. Huge thanks go specifically to the Phonetics Lab for kindly allowing me to use their eye tracker for research unrelated to phonetics. (I promise to look at Estonian intonation in future work!)

I wish to thank the many people who participated in my experiments – both in person and online, and the friends and family who helped to get the word out. Reflecting back on it now during the COVID-19 pandemic, those post-experiment debriefing chats with study participants about their linguistic intuitions were probably one of my most favorite parts of this work. I am also grateful for the UCLA Harry and Yvonne Lenart Travel Fellowship, which funded one of my research trips from Los Angeles to Tartu.

This work has gone through many iterations during my time at UCLA and has benefitted greatly from feedback from conference reviewers and audiences. I would like to thank the audiences at CLS 54, SLE 51, California Meeting on Psycholinguistics 2 and 3, and CUNY 2019 and 2020. Perhaps more importantly – a big thank you to the attendees of the UCLA Psycholinguistics Seminar throughout the years for your questions, suggestions and constructive criticism on work in progress.

My time at UCLA was made memorable by friends and colleagues in the Linguistics department and in UCLA Family Housing. Thank you for the lunches, dinners and drinks, random hallway chats, shared bus rides to campus, conference trips, little gifts, nights out,

nights in, swapped discussion sections and class notes, baked goods, car rides, dog walks and hikes, picnics, BBQs and celebrations, workout classes, writing sessions, and for being there for me through the Zoom and gloom of the pandemic. I have learned a lot from you and I couldn't have asked for a better group of people to spend the past five years with!

Last but not least, I want to thank my family for being supportive – my mom, sisters, and of course my husband. I would also thank my dogs for their important emotional support role in the dissertation writing process, but they are unlikely to get through more than a half a page of these acknowledgements.

Curriculum Vitae

2015 – 2020	M.A. in Linguistics
	University of California, Los Angeles (UCLA), United States
2017	Advancement to candidacy for Ph.D. in Linguistics
	University of California, Los Angeles (UCLA), United States
2011 – 2015	M.A. (Hons) in Psychology and Linguistics
	The University of Edinburgh, Scotland, United Kingdom

CHAPTER 1

Introduction

Estonian is a Finno-Ugric language with approximately 1.1 million native speakers (Kilgi, 2009). It is a flexible word order language, meaning that the preferred ordering of syntactic constituents in Estonian is influenced by discourse context and more specifically by information structure. While the language is generally verb-second (V2) for root clauses (Ehala, 2006; Holmberg, 2015; Holmberg et al., 2020) with a preference for subjects in the clause-initial position, the presence of a preverbal Contrastive Topic (CT; see Büring 2003; Lee 2003 and discussion in Chapter 2) allows for multiple constituents to precede the verb (Henk, 2010; Kaps, 2019). Root clauses where the verb occurs in the third or later position (V3+) are generally marginal or ungrammatical in Estonian in the absence of a CT, as exemplified in (1). The necessity of a preverbal CT constituent in V3+ clauses means that CT structure is conveyed syntactically in Estonian.

(1) a. Anna tegi täna sporti.
Anna.NOM did today sport.PART
'Anna exercised today.' (V2)

b. Anna_{CT} tegi täna sporti.
Anna.NOM did today sport.PART
'ANNA exercised today (but MARI slept the whole day).' (V2)

c. */?Anna täna tegi sporti.
Anna.NOM today did sport.PART
'Anna exercised today.' (V3)

d. Anna_{CT} täna tegi sporti.
Anna.NOM today did sport.PART
'ANNA exercised today (but MARI slept the whole day).' (V3)

In this dissertation, I make use of syntactic CT-marking in Estonian, as well as findings from the sentence processing literature pertaining to the processing of ellipsis and syntactic ambiguity resolution in order to examine how the human language processing mechanism ("the processor") computes contrast (Molnár, 2002; Repp, 2010). While it can be difficult to experimentally examine the nature of information-structural representations, contrast (whether it is expressed as a CT or a Contrastive Focus) offers a window to if/how/when the processor computes information-structural relations. This is because contrast necessarily holds *between* alternatives in a set, rather than of just the highlighted linguistic constituent. As a consequence, if the processor, say, anticipates a particular kind of a contrastive alternative to a CT/CF-marked constituent, we expect to see a processing advantage (shorter reading times or faster response times to a question prompt) when processing that contrastive alternative, compared to if the alternative was encountered in a neutral context. Any facilitation observed on a potential contrastive alternative suggests that the processor had previously represented a constituent as contrastive.

There has been some past work looking at the processing of (contrastive) Focus (see Kim 2019, for a recent review), but much less is known about the processing of CTs. As CTs occur in partial answers to a salient question under discussion (Büring, 2003) and can be linguistically encoded,[1] looking at the processing of CTs contributes to a growing literature at the intersection of syntactic and pragmatic processing. In this dissertation I address questions pertaining to how non-canonical V3+ word order is interpreted during moment-by-moment comprehension, how information-structural representations influence parsing decisions, and how discourse context and syntactic CT-marking contribute to the processing profile of CT structures.

[1]Besides syntactic encoding in Estonian, CTs can be marked through morphological means in languages like Japanese (Hara, 2006) and Korean (Han, 1998), and prosody also plays a role in contrast-marking cross-linguistically (e.g. Molnár 2002; Oshima 2005; Constant 2014; Sahkai and Mihkla 2017).

1.1 Central questions

Contrast inherently holds between elements in the discourse as contrast-marking presupposes the existence of a contextually salient alternative to the highlighted constituent (Molnár, 2002). This means that the processing of a CT must involve both identifying the highlighted constituent as a CT as well as either identifying its alternative in the linguistic context (if the latter is is overt) or inferring its alternative based on what is in the common ground.

I assume, as laid out in more detail in Chapter 2, that CTs and their alternatives occur in partial answers to a salient Question under Discussion (QUD; see Beaver et al. 2017 for a recent review). Consider the example in (2). The CTs ("on Mondays", "on Tuesdays", "on Wednesdays", etc) occur in subquestions to the broader QUD ("What subjects is Mari learning about on which day?") – namely, "What subject is Mari learning about on Mondays?", "What subject is Mari learning about on Tuesdays?", etc. In this particular example, the CTs contrast with each other on account of differing in the focused content (e.g. "molecular biology", "tax law") occurring in their respective clauses.

(2) *Context:* Mari enrolled in online courses and is learning about a different subject every day of the week. You want to know what classes she's taking.

QUD: What subjects is Mari learning about?

A: [On Mondays]$_{\text{CT}}$, Mari is learning about [molecular biology]$_{\text{F}}$. [On Tuesdays]$_{\text{CT}}$, she's learning about [tax law]$_{\text{F}}$. [On Wednesdays]$_{\text{CT}}$, ...

The use of CT-marking is licensed when a speaker cannot felicitously assert the proposition applying to a CT of its alternatives (e.g. Constant 2014). As shown in example (3), this may arise through several means – the speaker knows that the proposition ("Mari is learning about molecular biology") does not apply to the alternatives, the speaker does not know whether the proposition applies to the alternatives or not, or the speaker does not wish to reveal whether the proposition holds of the alternatives. In short, the use of CT-marking on a constituent (e.g. "on Mondays") means that there is at least one contrastive alternative (e.g. "on Tuesdays") that would not yield an utterance the speaker is committed to if

substituted for the CT constituent (e.g. "On Tuesdays, Mari is learning about molecular biology").

(3) Q: What subjects is Mari learning about?

A: [On Mondays]$_{\text{CT}}$, Mari is learning about [molecular biology]$_{\text{F}}$.

a. "A" knows what subjects Mari learns about on other days and that they are not molecular biology. "A" may continue to list those or allow their interlocutor to expand on the discussion based on the information already provided.

b. "A" only knows what classes Mari takes on Mondays, but acknowledges that their response does not fully answer the QUD.

c. "A" does not want to reveal what classes Mari takes on other days.

Comprehending clauses containing CTs thus involves managing the discourse representation and keeping track of the salient QUD, and there are many interesting questions to be asked about how CT structures are comprehended in the broader discourse context. This dissertation takes a somewhat narrower psycholinguistic approach, by looking at the time course of processing CT structures and how information-structural representations interact with and influence syntactic processing ("parsing"). The central questions I address are as follows:

1. Does non-canonical word order lead to rapid and automatic computation of information-structural representations during online comprehension?

2. Do information-structural representations bias the processor away from its default structural preferences?

My hope is that the present work contributes towards a more integrated understanding of sentence processing that combines syntactic and pragmatic processes. This is of particular importance in flexible word order languages where word order conveys information-structural information (e.g. Kaiser and Trueswell 2004.

1.2 Preview of main claims

I conceptualize the processing of CT stucture as involving two steps – identifying that a particular constituent is a CT and pairing that CT with its overt (or otherwise salient) alternative. I show experimental evidence that the assignment of CT structure is rapid, in the sense that a constituent in a V3 clause in Estonian can be marked as a CT before any alternative to it has been encountered. At the same time, the computation of CT structure is not fully automatic, as it is influenced by contextual factors and the constituent that acts as a CT in a non-canonical clause may be (temporarily) underspecified.

We will also see evidence that CT structure counters the processor's preference for local correlates to remnants of clausal ellipsis (see Clifton and Frazier 1998; Carlson et al. 2009; Harris 2015; Harris and Carlson 2018; Harris 2019; Lawn 2020) and can override the bias to resolve syntactically ambigous strings towards the syntactically simplest parse (Frazier 1987a; Hoeks et al. 2002, 2006; Staub and Clifton 2006; Engelhardt and Ferreira 2010, among others).

Broadly, I claim that the human language processing system is rapidly sensitive to variations in word order, even though a language like Estonian does not rely on word order to mark basic grammatical notions like subjecthood and objecthood. Information-structural representations exert a strong influence on parsing, and should thus play a central role in understanding the processing of discourse-configurational languages.

1.3 Organization of the dissertation

The dissertation is organised as follows. In Chapter 2, I lay out my assumptions regarding the information-structural notions discussed in this dissertation as well as provide a syntactic analysis for deriving V3+ clauses in Estonian. We will observe that the previous accounts for the syntax of the Estonian left periphery (Henk, 2010; Holmberg et al., 2020) cannot fully capture the word order possibilities discussed in Chapter 2 (or the experimental observations presented in later chapters). In Chapter 3, I provide an overview of previous work relevant

to the processing of information structure and set up the framework I propose for the processing of CTs more specifically. I argue that the processing of CT structures involves two conceptual steps – marking a particular constituent as a CT and identifying (or inferring, if not overtly present) its contrastive alternative. These two processes are explored in more detail in the following experimental chapters. Chapter 4 presents two experiments looking at the assignment of CT status to a preverbal constituent in V3+ clauses, by following matrix clauses of different configurations with case-marked contrastive remnant ellipsis. Looking at the processing difficulty arising from encountering remnants of different syntactic categories (subjects, objects) allows us to infer which constituent (if any) had been marked as contrastive during the processing of the matrix clause. In Chapter 5, I discuss two experiments on the resolution of temporary coordination ambiguity, looking at whether the search for a contrastive alternative to a previously CT-marked constituent overturns the processor's preference for syntactically simpler structures (Frazier, 1987a; Hoeks et al., 2002). Finally, Chapter 6 concludes by summarizing the findings and discussing the broader implications of and future directions for this work.

1.4 Broader impact

In a very broad sense, information structure deals with how an utterance fits into a broader discourse context and how speakers convey and comprehenders interpret changes to the discourse representation. The processing of information structure is an interesting and growing area of psycholinguistic research as it encompasses morphosyntactic, semantic, pragmatic and prosodic representations. There is accruing evidence that incremental structure-building is sensitive to multiple sources of information, including syntactic simplicity (Frazier, 1987a; Hoeks et al., 2006; Engelhardt and Ferreira, 2010), the frequency of a particular parse (Cuetos and Mitchell, 1988; Trueswell et al., 1993; MacDonald et al., 1994), its plausibility based on the preceding linguistic context (Crain and Steedman, 1985; Altmann et al., 1992; Hoeks et al., 2002) and extralinguistic context (Tanenhaus et al., 1995; Knoeferle et al., 2005; Knoeferle and Crocker, 2007), as well as prosodic phrasing and accents (Snedeker and Trueswell,

2003; Nakamura et al., 2012; Carlson and Tyler, 2018). Core sentence processing research – looking at the effects of these various linguistic and non-linguistic factors on parsing – has largely been conducted on English and similar languages. An important property of discourse-configurational languages like Estonian is that there is a tighter link between (overt) syntax and information structure than there is in, say, English, and further, languages show considerable variability in which information-structural notions (e.g. contrast, exhaustivity, topicality) are conveyed through grammatical means. The processing of information structure is thus an area of research that immensely benefits from linguistic diversity. This dissertation makes use of the unique grammatical properties of Estonian to investigate the effects of linguistically encoded contrast on language comprehension. I build on previous work on sentence processing by looking at how information-structural representations influence the processing of clausal ellipsis and temporary syntactic ambiguity.

CHAPTER 2

The Structure of CT-clauses in Estonian

The aims of this chapter are to frame the information-structural concepts explored in the following chapters and to provide a syntactic analysis of Estonian CT clauses. Additionally, I sketch an analysis for contrastive ellipsis in Estonian, as the processing of these structures will be explored in Chapter 4.

2.1 What are CTs?

Below, I go over basic notions of information structure and how CTs relate to other information-structural notions like Topicality and Contrast.

2.1.1 Topicality in relation to other basic notions of Information Structure

The notion of topicality has long been a subject of debate in linguistics (e.g. Hedberg 2006). What exactly fits under the umbrella of topicality? The space of information-structural categories has been carved up in different ways in the past literature (see Féry and Ishihara 2016 for a recent overview). It is generally agreed that the contents of an utterance can be divided into Discourse-given (also, Discourse-old or Common Ground) and Discourse-new. The latter is sometimes treated synonymously with Focus, although recent work distinguishes between new information Focus and contrastive Focus (Büring, 2016; Kratzer and Selkirk, 2020).[1] Different definitions of topicality share the assumption that Topics are at least in

[1]Another set of terms seen in the literature is "broad" and "narrow" Focus, but these have to do with the amount of material in the clause that is discourse-given, rather than the contrastiveness of the focused constituent itself. When only the pitch-accented constituent is focused, focus is narrow. Below, (a) shows

some sense discourse-old. Yet, discourse-old (or discourse-given) material does not behave uniformly when it comes to how it is linguistically expressed, and fine-grained interpretational distinctions between different structural configurations can be difficult to pin down (e.g. Molnár 1998; Rizzi 2013; Özkan Grigoraş 2020). For instance, in recent work on Turkish, Özkan Grigoraş (2020) shows different syntactic distributions for three information-structural categories that convey discourse-given information. I exemplify these three categories in (4), using her terms (although note that I will be using the term "Given information" instead of "Discourse-Given Topic" throughout this dissertation).

(4) a. Q: Tell be about Mary. What has she been up to? (Aboutness Topic)
A: Mary $_{\text{Top}}$ adopted a dog recently.

b. Q: What have Mary and Sue been up to? (CT)
A: Mary $_{\text{CT}}$ adopted a dog recently. Sue $_{\text{CT}}$ is becoming proficient in Turkish.

c. Q: What has Mary been up to recently? (DG Topic)
A: Mary has done almost nothing noteworthy in the past three months $_{\text{Given}}$.

Turkish, which is also a discourse-configurational language like Estonian (meaning that, in syntactic terms, it has structural projections for information-structurally marked constituents) provides evidence that the grammatical system can be sensitive to differences between the categories shown in (4). Özkan Grigoraş shows that in Turkish, "Aboutness Topics", or constituents whose referent the utterance is about (Reinhart, 1981), must occur in the clause-initial position. "Contrastive Topics" (CTs), which will be discussed in more detail in the following sections, must be left-peripheral, following a left-peripheral Contrastive Focus (see Section 2.1.3). Other discourse-given elements ("Discourse-Given Topics") are allowed to occur post-verbally in Turkish in addition to their left-peripheral position, which

an instance of narrow focus on "cake", while (b) has the same prosodic realisation as (a) but the scope of focus is broader. Contrastiveness, on the other hand, arises from how the focused constituent relates to other material in the discourse representation, as discussed in more detail below.

(a) What did you eat? I ate [CAKE]$_{\text{F}}$
(b) What did you do? I [ate CAKE]$_{\text{F}}$

is not an option for Aboutness Topics and CTs. It is thus necessary to minimally distinguish between constituents that are discourse-given but not topical in the traditional aboutness-sense of the word, non-contrastive (or "simple") Aboutness Topics, and CTs.While these distinctions may not be expressed through linguistic means cross-linguistically, maintaining the distinctions and considering where a particular language falls when it comes to expressing information structure contributes towards building a unified understanding of the human language capacity. In Section 2.1.5, I argue based on evidence from Estonian that CTs are not necessarily Topics in the aboutness-sense, but belong under the broader category of Discourse-given information-structural notions.

Another partitioning of the information-structural space often seen in the literature is the distinction between Topic and Comment – what the utterance is about, and the information the utterance conveys about its Topic, respectively.[2] While Topics are assumed to be Discourse-given, or part of the Common Ground between the interlocutors, the Comment part of the utterance necessarily contains focused information, and depending on the scope of Focus, may also contain discourse-given information. The amount of material that is neither Topic nor Focus ("Other discourse-given") depends on the scope of focus, as illustrated in example (5).

(5) a. Q: What did you do today?
A: $\mathrm{I}_{\mathrm{TOP}}$ [watched Netflix for 10 hours]$_{\mathrm{F}}$.

b. Q: How much Netflix did you watch today?
A: $\mathrm{I}_{\mathrm{TOP}}$ watched Netflix [for 10 hours]$_{\mathrm{F}}$.

In (5a), the target sentence occurs in a broad focus context, such that the answer is divided into the Topic (the speaker) and Focus ("watched Netflix for 10 hours"). The adverb "today" is discourse-given but has been omitted here. In example (5b), with narrow Focus on the PP "for 10 hours", "watched Netflix" would be categorized as "Other discourse-

[2]Note that there is also a distinction between discourse Topics and sentence Topics (Van Dijk, 1977; Davison, 1984), with the latter being overtly expressed in the sentence. In what follows, I omit "sentence" from "sentence Topic" when talking about linguistic forms.

given" material as it is outside the scope of Focus, but not necessarily interpreted as topical as the speaker is most naturally interpreted as saying something about themselves, rather than about Netflix. In both (5a) and (5b) the nuclear pitch accent (the most perceptually prominent pitch accent) falls on the most deeply embedded constituent in the scope of Focus (the NP "hours"; see Selkirk 1986; Cinque 1993), showing that prosody can underdetermine information structure.

In the following, I assume that every clause that is at-issue, i.e. conveys an answer to some salient Question under Discussion (QUD), contains a focused constituent.[3] The Focus roughly corresponds to the *wh*-word in the corresponding question (Büring, 2016). While, intuitively, every utterance is about *something*, in the sense that there is a discourse Topic (see Van Dijk 1977), the Topic does not need to be overtly stated in the sentence.[4] For instance, in example (6), the answer (A) is most naturally interpreted as being about "the here and now", rather than any of the referents it explicitly mentions (your housemate, the raccoon, the flour).

(6) *Context:* You walk into the kitchen and notice that the door to the garden is open, every horizontal surface is covered in a layer of flour, and that there are peculiar footprints running across the floor. You ask:

Q: What happened here?

Your housemate responds with:

A: I fought the raccoon off with a bag of flour.

In addition to Topic and Focus, Contrast is also an important information-structural notion, as discussed in more detail below.

[3]Note that a clause may contain multiple Foci, e.g. "Did you give Mary a flower? No, I gave ANNA a CAKE." See Krifka (1992) for a discussion.

[4]I remain agnostic about whether a clause can contain multiple Aboutness Topics.

2.1.2 What is contrast?

Evidence from Finnish (Vallduví and Vilkuna, 1998; Kaiser, 2006), which shows a left-peripheral syntactic position for contrastive constituents that are either CTs or CFs, has been used to argue for Contrast being a linguistically relevant category that is independent of Topic and Focus features.

Molnár (2002) emphasizes two essential components of Contrast – highlighting (e.g. prosodic, by making the target constituent the most prominent in the clause) and opposition between the highlighted constituent and its alternatives. The contrast-marked constituent is a member of a limited set of alternatives that it stands in opposition with. These alternatives may or may not be explicitly mentioned in the discourse.

While both Focus and Contrast involve a set of alternatives, it has been argued that a crucial difference between these two information-structural notions is the size of the set of alternatives (Chafe, 1976; Kiss, 1998). The set of Focus alternatives can in principle be infinite, as shown in example (7) below.

(7) Q: What is your favorite number?
A: My favorite number is twenty$_{\mathrm{F}}$.
Focus alternatives: {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, ...}[5]

By limiting the number of alternatives to the constituent of interest, as shown in (8), the alternatives form a contrastive set. In this particular case, as the highlighted constituent constitutes an answer to a salient question, we have an instance of CF (rather than CT; see Section 2.1.3).

(8) Q: Would you prefer a window seat or an aisle seat?
A: I would like a [window seat]$_{\mathrm{CF}}$.
Contrastive alternatives: {window seat, aisle seat}

[5] We could also include negative numbers, fractions, irrational numbers, ...

Repp (2010) expresses her intuition that while Focus evokes alternatives (see Rooth 1992), Contrast is more relational as it holds *between* items in the alternative set (rather than *of* an item). By asserting some proposition of a contrastive alternative, some information can be inferred about the other members of the alternative set – typically that the proposition does not hold of the alternatives (but see discussion below). As a consequence, the items that the contrast-marked constituent stands in opposition with must be easily accessible to the interlocutors, if not explicitly mentioned in the discourse. This opposition between salient alternatives makes Contrast an interesting subject for psycholinguistic exploration, as the comprehension of a clause containing a contrastive constituent necessarily involves the accessing of its contrastive alternatives in the discourse. I discuss my assumptions regarding the processing of Contrast in more detail in Chapter 3.

2.1.3 Contrastive Topics and Contrastive Foci

As alluded to above, CFs are focused constituents with a small set of alternatives. While some past work (e.g. Krifka 2008) views CTs as a combination of Topic and Focus features, evidence from Finnish (Kaiser, 2006) suggests that both CTs and CFs rely on a Contrast (or "Kontrast") feature. Büring (2016) advocates for keeping Focus and Givenness features separate and univariate on the grounds that a referent can be generally discourse-given, but focused in a particular context.[6] For the sake of simplicity, in the present work I adopt a view whereby the two are complementary. The distinction between CTs and CFs is then in their Focus feature – CFs have the features [+Contrast, +Foc] and CTs the features [+Contrast, -Foc], with an optional +Topic feature depending on whether the CT constituent corresponds to what the clause is about.

The different valuation of the Focus feature gives rise to the different syntactic distribution of CTs and CFs. CFs can express the main Focus of a clause (9a) while CTs, on the other hand, necessarily occur in pairwise contrast (Konietzko and Winkler, 2010), as

[6]Consider for instance the pronouns in the sentence"First John mocked Mary and then SHE insulted HIM". They refer to entities given in the discourse context, but are focused due to their relation to the preceding clause. Also see Lakoff (1976) for a discussion of similar examples involving stressed pronouns.

exemplified in (9b). Following the assumption that every at-issue clause needs to contain Focus and that CTs are not the carriers of Focus, they must necessarily be accompanied by another focused constituent.[7]

(9) Q: Did Anna and Mary finish the cake?

a. It was Anna_{CF} who took the last piece.

b. Sure, Anna_{CT} [took the last piece]$_{\text{F}}$ but Mary_{CT} [wasn't even there]$_{\text{F}}$.

There are also semantic differences between CTs and CFs, which have implications for their processing. Repp (2010) argues that CFs are associated with an exhaustivity entailment, while CTs only carry an exhaustivity implicature. For instance, (10a) is not semantically compatible with a scenario where Mary also tried some cake. In contrast, (10b) could be felicitously uttered in a context where the speaker does not know whether Mary had any cake or not.

(10) Q: Did Anna and Mary try the cake?

a. It was Anna_{CF} who tried the cake.

b. Anna_{CT} had some.

We will return to the importance of this asymmetry to the online processing of CTs and CFs in Chapter 3.

2.1.4 Diagnosing CTs

Different languages utilize different linguistic tools to mark CTs. Generally, CTs are marked with contrastive prosody (Molnár 2002; see Sahkai and Mihkla 2017 for Estonian). At the same time, overt prosody can be underinformative when it comes to the intended information structure (Selkirk, 1986; Cinque, 1993) and experimental work shows that how information structure is interpreted by listeners during online comprehension is not fully determined by

[7]For potential counterevidence to the pairwise contrast view, see the discussion of the English rise-fall-rise contour as an expression of a "bare" CT in the absence of Focus in Büring 2016.

overt prosodic marking (e.g. Harris and Carlson 2018). Languages like Japanese (Kuno, 1973) and Korean (Han, 1998) use morphological Topic markers, but these are used both for simple Topics and for CTs. As linguistic realizations of CTs are somewhat idiosyncratic for different languages and are not always unambiguous, I will rely on a context-based diagnostic for identifying CTs. I adopt the view that CTs are used in partial answers to a salient QUD (Büring, 2003).[8]

A CT structure occurs when an utterance conveys a partial answer to the salient discourse question,[9] while maintaining the Focus structure conveyed in the question. A CT clause thus introduces a partition to the QUD by answering a subquestion of it, as exemplified in (11), where F stands for Focus and CT for Contrastive Topic. Here, instead of answering the QUD, the Answer addresses a subquestion of it, by introducing a partition through the CT "in the morning".

(11) QUD: Who_{F} did you meet today?
Answer: $[\text{In the morning}]_{\text{CT}}$, I met Anna_{F}.
Answered sub-question: Who_{F} did you meet this morning?

Not all partial answers to a salient QUD introduce a CT. Partial answers that introduce a partition on the Focus, as exemplified in (12), do not introduce a CT. Below, "in the morning" corresponds to the *wh*-part of the question, and is thus still marked as a Focus.

(12) QUD: $[\text{Where and when}]_{\text{F}}$ did you meet Anna?
Answer: I met Anna $[\text{in the morning}]_{\text{F}}$.
Answered sub-question: When_{F} did you meet Anna?

In introducing a partition to the salient QUD, the CT clause must maintain the Focus

[8] Büring (2016) also discusses two additional types of CT – "shifting topics" and "implicational topics", which are used to override the immediate QUD in favor of a broader one. However, different subtypes of CT go beyond the scope of the present dissertation.

[9] CTs can also occur in questions, where prosody is required to disambiguate between CT+F structures and multiple Focus structures. I will only be discussing CTs in declaratives in this dissertation.

structure of the original QUD. CTs convey discourse-given (i.e. [-Foc]) material and their presence does not bear on which constituent carries the [+Foc] feature.

2.1.5 Differences and overlap between CTs and (Aboutness) Topics

Is a CT simply a Topic with the additional property of presupposing a contrastive alternative? Analyses that view CTs as being composed of Topic and Focus features (Krifka, 2008) or even Topic and Contrast features predict that any constituent that can be a CT should also be able to function as a simple Topic in a context where the QUD is answered directly. In this section, I show that CTs are not a subset of Aboutness Topics. While CT status can be diagnosed through how the clause relates to the salient QUD (as discussed in Section 2.1.4 above), diagnosing topicality through context (e.g. "Tell be about X") is harder, particularly when the constituent of interest is not a DP. Here, I rely on the word order restrictions of Estonian in order to determine what categories can or can not be a simple (non-contrastive) Topic.

In Estonian verb-second (V2) clauses, the subject (regardless of its information-structural status), a CT, an Aboutness Topic, or another element may occur preverbally, with relative salience playing a role in which constituent is fronted (Lindström, 2001). Examples like (13), where the whole clause contains discourse-new material, show that a constituent does not, in fact, need to be a Topic to occur preverbally. In this particular case, the Topic (possibly the location where is raining) is implicit.

(13) Vihma sajab.
rain.PART rains
'It is raining.'

Which constituent occurs preverbally in V2 clauses appears (at least in part) to be driven by the relative salience between the constituents that could grammatically occur in this position. Sridhar (1988) proposes that leftward movement of constituents is driven by salience, which is defined as the constituent's "intrinsic semantic vividness" among other factors. Under this view, factors like the animacy of the constituent and its thematic role (e.g.

Agent, Patient, Theme) play a role in constituent ordering. Some researchers (e.g. Belletti and Rizzi 1988; Grimshaw 1990; Speas 1990) have argued for a the existence of a thematic hierarchy, where Agents are more prominent (or salient) than other thematic roles and thus occur in a higher (subject) position syntactically. While the grammar of the language and the semantics of particular verbs play a role in which thematic role is mapped to which argument or modifier position, discourse-configurational languages allow for flexibility when it comes to constituent ordering, which means that salience likely continues to exert its influence at the point of A-bar movement and up until spellout. This could be driven by language processing considerations. Recent psycholinguistic work on speech production shows that the retrieval of lexical items in speech planning is ordered based on hierarchically-defined dependencies rather than linear order (Momma and Ferreira, 2019). What this means for a flexible word order language like Estonian is that the speaker has the option to utter a more salient (i.e. accessible) constituent that has already been lexically retrieved, before spelling out less salient constituents that take longer to retrieve. With subjects being inherently more semantically salient than other constituents (Sridhar, 1988), I assume that a constituent is a Topic when it can occur preverbally in clauses that also contain a subject, in the absence of CT-licensing contrast.[10]

Below, I use direct QUDs and superset QUDs in order to compare the distributions of Topics and CTs, respectively. Following Büring (2003), I adopt an approach where the superset (or broad) QUD dominates the direct (or immediate) QUD in a discourse tree. In the present case, this hierarchical connection is made explicit by constructing the examples so that the superset QUD mentions a superset of the constituent of interest. In each example, part (a) tests for the possibility of Topic status and part (b) for the possibility of CT status. The constituent of interest is underlined in the target sentence. For part (a), a follow-up sentence refers back to the target element, in order minimize a possible confound where the

[10]Estonian speakers may notice that in some of the cases below, the canonical SVO order would be more natural than the presented Topic-initial order. The subject may be preferred in the preverbal position over another topical constituent, but I argue that the possibility of the constituent in question occurring preverbally in the presence of an overt subject shows that it *can* have Topic status.

intended simple Topics are interpreted as being in contrast with an implicit alternative,[11] and thus being treated like CTs. For part (b), the follow-up sentence introduces a contrastive alternative to the previously mentioned CT.

First, let us examine some cases where the target constituent can be both a Topic and a CT, according to the criteria laid out above. Both Accusative objects (14) and Partitive objects (15) are felicitious in Topic contexts and CT contexts, although both are more natural in the clause-initial position when contrastive.[12]

(14) Accusative Object

a. What event did Mari invite Andres to?

?Andrese$_{\text{TOP}}$ kutsus Mari peole. Too oli Mari
Andres.ACC invited Mari.NOM party.ALL That.NOM was Mari.GEN
kutsest meelitatud.
invitation.ELA flattered

'Mari invited Andres to the party. He was flattered by Mari's invitation.'

b. Where did Mari invite the guys?

Andrese$_{\text{CT}}$ kutsus Mari peole. Toomase$_{\text{CT}}$ kutsus ta
Andres.ACC invited Mari.NOM party.ALL Toomas.ACC invited she.NOM
kontserdile.
concert.ALL

'Andres, Mari invited to the party. Toomas, she invited to the concert.'

(15) Partitive Object

a. Where did Mari meet Andres?

?Andrest$_{\text{TOP}}$ kohtas Mari peol. Tollel oli hea meel
Andres.PART met Mari.NOM party.ADE. That.ADE was good mind
Marit näha.
Mari.PART see.INF

[11] A listener may construe any explicit QUD as being part of a wider discourse context.

[12] For an accurate interpretation of (14a) and (15a), it is important that the object DP is not implicitly contrasted with another discourse-salient entity.

'Mari met Andres at the party. He was happy to see Mari.'

b. Where did Mari meet the guys?

Andrest.CT	kohtas	Mari	peol.	Toomast.CT	kohtas	ta
Andres.PART	met	Mari.NOM	party.ADE.	Toomas.PART	met	she.NOM
kontserdil.						
concert.ADE						

'Andres, Mari met at the party. Toomas, she met at the concert.'

In example (16) below, we see that DPs that are marked with a locative case (in this instance, Adessive) and resemble English preposition phrases are acceptable as both simple Topics and CTs. The same holds for temporal DPs, which are equivalent to English temporal adverbs, as seen in (17).

(16) Locative DP

a. Who did Mari meet at the party?

Peol.TOP	kohtas	Mari	Andrest.	Seal	oli	palju	uusi
party.ADE	met	Mari.NOM	Andres.PART.	there	was	much.PART	new.PART
inimesi.							
people.PART							

'At the party Mari met Andres. There were many new people there.'

b. Who did Mari meet on her night out?

Peol.CT	kohtas	Mari	Andrest.	Kontserdil.CT	kohtas	ta
party.ADE	met	Mari.NOM	Andres.PART.	concert.ADE	met	she.NOM
Toomast.						
Toomas.PART						

'At the party, Mari met Andres. At the concert, she met Toomas.'

(17) Temporal DP

a. What did Mari eat this morning?

Hommikul$_{\text{TOP}}$ sõi Mari putru. Seekord ei olnud Mari
morning.ADE ate Mari.NOM porrige.PART. this.time NEG-was Mari.NOM
eriti näljane.
particularly hungry

'In the morning Mari ate porridge. She wasn't particularly hungry then (so she didn't choose to eat anything more filling than porridge, like a full English breakfast).'

b. What did Mari eat today?

Hommikul$_{\text{CT}}$ sõi Mari putru. Pärastlõunal$_{\text{CT}}$ sõi ta
morning.ADE ate Mari.NOM porrige.PART. afternoon.ADE ate she.NOM
suppi.
soup.PART

'In the morning, Mari ate porridge. In the afternoon, she ate soup.'

A different pattern is seen with manner adverbs, which unlike the DP instances above, are not referential. Constructing simple Topic examples with a manner adverb is tricky as most have antonyms that are easily accessible (e.g. "slowly" and "fast"), which can give rise to a contrastive interpretation when the adverb is used in the clause-initial position. Below in (18) I use an adverbial form of the adjective *võidukas*, which roughly translates to "boastful following a win or achievement", as it is not listed with an antonym in the Estonian Antonym Dictionary.[13] Due to lack of a direct translation, the contexts are a bit awkward, but we observe that as a CT, the manner adverb can be easily fronted in (18b), while in the absence of contrast, the adverb is infelicitous in the clause-initial position, as shown in (18a).

(18) Manner Adverb

a. What did Mari go off to do to show everybody how proud he was to have been accepted to UCLA?

[13]The Antonym Dictionary is available here: `http://portaal.eki.ee/dict/antonyymid`

#Võidukalt$_{\text{TOP}}$ asus Mari kohvreid pakkima. Selles tujus
boastfully started Mari.NOM suitcases.PART pack.INF this.INE mood.INE
oli ta terve päeva.
was she.NOM whole.ACC day.ACC

'Boastfully, Mari started packing her suitcases. She was in this mood the whole day.'

b. What did Mari go off to do to after she heard she had been accepted to UCLA?

Võidukalt$_{\text{CT}}$ asus Mari kohvreid pakkima. Salaja$_{\text{CT}}$ aga
boastfully started Mari.NOM suitcases.PART pack.INF secretly AGA
poetas ta paar pisarat.
dropped she.NOM couple.ACC tears..ACC

'Boastfully, Mari started packing her suitcases. But secretly, she shed a couple of tears.'

Above, we have seen that non-referential elements like manner adverbs can act as CTs in Estonian, provided that their use is coherent with the discourse context. In the absence of contrast, manner adverbs are not good simple Topics. The important take-away here is that the category of constituents that can function as a CT is broader than those that can function as a Topic, as referentiality is not a prerequisite for CT status. As a consequence, care has to be taken when identifying which constituent in a CT-clause receives a contrastive interpretation, both in theoretical explorations of the clause structure of Estonian, as well as in experimental manipulations.

Now that I have provided an overview of where CTs fit with respect to other information-structural categories, let us explore how CTs are syntactically marked in Estonian.

2.2 Word order in Estonian CT clauses

Estonian is generally taken to be a V2 language (Ehala, 2006; Holmberg, 2015), where the subject or another discourse-given element is raised to a single preverbal position (Henk, 2010). Previous work on Estonian syntax (e.g. Lindström 2001; Ehala 2006; Henk 2010;

Holmberg et al. 2020) has not explored the full range of exceptions to V2 order, which is why I lay out descriptive observations of what a theory of the Estonian left periphery should be able to account for below. These data rely on native speaker judgments. We will see that CT-clauses in Estonian may have V2, V3, V4, and verb-final order and that V3+ order (where the verb occurs in the third or later linear position) is licensed by the presence of a CT in the left periphery.

2.2.1 Conditions governing the use of V3+ word order

I postulate that V3 order in Estonian introduces a presupposition for the existence of a CT alternative to a preverbal constituent. Example (19) demonstrates that the inference projects under questions (which, similarly to declaratives, show variability in their word order in Estonian[14]), confirming its presuppositional status (Beaver, 1997). The V3 question in (19) is acceptable when there are contextually salient CT alternatives to Marleen (or the preverbal adverb), for instance in a sequence of questions like 'Did Anna invite Jaan over today? Did Mari invite Jaan over today? Did Marleen invite Jaan over today?' or when it is contextually salient that an alternative to Marleen (e.g. Anna) has or has not invited Jaan over. The V2-equivalent polar question, where the polar question particle is added to the left periphery of the V2 clause, can be felicitously uttered without this presupposition being met.

(19) a. Marleen kutsus täna Jaani külla.
Marleen.NOM invited today Jaan.ACC to.visit
'Marleen invited Jaan over today.' (V2: Neutral)

b. Kas Marleen kutsus täna Jaani külla?
whether Marleen.NOM invited today Jaan.ACC to.visit
'Did Marleen invite Jaan over today?' (V2 Q: Neutral)

c. Marleen täna kutsus Jaani külla.
Marleen.NOM today invited Jaan.ACC to.visit
'MarleenCT invited Jaan over today (but Anna did't).' (V3: CT-marked)

[14]Note that the polar question particle *kas* is extra-clausal from the perspective of the V2 requirement

d. Kas Marleen täna kutsus Jaani külla?
whether Marleen.NOM today invited Jaan.ACC to.visit

'Did MarleenCT invite Jaan over today?' (V3 Q: CT-marked)

2.2.2 Focused constituents are not allowed preverbally in CT structures

In general, Estonian does not allow preverbal Foci with the exception of focused subjects, as exemplified in (20). Subjects thus have a special status in the language with respect to Focus. The ability of focused subjects to occur preverbally in V2 clauses is likely due to the high structural position of the subject at the point when the V2 property must be satisfied.

(20) a. Q: Who ate cake today? (Subject Focus)

MariF sõi täna kooki. or Täna sõi kooki MariF.
Mari.NOM ate today cake.PART today ate cake.PART Mari.NOM

'MARI ate cake today.'

b. Q: When did Mari eat cake? (Adverb Focus)

*TänaF sõi Mari kooki.
today ate Mari.NOM cake.PART

'Mari ate cake TODAY.'

Mari sõi kooki tänaF.
Mari.NOM ate cake.PART today

'Mari ate cake TODAY.'

Interestingly, while focused subjects (including CFs) can occur preverbally in V2 clauses, they cannot be preverbal in the presence of another preverbal constituent (such as a CT) in V3 clauses. Consider the examples in (21) with a preverbal focused subject. In (21a), the focused subject "Anna" occurs preverbally. In (21b), marking the indirect object "from Mari" as a CT results in marginal grammaticality. In contrast, the same linear main clause order is fully acceptable in (21c), where the subject is marked as discourse-given (i.e. [-Foc]) by the preceding context.

(21) a. Q: Who got a gift from Mari?

AnnaF sai Marilt kingituse.
Anna.NOM got Mari.ABL gift.ACC

'Anna got a gift from Mari.' V2

b. *Context:* Mari and Jaan decided to each give a gift to a person they know.

Q: Who got a gift from Mari and who from Jaan?

??MariltCT AnnaF sai kingituse (ja JaaniltCT TiiuF).
Mari.ABL Anna.NOM got gift.ACC and Jaan.ABL Tiiu.NOM

'Anna got a gift from Mari (and Tiiu from Jaan).' ??V3

c. *Context:* Mari and Jaan decided to give something to Anna for her birthday.

Q: What did Anna get from Mari and what did she get from Jaan?

MariltCT Anna sai kingituseF (ja JaaniltCT lilledF).
Mari.ABL Anna.NOM got gift.ACC and Jaan.ABL flowers.ACC

'From Mari, Anna got a gift (and from Jaan, flowers).' V3

In V3+ clauses, all [+Foc] constituents must follow the finite verb,[15] unless, of course, it is the verb itself that is focused. There is a preference for the Focus being clause-final (possibly for prosodic reasons, in order to not have deaccented material follow the nuclear pitch accent). However, as the examples in (22) illustrate, Focus does not have to end up in the final position in CT clauses, even with V3 order. In (22), the focused adverb (which carries the nuclear pitch accent) is shown in capital letters.[16]

(22) *Context:* Mari really loves this particular story book and has been begging for her parents to read her from it every night.

Q: Who read the book to Mari when?

[15]Note that I label CTs [+Contrast, -Foc], while CFs are [+Contrast, +Foc], along what Kaiser (2006) proposes for Finnish. This system is at odds with alternative analyses (most recently by Kratzer and Selkirk 2020), under which FoC (contrastive Focus) is seen as a feature of contrast that combines with a linguistic CT operator to yield a CT (as opposed to a CF) interpretation. Further work is needed to explore whether the FoC analysis of CTs in Estonian is tenable, given the restrictions on Foci in the left periphery.

[16]Note that examples in (22) make up just a subset of grammatical word order possibilities for a clause with a CT subject and an adverbial Focus.

a. EmaCT Marile luges seda raamatut EILEF (... ja
mother.NOM Mari.ALL read this.PART book.PART yesterday and
isaCT TÄNAF).
father.NOM today

'Mom read the book to Mari yesterday (and Dad today).'

b. EmaCT Marile luges EILEF seda raamatut (... ja
mother.NOM Mari.ALL read yesterday this.PART book.PART and
isaCT TÄNAF).
father.NOM today

'Mom read the book to Mari yesterday (and Dad today).'

c. EmaCT seda raamatut luges Marile EILEF (... ja
mother.NOM this.PART book.PART read Mari.ALL yesterday and
isaCT TÄNAF).
father.NOM today

'Mom read the book to Mari yesterday (and Dad today).'

d. EmaCT seda raamatut luges EILEF Marile (... ja
mother.NOM this.PART book.PART read yesterday Mari.ALL and
isaCT TÄNAF).
father.NOM today

'Mom read the book to Mari yesterday (and Dad today).'

To summarize, the distribution of preverbal Foci is extremely limited in Estonian – only focused subjects are allowed to occur preverbally, and only in V2 clauses. CTs are thus clearly distinct from Foci in Estonian.

2.2.3 A varying number of [-Foc] constituents may precede the verb

Previous work on Estonian CT clauses (Henk, 2010) has presented structures where CTs are either the only preverbal constituent, or where a non-subject CT precedes a preverbal subject in a V3 clause. However, this is only a subset of possible word order configurations in CT clauses.

Consider (23), which involves Focus on the polarity of the clause in response to a polar question. Here, the target clause is the second clause ("In the evening, they really enjoyed the chicken", *lit.* "In the evening, the chicken tasted really well to them"), in order to further

license the discourse-given status of constituents that are not marked for Focus or Contrast. As a direct repetition of the discourse-given material in the second clause is unnatural for independent reasons, the second clause in (23) is paraphrased so that it entails the intended meaning (namely that the dogs did eat chicken in the evening). The inflected verb is bolded. The manner adverb "verb well", must follow the finite verb, as it is [+Foc].

(23) Q: Did the dogs eat chicken today?

HommikulCT koerad kana ei söönud.
morning.ADE dogs.NOM chicken.PART NEG-ate

'In the morning, the dogs did not eat chicken.'

a. ÕhtulCT **maitses** kana neile väga hästi.
evening.ADE tasted chicken.NOM they.ALL very well
'In the evening, they really enjoyed the chicken.' V2

b. ÕhtulCT **maitses** neile kana väga hästi.
evening.ADE tasted they.ALL chicken.NOM very well
'In the evening, they really enjoyed the chicken.' V2

c. ÕhtulCT kana **maitses** neile väga hästi.
evening.ADE chicken.NOM tasted they.ALL very well
'In the evening, they really enjoyed the chicken.' V3

d. ÕhtulCT neile **maitses** kana väga hästi.
evening.ADE they.ALL tasted chicken.NOM very well
'In the evening, they really enjoyed the chicken.' V3

e. ÕhtulCT kana neile **maitses** väga hästi.
evening.ADE chicken.NOM they.ALL tasted very well
'In the evening, they really enjoyed the chicken.' V4

f. ÕhtulCT neile kana **maitses** väga hästi.
evening.ADE they.ALL chicken.NOM tasted very well
'In the evening, they really enjoyed the chicken.' V4

Examples (23a–23f) above show possible word order variations when the CT is clause-initial.[17] We observe non-contrastive discourse-given constituents ("chicken" and "they")

[17]Appropriate contrastive prosody is required on both clause-initial CT-marked elements ("morning" and

can intervene between the CT and the verb. Their relative ordering appears to be free, much like it is in the V2 clauses shown in (23a–23b).

While in the examples in (23), the post-verbal material is most naturally interpreted as being focused, it's also possible to have a non-focused constituent in the clause-final position, provided that Focus is expressed on the verb. Below, we see examples where the verb itself is focused (24a–24c) and where the polarity of the clause is focused (25a–25b). In both cases, the most prominent (Focus) accent in the clause of interest is shown in capital letters and we observe that [-Foc] constituents may precede or follow the verb.

(24) *V Focus*

Q: What did Anna and Mari do when they heard about Jaan's promotion?

a. Anna$_{\text{CT}}$ ÕNNITLES$_{\text{F}}$ kohe teda.
Anna.NOM congratulated immediately 3SG.PART
'Anna congratulated him straight away. (Mari organized a party for him.)'

b. Anna$_{\text{CT}}$ kohe ÕNNITLES$_{\text{F}}$ teda.
Anna.NOM immediately congratulated 3SG.PART
'Anna congratulated him straight away. (Mari organized a party for him.)'

c. Anna$_{\text{CT}}$ teda kohe ÕNNITLES$_{\text{F}}$.
Anna.NOM 3SG.PART immediately congratulated
'Anna congratulated him straight away. (Mari organized a party for him.)'

(25) *Polarity Focus*

Q: Did Anna and Mari see the new Sherlock Holmes movie?

a. Anna$_{\text{CT}}$ NÄGI seda filmi, Mari$_{\text{CT}}$ mitte$_{\text{F}}$.
Anna.NOM saw this.PART movie.PART Mari.NOM NEG
'Anna did see the movie, Mari did not.' (V2)

b. Anna$_{\text{CT}}$ seda filmi NÄGI, Mari$_{\text{CT}}$ mitte$_{\text{F}}$.
Anna.NOM this.PART movie.PART saw Mari.NOM NEG
'Anna did see the movie, Mari did not.' (V3)

"evening"). In the target clause, the nuclear pitch accent falls on the clause-final AdvP *väga hästi*, "very well".

2.2.4 CTs are not necessarily clause-initial

While we see CTs in a clause-edge position in Estonian, CTs may also be preceded by other non-focused material. The observation that contrast is allowed in a non-initial position in Estonian is interesting in the light of the cross-linguistic observation that contrastive constituents in the left periphery tend to precede other information-structurally marked projections (Molnár and Winkler, 2010).

The examples in (26) show some possible further variations, continuing from (23). We observe that either (or both) of the discourse-given constituents can precede the CT.

(26) Q: Did the dogs eat chicken today?

HommikulCT koerad kana ei söönud.
morning.ADE dogs.NOM chicken.PART NEG-ate

'In the morning, the dogs did not eat chicken.'

a. Kana õhtulCT **maitses** neile väga hästi.
chicken.NOM evening.ADE tasted they.ALL very well
'In the evening, they really enjoyed the chicken.' V3

b. Neile õhtulCT **maitses** kana väga hästi.
they.ALL evening.ADE tasted chicken.NOM very well
'In the evening, they really enjoyed the chicken.' V3

c. Kana õhtulCT neile **maitses** väga hästi.
chicken.NOM evening.ADE they.ALL tasted very well
'In the evening, they really enjoyed the chicken.' V4

d. Kana neile õhtulCT **maitses** väga hästi.
chicken.NOM they.ALL evening.ADE tasted very well
'In the evening, they really enjoyed the chicken.' V4

e. Neile kana õhtulCT **maitses** väga hästi.
they.ALL chicken.NOM evening.ADE tasted very well
'In the evening, they really enjoyed the chicken.' V4

In silent reading, the constituent that is contrastive in V3+ clauses can be ambiguous. It is important to note, however, that in speech the information structure of these clauses is

disambiguated using prosody. I exemplify this in Figure 2.1, using the sentence *Veini Anna eile jõi* "Wine Anna yesterday did drink", where any of the three preverbal constituents may act as a CT. We observe that the CT-marked constituent (which, in this example, is always bisyllabic)[18] receives a rise-fall pitch accent, and there is another high tonal target on the clause-final verb.[19] The rest of the preverbal constituents are prosodically deaccented (i.e. do not contain tonal targets). We also observe that the CT-marked constituent is relatively longer than the other preverbal constituents.

To summarize the data from the last couple of sections, CT clauses in Estonian are quite flexible in their word order, with one or multiple discourse-given elements being able to immediately precede or follow the CT in the preverbal domain. Much like prosody can be used to mark different information-structural configurations in canonical SVO clauses, it is also important for disambiguating information structure in non-V2 clauses – in all of the examples discussed above, CTs receive a contrastive pitch accent (see Sahkai and Mihkla 2017), while other preverbal constituents are deaccented.

2.2.5 Multiple CTs are possible

Estonian allows for multiple CTs in a clause, like Japanese (Yabushita, 2008) and English (Constant, 2014), among others. In (27), we observe that in a context that marks a multiple CT structure, it's possible to get V2 order where only one of the CTs is preverbal ("on Monday" in 27a) or V3 order with both CTs being preverbal ("on Monday" and "Anna" in 27b).

[18]The low-high-low (LHL) pitch accent falls on the initial, stressed syllable of the CT-marked constituent.

[19]The high target occurs at the beginning of the verb in (a) and (b) but is delayed in (c), possibly due to prosodic constraints against two pitch accents occurring in adjacent positions, or in order to accommodate a low tonal target on the second syllable of the CT *eile* "yesterday".

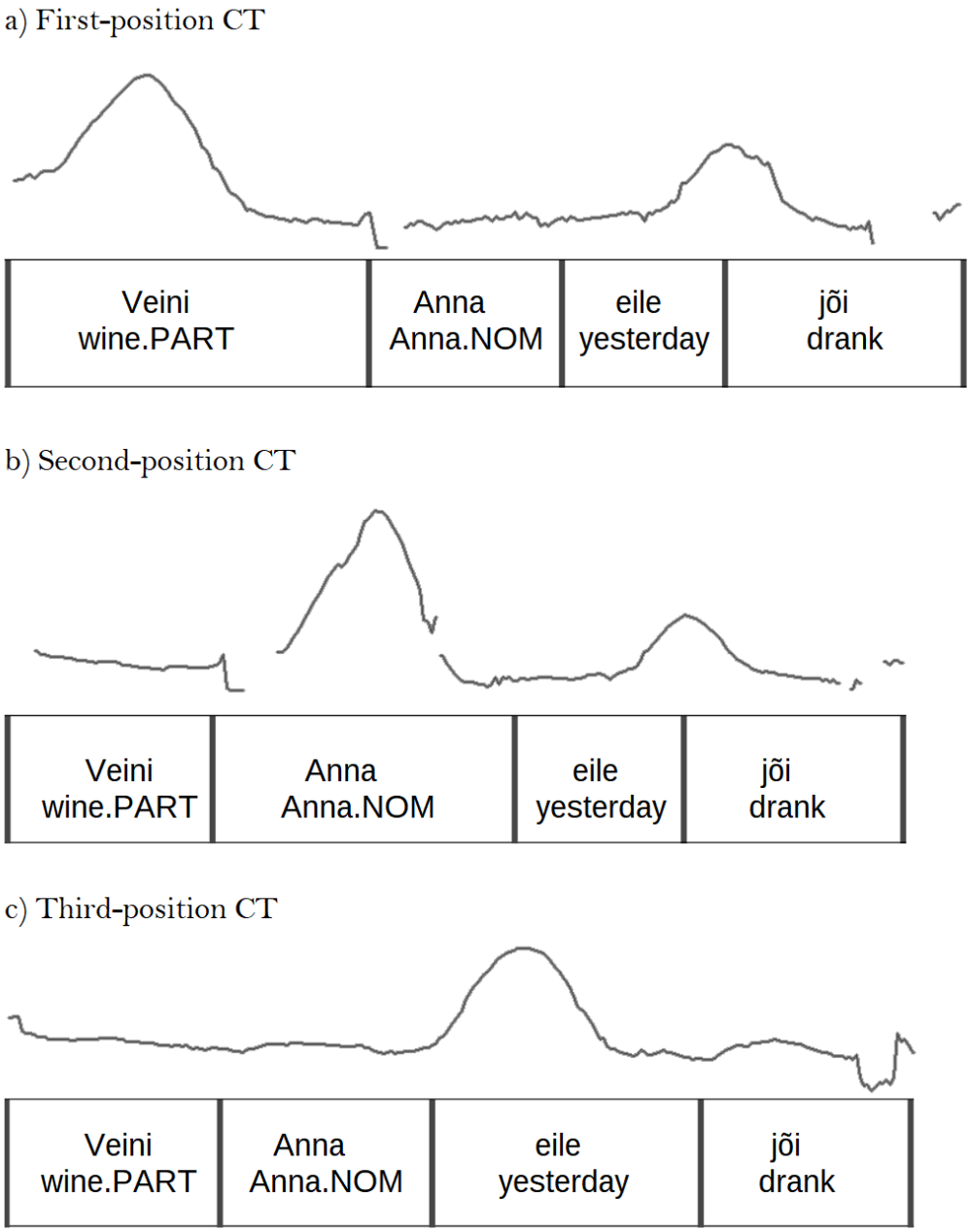


Figure 2.1: Pitch contours for first, second and third position CTs. Time plotted horizontally and F0 vertically.

(27) *Context:* Anna and Mari are taking an arts class because they want to learn to draw animals. This week, they are practicing drawing woodland creatures. They each decide to focus on an animal of their choosing every day.

Q: Which animal will Anna and Mari draw on each day of the week?

a. EsmaspäevalCT joonistab AnnaCT rebaseidF ja MariCT oravaidF.
Monday.ADE draws Anna.NOM foxes.PART and Mari.NOM squirrels.PART
TeisipäevalCT ...
Tuesday.ADE
'On Monday, Anna draws foxes and Mari squirrels. On Tuesday, ...' V2

b. EsmaspäevalCT AnnaCT joonistab rebaseidF ja MariCT oravaidF.
Monday.ADE Anna.NOM draws foxes.PART and Mari.NOM squirrels.PART
TeisipäevalCT ...
Tuesday.ADE
'On Monday, Anna draws foxes and Mari squirrels. On Tuesday, ...' V3

I will leave further details of multiple CT structures to future work, but it is worth noting that any syntactic projection hosting CTs in the left periphery of Estonian is likely recursive (see also Rizzi 1997, 2004).

2.3 The syntax of CT-clauses in Estonian

Below, I provide a syntactic analysis for the Estonian left periphery that aims to capture the descriptive facts laid out above. I will then show why two previous theoretical proposals for explaining deviations from V2 order in Estonian (Henk, 2010; Holmberg et al., 2020) can not account for the data presented in Section 2.2. Finally, I extend the structure adopted for full CT-clauses to CT remnant ellipsis (as well as CF remnant ellipsis).

2.3.1 The cartographic approach

Linguists have long been incorporating notions like Topic and Focus into syntactic structure, with cartographic work mapping out the left-peripheral positions of different information-structural projections in individual languages (e.g. Horvath 1986; Rizzi 1997, 2004). Under

this view, the syntactic projections for different information-structural notions are fixed relative to other clausal heads, and constituents are moved to specifier positions to check the features of a Focus, Topic, Contrast or CT head. The order of information-structural projections is assumed to be fixed in any given language, although covert movement can be postulated to account for cross-linguistic variability and word order variations within a particular language. I do not touch on the issue of whether the hierarchical order of projections is language-specific or universal, although linguists have noticed cross-linguistic tendencies, such as a preference for given information to precede new information (Gundel, 1988). Following the assumption that information-structural notions are encoded in the syntax (at least in flexible word order languages), let us consider the structure of the syntactic left periphery in Estonian.

2.3.2 The present analysis

I propose the structure shown in (28)[20] for Estonian CT clauses, where CTopP is recursive and takes as its sister GivenP, which can host an optionally raised [-Foc] constituent.[21] CP, which hosts complementizers, and QP, which hosts *wh*-words and the polar question word *kas*, occur in both CT clauses and non-CT clauses and will be omitted for brevity from here on.[22]

(28) [CP [QP [CTopP [GivenP* [CTopP [GivenP* [FinP [TP [FocP [vP ...]]]]]]]]]]]

V3+ order in non-CT clauses is ruled out by GivenP being introduced by CTopP, and not being able to occur on its own. As discussed in Section 2.1.3, CT clauses obligatorily

[20] I do not discuss the position of NegP here, but it likely occurs somewhere between FinP and TP, as verbs with the negative clitic *ei* are inflected for tense but not for subject agreement.

[21] Along the same line, in Finnish, Kaiser (2006) analyzes clause-initial Pol heads as obligatorily taking a TopP complement, although TopP does not need to be filled in the absence of a sufficiently salient constituent.

[22] The order of CP and QP is seen in embedded questions, which optionally allow for overt complementizers in the presence of *wh*-words. The pragmatic conditions governing the presence or absence of the complementizer are an interesting area of future research.

contain a Focus (as CTs themselves are [-Foc]). The movement of discourse-given [-Foc] constituents to the left-peripheral GivenP projections can be motivated by prosodic reasons, if there is a preference for the nuclear pitch accent occurring close to the right edge of the clause (in line with Holmberg et al. 2020, although their syntactic implementation differs from mine). General information-packaging principles like Gundel (1988)'s Given-Before-New principle could also be playing a role. Still, raising to GivenP is optional, as witnessed by the possibility of V2 order in CT clauses.[23]

I follow Holmberg et al. (2020) in assuming that FinP forms the core of non-CT clauses in Estonian and that the finite verb raises to the Fin head position. V2 order in non-CT clauses has been explained by a single XP raising to Spec-FinP in order to satisfy FinP's Extended Projection Principle (EPP; Chomsky 1982, 1993, 2000).[24] As mentioned in Section 2.1.5, the raising of non-contrastive object Topics to the preverbal position in the presence of an overt subject in the clause is somewhat marginal in Estonian. This is compatible with Estonian not having a left-peripheral TopP to motivate such a movement.

FinP must also be present in CT clauses in order for the verb to be fully inflected, as there are no differences between verb forms in CT structures and non-CT structures. Focused subjects, which can normally occupy Spec-FinP, cannot be raised to a preverbal position in the presence of a CT (as we saw in Section 2.2.2). This could be explained if a CT constituent is first raised to Spec-FinP and satisfies the EPP requirement, before moving up to a higher CTopP projection in order to check a [+Contrast] feature.[25]

More broadly, it may be the case that a focused subject is only raised to Spec-FinP as *a last resort* to satisfy the EPP requirement (where Spec-FinP attracts the closest, structurally highest XP), when no other constituent is salient enough to be moved there. There is some

[23]A previously proposed alternative account where V3+ order is derived by optionality in verb movement (more precisely, where the verb is spelled out), rather than through the optional movement of XPs to the left periphery is presented below in Section 2.3.3. However, we will see that explaining differences in the linear position of the verb through where the verb is spelled out fails to account for the information-structural restrictions on preverbal constituents.

[24]But see Lindström (2001) for work on stylistically motivated (narrative) verb-initial declaratives.

[25]This way, the explanation for V2 order in non-CT clauses (EPP for FinP) still holds in V3+ clauses.

indirect evidence for the claim that focused subjects are raised to a preverbal position as a last resort from the experimental finding that CF subjects are rated as more natural in OVS clauses than in SVO clauses in Estonian (Kaps, 2019).

Why postulate GivenP and not TopP in the structure shown in (28)? I assume that a central property of Aboutness Topics is referentiality (Reinhart, 1981). While the preverbal constituents in CT-clauses can be topical, they are not necessarily so. To illustrate, consider the example in (29), where the indefinite subject DP *keegi* "somebody/anybody/nobody" can be interpreted as being non-referential.[26] As usual, it is possible to just have the object CT ("Mari") itself precede the verb as shown in (29a), but with prosodic deaccenting of non-contrastive preverbal constituents (as in all of these examples), the non-referential subject can also occur preverbally, as shown in (29b) and (29c).

(29) *Context:* Mari and Anna are discussing otherwise common gifts that they have personally never received from anybody.

Q: What gifts do Mari and Anna never receive?

a. MarileCT ei kingi keegi kunagi lilliF ja AnnaleCT küünlaidF.
Mari.ALL NEG-gift anybody.NOM ever flowers.PART and Anna.ALL candles.PART

'To Mari, nobody ever gives flowers and to Anna, candles.'

b. MarileCT keegi kunagi ei kingi lilliF ja AnnaleCT küünlaidF.
Mari.ALL anybody.NOM ever NEG-gift flowers.PART and Anna.ALL candles.PART

'To Mari, nobody ever gives flowers and to Anna, candles.'

c. Keegi MarileCT kunagi ei kingi lilliF ja AnnaleCT küünlaidF.
anybody.NOM Mari.ALL ever NEG-gift flowers.PART and Anna.ALL candles.PART

'To Mari, nobody ever gives flowers and to Anna, candles.'

[26]Note that a referential interpretation of *keegi* ("Somebody never gives Mari flowers") is also grammatically licensed in these examples but is ruled out by the context.

The recursivity of CTopP in the proposed structure addresses two of the observations made in Section 2.2. Firstly, it allows for multiple CT-marked constituents to occur in the preverbal domain. Secondly, it can account for instances where discourse-given material precedes the CT-marked constituent.

I follow the basic assumption that heads impose restrictions on their complements but not *vice versa*. This means that introducing CTopP to the left periphery can not obligatorily come with another projection (such as GivenP) above CTopP. In order to get discourse-given material to occur in front of a CT, I thus propose that the [CTopP [GivenP* ...]] sequence can be iterated. The CT-marked constituent is moved through every instance of Spec-CTopP. Other discourse-given material linearly precedes the CT when the CT is spelled out in a lower Spec-CTopP position.[27] Whether the CT is clause-initial or not is not associated with clear interpretational differences. While my proposed structure does not impose an upper limit on the number of CTopP projections allowed, three and more sets of CTs in the discourse representation likely impose insurmountable difficulty on computing the interpretation, so would be ruled out for language processing reasons.

2.3.3 Shortcomings of previous analyses

Below, I discuss two previous approaches to the variation in Estonian word order. Under the first view (Henk, 2010), there is a single CTopP above FinP. Under the second view (Holmberg et al., 2020) the structure of the left periphery is fixed, but the verb can be spelled out at different heights in the structure based on prosodic considerations.

The simplest analysis of Estonian CT clauses (e.g. Henk 2010) assumes that CT clauses are derived like regular V2 clauses in Estonian, with the addition of a single CTopP projection above FinP. I call this the CT+V2 hypothesis and schematize it below in (30). Following (30), V2 clauses contain a FinP (plus any higher projections determining clause type and the

[27] While there is variability in which of the copies of the CT gets spelled out, spelling out the highest copy may be preferred for prosodic reasons, as it results in the pitch accents on the CT and on the Focus being spaced apart. Further work is needed to explore the prosody of word order variability in the left periphery.

like), and in CT-clauses a higher CTopP projection above FinP becomes available for a CT constituent to raise into. Under this account, CT structures are associated with an expanded left periphery, but only a single CTopP is postulated, without additional projections for other discourse-given constituents.

(30) <u>CT+V2 Hypothesis:</u> [CTopP [FinP [TP [vP]]]]

Under the CT+V2 Hypothesis, V3 order is derived when in addition to the CT constituent raising to the left periphery, whatever constituent that would otherwise have raised to Spec-FinP still raises to Spec-FinP. This hypothesis has been used to explain the naturalness of structures like (31), where a subject occurs between a clause-initial non-subject CT and the inflected verb.

(31) Q: Did Mari see Anna and Liisa today?

AnnatCT Mari täna nägi.
Anna.PART Mari.NOM today saw

'Anna, Mari did see today.'

However, this hypothesis both undergenerates and overgenerates grammatically acceptable structures. It cannot account for cases where more than two constituents precede the verb in CT clauses, such as the example in (32a), or cases where the CT occurs in a non-initial position (32b).

(32) *Context:* Mari has made a habit of giving Anna a small gift every day.

a. TänaCT Mari Annale andis märkmikuF.
today.ADE Mari.NOM Anna.ALL gave notebook.ACC
'Today, Mari gave Anna a notebook.'

b. Mari tänaCT Annale andis märkmikuF.
Mari.NOM today.ADE Anna.ALL gave notebook.ACC
'Today, Mari gave Anna a notebook.'

Additionally, the CT+V2 Hypothesis *over*generates by not being able to successfully rule out structures where a focused subject occurs preverbally in the presence of a CT. If

a constituent can be raised to Spec-FinP in a non-CT clause, then under this approach it should also be able to raise to Spec-FinP (i.e. the second position of the clause) in CT clauses. This is not the case. Any material intervening between a CT and the verb is necessarily [-Foc], unlike what can occur clause-initially in V2, non-CT clauses.

A recent proposal by Holmberg et al. (2020) incorporates prosodic conditions to explaining deviations from V2 order in Estonian. They do not explicitly discuss CT structures, but with CTs receiving prosodic prominence, let us consider the predictions of their hypothesis to CT structures. Holmberg et al. (2020) propose that prosodic phrasing affects which copy of a particular specifier or verbal head is spelled out, and that there is a general preference for nuclear pitch accents (roughly, realizations of Focus) to occur later in the clause. These conditions result in a dispreference for more than one preverbal constituent (with the exception of deaccented pronouns), and the observation that accented verbs can occur later in the clause than unaccented verbs. Much like the CT+V2 Hypothesis, Holmberg et al. assume a fixed cartography for the clause, schematized in (33).

(33) <u>Prosodic Hypothesis:</u> [OpP [FinP [TP [vP]]]]

Conditions on PF:

I. Only one phonological word allowed to be spelled out in Spec-OpP or Spec-FinP

II. The verb is spelled out in Fin, unless it carries a nuclear pitch accent.

Note that the authors postulate a more general Op(erator)P instead of CTopP, which is argued to allow CTs, *wh*-words or relative clause heads to occur in its specifier.[28] When Spec-OpP is filled by another constituent, CTs are only raised as high as Spec-FinP at LF. Copies of the verb occur in Fin, T and v[29], with typically the highest copy being spelled out at PF.

[28]Interestingly, complementizers do not occur in this position, as evidenced by the possibility of having a clause-initial complementizer co-occur with a fronted *wh*-word in embedded questions. In embedded clauses, an additional CP layer would have to be added on top of OpP.

[29]The authors do not discuss the internal structure of the vP in Estonian, which also goes beyond the scope of the present dissertation

Condition I is used to account for the observation that weak pronouns (see Pajusalu 2009; Kaiser 2010 are often "invisible" to the V2 constraint (particularly in spoken language), as shown in their examples reproduced in (34), with my addition of the long pronoun example in (34c) to complete the paradigm. The relative position of the weak pronoun (bolded) is argued to not influence interpretation, however, the possibility of the clause-initial adverb being interpreted as (implicitly) contrastive with other days of the week cannot be ruled out. Empirical work is needed to examine potential information-structural differences in interpretations between (34a) and (34b).

(34) a. Pühapäeviti küpsetab **ta** kooki.
on.Sundays bakes 3SG cake.PART
'On Sundays (s)he bakes a cake.' (V2)

b. Pühapäeviti **ta** küpsetab kooki.
on.Sundays 3SG bakes cake.PART
'On Sundays (s)he bakes a cake.' (V3)

c. ?Pühapäeviti **tema** küpsetab kooki.
on.Sundays 3SG bakes cake.PART
'On Sundays (s)he bakes a cake.' (V3)

While Condition I does rule out structures where a CT and a focused subject both occur preverbally, it is not clear that a fully phonological account of what is spelled out in the left periphery can ever hold, as it fails to distinguish between focused subjects and subject CTs.

Condition II, or the proposal that verbs carrying a nuclear pitch accent (a realization of Focus) can be spelled out lower than in Fin, allows for V3+ order (including in CT-clauses) when the verb is accented, for instance when the verb itself or the polarity of the clause is focused). However, this only covers a subset of the data as V3+ order is also possible with clause-final focused subjects, objects and adverbs.

Additionally, the Prosodic Hypothesis inherits problems from the CT+V2 Hypothesis that cannot be ameliorated using the two prosodic conditions. The ordering of projections in (33), with OpP in the clause-initial position, does not allow for clauses where non-contrastive material precedes the CT constituent. While a CT may be spelled out in Spec-FinP un-

der Holmberg et al.'s proposal, [-Foc] constituents cannot be raised to Spec-OpP, which is reserved for functional categories and CTs.

To summarize, we have observed that the previous proposals for Estonian clause structure cannot account for the range of word order variability in CT-clauses. In the experimental portion of this dissertation, I will take advantage of this word order variability in order to explore how comprehenders compute syntactic and information-structural representations in real time.

But before moving on to more psycholinguistic aspects of this work, let us sketch a syntactic analysis for ellipsis clauses with contrastive remnants, which will form an important part of my experimental work.

2.3.4 Contrastive ellipsis in Estonian

Estonian distinguishes between CT and CF remnant ellipsis, much like French (Morris, 2008), German (Repp, 2009; Konietzko and Winkler, 2010), Persian (Rasekhi, 2018) and Romanian (Bîlbîie, 2019). In this section I provide an overview of the two types of constructions in Estonian.

CF and CT remnant ellipsis constructions are used in markedly different contexts, as predicted by the information structure of the remnants. While CT remnant ellipsis (CTE) is natural in partial responses to a salient QUD (provided that a CT alternative is presented in the antecedent clause), CF remnant ellipsis (CFE) is not, as shown in (35).

(35) Q: Did Anna and Mari see Liisa?

a. Anna$_{CT}$ nägi Liisat, Mari$_{CT}$ mitte.
Anna.NOM saw Liisa.PART Mari.NOM NEG
'Anna did see Liisa, Mari didn't.'[30] (CTE)

[30]Note that the loose translation in English involves VP ellipsis, but there is no auxiliary present in the Estonian example. I consistently use VPE in translations of Estonian CTE in this dissertation as VPE offers the intuitively closest semantic interpretation of the construction.

b. #Anna$_{CT/CF}$ nägi Liisat, mitte Mari$_{CF}$.
Anna.NOM saw Liisa.PART NEG Mari.NOM
'Anna saw Liisa, not Mari.' (CFE)

Instead, CFE is used in corrective contexts, as exemplified in (36) below.

(36) Q: Did Mari see Liisa? *or* Mari saw Liisa.

(Ei,) Anna$_{CF}$ nägi Liisat, mitte Mari$_{CF}$.
no Anna.NOM saw Liisa.PART NEG Mari.NOM

'(No,) Anna saw Liisa, not Mari.'

The information-structural differences between CTE and CFE in Estonian are also evidenced in the different prosodic contours associated with (35a) and (36), as shown in Figure 2.2 below. In (a), we observe two pitch accents in the matrix clause – on the CT "Anna" and the verb carrying polarity Focus. Similarly, the remnant has two pitch accents – one on the CT "Mari" and the other on the polarity particle (although the latter is obscured on the pitch track by the geminate [t]).[31] In (b), we observe as single pitch accent in the matrix clause on the CF "Anna", and a single one in the remnant on the CF "Mari".

Various structural and non-structural analyses have previously been proposed for ellipsis (see Merchant 2009 for an overview). In this dissertation, I follow a structural analysis of ellipsis where the ellipsis site contains unpronounced syntactic structure (see e.g. Merchant 2001; Yoshida et al. 2015), but it's worth noting that the experimental findings reported in Chapter 4 are in principle not incompatible with non-structural (including pronominal) accounts of ellipsis (e.g. Keenan 1971; Ginzburg and Sag 2000).

The syntax of contrastive ellipsis has previously been analyzed in German. Konietzko and Winkler (2010) argue that in German, CTE and CFE can both be derived through vP deletion, following the raising of ellipsis remnants to the appropriate information-structural projections, as shown in (37). Under their analysis, Foc and Neg are left-adjoined to vP, with

[31] The gaps in the pitch track occur at voiceless consonants – orthographic <g> is [k], /l/ in "Liisa" is devoiced in rapid speech, and [s] and [t] are voiceless.

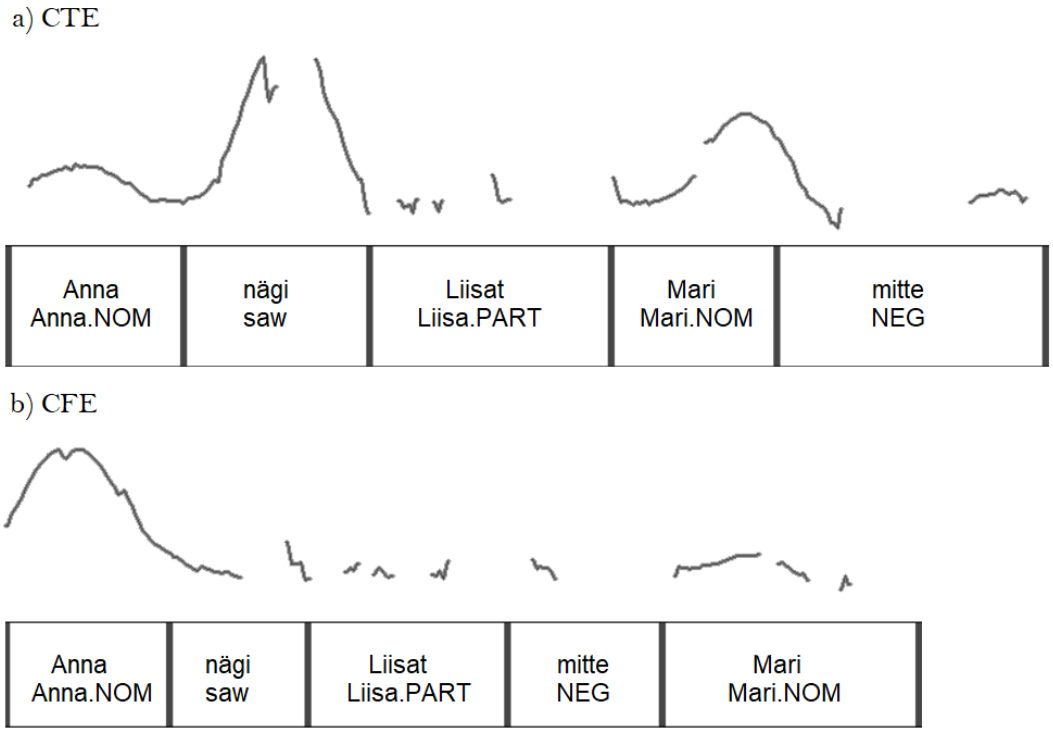


Figure 2.2: Pitch contours for a V2 clause containing a CT subject, followed by CTE (a), and a V2 clause with a CF subject, followed by CFE (b). Time plotted horizontally and F0 vertically.

CTs (or in (37), "TOP") occurring in the left periphery, in Spec-CP. CFs move to a position at the left edge of vP, with the rest of the vP (or the VP) deleted. Additionally, Konietzko and Winkler propose that in contrastive ellipsis, given material that would otherwise be deaccented is simply not pronounced, which results in there not being an overt inflected verb present in IP or CP.

(37) *CTE in German:* [CP TOP [IP [vP Neg [vP FOC [~~vP~~]]]]]
CFE in German: [vP Neg [vP FOC [~~vP~~]]]

Under this account, the verb and its arguments do not raise out of vP overtly before being deleted, with the exception of information-structurally marked constituents (CTs and CFs). Konietzko and Winkler provide evidence for material above vP in German not being deleted under contrastive ellipsis by showing that sentential adverbs argued to occur in the middle field (between TP and vP, along with other elements like quantifiers and definite objects) are

allowed to be overt in contrastive ellipsis. I reproduce their examples below, in (38), where I have marked the assumed ellipsis sites in both constructions below with <e>. In accordance with the structures proposed in (37), we observe that the adverb *vermutlich*, "probably" follows the CT "Hans" in CTE, while it precedes the CF "Hans" in CFE. Assuming that the adverb occurs between TP and vP, these data are in line with CTs moving to a high, left-peripheral position and CFs only raising to a Focus position below the middle field in German.

(38) a. Q: Will both of your siblings go to France? (CTE)

Maria wird wohl fahren, aber Hans vermutlich nicht <e>.
Maria will PART go but Hans probably not

b. Q: Will Maria go to France? (CFE)

Maria wird wohl nicht fahren, aber vermutlich Hans <e>.
Maria will PART not go but probably Hans

Much like German uses the negative particle *nicht* in contrastive ellipsis, Estonian also has polarity particles that function in similar ways – both negative and affirmative ones. Before discussing the structure of CTE and CFE in Estonian, a bit of background on Estonian polarity particles is needed. The work on polarity particles in Estonian is limited (but see e.g. Tamm 2015, for a discussion on negation in Estonian, and Hakulinen and Keevallik 2016 for work on the affirmative Verum particle in Finnish and Estonian). I present some data on the use of these particles in other (not CTE or CFE) constructions in Estonian below, for context.

The negative particle *mitte* "not" is used in both CTE and CFE and also participates in optional negative concord with the sentential negation clitic *ei* (see Kaps 2020, for experimental evidence), including with existential quantifiers as shown in (39).

(39) a. Seda raamatut ei lugenud (mitte) keegi.
this.PART book.PART NEG read NEG anybody.NOM
'Nobody read this book.'[32]

[32]This utterance is not ambiguous, as the referential interpretation "somebody" for *keegi* is not available

b. *Seda raamatut luges mitte keegi.
this.PART book.PART read NEG anybody.NOM
'Nobody read this book.' [Intended]

The affirmative counterpart of *mitte* in CTE is the particle *küll* "indeed", which also has Verum usages in the language (Hakulinen and Keevallik, 2016), as exemplified in (40). The particle can optionally occur in a sentence to strengthen the assertion or to (implicitly or explicitly) contrast the asserted content with some salient alternative.

(40) Ma (küll) lugesin (küll) seda raamatut (küll).
I.NOM AFF read AFF this.PART book.PART AFF
'I did READ the book (... but I didn't understand it).'

Additionally, as shown in (41), neither the negative particle *mitte* nor the affirmative particle *küll* can act as a fragment answer to a polar question.

(41) Q: Did Anna read this book?

A: Ei.	A': *Mitte.	Negative answer
A: Jah.	A': *Küll.	Affirmative answer

The affirmative counterpart of *mitte* in CFE is the particle *vaid* "but", which is homophonous with the focus particle "only" in Estonian, as shown in (42). The two uses of *vaid* have structural differences, as shown by the ungrammaticality of (42a). In a CF ellipsis structure, *vaid* must necessarily occur in the second clause as shown in (42b).

(42) Seda raamatut luges vaid Anna.
this.PART book.PART read only Anna.NOM
'Only Anna read this book.'

a. *Seda raamatut luges vaid Anna(,) mitte Mari.
this.PART book.PART read only Anna.NOM NEG Mari.NOM
'Not Mari but Anna read this book.' [Intended]

---

when the indefinite occurs below negation.

b. Seda raamatut luges mitte Mari(,) vaid Anna.
this.PART book.PART NEG Mari.NOM read only Anna.NOM
'Not Mari but Anna read this book.'

In its contrastive coordinator ("but") usage, *vaid* patterns like the German particle *sondern* "but, rather" and not the particle *aber* "but" (see Asbach-Schnitker 1979, for a discussion of the two German coordinators; also see Dascal and Katriel 1977, for a similar contrast in Hebrew).[33]

Let us not return to contrastive ellipsis in Estonian. As a reminder, in full CT clauses (schema repeated in 43), CTs were proposed to occur in the left periphery (above FinP) and Foci to occur lower (presumably, above vP).

(43) [CTopP [GivenP* [CTopP [GivenP* [FinP [TP [FocP [vP ...]]]]]]]]

Similarly to German, the high position of CTs and low position of CFs is directly observed in the linear order between CTs/CFs and polarity particles in Estonian bare argument ellipsis. CTs precede the polarity particle (*küll* for positive polarity and *mitte* for negative polarity) and CFs follow the polarity particle (*vaid* for positive polarity and *mitte* for negative polarity). The particles in the ellipsis clause have a slightly different function in the two constructions. In CTE, the polarity particle expresses Focus and conveys the polarity of the elided clause. In CFE, the particles also express polarity, but associate with the CF rather than being carriers of Focus themselves.[34]

Let us compare the structure of contrastive ellipsis in Estonian to German by looking at the placement of sentential adverbs in CTE and CFE in Estonian. In (44), we observe that the only possible position for the adverb *vist* "probably" in CTE is between the CT remnant and the negative particle. Even though the adverb is not marked for Focus, it cannot linearly precede the CT. This suggests that the adverb is not raised to the left periphery along with the CT in the second clause, as we saw previously that discourse-given elements following

[33]The Estonian coordinator *aga* "but" functions like German *aber*.

[34]The particles receive a pitch accent in CTE (where they expresses Focus) but not in CFE.

the CT in the left periphery are also freely allowed to precede the CT. Thus, the adverb likely occurs below FinP. This observation is in line with the structure proposed for German by Konietzko and Winkler (2010).

(44) Anna$_{CT}$ nägi Liisat, (*vist) Mari$_{CT}$ (vist) mitte (*vist).
Anna.NOM saw Liisa.PART probably Mari.NOM probably NEG probably
'Anna saw Liisa, Mari probably didn't.' (CTE)

CFE is used for corrections, as the speaker explicitly removes a particular proposition (e.g. "Anna saw Liisa" in example 45 below) from the common ground. The corrective usage of CFE is pragmatically incompatible with the adverb "probably", so in the CFE example below, I will use a the adverb *hoopis*, "instead" . Example (45a) shows that the adverb can only occur between the particle *vaid*, "but, only" and the CF remnant. In the presence of the adverb "instead", the adverb "probably" can also be added to the ellipsis clause. As shown in (45b), the only position it can occur in to yield a grammatical utterance is between "but" and "instead" – *vaid vist hoopis Mari*. The adverb data are compatible with the CF in CFE being located in FocP at the left edge of vP. The polarity particle here appears to function like a coordinator at the left edge of the ellipsis clause, as no material is allowed to precede it. This is confirmed in the full clause equivalent of (45b) shown in (45c).

(45) a. Anna$_{CF}$ ei näinud Liisat, (*hoopis) vaid (hoopis) Mari$_{CF}$ (*hoopis).
Anna.NOM NEG-saw Liisa.PART instead but instead Mari.NOM instead
'Anna didn't see Liisa, but rather Mari (did).' (CFE)

b. Anna$_{CF}$ ei näinud Liisat, (*vist) vaid (vist) hoopis (*vist)
Anna.NOM NEG-saw Liisa.PART probably but probably instead probably
Mari$_{CF}$ (*vist).
Mari.NOM probably
'Anna didn't see Liisa, but probably Mari did instead.' (CFE)

c. Anna$_{CF}$ ei näinud Liisat, vaid vist hoopis Mari$_{CF}$ nägi
Anna.NOM NEG-saw Liisa.PART but probably instead Mari.NOM saw
Liisat.
Liisa.PART
'Anna didn't see Liisa, but probably Mari saw Liisa instead.'

To summarize, the adverb data in Estonian show that in contrastive ellipsis, CTs necessarily precede sentential adverbs while CFs necessarily follow sentential adverbs. This observation is compatible with CTs occurring in the left periphery in contrastive ellipsis (as they do in full clauses) and CFs occurring in a lower Focus position (as in full clauses). We also observed that polarity particles in CTE necessarily carry Focus accent and are the final element in the surface string, which I take to indicate that they occur in or are close to FocP, which licenses the ellipsis of the structure below. In CFE, the polarity particles necessarily precede the Focus constituent and occur at the left edge of the clause. I take these particles to be clausal coordinators, occurring above FinP (see e.g. Vicente 2010 and Perez-Jimenez and Moreno-Quibén 2012, for similar treatments of adversative coordinators cross-linguistically). We saw that sentential adverbs can occur in both CTE and CFE, as they do in German (Konietzko and Winkler, 2010), which is compatible with the projections occurring between FinP and FocP not being deleted under ellipsis (assuming that ellipsis targets constituents), but rather deleted through mechanisms similar to those that apply to deaccenting given material (Konietzko and Winkler, 2010). I settle on a vP ellipsis analysis for contrastive ellipsis in Estonian here, leaving details of whether the absence of elements like inflected verbs and auxiliaries (*cf.* VP ellipsis in English) is best explained by ordering ellipsis before verb movement or by independent processes that eliminate (or deaccent) repeated material at PF (spellout), to future work. The preliminary structures for Estonian are schematized in (46) below. I omit intermediate projections (like ArgP, TP) here, but assume that features like tense and subject-verb agreement can be checked without the verb being overt.[35] The contrastive remnant (CT/CF) and the polarity particle (Pol) have been bolded for clarity. The CT occurs in Spec-CTopP and the CF in Spec-FocP. While the raising of contrastive constituents to an information-structurally marked position is similar in CTE and CFE, the polarity particles behave in different ways. In CTE, the polarity particle receives a Focus interpretation (here, by raising to Spec-FocP) while in CFE, the coordinator

[35]For agreement patterns in CFE in Estonian, see recent experimental work in Kaps (2020), where I show that there is a preference for less featurally marked 3rd person verb forms when two subjects in a replacive construction mismatch in their person features (e.g. "Not $\text{Mari}_{3\text{Sg}}$ but $\text{I}_{1\text{Sg}}$ $\text{ate}_{1\text{Sg}/\mathbf{3Sg}}$ cake").

status of the particle means that it is base-generated as a head in &P.

(46) *CTE in Estonian:* [CP [CTopP **CT** [FinP [FocP **Pol** [vP ~~Pol~~ [~~vP~~]]]]]] [36]

CFE in Estonian: [&P **Pol** [FinP [FocP **CF** [~~vP~~]]]]

Let us illustrate these analyses of contrastive ellipsis with subject and object remnants. Example (47a) shows CTE with a subject remnant and example (47b) shows CTE with an object remnant, with the elided constituent marked by angled brackets.

(47) a. Mari nägi Kadit, [$_{\&P}$ (ja/aga) [$_{CTopP}$ Anna$_i$ [$_{FinP}$ [$_{FocP}$ mitte
Mari.NOM saw Kadi.PART and/but Anna.NOM NEG
[$_{vP}$ ~~mitte~~ <t$_i$ nägi Kadit>]]]]]
saw Kadi.PART

'Mari saw Kadi, (and/but) Anna didn't. (CT subject remnant)

b. Kadit Mari nägi, [$_{\&P}$ (ja/aga) [$_{CTopP}$ Annat$_i$ [$_{FinP}$ [$_{FocP}$ mitte
Kadi.PART Mari.NOM saw and/but Anna.PART NEG
[$_{vP}$ ~~mitte~~ <Mari nägi t$_i$>]]]]]
Mari.NOM saw

'Mari saw Kadi, (and/but) Anna she didn't. (CT object remnant)

For CFE, a subject remnant example is shown in (48a) and an object remnant example is shown in (48b).

(48) a. Mari nägi Kadit, [$_{\&P}$ mitte [$_{FinP}$ [$_{FocP}$ Anna$_i$ [$_{vP}$ <t$_i$ nägi
Mari.NOM saw Kadi.PART NEG Anna.NOM saw
Kadit>]]]]
Kadi.PART

'Mari saw Kadi, not Anna.' (CF subject remnant)

b. Mari nägi Kadit, [$_{\&P}$ mitte [$_{FinP}$ [$_{FocP}$ Annat$_i$ [$_{vP}$ <Mari nägi
Mari.NOM saw Kadi.PART NEG Anna.PART Mari.NOM saw
t$_i$>]]]]

[36] I assume, like Konietzko and Winkler (2010) do for German, that the polarity particle is adjoined to the vP, but also add a FocP at the edge of vP, following e.g. Kiss (2002) for Hungarian. The polarity particle could be raised to Spec-FocP as shown here to receive a Focus interpretation, or alternatively, the Focus feature could probe down into vP. I leave more detailed examinations of the left periphery of the vP in Estonian to future work.

'Mari saw Kadi, not Anna.' (CF object remnant)

The processing of these constructions is explored in Chapter 4. In Experiment 1, we will be looking at CT subject remnants, as seen in (47a), and CF object remnants, as seen in (48b). Experiment 2 involves subject and object CT remnant ellipsis, as shown in (47). Some of the additional structures in (47–48) have been looked at elsewhere (see e.g. Kaps 2019, for experimental work on CT and CF subject remnant ellipsis).

CHAPTER 3

Processing Information Structure: Background

In this chapter, I set the stage for exploring the processing of CTs in Estonian by discussing previous work on the processing of non-canonical word order, highlighting unique challenges with interpreting measures of "comprehension difficulty" such as reading times. I also summarize previous psycholinguistic work on CF constructions. After that, the chapter builds on the introduction to information-structural concepts presented in Chapter 2 by expanding on semantic and pragmatic differences between CTs and CFs that are expected to be reflected in the processing profile of these constructions. Finally, I set up the conceptual framework I propose for the processing of CT structures and lay out the hypotheses to be tested in the following experimental chapters.

3.1 Processing non-canonical word order

As discussed in Chapter 2, non-canonical V3+ clauses (where the verb occurs in the third or later linear position) arise when the left periphery is expanded in the presence of a CT, occurring in CTopP, along with the possibility of moving additional [-Focus] constituents to GivenP positions above FinP (the highest landing position for finite verbs). When no other constituents besides the CT raise to the preverbal domain, CT-clauses may also have V2 (verb-second) order, which has been claimed to be the canonical order in the language – particularly when the first constituent is a subject (Ehala, 2006; Holmberg, 2015; Kaps, 2019; Holmberg et al., 2020). CT structure is thus optionally conveyed through non-canonical word order. Below, I review work on the processing of non-canonical word order in other flexible word order languages. We will return to a discussion of the effects non-canonical word order

is expected to have in processing CT clauses in Section 3.6.1.

In languages with flexible word order, canonical word order (also "dominant word order" in the terminology of Dryer 2005) is defined as being the least marked (e.g. SVO in Estonian, Finnish or German main clauses) in the sense that it can occur out of the blue (as a response to a broad-focus question like "What happened?')'.[1] Marked word orders are also less frequent in corpora than canonical orders (see discussion in Bornkessel et al. 2002).

Deviations from the canonical order are licensed in specific contexts and thus linguistically encode information structure. Looking at the processing of non-canonical clauses in flexible word order languages thus naturally presents itself as a window to how the language processing mechanism deals with information structure. Past work has explored the discourse conditions governing the use of non-canonical word order and how its processing may differ from that of canonical word order. There is work looking at whether non-canonical order elicits longer reading times than canonical order (Gorrell, 2000), whether non-canonical word order facilitates the processing of information structure (Kaiser and Trueswell, 2004) and whether context modulates word order preferences (Weskott et al., 2011).

Studies on non-canonical word order often find penalties for marked structures, but the relationship between slower reading times for non-canonical clauses and comprehension difficulty is not completely clear. Kristensen et al. (2014) found in a self-paced reading experiment in Danish that clauses ambiguous between SVO and OVS order were read more slowly in contexts licensing OVS order compared to a neutral context, suggesting that entertaining the possibility of a non-canonical order incurs an additional processing load, compared to situations were the non-canonical structure is not contextually supported and might thus not be entertained by the parser. One possibility is that competition between two alternative structures for an ambiguous input slows the reader down (but see Clifton and Staub 2008 for arguments against competition effects in parsing, and Van Gompel et al. 2000 for evidence that structural ambiguity actually *reduces* reading times in certain constructions). Another

[1]Canonical word order can be used in a range of discourse contexts, with information structure marked through prosodic means.

possibility is that non-canonical word orders prompt the parser to engage in discourse updating (making changes to the discourse representation) in addition to syntactic processing (Kaiser and Trueswell, 2004), which is then associated with increased processing time. Under the latter view, observed processing difficulty or slowdown in non-canonical clauses indexes a deeper engagement with the discourse representation (including information-structural computations), compared to canonical clauses where information structure can remain underspecified.

More direct evidence for the engagement of additional processes in non-canonical clauses compared to canonical clauses comes from Finnish, where Kaiser and Trueswell (2004) found in a visual world eye tracking experiment using OSV clauses that hearing a non-canonical OV sequence at the beginning of the sentence lead to anticipatory looks to potential discourse-new referents for the subject in a visual scene. In canonical SVO clauses, participants were not more likely to fixate on discourse-new (as opposed to previously mentioned) referents for the clause-final object. This is explained by only discourse-new subjects being able to occur post-verbally in Finnish, while postverbal objects may be discourse-old or discourse-new. The authors propose that a processing slowdown in non-canonical clauses, which they also observe for OVS clauses in Finnish in a self-paced reading experiment, is due to the parser having access to more discourse information in non-canonical clauses than canonical clauses, allowing for additional processes such as referential prediction to take place. Kaiser and Trueswell's study leaves open the question of whether non-canonical word order automatically and necessarily induces discourse updating, or whether this is an optional process. When processing load is increased, for instance by introducing comprehension questions to the experiment (Kristensen et al., 2014), canonical structures may still be preferred. Kristensen et al. (2014) found evidence for poorer comprehension question accuracy for non-canonical clauses compared to canonical clauses, and the difference was not completely eliminated by supportive context.

At the same time, the markedness of non-canonical order does not always produce processing difficulty. In general, psycholinguists have observed that discourse context facilitates

the processing of more complex syntactic structure (Altmann and Steedman, 1988; Eberhard et al., 1995; Trueswell et al., 1999) and these effects have been observed in non-canonical constructions as well (Kaiser and Trueswell, 2004; Weskott et al., 2011; Kristensen et al., 2014). For instance, Weskott et al. (2011) showed that in contexts allowing an object to be accommodated as discourse-given in German, non-canonical OVS clauses where that object occurs in a clause-initial Topic position are in fact rated as more natural than canonical SVO clauses, where the topicalized object is clause-final. Additionally, in a self-paced reading experiment Weskott et al. used clauses that were temporarily ambiguous between being subject-initial and object-initial in an OVS-biasing context and found a reading time penalty for the canonical SVO clauses compared to OVS clauses on the sentence-final region. A penalty for SVO compared to OVS is a surprising finding if the language processor independently favors canonical word order.

Weskott et al.'s findings suggest that reading time penalties previously reported for non-canonical clauses (Gorrell, 2000) may arise from a difficulty with contextual integration, and their findings suggest that with proper contextual licensing, there is in fact no independent advantage for canonical orders. Their findings are compatible with discourse representations (such as the discourse status of referents) being easily accessible during sentence processing, allowing for marked word order to be rapidly accommodated (or even preferred) when the presuppositions for its use are met. This apparent lack of preference for canonical word orders in supporting discourse contexts provides evidence against the view that the frequency of particular syntactic configurations plays a central role in parsing (as proposed by e.g. Hujanen 1997 and Gibson 1998).

These mixed findings indicate that there is still a lot of work to be done in understanding the processing of information structure. Non-canonical word order acts as a syntactic realization of discourse structure, and how this syntactic information is treated also raises interesting questions for the study of sentence processing more broadly. Psycholinguists have long debated the question of whether all syntactic dependencies must be resolved im-

mediately[2] (e.g. Frazier and Fodor 1978) or whether the processor allows for a certain amount of structural underspecification during moment-by-moment comprehension (Frazier and Clifton, 1996; Ferreira et al., 2002). More recently, there is also growing interest in understanding the time course of pragmatic processing relative to other linguistic computations, although much of the work informing models of semantic and pragmatic processing has been on the computation of (scalar) implicatures (e.g. Noveck 2001; Bott and Noveck 2004; Huang and Snedeker 2009; Degen and Tanenhaus 2015).

3.2 Processing Contrast – the view from Contrastive Focus

Previous work on the processing of information structure has primarily dealt with the processing of Focus (see Kim 2019 for a recent review), and most of the work on the processing of contrast has been centered around CFs. This could be due to more extensive linguistic marking for CFs than for CTs – CFs can be marked using contrastive pitch accents[3] and also using Focus-sensitive particles like *only* and *also*. CTs, meanwhile, are primarily marked through prosodic means. As discussed in Chapter 2, CFs are distinguished from other kinds of Focus (such as new information Focus) by having a limited set of salient alternatives. There is evidence that these alternatives to focused expressions remain active in the discourse representation[4] and comprehenders have better memory for words that act as contrastive alternatives to a CF-marked constituent (Fraundorf et al., 2010; Spalek et al., 2014). There is also evidence that focus-marking on a constituent facilitates the processing of its alternatives when those are encountered later in the discourse (e.g. Carlson 2001; Carlson et al. 2009; Harris and Carlson 2018, for bare argument ellipsis, or stripping), compared to

[2]Allowing for later reanalysis if needed.

[3] In the ToBI system (Silverman et al., 1992), H* or a high tone on a stressed syllable typically conveys new information, while L+H* (where a high tone on a stressed syllable is immediately preceded by a low tonal target, creating a steep pitch excursion), typically conveys Contrastive Focus (e.g. Pierrehumbert and Hirschberg 1990)

[4]But see Washburn (2013) for evidence from a mouse-tracking experiment that Focus actually *suppresses* access to its alternatives.

structures without Focus on the expected constituent in the antecedent clause.

A considerable amount of work has been exploring how contrastive alternatives are activated during moment-by-moment comprehension, and how these contrastive alternatives are represented in the mind. Below, I present findings addressing two questions relevant to the present work:

1. Is the activation of CF alternatives automatic?
2. What is the content of the activated CF alternatives? Does the processor activate just lexical representations of the alternatives or full propositions/inferences?

There is some evidence bearing on the first question – whether the activation of alternatives is automatic – from work looking at the influence of focus particles on online processing, as focus particles allow in many cases for CF structure to be conveyed unambiguously).[5] Some past work looking at the processing of the focus particle *only* (e.g. Ni et al. 1996; Paterson et al. 2007) has implicitly assumed that the focus particle automatically triggers the activation (or search for) CF alternatives. Indirect evidence for the activation of focus alternatives being automatic comes from the observed experimental effects occurring rapidly in incremental processing. Ni et al. (1996) explored whether garden path sentences (i.e. sentences where comprehenders typically first construct a parse that is later shown to be untenable) can be resolved towards the correct, more complex parse rapidly (in first-pass reading) when presented in a supportive referential context. They found that using the focus particle *only* instead of the definite determiner *the* in temporarily ambiguous items as shown in (49) had a rapid effect on the processing profile of the sentence. In sentences like (49a) comprehenders initially construct a syntactically simpler parse where "taught" is a main verb and "the people" its agentive subject. Processing difficulty (in terms of a slowdown in reading, and regressive eye movements to preceding words) arises when this analysis is ruled

[5]The focus particle *only* can associate with a constituent it c-commands (Jackendoff, 1972; Rooth, 1992), which can give rise to ambiguities that I will not address in this work. The particle *even* gives rise to further ambiguities by being able to associate with constituents that linearly precede it.

out by further lexical input ("will"). In sentences like (49b), there is evidence (in reading and comprehension measures) for comprehenders being less likely to compute the erroneous main clause analysis, as the reduced relative clause analysis ("Only people [who were] taught new math...") is accessed more easily.[6]

(49) a. The people taught new math will pass the test.

b. Only people taught new math will pass the test.

c. Only smart people taught new math will pass the test.

Ni et al. argue that the processing of the reduced relative clause interpretation in (49b) is facilitated by the processor accessing the presupposition for the existence of a contrastive alternative in the discourse representation introduced by the particle *only*. Appealing to the principle of parsimony, the authors postulate that using material encountered in the sentence to construct a contrastive alternative (people who were taught new math *versus* people who were not taught new math) is less costly than inferring an alternative that is less contextually accessible (people *versus* #non-people). The bias to interpret material following the NP "people" as a modifier eases the computation of the reduced relative clause interpretation. In support of this hypothesis, they observed that sentences where a modifier suitable for contrast – "smart" in (49c) – was encountered before the introduction of the ambiguity patterned with the baseline condition (49a). The findings from Ni et al. (1996) suggest that the processor is rapidly sensitive to the presupposition for the existence of a contrastive alternative introduced by the CF-particle *only* and aims to identify this alternative as rapidly as possible, overriding preferences for syntactic simplicity when needed.

Similarly, Paterson et al. (2007) show in a reading study that comprehenders are sensitive to the placement of *only* in items like (50), suggesting that the features of a suitable CF alternative to the *only*-adjacent constituent are rapidly activated. The researchers found reading time penalties when a contrastive alternative ("her father") presented in a following

[6]The authors did not test the processing of bare forms such as "People taught new math will pass the test."

ellipsis clause was an implausible alternative to the *only*-adjacent constituent ("the salt" in 50b) compared to when the contrastive alternative was congruent with the *only*-adjacent constituent ("her mother" in 50a).[7]

(50) a. Jane passed <u>only her mother</u> the salt but not her father.

b. Jane passed her mother <u>only the salt</u> but not her father.

Replacive ellipsis does not require its correlate (the contrastive alternative to the remnant in the antecedent clause) to be overtly marked with the focus particle *only*, meaning that if the pairing between the CF alternatives ("her mother" and "her father" in 50) only occurred during the processing of the remnant ("her father"), we might not expect to see large asymmetries between (50a) and (50b). This is because the semantically congruent correlate candidate ("her mother") should always be grammatically accessible as a CF alternative to the remnant. Yet, Paterson et al.'s data are most compatible with the processor (initially) entertaining a semantically anomalous analysis in (50b) (that Jane didn't pass her mother her father). These results are thus better explained if encountering the CF-marking *only* rapidly triggers the search for (or activation of) a potential CF alternative to the constituent immediately linearly adjacent to *only*.

At the same time, there is evidence to suggest that while the computation of CF structure can be rapid, it may not be completely automatic (or mandatory). For the computation of CF to be automatic, it would have to obligatorily take place in the presence of a linguistic cue to CF structure. This means that we would not expect to see a difference in the probability of CF structure being computed based on whether there is a single linguistic cue to CF structure (such as contrastive prosody) or multiple cues to CF structure (such as prosody and a focus particle). As long as CF structure is conveyed unambiguously, the processor should compute it automatically. While contrastive pitch accents (such as L+H* in English

[7]The configuration where "only" precedes the direct object ("the salt") is only marginally grammatically acceptable with an indirect object contrast ("but not her father"). In a sentence completion experiment, the authors observed that 84% of the completions that participants provided in this experimental condition involved direct object contrast, while only 13% involved indirect object contrast.

ToBI, Pierrehumbert and Hirschberg 1990) have been shown to rapid activate CF alternatives to pitch-marked constituents (Husband and Ferreira, 2016), some work (Spalek et al., 2014; Gotzner, 2017) has shown more robust effects when both a contrastive pitch accent and a focus particle are used to mark a constituent as a CF, rather than a pitch accent alone. If the computation of CF structure was automatic, we would expect a single reliable cue for CF-marking to be sufficient for activating contrastive alternatives to the CF-marked constituent (even if the process is slower than in the presence of multiple cues).[8] The presence of a contrastive pitch accent and a focus particle to disambiguate the intended information structure of the clause could act as two cues that support each other during the computation of the discourse representation (but see Gotzner et al. 2013, for evidence that the effects of pitch-accenting and focus particles are slightly different from each other in online processing).

Interestingly, recent work by Potter and Carlson (2019) on the effects of focus-marking on modifier attachment ambiguity resolution (see also Carlson and Tyler 2018) shows stronger effects of the placement of focus particles than the placement of pitch accents in determining interpretations. Using items like (51) where capitalization marks the most salient pitch accent in the clause and % marks a prosodic boundary, Potter and Carlson found that in the absence of the particle *only*, the modifier "on Monday" was interpreted as more likely to attach to the verb "claimed" when this verb was accented (51a) compared to when another verb was accented (51b). However, when *only* immediately preceded "claimed", the placement of prosodic prominence did not influence attachment preferences. Thus, adding the particle "only" to the antecedent clause overrode the effects of overt prosody.[9]

(51) a. Kathie (only) CLAIMED that Alex had lied % on Monday.

[8]Depending on the experimental paradigm, it may be difficult to determine whether a particular computation takes place at a delay, or not at all. For instance, in a lexical priming experiment a slower response to a target word in a particular condition could indicate that the lexical item was not activated rapidly enough to speed up processing compared to an unrelated word, but the fast nature of the task could fail to capture effects occurring at a delay or confound them with other cognitive processes occurring downstream.

[9]Relatedly, see Harris and Carlson (2018) for more evidence of heuristics overriding overt prosodic marking in comprehension.

b. Kathie (only) claimed that Alex had LIED % on Monday.

This picture is complicated by the fact that depending on the experimental paradigm, prosodic marking is not always interpreted as reliable and can, to a certain extent, be ignored by listeners (Nakamura et al., 2019). Further, work by Filik et al. (2009) on the processing of the focus particles *only* and *even* in silent reading shows evidence that while the contrastive interpretation required for the two particles in computed rapidly, there is a delay in the time course of processing *even* (which has the added pragmatic function of conveying that the proposition is the least likely from a set of alternatives) compared to *only*.[10] Thus, the access to CF alternatives appears to be influenced by multiple factors, and while rapid, is not necessarily automatic.

Let us now turn to the second question – what exactly is being activated when the processor determines that the presupposition for a contrastive alternative to the CF-marked constituent is met? Experimental work at the interface of lexical and pragmatic processing (e.g. Gotzner 2017) argues that lexical elements that are contextually compatible with being focus alternatives to a focus-marked DP are rapidly activated and compete for activation with the focused DP itself. Under this view, the activation of alternatives is initially lexical in nature. Husband and Ferreira (2016) propose that lexical representations of CF alternatives then act as input to further inference processes. In a cross-modal priming study, they used items like (52) and found that upon hearing a pitch-accented word ("duck") in a sentence context, there was initially facilitation for the lexical processing of its semantic associates ("swan" and "nest") but after a delay, only candidates that were compatible with being CF alternatives to the focused word in the particular context ("swan") remained active. At this point, the authors propose that relevant inferences can be drawn – e.g. that the boy did not like to feed swans in the park.

(52) The boy liked to feed the DUCK in the park.

a. Contrastive associate: SWAN

[10]In addition to semantic differences the two particles also have syntactic differences, which may (partially) account for the asymmetry.

b. Non-contrastive associate: NEST

There is also evidence that comprehenders can rapidly take the broader discourse context into consideration when computing contrastive alternatives. Kim (2012) showed in a visual scene eye-tracking experiment that the choice of a focus particle (*only* or *also*) influenced anticipatory eye movements to plausible alternatives. She used story contexts like (53) along with a four-image display, which contained the mentioned set (pears and apples), a subset (apples), a superset (pears, apples and oranges) and a novel set (oranges). She found that hearing the story with the exclusive particle *only* prompted early fixations to the subset image while hearing the story with the additive particle *also* prompted early fixations to the superset image. Thus, listeners were immediately sensitive to the semantics of the two particles (rather than just the presence of contrast) and used this information to predict whether " pears and apples" would be contrasted with "apples" or "pears, apples and oranges". This finding suggests that rather than simply lexically activating the alternatives to "pears and apples", comprehenders rapidly compute an exclusive or additive inference, as appropriate.

(53) Mark has some pears and some apples. Jane only/also has some apples.

It is possible that the computation of contrastive inferences proceeds in a somewhat serial manner, where early lexical representations of CF alternatives can be rapidly combined with the broader sentence context to activate the relevant inferred meaning. However, work by Spalek et al. (2014) suggests that the lexical activation of contrastive alternatives also persists at a delay. Spalek et al. conducted a delayed recall task using items like (54) in German, where the critical manipulation was whether the CF constituent in the final sentence was marked by the exclusive particle *nur* ("only"), the inclusive particle *sogar* ("even"), or no particle at all. After hearing ten trials (a mix of experimental and filler items), participants were asked to recall the Focus alternatives presented in the first sentence. The experimenters were interested in whether the presence of a focus particle improves the recall (and by hypothesis, activation) of the CF alternatives.

(54) There are shirts, trousers, and jackets in the catalogue.

I bet Matthias has bought shirts and trousers.

No, he (only/even) bought jackets.

Recall question: What was in the catalogue?

(Expected response: shirts, trousers, jackets)

Spalek et al. (2014) found that both focus particles improved recall for focus alternatives compared to the no-particle condition, and that there was no difference between recall accuracy for the "only" and "even" conditions. This is an interesting finding, as the inferences expected to be drawn in the two particle conditions are different. Consider (55), showing the inferences drawn from (54). There is an asymmetry whereby "even" (55b) is expected to activate all three alternatives, while "only" (55a) explicitly excludes two of the alternatives. This asymmetry not showing up in recall accuracy suggests that inferences, if activated, were not encoded in longer-term memory.

(55) a. Inference from "only": Matthias did not buy shirts or trousers.

b. Inference from "even": Matthias bought jackets, shirts and trousers.

The idea that the activation of contrastive alternatives is lexically modulated gives rise to further issues when we consider instances where the CF is not a single world, but rather a larger constituent.[11] In order to comprehend a dialogue like the one shown in (56), the processor may need to access a larger constituent from the discourse representation, such as "all day" to contrast with "until lunchtime" in (56a) and "stay in bed all day" to contrast with "have been working hard since 7 A.M." in (56b).

(56) Q: Did you stay in bed all day?

A: No, I ...

a. ... only stayed in bed [until lunchtime]$_{\text{CF}}$

b. ... [have been working hard since 7 A.M.]$_{\text{CF}}$

[11] Also see the discussion on "sentential contrastive focus" in Büring (2016).

To summarize, the content of the mental representations activated during the processing of contrast is still very much an open research question. In the present work, I will primarily use proper names as contrast-marked elements. As most proper names do not have conventionalized lexical associations,[12] , the access to contrastive alternatives in this work is not expected to be mediated by lexical activation. We will, however, observe that the processor is sensitive to the linguistic structure of the clause that the contrastive alternative occurs in.

In the following section, I discuss semantic and pragmatic differences between CTs and CF that may bear on the activation and representation of contrastive alternatives to CTs during sentence processing.

3.3 Semantic and pragmatic differences between CF and CT

As we saw above, work on the processing of CFs has shown that the processing of contrast involves the activation of contrastive alternatives, although questions pertaining to the time course of activating alternatives and the exact nature of these alternatives during incremental processing have not be resolved in the literature. To my knowledge, the online processing of CT structures has not been explicitly studied, although there is psycholinguistic work on "contrastive sentences" (Lee and Lee, 2005), on "multiple topic" contexts (Hoeks et al. 2002, discussed in more detail in Chapter 5), and on topicality more broadly (e.g. Wang and Schumacher 2013; Burmester et al. 2014). In the present work, I am thus building on previous findings on the processing of CFs.

First, as a notational note – in the following, I use the label CT1 for a CT-marked constituent and the label CT2 for a member of CT1's set of contrastive alternatives. While a CT may have multiple contextually salient alternatives, for the sake of simplicity I assume that a single contextually relevant alternative is sufficient to license the use of a CT structure.

Some researchers have argued that CT structure triggers an automatic "reverse po-

[12]There are culturally specific associations like "Ben and Jerry" for the ice-cream and "Tom and Jerry" for the cartoon, but I assume that most lexical associations involving proper names are idiosyncratic.

larity inference"[13] (Krifka, 1998; Lee, 1999; Oshima, 2005; Hara, 2006), that is, the contrastive alternative and its contrastive relationship to CT1 (such as occurring in information-structurally parallel clauses of the opposite polarity) can be inferred. For instance, in (57), the reverse polarity inference would be that Mari did not eat cake. One criticism of the reversed polarity account is that it doesn't take into consideration the Focus structure of the clause. In this particular case, CT2 (Mari) could also contrast with CT1 (Anna) in virtue of differing in the Focus value of the clause, yielding the inference that Mari ate something other than cake.

(57) Q: What did Anna and Mari eat?

A: Anna_{CT} ate cake_{F} [14]

Reversed polarity inference: ¬(Mari ate cake.)

Contrastive inference: Mari ate x s.t. $x \neq$ cake.

The variability of possible inferences in a CT structure results in an asymmetry between CTs and CFs, and I argue that there is a pragmatic reason for actively maintaining potential CT alternatives in memory. Following Grice (1975), comprehenders expect utterances to be informative and bring the interlocutors closer to the conversational goal. I will show that the use of a CT structure does not rule out that the proposition that is stated to apply to CT1 does not apply to its CT alternatives. As a result, explicitly stating CT2 and whether the relevant proposition ("x ate cake" in 57) applies to CT2 or not ends up being informative.

To illustrate, let us look at the case of the exclusive focus particle *only* in (58). As *only* is taken to overtly[15] entail or presuppose the exclusion of focus alternatives (Ippolito,

[13] An implicature or a presupposition, depending on the author.

[14] Whether this utterance implies that Mari ate anything is partially influenced by the scope of focus – when only the object "cake" is focused, "ate" is backgrounded and not felicitously substituted with another predicate in any parallel clause about Mari (but of course, one could utter "And Mari ate NOTHING"). When the focused constituent is "ate cake", the implication that Mari ate something is weakened. As discussed in Section 2.1.1, prosody in examples like this underdetermines the scope of Focus.

[15] Some analyses of Focus, e.g. Kiss (1998), postulate a silent exhaustivity operator that is similar in its semantics to *only*, but the intended type of focus (CF vs Informational Focus, see Büring 2016) can be difficult to communicate to comprehenders unambiguously when an overt particle is not used. This possibly

2008), answer (58a) is as informative as (58b), where the exclusivity inference is made overt by spelling out the focus alternative and the proposition applying to it. This is because the entailment (that no other conference guest stayed at the hotel) is necessarily true and cannot be canceled, as shown by the infelicity of (58c). When reading or hearing (58a), comprehenders may activate the entailment that no other conference guest besides Anna stayed at the hotel. Conceptually, the activation of this alternative does not mean that the processor is expecting it to be overtly spelled out, as shown in (58b). For a speaker to produce the focus alternative ("nobody else") overtly as in (58b) would violate the Gricean maxims of Manner and Quantity – (58a) and (58b) convey identical semantic content, which shows that (58b) does not convey the message in the briefest possible way.

(58) Which of the conference guests stayed at the hotel?

a. Only Anna_{CF} stayed at the hotel.

b. Only Anna_{CF} stayed at the hotel. Nobody else did.

c. # Only Anna_{CF} stayed at the hotel. In fact, Mary_{CF} did too.

Now consider the CT example in (59). We see that the overtly spelled out full response (59b) is more informative than just the statement including CT1 ('Anna') in (59a). This is because the polarity-reversed inference ("Everybody else didn't")[16] is not necessarily true – it can actually be canceled by using the additive particle "too" as shown in (59c).[17] Thus, CT2 (Mary)and the proposition conveyed by the clause it occurs in are not redundant. During incremental processing, a comprehender may thus expect CT2 and the proposition applying to it to be explicitly spelled out.

(59) Did the conference guests stay at the hotel?

---

contributes to diminished or delayed effects of contrast in the absence of an overt focus particle in some prior studies (e.g. Paterson et al. 2007; Spalek et al. 2014).

[16]Note that since CT structure presupposes the existence of contextually salient alternatives, 'nobody' is not a felicitous subject here. Instead, 'everyone' is used along with sentential negation.

[17]Work on the stressed German additive particle *auch* actually suggests that depending on their syntactic position, additive particles can associate with CTs and not just Foci (Krifka, 1998).

a. Anna$_{CT}$ did.

b. Anna$_{CT}$ did. [Everybody else]$_{CT}$ didn't.

c. Anna$_{CT}$ did. In fact, [everybody else]$_{CT}$ did too.

Prediction here takes the form of (partial) preactivation (see Kuperberg and Jaeger 2016) – the processing of an overt CT2 is facilitated once encountered, as the discourse representation has already been partially updated. Another component of predicting an upcoming contrastive alternative is that the content conveyed by the clause containing the alternative should not be redundant, as was exemplified in (58). Namely, a structure or interpretation may be activated before it is encountered, without it having been predicted in a true sense of the word. This is due to a preference against redundancy in language, as documented for instance for referential forms – as Arnold (2010) illustrates with the example in (60), a particular linguistic form (the full DP "Elsi") may be activated and made highly salient by the context, but be judged as unnatural or inappropriate when encountered (here, in the second sentence and definitely in the third).

(60) Elsi called Sarah. Elsi asked lots of questions. Elsi told Sarah lots of funny stories too.

As CTs are used in structures conveying partial answers to a salient discourse question, the clause containing CT1 by definition does not fully answer the question under discussion. A clause containing CT2 would thus convey an informative proposition, while the same is not always true in CF constructions. To summarize, we see an asymmetry between CTs and CFs as there are pragmatic grounds to activate CT alternatives and anticipate them in the discourse, if not previously encountered. There isn't a semantic reason for CT alternatives to be suppressed in online processing the way that CF alternatives may be (Washburn, 2013).[18]

Before laying out our hypotheses for the incremental processing of CT constructions, let us consider different possible configurations between CT1 and CT2 in text.

[18]Some theoreticians have defined CTs as involving a change to the discourse topic (e.g. Özkan Grigoraş 2020), which implicitly assumes that the previous topic is overridden (and perhaps deactivated in processing), but as laid out in Chapter 2, this is not the approach I adopt here.

3.4 Directionality of contrast

I adopt the terms "forward-looking" and "backward-looking" to describe whether a contrastive alternative to a CT is expected to follow or has been encountered in the preceding discourse, respectively. Natural language allows for forward and backward dependencies in a range of constructions, including syntactic dependencies in gapping ellipsis (Citko, 2018) and NPI licensing (Pablos et al., 2019), as well as discourse dependencies in the computation of inferences (Rickheit et al., 1985).

In instances where contrast is forward-looking, CT2 has not yet been encountered. As CT-marking presupposes the existence of a contrastive alternative, the use of CT-marking is not (yet) contextually licensed at this point. An example of forward-looking contrast is provided in (61), where the CT "Anna" does not have an explicitly mentioned contrastive alternative. From the context question, we can infer that these alternatives belong to a set of Mari's friends, but there is no single alternative that could be contrasted with Anna at this point. In the terms of Büring (1997), whether Mari saw the rest of her friends is the "Residual topic" of the discourse here, i.e. the part of the QUD still to be addressed.

(61) Q: Did Mari see her friends?

AnnatCT Mari nägi.
anna.PART Mari.NOM saw

'Anna, Mari saw.'

Contrast is backward-looking when the CT-marked constituent is being contrasted with a previously encountered CT-alternative. The particles *aber* "but" in German (Sæbø, 2003) and *aga* "but" in Estonian mark CTs with previously highlighted CT alternatives. Another instance where contrast is backward-looking is contrastive remnant ellipsis[19] (discussed in

[19]See Section 4.1.1 for more examples. CFE can involve forward-looking contrast in "preverbal CFE" constructions as shown in example (a) below. These configurations will not be explored in the present work, but see discussion in Kaps (2020).

(a) Mitte Anna vaid Mari nägi Jaani.
NEG Anna.NOM but Mari.NOM saw Jaan.PART
'Not Anna but Mari saw Jaan.'

more detail in Chapter 4), as exemplified in (62), where we also see the optional particle *aga*. The CT "Jaan" in the ellipsis remnant is contrasted with the previously encountered subject of the antecedent clause ("Mari"). In this instance, CT2 (Mari) linearly precedes CT1 (Jaan).[20]

(62) MariCT nägi Annat, **Jaan**CT (aga) mitte.
Mari.NOM saw anna.PART Jaan.NOM AGA NEG
'Mari saw Anna, Jaan didn't.'

The terms forward-looking contrast and backward-looking contrast are useful descriptive labels when talking about the linear ordering between CT1 and CT2. When it comes to processing more naturalistic text, and instances where multiple CT-alternatives are present, these terms may prove less useful. For the present purposes, the two kinds of contrast are distinguished by whether a contrastive alternative can be accessed from (or easily inferred based on) the previous discourse representation. Therefore, instances where CT2 is not explicitly present in the text but has to be inferred by the processor in order to satisfy the conditions on CT-marking would also be considered cases where contrast is forward-looking. In the experimental portion of this dissertation, I will use instances of backward-looking contrast (namely, contrastive remnant ellipsis) in order to examine how word order is used to encode information structure. Forward-looking contrast in CT structures will be used to investigate whether comprehenders predict upcoming contrast based on contextual and syntactic factors. Looking at the online processing of forward-looking and backward-looking contrast allows us to examine the encoding and resolution of contrast during language comprehension.

3.5 Conceptual steps in CT processing

Contrast, which has been argued to be an information-structural category independent of Topic and Focus (see e.g. Molnár 2002), offers unique insights when it comes to processing

[20]This is assuming that when encountering the canonical SVO matrix clause, the processor does not mark the subject Mari as CT1.

information structure. This is because unlike other information-structural categories like Aboutness Topics and informational Focus, the use of CTs and CFs requires that a salient set of alternatives be accessible within the discourse context. The processing of a contrastive element (say, a CT) could thus be conceptualized as involving two steps – firstly, encoding information structure by marking the constituent of interest as a CT, and secondly, resolving contrast by pairing the CT element with a salient contrastive alternative, which may be overtly present in the discourse or otherwise accessible. Previous psycholinguistic work on syntactic dependency resolution offers an analogy for how the parser may be treating contrast during online comprehension. Before discussing CT-marking and contrast resolution, let us first consider the analogy from the processing of *wh*-dependencies.

3.5.1 An analogy from processing syntactic dependencies

Research shows that filler-gap dependencies introduced by *wh*-movement are actively resolved through predictive syntactic processing (e.g. Frazier et al. 1983; McElree and Bever 1989; Omaki et al. 2015). Namely, in sentences like (63), readers typically experience processing difficulty when encountering at the object "Anna" (underlined), which has been taken to indicate that a gapsite for the *wh*-word "who" is initially postulated in the object position of the verb. A processing penalty occurs when the initially preferred analysis (with "who" being the direct object of "see") is ruled out by bottom-up, lexical input.

(63) Who$_{\mathrm{i}}$ did Mary see <u>Anna</u> with t_{i} yesterday?

This finding suggests that the processor immediately marks left-peripheral *wh*-words as moved, and attempts to reconstruct the original position of the moved element. This requires representing the *wh*-word in memory. Holding the moved constituent in memory is costly, leading to the processor forming the required dependency as soon as grammatically permissible. Thus, *wh*-words remain active in memory during sentence comprehension and the resolution of the *wh*-dependency takes precedence over other parsing considerations.

3.5.2 CT-marking

As discussed in Chapter 2, CT structure can be marked through several means – prosody, discourse context, topic particles, and – in Estonian – word order. How does the language processor handle these cues during comprehension? Different models of sentence processing make different assumptions about the extent to which the language processor rapidly and automatically specifies structural relations during comprehension (as opposed to leaving certain dependencies underspecified). For instance, the traditional serial Garden Path Model (e.g. Frazier 1987a) and various constraint-based models of parsing (e.g. Altmann and Steedman 1988) propose that syntactic structure is fully specified on a moment-by-moment basis, while under the Construal Model (Frazier and Clifton, 1996) the resolution of some dependencies (such as modifier attachment) is delayed compared to the computation of basic argument structure. Others, e.g. the Good Enough Model (Ferreira et al., 2002) propose that certain syntactic and semantic relations may remain underspecified in online processing, depending on task demands. More recent constraint-based models of semantic and pragmatic processing (e.g. Degen and Tanenhaus 2015) also allow for contextual variability in the extent to which certain inferences are drawn during comprehension. There is thus variability in the conceptual options when it comes to how rapidly and automatically the processor specifies information-structural relations, such as marking a particular constituent as a CT during incremental comprehension.

In Chapter 4, I test the hypothesis that constituents are marked as CTs during online processing (rather than at a delay), provided that there is sufficient (contextual or word order) information for doing so. Following Hoeks et al. (2002), I assume that in the absence of contextual (or grammatical) cues biasing towards a CT structure, the processor would maintain the simplest, topic-comment representation for the information structure of the clause.

What does it mean for a constituent to be marked as a CT? I assume that marking a constituent as a CT is minimally associated with representing the clause it occurs in as a CTopP, rather than a FinP (see discussion of the Estonian left periphery in Chapter 2).

Additionally, information-structural processing also involves non-syntactic components. In silent reading,[21] a CT-marked constituent would be assigned contrastive implicit prosody (see e.g. Breen 2014, for a discussion of implicit prosody effects in reading). When no overt QUD is present but there is CT-marking in the clause itself (e.g. prosody, word order), the comprehender is also expected to accommodate a QUD that the clause containing the CT offers a partial answer to. I will not experimentally address prosodic and broader discourse/QUD processing in the present dissertation, but we will return to these topics in the discussion in Chapter 6.

Most importantly for the present work, CT-marking on a constituent presupposes the existence of a contrastive alternative to this CT in the context. If no such alternative is explicitly mentioned (see *backward*-looking contrast in section 3.4), the processor may either infer the identity of this contrastive alternative based on contextual information, or anticipate a contrastive alternative to be mentioned later in the discourse (see *forward*-looking contrast in section 3.4). I use the term contrast resolution for matching a CT-marked constituent with a contrastive alternative.

3.5.3 Contrast resolution

In Section 3.3, I alluded to the possibility of the processor actively anticipating a CT alternative in the upcoming discourse after having encountered a CT-marked element. Intuitively, whether a CT2 is anticipated by the processor depends on the earlier encoding (CT-marking) of CT1.

Depending on how accessible CT2 is from the preceding context, more or less of its features may be specified at the point of encoding CT1. Let us consider the following example. In

[21] This dissertation only involves experiments using silent reading, but future work using overt prosody may well reveal that prosody mediates between syntactic CT-marking and the computation of information-structural representations. But clearly, information-structural processing cannot just be reduced to prosodic processing – work by Stolterfoht et al. (2007) shows that prosodic reanalysis and focus-structural revision are associated with different ERP effects. In a similar vein, work on ambiguity resolution in relative clause attachment shows that overt prosodic disambiguation does not fully eliminate processing difficulty associated with a less preferred syntactic structure (Harris et al., 2019).

the most straightforward cases, a conjunctive QUD is partially answered using a clause containing CT1, as shown in (64). Here, CT2 can be straightforwardly inferred by comparing the Topic in the question ("Anna and Mary") and CT2 ("Anna").

(64) Q: Did Anna and Mary stay at the hotel during the conference?
A: AnnaCT did. CT2 = Mary

In other instances, the comprehender would need to consult world knowledge in order to infer the intended CT2, as exemplified in (65).[22]

(65) Q: Where did the linguists stay during the conference?
A: [The psycholinguists]CT stayed at the hotel.
CT2 $\in$ {syntacticians, phonologists, sociolinguists, morphologists ...}

Previous work on Focus alternatives in ellipsis suggests that parallelism (or similarities between syntactic and semantic features between contrastive alternatives) is also relevant for establishing contrastive relations (see Carlson 2013). So, for instance, if CT1 is an animate Nominative subject, CT2 might be expected to also be animate and occur in the subject position. Since the set is open and the syntactic and semantic properties of the first member are relevant for the evaluation potential contrastive alternatives, it is actively maintained in memory. In Chapter 5, I test the hypothesis that following the encoding of CT structure, the processor actively anticipates an upcoming contrastive alternative.

Finally, after identifying CT1 and CT2, the processor would need to either draw the appropriate inference (e.g. "Mary did not stay at the hotel during the conference" in 64) or, when the proposition applying to CT2 is encountered in the discourse, compare the two propositions in order to establish that semantic conditions on the use of a CT structure are met.

As CT structure will primarily be conveyed through non-canonical V3+ word order in the experimental work reported in this dissertation, it is worth considering some concep-

[22]See Büring 2003 for a discussion of a similar example.

tual options regarding how non-canonical word order contributes to the processing of CT structure.

3.6 Non-canonical word order and CT processing

As discussed in Chapter 2, the syntactic marking of CT structure through non-canonical word order in Estonian is optional. Consider example (66), where both (66a) and (66b) provide a partial answer to the question "What did the girls do today?". In both (66a) and (66b), the subject "Anna" is compatible with being a CT due to how the clause it occurs in relates to the explicit QUD. An interesting question is how the non-canonical word order of (66b) influences the processing of its CT subject, compared to the canonical order in (66a).

(66) Q: What did the girls do today?

a. Anna$_{\text{CT}}$ tegi täna sporti.
Anna.NOM did today sport.PART
'Anna exercised today (... but Mari slept the whole day).' (V2)

b. Anna$_{\text{CT}}$ täna tegi sporti.
Anna.NOM today did sport.PART
'Anna exercised today (... but Mari slept the whole day).' (V3)

During incremental processing, any differences between V2 and V3 order could arise at the point of encoding or at the point of contrast resolution. While these two options can be difficult to pull apart experimentally (and the experiments presented in the following chapters are not necessarily designed to do so), it is useful to lay out some conceptual options in order to interpret potential word order effects. Let us consider some potential mechanisms through which word order could influence CT-marking and contrast resolution, in turn.[23]

[23]Here, I discuss scenarios where V3 order does facilitate the computation of CT structure. However, in instances where the context particularly strongly disambiguates the information structure of the following material, the effects of additional syntactic marking may be substantially reduced. For instance, if (66) was presented in a context where the speaker says "First, tell me what Anna did today. Then, tell me what Mari did today.", the contrastive relationship between Anna and Mari would already be established before encountering the response.

3.6.1 V3 and CT-marking

How could the use of V3 order in (66b) facilitate the marking of "Anna" as a CT compared to the canonical V2 order in (66a)? One option is that having a context that supports a CT interpretation of a particular constituent and syntactically marking that constituent as a CT act as two cues for the processor to mark the constituent as a CT. This is analogous to what has been observed in past work on CFs, which can be marked through prosody and/or through the use of focus particles (as discussed in Section 3.2). Having multiple cues to the information structure of the clause could, in particular, be useful to the processor when the context is not sufficiently biasing towards marking a single constituent in the target clause as a CT, or when there is a possibility that there is a mismatch in the common ground shared by the interlocutors. For instance, a string-identical variant of the V2 utterance (66a) could also be used if the subject "Anna" was a CF – the speaker could utter *ANNA tegi täna sporti* "ANNA exercised today" to correct their interlocutor who's misremembered how many female children the speaker has. The use of V3 order in (66b) eliminates this possibility.

Another option is that the processor does not immediately have access to contextual information, but rather prioritizes syntactic information over contextual factors to some degree. Traditional syntax-first models of sentence processing (e.g. Frazier 1987a) focus on parsing and syntactic ambiguity resolution, without explicitly discussing the computation of information-structural representations. However, in a language like Estonian where information structure can be syntactically encoded, the processor may be adapted to rapidly constructing information-structural representations (projecting a CTopP) when the input is incompatible with being a canonical (FinP) clause.

3.6.2 V3 and contrast resolution

How could V3 order facilitate the search for an explicit contrastive alternative to CT1 ("Anna") and the marking of that constituent as a CT when encountered? One option

is that asymmetries at the point of encoding simply carry on to contrast resolution – if a preverbal constituent is not marked as CT1 in a V2 clause (despite some contextual support for a CT interpretation), the processor does not need to search for a contrastive alternative to it. It is not clear whether the effects of contrast encoding vs. contrast resolution can be fully pulled apart in an experimental manipulation as one feeds the other.

However, there is a way in which non-canonical order could directly bear on the search for a contrastive alternative. It is possible that the discourse conditions governing the use of V3 word order are stricter than what has been previously proposed for CT structure (a presupposition for the existence of a salient contrastive alternative in the discourse representation). The use of V3 order may require a CT alternative to be explicitly mentioned in the discourse,[24] prompting the processor to search for this alternative. Under this view, the processor may anticipate an upcoming contrastive alternative when V3 word order is used, but delay contrast resolution in canonical clauses where an explicit contrastive alternative is not necessary to license CT-marking.

Now that we have laid the conceptual groundwork for the processing of CT structures, let us take stock of the upcoming chapters. Questions pertaining to CT-marking in Estonian V3+ clauses are addressed in Chapter 4, by looking at how non-canonical word order (and the information structure conveyed by it) influences the processing of backward-looking contrast in contrastive remnant ellipsis. Chapter 5 looks at whether the processor actively anticipates an upcoming contrastive alternative and uses this information to resolve temporarily ambiguous coordination. Chapter 4 is primarily investigating the time course of assigning CT status based on syntactic cues from V3 order, and the experiments do not compare the processing of V2 and V3 structures in *fully CT-licensing discourse contexts*. This means that the

[24] I do not address this question directly in this dissertation, rather it is a theoretical possibility that could be explored in future work. There are counter-examples to this claim when the alternatives are highly contextually salient, for instance the slogan for Uus Maa (an estate agent), which is inherently designed to set the company apart from its competitors:

Meid kliendid soovitavad!
We.PART clients.NOM recommend
'Us, clients recommend!'

unique contributions of syntactic CT-marking (over and above contextual disambiguation) cannot be teased out. Chapter 5 includes a more intricate experimental manipulation where V2 and V3 clauses are presented in a CT-marking discourse context, allowing for a closer investigation of the phenomena laid out above. Taking into consideration the experimental findings from both of these chapters, I will return to a general discussion of the role of V3 order in information-structural processing in Chapter 6.

CHAPTER 4

Processing Verb-third Clauses (... and Ellipsis)

In this chapter, I discuss two experiments looking at the processing of clauses where the verb occurs in the third or later position (I will refer to these as V3+ clauses). The experiments disambiguate the information structure of these non-canonical clauses by following them with contrastive remnant ellipsis, which necessitates the presence of a contrastive constituent in the preceding clause (see Stolterfoht et al. 2007 and Kaps 2019, for a similar experimental logic). Contrastive ellipsis, through structural parallelism, allows for a particular constituent in the (non-canonical) antecedent clause to be disambiguated as being contrastive.

Firstly, in an eye-tracking during reading experiment (Experiment 1), I show that comprehenders rapidly use non-canonical word order to assign information structure during reading. Secondly, a speeded acceptability experiment (Experiment 2) looks at the processing of temporary information structural ambiguity, providing further evidence that contrast is computed rapidly during online comprehension. These two experiments jointly suggest that the processor may initially underspecify which of the preverbal constituents in a V3+ clause is the CT, but that non-canonical word order is indeed used to anticipate upcoming contrast. How this expectation informs syntactic structure-building will be explored in more detail in Chapter 5.

4.1 Background

Below, I discuss relevant aspects of contrastive ellipsis in Estonian, and offer some background on the processing of contrastive ellipsis in order to set up the general logic of the experiments presented in this chapter.

4.1.1 Contrastive ellipsis in Estonian

As discussed in Chapter 2, Estonian has ellipsis constructions where the remnant is necessarily a CT and must have a CT correlate of the same grammatical category (e.g. subject or object) in the preceding antecedent clause. CT remnant ellipsis (CTE) bears structural similarities to CF remnant ellipsis (CFE), which in turn requires a CF correlate in the antecedent clause. The structures I proposed for CTE and CFE are repeated in (67) below, where "Pol" marks the position of a polarity particle (or a contrastive, polarity-marking coordinator). The information structure of the remnant (CT or CF) in these constructions can be identified through the relative order between the remnant and the polarity particle. This unambiguous mapping between word order and information structure in contrastive remnant ellipsis in Estonian makes these constructions useful for studying the online processing of contrast.

(67) *CT-Remnant Ellipsis:* [ConjP [CTopP **CT** [FocP **Pol** [vP ~~Pol~~ [~~vP~~]]]]]
CF-Remnant Ellipsis: [ConjP **Pol** [FocP **CF** [~~vP~~]]]

Parallelism conditions between the ellipsis clause and its antecedent clause (Carlson, 2013) mean that the grammatical properties of a contrastive remnant (e.g. case) and its information-structural status (CT vs. CF) can be used to disambiguate the information structure of the antecedent clause. Estonian contrastive ellipsis clauses with polarity particles necessarily involve backward-looking contrast (the contrastive alternative must precede the CT or CF). As exemplified in (68), "sprouting" is not possible with core arguments like objects.[1] This means that the contrastive alternative to the remnant must be overt.

(68) a. *Mari sõi, (aga) kooki$_{CT}$ mitte.
Mari.NOM ate, but cake.PART NEG
'Mari ate, but cake she didn't eat.' [Intended] (Object CTE)

[1]Note that there is a similar construction to convey the meaning intended in (68b) – *Mari sõi, aga mitte kooki.* The contrastive coordinator *aga* "but" is not compatible with corrective usages of CFE, but is used in conjunction with the negative particle *mitte* in order to pick out a member of a previously highlighted set (here, "food items"). I take this construction to be distinct from the instances of CTE and CFE discussed in this dissertation.

b. *Mari sõi, mitte kooki$_{CF}$.
Mari.NOM ate, NEG cake.PART
'Mari ate, but it wasn't cake that she ate.' [Intended] (Object CFE)

Additionally, CTE and CFE in Estonian do not allow for forward-looking contrast, as shown in (69a–69b) below, unless the ellipsis clause itself constitutes a fragment answer to a question, as shown in (69c). The improved acceptability of forward-looking contrast in examples like (69c) could be due to pragmatic reasons, if an overt QUD answered by the ellipsis clause aids in the licensing of ellipsis (see Park 2016, for a discussion of the relationship between QUD and gapping ellipsis).

(69) a. *Kooki$_{CT}$ mitte, aga salatit$_{CT}$ Mari sõi (küll).
cake.PART NEG but salad.PART Mari.NOM ate AFF
'Cake, she didn't, but salad Mari did eat.' [Intended] (Object CTE)

b. *Mitte kooki$_{CF}$, vaid Mari sõi salatit$_{CF}$.
NEG cake.PART but Mari.NOM ate salad.PART
'Mari ate not cake but salad.' [Intended] (Object CFE)

c. Q: Did Mari eat cake?

?Kooki$_{CT}$ mitte, aga salatit$_{CT}$ Mari sõi (küll).
cake.PART NEG but salad.PART Mari.NOM ate AFF
'Cake, she didn't, but salad Mari did eat.' (Object CTE)

With contrastive ellipsis preferentially[2] involving backward-looking contrast, the processor must access the representation of the previously processed antecedent clause in order to pair the contrastive element with its alternative (its correlate). Looking at the processing of ellipsis thus gives us a window to how the matrix clause (and its information structure) was previously represented.

[2]See discussion in Section 3.4.

4.1.2 Processing contrastive ellipsis

Following Harris and Carlson (2018), I assume that the processing of clausal ellipsis (including bare argument ellipsis and sluicing) involves assigning the remnant a parse that is consistent with the input, pairing the remnant with its correlate in the antecedent clause and finally, regenerating the elided phrase. Consider the example in (70). The matrix clause ("Mari met Anna") lacks a focus particle that would indicate to the processor that there is upcoming contrast, and in silent reading, there is no contrastive prosody to help anticipate contrast either. However, for the use of ellipsis to be licensed in the second clause ("not Liisa"), the remnant "Liisa" must be contrasted with a constituent (it's correlate) in the antecedent clause. Thus, when the processor encounters the ellipsis clause, it must consult the previously computed linguistic representation in order to pair the contrastive remnant to its correlate. The pairing of the remnant and its correlate allows for the two clauses to be compared and the elided content ("Mari met t" or "t met Anna") to be recovered. In the absence of contrast indicators on the matrix clause (or sufficiently biasing contextual cues), the processor likely resorts to its default information-structural preferences.

(70) Mari met Anna, not Liisa.

These preferences can be observed experimentally by probing interpretations when the remnant is ambiguous, or presenting participants with a disambiguated remnant (by using linguistic features like case, number or gender marking, e.g. Lawn 2020) and measuring indicators of processing difficulty (reading times, reaction times, comprehension question accuracy etc). There is also evidence that mismatches between the (default) focus structure of the antecedent clause and the remnant produce neurophysiological effects (Stolterfoht et al., 2007).

Past research using overt prosody in the matrix clause (e.g. Carlson 2001) has shown that, all else being equal, comprehenders prefer pitch-accented correlates over unaccented correlates. This suggests that by the time the remnant is encountered, the comprehender has built a representation of the preceding matrix clause that facilitates access to the remnant. In

this chapter, I follow the same logic to gauge whether non-canonical word order facilitates the encoding of CT structure. In Experiment 1, I look at contrast-assignment to a clause-initial subject, when it is unambiguously marked as a CT by fronting another, non-contrastive constituent to the preverbal domain. In Experiment 2, I look at verb-final matrix clauses where the identity of the CT is temporarily ambiguous, in order to examine whether contrast is assigned to a preverbal constituent as rapidly as possible. In both instances, asymmetries observed in the processing of the CT-remnant ellipsis clause following the matrix clause suggest that the processor is sensitive to word order in computing information-structural relations.

4.2 Exp 1: Computing contrast during incremental processing

Below, I discuss an eye-tracking during reading experiment that was designed to test whether non-canonical, V3 word order in Estonian facilitates the online processing of CTs, compared to canonical V2 word order.

Eye-tracking during reading is a method commonly used to investigate processing difficulty online, as measures like first and second pass reading times on a particular region or the probability of regressing out of or into a particular region offer a window to (roughly) when and where comprehension difficulty occurs.

4.2.1 Motivation and hypotheses

Previous cross-linguistic work shows that non-canonical word order allows comprehenders to make inferences about the discourse status of constituents during incremental processing (Kaiser and Trueswell, 2004). The aim of the present study was to establish whether comprehenders assign information structure during the processing of non-canonical V3 clauses in Estonian. I capitalize on a general finding from the psycholinguistic literature on ellipsis that contrastive remnants are preferentially associated with the most recently encountered correlate in the antecedent clause, meaning that remnants with non-local correlates are asso-

ciated with processing difficulty (Clifton and Frazier, 1998; Carlson et al., 2009; Harris, 2015; Harris and Carlson, 2018; Harris, 2019; Lawn, 2020). The preference for the most recently encountered correlate is known as the Locality bias.

The Locality bias (at least in English, where structures with focused remnants have been studied) has been argued to arise from the processor's access to information-structural representations during the processing of ellipsis (Carlson et al., 2009; Harris and Carlson, 2018). Extensive literature (see e.g. Breen 2014, for an overview) shows evidence that comprehenders assign prosody on silent reading and that this implicit prosody influences parsing decisions. It is assumed that nuclear pitch accent is assigned to the most deeply embedded syntactic constituent (Selkirk, 1986; Cinque, 1993), which is typically a clause-final object. The presence of the nuclear pitch accent in the sentence representation then, in turn, is assumed to facilitate the assignment of Focus status to that constituent. While there isn't a one-to-one mapping between prosody and information structure in English (a nuclear pitch accent occurs on the clause-final object of the verb whether the object itself or the whole VP is focused), a preference for a pitch accent on an object could explain why a reader is more likely to assign object focus, as opposed to subject focus, by default (Carlson et al., 2009; Harris and Carlson, 2018).[3] As a result, an object correlate interpretation would be preferred over a subject correlate interpretation when the remnant is ambiguous between being an object and being a subject.

In order to resolve contrastive remnant ellipsis (i.e. build a syntactic and/or semantic representation for the material that has been elided) the processor needs to pair the remnant with its correlate in the antecedent clause. I assume that this process is mediated by information-structural processing (see also evidence from English in Harris and Carlson 2018). Due to a constraint on information-structural parallelism between the ellipsis clause and the antecedent clause, the remnant and its correlate must share the same information-structural status (e.g. Focus, CT). The pairing of the remnant and its correlate allows for

[3]See also recent work by Yan and Calhoun (2020) for evidence that the default focus position influences language processing in Mandarin Chinese.

the remainder of the antecedent clause to be identified. This discourse-given material is then taken to be elided in the ellipsis clause.

During the processing of CT remnant ellipsis, the processor recognizes that the remnant is a CT and initiates a search for a constituent that is grammatically compatible with being a CT in the antecedent clause.

In Estonian, clause-initial subjects may act as CTs regardless of the word order of the clause, as exemplified in (71) below. This means that the linear distance between a subject CT remnant and its correlate in the antecedent clause can be kept constant in an experimental manipulation, allowing us to examine whether non-canonical V3 order leads to the encoding of the subject as a CT, which would subsequently aid in the processing of subject CT remnant ellipsis.

(71) a. Agnes$_{CT}$ tunneb tegelikult Joonast, Katrin$_{CT}$ mitte.
Agnes.NOM knows actually Joonas.PART Katrin.NOM NEG
'Actually Agnes knows Joonas, but Katrin doesn't.' (V2)

b. Agnes$_{CT}$ tegelikult tunneb Joonast, Katrin$_{CT}$ mitte.
Agnes.NOM actually knows Joonas.PART Katrin.NOM NEG
'Actually Agnes knows Joonas, but Katrin doesn't.' (V3)

Crucially, while I assume that every finite clause that is under discussion must involve some form of focus, whether it is broad informational focus (i.e. new information) or narrow focus on a particular constituent (including contrastive focus), CTs are optional. So, while a subject in a subject-initial V2 clause is compatible with being a CT, it is not expected to be marked as a CT by default, due to a preference for simpler discourse structures (see Hoeks et al. 2002, for a discussion of discourse simplicity effects in sentence processing). In V3 clauses, on the other hand, one of the preverbal constituents must be marked for CT status. Particularly, if other preverbal elements are not semantically compatible with being contrastive, such as in the case of speaker-oriented adverbs (72), the subject would necessarily need to be marked as a CT.

(72) *Context:* You are discussing the your level of certainty about who Agnes is acquainted with. In your mind, different people fall in different categories with respect to how much evidence you have for their relationship to Agnes.

#/?Agnes tegelikult$_{CT}$ tunneb Joonast, aga võib-olla$_{CT}$ Matit.
Agnes.NOM actually knows Joonas.PART but maybe Mati.PART

'ACTUALLY Agnes knows Joonas, but MAYBE she knows Mati.'

Does the processor interpret V3 word order online to assign CT status to a preverbal element, thus updating the discourse representation upon encountering non-canonical V3 order? How can we tell? If the processor marks the initial subject in structures like (72) above as a CT, the processing of subject CT remnant ellipsis should be facilitated in V3 clauses compared to the corresponding subject-initial V2 clauses.

This experimental comparison may complicated by other factors guiding the processing of canonical versus non-canonical clauses (see e.g. Gorrell 2000; Kaiser and Trueswell 2004; Kristensen et al. 2014, for work on processing difficulty associated with non-canonical word order). This is why in the experiment discussed below, I use CF object remnant ellipsis as a control. Clause-final objects, whether they occur in V2 or V3 clauses, can be felicitously taken to be focus-marked, meaning that any asymmetries between V2 and V3 clauses that are independent of pairing the remnant with its correlate (such as, potentially, slower reading of non-canonical V3 clauses), can be controlled for statistically.

I take a basic topic-comment[4] structure – as exemplified in (73) – to be an information-structural default, as it requires the least amount of information to be in the common ground. "Information-structurally marked status" here refers to instances of narrow focus and contrast - CTs and CFs are information-structurally marked as they presuppose a more complex question under discussion (see Chapter 2).

(73) Q: How is Agnes doing?

A: [Agnes]$_{Top}$ [has recently adopted a dog]$_{Comment}$

[4]Comment here is pretty much synonymous with broad focus.

There are different theoretical possibilities when it comes to how and when information-structural representations are constructed. Below, I propose two alternatives, and their predictions for the processing of structures like (71). These two hypotheses differ by the proposed time course of computing information-structural representations relative to other (grammatical) representations, such as argument structure (Frazier and Clifton 1996 define the latter as "primary").

(i) Immediate Discourse Update: The processor immediately commits to an information-structurally marked status for clauses that are not compatible with a simple topic-comment structure.

(ii) Delayed Discourse Update: The processor initially only computes basic syntactic relations such as argument structure. The processing of non-primary relations, including contrast, is delayed (*cf.* Frazier and Clifton 1996).

The Immediate DU account predicts an advantage for subject-CT remnant ellipsis following CT-marking V3 clauses compared to subject-CT remnant ellipsis following canonical V2 clauses. While CT structure can be conveyed through various means (e.g. discourse contexts, prosody, word order), under this hypothesis V3 order in Estonian in particular is expected to have an early effect on CT-marking, as V3 order is not compatible with the clause being a FinP. Rather, as discussed in Chapter 2, the left periphery needs to be expanded in order to accommodate multiple preverbal constituents. This results in the clause receiving a marked information-structural status.

The Delayed DU account does not predict an asymmetry between V3 and V2 clauses, if it is the case that CT structure is not assigned until necessitated by encountering CT-remnant ellipsis, where information-structural relations need to be determined in order to compute argument structure and reconstruct the elided material (Harris and Carlson, 2018). Once the CT remnant is encountered and the processor initiates a search for a CT-marked subject correlate in the antecedent clause, initial subjects in V2 and V3 clauses should act as equally good candidates for contrast, as they both occur in the clause-edge position. This approach

is compatible with models of sentence processing that allow for structural relations to be (temporarily) underspecified (e.g. Frazier and Clifton 1996; Ferreira et al. 2002).

4.2.1.1 Polarity

I was additionally interested in whether the polarity of the antecedent clause bears on the difficulty of processing contrastive ellipsis. Previous corpus work on Estonian (Lindström, 2005) identifies negation in the clause as a predictor for non-V2 word order. In particular, clauses involving negation show higher rates of verb-final word order than affirmative clauses. Verb-final word order would arise from the presence of a CT constituent along with Focus (for instance, polarity focus) expressed on the verb. It is possible that polarity focus (and CT structure) is more felicitous in negative clauses than in affirmative clauses for pragmatic reasons.

A potential source for this asymmetry is that negated clauses are typically[5] less informative than affirmative clauses. For instance, saying that Mary had porridge for breakfast narrows down the set of possible worlds more than saying that Mary didn't have porridge for breakfast – she could have had eggs, French toast, cereal, a half a bottle of wine, or skipped breakfast altogether. Assuming that speakers strive for informativity (in the sense of Gricean maxims of Quantity and Relation, Grice 1975), and that listeners interpret utterances with this in mind, I propose that a negated clause makes its contrastive alternatives more salient (i.e. accessible in the discourse) than an affirmative clause does. To exemplify, in (74) it is infelicitous for A's interlocutor to raise B or B' as genuine information-seeking questions[6].

(74) A: Mary had cereal for breakfast.
B: # And/so who didn't?
B': # And/so what did she not have?

[5]This is, of course, dependent on the predicate being conveyed. "My dog doesn't have hair" is arguably more informative than "My dog has hair", in the sense that the former would probably make it easier for you to tell which dog is mine from a lineup of typical, dog-like dogs.

[6]At best, we can accommodate these questions as rhetorical or sarcastic

In contrast, in the case of reversed polarity, as seen in (75), the information-seeking questions in B and B' are natural.

(75) A: Mary didn't have cereal for breakfast.
B: And/So who did?
B': And/So what did she have?

Examples (74) and (75) show that negative clauses highlight their contrastive alternatives in a way that positive clauses (in the absence of a contrastive context or contrastive prosody) do not. While the present hypotheses (Immediate *versus* Delayed DU) address grammatical contrast-marking, it is well-documented in the sentence processing literature that contextual and pragmatic effects play a role in parsing decisions as well (e.g. Altmann and Steedman 1988; Tanenhaus et al. 1995; Hoeks et al. 2002; see discussion in Chapter 5). Pragmatic context could thus strengthen the effects of grammatical contrast-marking during incremental processing, or conversely, aid in the computation of contrast in the absence of grammatical context-marking. I was therefore interested in whether polarity facilitated the processing of CTE, or interacted with syntactic CT-marking in the online processing of contrast.

If negative polarity increases the expectation for contrast, we would expect to see a main effect of polarity whereby contrastive ellipsis is easier to process following matrix clauses involving negation, compared to after affirmative matrix clauses. Additionally, polarity may interact with word order if it facilitates the processing of contrast in canonical V2 clauses more than in already contrast-marked V3 clauses.

Further, polarity effects could shed light on how automatic the assignment of contrast in V3 clauses is. Evidence for CT-marking in both affirmative and negative V3 clauses (with polarity having a minimal influence) accompanied by strong polarity effects in V2 clauses would indicate that V3 order leads to CT-marking even in the absence of contextual cues or pragmatic support.

4.2.2 Design and materials

As shown in Table 4.1, the eye-tracking during reading experiment crossed remnant category (CT Subject, CF Object) with the word order of the matrix clause (Canonical V2, Subject-CT marking V3). Each target sentence was preceded by a lead-in sentence, in order to avoid placing the subject correlate at the site of initial eye fixations at the left of the display. The lead-in sentences were intended to overall not be biased towards neither Subject contrast nor Object contrast. The lead-in sentence and the target sentence appeared on the screen simultaneously. 20 experimental quadruplets[7] were presented in a Latin square design, along with 70 filler items (including items from unrelated experiments and distractor items). The order of items was randomized on a by-participant basis. Half of all items were followed by a forced choice comprehension question. The comprehension questions (e.g. "Does Agnes know Joonas? yes/no" for Item 1) never inquired about the ellipsis remnant (see Appendix for more examples).

To illustrate what participants read in a typical trial, I show a full example of the V2, Subject CT condition in (76) below.

(76) Keda peaks üksteisele tutvustama? Agnes tunneb tegelikult
who.PART should each.other.ALL introduce.INF Agnes.NOM knows actually
Joonast, Katrin mitte, kuigi kõik on omavahel
Joonas.PART Katrin.NOM NEG although everybody.NOM is amongst.ALL
korduvalt kohtunud.
repeatedly met
'Who should be introduced to each other? Actually Agnes knows Joonas, but Katrin doesn't, although everybody has repeatedly met each other.'

This manipulation resulted in the linear position of the matrix Subject and Object being constant across experimental conditions. This allowed for observing the effect of contrast marking on the non-local subject correlate independently of the linear distance between the remnant and the correlate. The lexical content of the material intervening between the

[7] A full list of items with comprehension questions is available in the Appendix.

Item 1 *Lead-in sentence:*

Keda peaks üksteisele tutvustama? 'Who should be introduced to each other?'

Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*
All conditions	V2	All conditions	Subject CT
Agnes	tunneb tegelikult	Joonast,	Katrin mitte,
Agnes.NOM	knows actually	Joonas.PART	Katrin.NOM NEG
	V3		Object CF
	tegelikult tunneb		mitte Kaupot,
	actually knows		NEG Kaupo.PART

Spillover	*Wrap-up*
All conditions	All conditions
kuigi kõik on omavahel	korduvalt kohtunud.
although everybody.NOM is amongst.ALL	repeatedly met

Subject remnant: 'Actually Agnes knows Joonas, but Katrin doesn't,

Object remnant: 'Actually Agnes knows Joonas, but she doesn't Kaupo,

...although everybody has repeatedly met each other.'

Item 2 *Lead-in sentence:*

Mis sinu sõprade elus uut on? 'What's new in your friends' lives?'

Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*
All conditions	V2	All conditions	Subject CT
Ants.NOM	ei armasta ilmselt	Jaanikat,	Margus küll,
Ants	NEG-love apparently	Jaanika.PART	Margus.NOM AFF
	V3		Object CF
	ilmselt ei armasta		vaid Hellet,
	apparently NEG-love		but Helle.PART

Spillover	*Wrap-up*
All conditions	All conditions
kuigi keegi ei taha	seda endale tunnistada.
although nobody.NOM NEG-want	this.PART self.ALL admit

Subject remnant: 'Apparently Ants doesn't love Jaanika, but Margus does,

Object remnant: 'Apparently Ants doesn't love Jaanika, but he does Helle,

...although nobody wants to admit it to themselves.'

Table 4.1: Two sample experimental items. Item 1 involves positive polarity in the matrix clause and negative polarity in the remnant. Item 2 involves negative polarity in the matrix clause and positive polarity in the remnant. Italicized labels correspond to analysis regions.

Subject remnant and its correlate was also kept constant by simply reordering the matrix verb and the adverb to yield the two word orders. Speaker-oriented adverbs were used throughout experimental items in order to reduce erroneous contrast-assignment to the adverb. Namely, as discussed in Section 4.2.1, manner adverbs (e.g. "fast", "slowly") and temporal adverbs (e.g. "today", "yesterday") can be at issue and thus targeted by subquestions of a QUD, while speaker-oriented adverbs are less natural in subquestions of a QUD, as exemplified in (77).

(77) a. What has Mary been up to this week? What did she do <u>today</u>? What did she do <u>yesterday</u>?

b. # What has Mary been up to this week? What did she do <u>for sure</u>? What did she do <u>possibly</u>?

A half of the items contained a positive polarity matrix clause (Table 4.1, Item 1) and a half of the items contained a negative polarity matrix clause (Table 4.1, Item 2). The polarity of the ellipsis remnant always differed from that of the matrix clause, as required for contrastive remnant ellipsis. The remnant regions were matched for length (in number of letters) between Subject CT and Object CF conditions, and always consisted of an unambiguously case-marked proper name and a particle, in the order appropriate to the type of ellipsis (proper name + particle for CT remnant ellipsis, particle + proper name for CF remnant ellipsis). Due to the grammatical properties of focus particles and polarity particles in Estonian (see Tamm 2015, for examples involving particles and negation in Estonian), negative remnants always included the negative particle *mitte* 'not', while positive remnants contained one of two different particles. Positive CT remnants included the Verum particle *küll*, while positive CF remnants included the focus particle *vaid* 'but, only'.

The post-remnant segment (e.g. "although everybody has repeatedly met each other." in Item 1) was included in order to avoid the critical (*Remnant*) analysis region coinciding with the end of the sentence. On clause-final material, eye movements and the underlying cognitive processes can be highly variable (see Hirotani et al. 2006, for a discussion of clause-final "wrap-up effects"). To better capture the time course of any effects occurring following

the reading of the remnant region, the sentence-final material was divided into two analysis regions of approximately equal prosodic weight (*Spill-over* and *Wrap-up*).

4.2.3 Participants and procedure

46 native Estonian speakers were recruited from the University of Tartu, Estonia and the surrounding community using flyers, social media and student mailing lists. Participants were compensated with 5 Euros for the 40-minute experiment. The final analysis includes a set of 36 participants. Five participants' data were excluded from the analysis due to track losses on the *Remnant* region on 30% or more of the trials. One participant's data were excluded due to a below 80% comprehension question accuracy on experimental items. A further four participants' data were excluded for counterbalancing reasons, optimizing for the smallest amount of track losses on the *Remnant* region.

Participants were seated alone in a sound-attenuated room in partial view of the experimenter and instructed to read silently, for comprehension, at their natural pace. They used a gamepad to proceed to the next trial and to answer comprehension questions. A few practice trials familiarized the participants to the procedure. An SR Research Eyelink 1000 Plus eye-tracker was used with a tower-mounted camera, allowing for binocular viewing while the participant's head was stabilized. Eye movements were sampled at 1000 Hz, from the right eye only. The 23" LCD monitor used to display the items was at a distance of 50 cm from the participant. The items were presented as a single line in a 14-point monospace font. A 9-point calibration procedure was used to calibrate eye movements at the beginning of the experiment and as needed, with drift correction performed at the start of each trial.

4.2.4 Results

Below, I first present findings from the main analyses crossing Word Order and Remnant Type. I show region-by-region data for the target sentence from the following four eye-tracking measures (Rayner, 1998) – first pass times (the sum of all fixations on the region until exiting it to the left or right), go-past times (the sum of all fixations on the region and

preceding regions from entering the region to exiting it to the right), total times (the sum of all fixations on the region) and regressions out (the probability of exiting the region to the left, i.e. going back in the text).

Reading time data were analyzed using linear mixed effects models and regression data using logistic mixed effects models, in the *lme4* package (Bates et al., 2015) in R (R Core Development Team, 2019). All models reported below include Word Order and Remnant Type as fixed effects, with random intercepts for Participants and Items. Effects at $p<.05$ were considered statistically significant.

Following an overview of the main analyses, I discuss the effects of matrix clause Polarity on the processing of non-canonical word order and contrastive remnant ellipsis. For these between-item comparisons, Matrix Polarity was added to the existing models as an interacting factor, with Positive polarity acting as a baseline for the statistical comparison.

4.2.4.1 First pass times

First pass data were winsorized (Dixon and Tukey, 1968) prior to modeling, by replacing the top and bottom 5% of values in each experimental condition with the 5th (or 95th) percentile cut-off value in every analysis region to reduce the statistical effect of outliers. Means and standard errors are given in Table 4.2.

Cond.	Region					
	Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*	*Spill-over*	*Wrap-up*
V2, Sub	273 (8)	589 (23)	321 (11)	516 (16)	690 (21)	515 (19)
V2, Obj	274 (7)	553 (19)	288 (9)	528 (13)	646 (21)	511 (19)
V3, Sub	272 (8)	567 (21)	318 (11)	518 (14)	642 (20)	511 (19)
V3, Obj	281 (9)	562 (20)	303 (10)	513 (13)	659 (22)	509 (18)

Table 4.2: Means (with standard errors in parentheses) for First pass times (ms)

There were no significant effects or trends on the *Matrix Subject* or *Verb & Adverb* regions. On the *Matrix Object* region, there was a significant penalty for Subject conditions

(M = 319 ms, SE = 8) over Object conditions (M = 295 ms, SE = 7), t = 3.057, p<.05, possibly due to an orthographic preview effect[8] arising from the following *Remnant* region beginning in an uppercase letter in the Subject conditions (see Cutter et al. 2019, for similar preview effects from capitalization). There were no significant effects or trends in first pass times on the *Remnant* region itself. On the *Spillover* region there was a trend towards an interaction between Word Order and Remnant Type (t = -1.882, p=.06), as V2 conditions showed a slight Subject penalty (diff = 44ms) while V3 conditions did not (diff = -17ms). No significant effects or trends were observed on the *Wrap-up* region.

4.2.4.2 Go-past times

Go-past data were trimmed manually based on visual inspection (with cut-off points chosen for each region to remove less than 1% of the data from that region), in order to reduce the statistical effect of outliers. Means and standard errors are given in Table 4.3.

Cond.	Region					
	Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*	*Spill-over*	*Wrap-up*
V2, Sub	338 (17)	728 (28)	570 (35)	796 (54)	814 (39)	2156 (166)
V2, Obj	301 (13)	687 (28)	511 (32)	651 (36)	802 (44)	2308 (163)
V3, Sub	319 (15)	790 (32)	504 (35)	671 (35)	813 (45)	2056 (137)
V3, Obj	322 (16)	730 (26)	417 (23)	680 (40)	746 (33)	2091 (156)

Table 4.3: Means (with standard errors in parentheses) for Go-past times (ms)

On the *Verb & Adverb* region, there was a penalty for non-canonical V3 word order (M = 759 ms, SE = 21) compared to V2 word order (M = 707 ms, SE = 20), t = 2.125, p<.05, as non-canonical word order in the matrix clause introduced a slowdown. Go-past times on the following *Matrix Object* region showed a reversed pattern, as V3 clauses were now passed faster (M = 461 ms, SE = 21) than V2 clauses (M = 540 ms, SE = 24), t = -2.669, p<.01, potentially due to a reduced need to reread V3 clauses, which were previously read more

[8]See Schotter et al. (2012) for parafoveal processing effects in reading.

slowly (see also the reduced probability of regressions out of the *Matrix Object* region in V3 clauses, below). On the *Remnant* region, we observe a significant locality preference in the form of a penalty for Subjects (M = 733 ms, SE = 32) compared to Objects (M = 666 ms, SE = 27), t = 2.732, p<.01. As seen in Figure 4.2.4.2, the Subject penalty appears to be driven by V2 clauses with Subject remnants, as also evidenced by a marginal interaction between word order and remnant type (t = -1.961, p=.05). Namely, V2 conditions showed a Subject penalty (diff = 145ms), while V3 conditions did not (diff = -9ms). No significant effects or trends were observed in go-past times on the *Spillover* or *Wrap-up* regions.

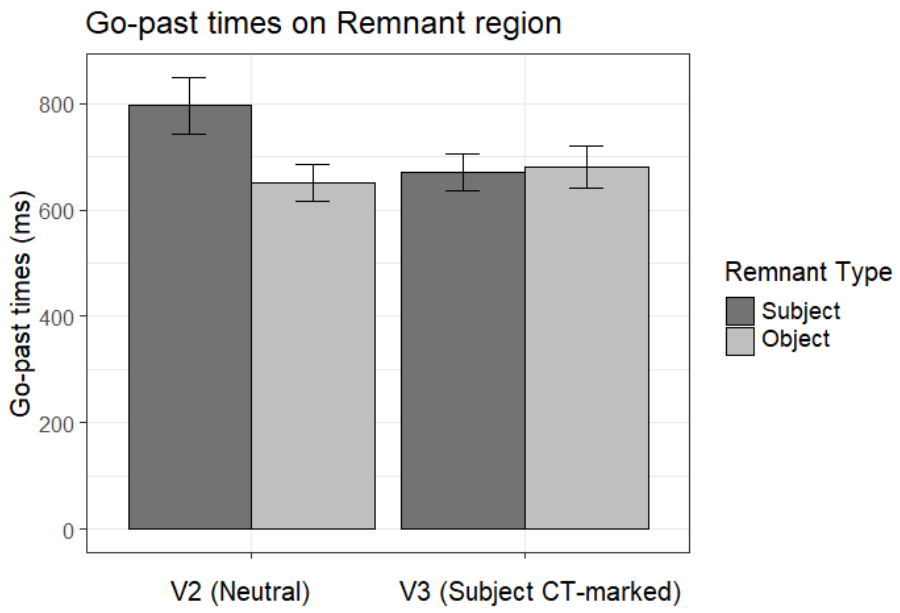


Figure 4.1: Go-past times (ms) on the *Remnant* region ("Katrin mitte" / "mitte Kaupot"), by Matrix clause word order (V2, V3) and remnant type (Subject, Object)

4.2.4.3 Total times

Total time data were trimmed manually based on visual inspection (with cut-off points chosen for each region to remove less than 1% of the data from that region), in order to reduce the statistical effect of outliers. Means and standard errors are given in Table 4.

There was a Subject penalty on the *Matrix Subject* region, indicating that the Subject correlate was read more in Subject remnant conditions (M = 548 ms, SE = 21) than in

Cond.	Region					
	Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*	*Spill-over*	*Wrap-up*
V2, Sub	569 (30)	1288 (56)	689 (35)	996 (44)	1010 (37)	703 (33)
V2, Obj	480 (22)	1177 (51)	618 (31)	875 (39)	984 (37)	737 (29)
V3, Sub	526 (29)	1246 (53)	609 (29)	889 (37)	1004 (43)	681 (29)
V3, Obj	481 (25)	1172 (51)	544 (27)	893 (38)	978 (41)	713 (31)

Table 4.4: Means (with standard errors in parentheses) for total times (ms)

Object remnant conditions (M = 481 ms, SE = 17), t = 2.823, p<.01. The following *Verb & Adverb* region showed a trend towards a Subject penalty as well (t = 1.836, p=.067). The Subject penalty persists on the following two regions, as discussed below and shown in Figure 4.2.4.3.

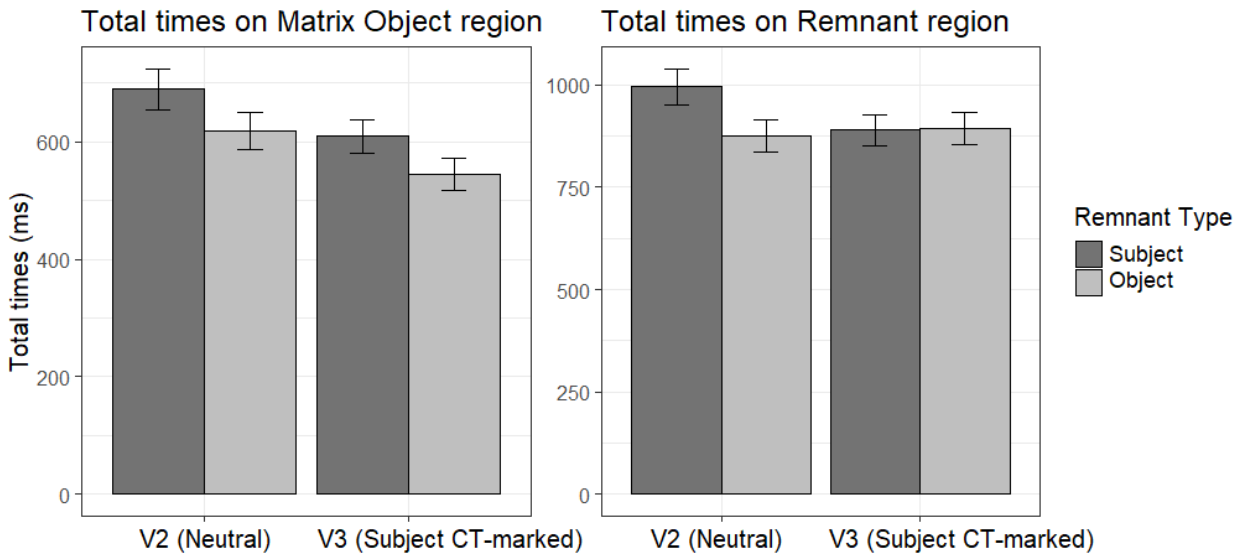


Figure 4.2: Total times (ms) on the *Matrix Object* region ("Joonast") and on the *Remnant* region ("Katrin mitte" / "mitte Kaupot"), by Matrix clause word order (V2, V3) and remnant type (Subject, Object)

On the *Matrix Object* region, there were two main effects. Firstly, a significant penalty for Subject remnant conditions (M = 650 ms, SE = 23) compared to Object remnant conditions (M = 580 ms, SE = 21), t = 1.997, p<.05, gives evidence for a locality preference. Partive matrix objects were likely re-read after encountering a Nominative remnant, with the case

mismatch between the remnant and the local candidate for a correlate causing processing difficulty. Secondly, an advantage for V3 clauses (M = 576 ms, SE = 20) over V2 clauses (M = 654 ms, SE = 24), t = -2.948, p<.01, may indicate that contrast (including Object contrast) is more natural in V3 clauses than V2 clauses.

On the *Remnant* region, there was a significant penalty for Subject remnants (M = 942 ms, SE = 29), compared to Object remnants (M = 884 ms, SE = 27), t = 2.755, p<.01, although the effect appears to be driven by V2 clauses, as evidenced by a trending interaction between Word Order and Remnant type (t = -1.833, p=.067). V2 conditions showed a Subject penalty (diff = 121ms) while V3 conditions did not (diff = -4ms). No significant effects or trends were observed in total times on the *Spillover* or *Wrap-up* regions.

4.2.4.4 Probability of regressions out

Means and standard errors for the probability of regressions out of each analysis region are provided in Table 4.5.

Cond.	Region					
	Matrix Subject	*Verb & Adverb*	*Matrix Object*	*Remnant*	*Spill-over*	*Wrap-up*
V2, Sub	9 (2)	16 (3)	31 (4)	22 (3)	8 (2)	52 (4)
V2, Obj	6 (2)	15 (3)	33 (4)	12 (2)	7 (2)	55 (4)
V3, Sub	9 (2)	21 (3)	19 (3)	13 (3)	10 (2)	51 (4)
V3, Obj	7 (2)	18 (3)	17 (3)	14 (3)	6 (2)	54 (4)

Table 4.5: Means (with standard errors in parentheses) for percentages of regressions out (%)

There were no significant effects or trends on the *Matrix Subject* or *Verb & Adverb* regions. The *Matrix Object* region showed a lower percentage of regressions out in V3 clauses (M = 18%, SE = 2) compared to V2 clauses (M = 32%, SE = 3), z = -4.455, p<.001. This points to different reading strategies in canonical and non-canonical clauses, in line with what was observed in go-past times. Canonical clauses appear to be read more quickly, with previous words re-fixated on as needed, while non-canonical clauses are read more slowly with fewer

looks back to the previous material.

The *Remnant* region showed two main effects as well as a significant interaction. Firstly, there were more regressions out of Subject remnants (M = 17%, SE = 2) compared to Object remnants (M = 13%, SE = 2), z = -2.716, p<.01. Secondly, more regressive eye movements occurred following V2 clauses (M = 17%, SE = 2) compared to V3 clauses (M = 13%, SE = 2), z = -2.497, p<.05. Finally, Word Order and Remnant type interacted (z = 2.300, p<.05), as the Subject penalty only appeared in V2 clauses (diff = 10%), and not in V3 clauses (diff = -1%). Thus, in fact, both main effects appear to be driven by a high proportion of regressions out of Subject remnants following V2 clauses (M = 22%, SE = 3). The percetage of regressive eye movements out of the *Remnant* region are shown in Figure 4.2.4.4. No significant effects or trends were observed in the probabilities of regressions out of the *Spillover* or *Wrap-up* regions.

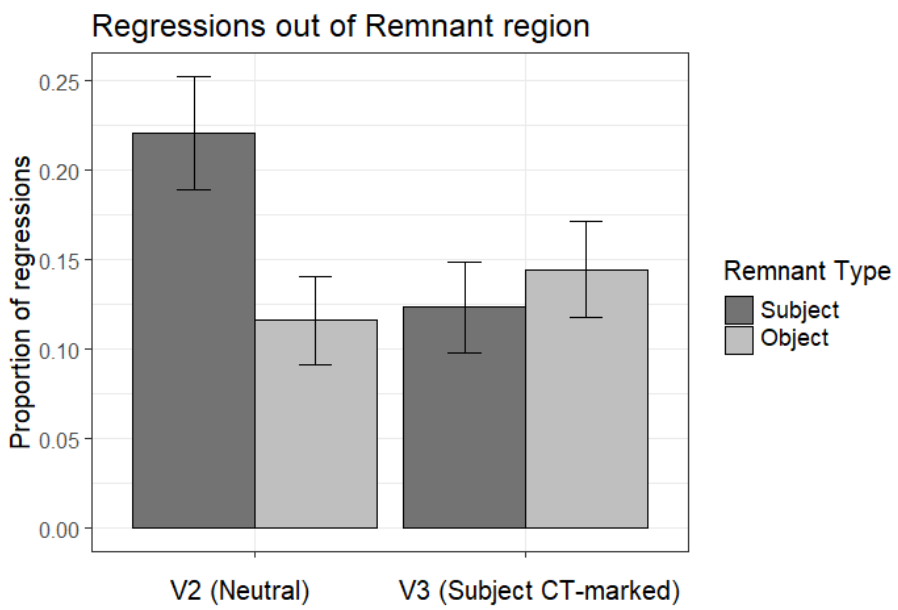


Figure 4.3: Percentage of regressions out (%) of the *Remnant* region ("Katrin mitte" / "mitte Kaupot"), by Matrix clause word order (V2, V3) and remnant type (Subject, Object)

4.2.4.5 Summary of main findings

Let us summarize the results shown above before considering the between-items manipulation of matrix clause Polarity. A few notable patterns emerge from the data. There is evidence for time course differences between the processing of canonical and non-canonical word order. Go-past times and proportions of regressive eye movements point to canonical clauses being initially read more quickly than V3 (CT-marked) clauses, followed by a higher proportion of regressions to the preceding material when a clause-final object is reached.

Most interestingly for the present purposes, several eye-tracking measures show trending or significant interactions between Word Order and Remnant on the critical *Remnant* region itself. V2 clauses show a Subject remnant penalty, while V3 clauses do not. In fact, Subject CT remnants following V3 (i.e. CT-marked) clauses are not penalized in reading times on or probabilities of regressions out of the *Remnant* region, compared to Object remnants following either antecedent clause word order.

Additionally, several measures (particularly total times) show evidence for a general preference for Object remnants compared to Subject remnants (i.e. a Locality preference), when it comes to reading the matrix clause material. Matrix clauses containing a correlate for a Subject CT remnant are associated with longer (re-)reading times. This effect does not simply emerge on the correlate (Subject) itself, rather, we see increased total reading times on all matrix clause regions in Subject CTE conditions, possibly indexing difficulty with recovering the elided material.

Overall, the data are compatible with syntactic CT-marking in the antecedent clause (in the form of V3 word order) facilitating the processing of a CT remnant of ellipsis, compared to canonical V2 antecedent clauses. This is in line with the hypothesis that V3 order creates an expectation for a contrastive alternative to a preverbal CT. Below, I present findings on the role of negation in the matrix clause in processing contrast.

4.2.4.6 Polarity effects

As shown in Table 4.1, the matrix clause involved positive polarity in a half of the experimental items and negative polarity in the other half. Below, I report main effects of Matrix Polarity and significant interactions between Polarity and the other experimental variables when Polarity was added as a fixed effect to the analyses discussed in above. The Polarity analyses have less statistical power than the analyses crossing Word Order and Remnant as Polarity was a between-items variable, but we do observe some interesting patterns, as laid out below.

A main effect of Polarity is seen in first pass times on the *Remnant* region, with an advantage for negative matrix items (M = 489 ms, SE = 9) compared to affirmative matrix items (M = 549 ms, SE = 11), t = -3.371, p<.01. As Polarity didn't interact with Remnant Type or Word Order in this analysis, the observed effect indicates that contrast (as conveyed by contrastive ellipsis) is more natural following negated clauses compared to affirmative clauses. We also see a main effect of Polarity in total times on the *Matrix Subject* region, where there is again a penalty for affirmative matrix clauses (M = 555 ms, SE = 20) compared to negative matrix clauses (M = 471 ms, SE = 17), t = -2.131, p<.05. As this effect did not occur in first pass times, it is likely due to longer re-reading of the antecedent clause when it is affirmative. This, again, suggests that contrast is less anticipated after affirmative clauses compared to after negative clauses.

Polarity interacts with Word Order in the probability of regressions out of the *Remnant* region (z = 1.989, p<.05), as there is a penalty for V2 antecedents compared to V3 antecedents following affirmative matrix clauses (diff = 7%) but not after negative matrix clauses (diff = 0%). This is compatible with contrast not having been computed in canonical clauses in the absence of negation, resulting in looks back to the antecedent clause upon encountering contrastive ellipsis.

Total times also show an interaction between Polarity and Word Order, on both the *Matrix Object* region and the post-remnant *Spillover* region, as shown in Figure 4.2.4.6. There was no interaction between Polarity and Word Order in total times on the intervening

Remnant region.

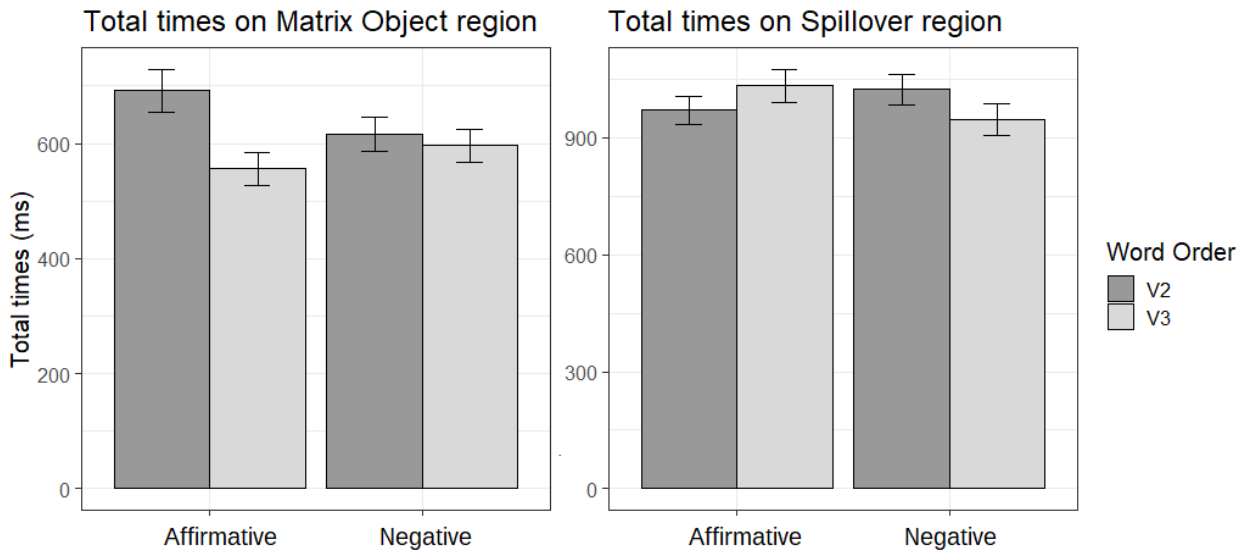


Figure 4.4: Total times (ms) on the *Matrix Object* region, on the *Remnant* region and on the post-remnant *Spillover* region by matrix clause polarity (affirmative, negative) and word order (V2, V3)

On the *Matrix Object* region, Polarity and Word Order interact (t = 2.201, p<.05), as affirmative matrix clauses show longer total times on this region for V2 compared to V3 order (diff = 136ms) and negative matrix clauses do not show this word order effect (diff = 19ms). As this interaction is not seen in first pass times, it appears to have arisen from increased re-reading of affirmative canonical matrix clauses, where there were no cues present to allow the processor to anticipate contrast (in the form of contrastive remnant ellipsis). The two-way interaction on the *Spillover* region (t = -2.282, p<.05) shows a slightly different pattern. Following affirmative matrix clauses, there is actually a numerical penalty for V3 clauses (M = 1034 ms, SE = 43) compared to V2 clauses (M = 970 ms, SE = 35). The opposite is seen after negative matrix clauses – there is a numerical advantage for V3 clauses (M = 948 ms, SE = 41) compared to V2 clauses (M = 1024 ms, SE = 39) here. These interactions on the *Matrix Object* and post-remnant *Spillover* regions seem to be partially canceling each other out, and may thus signal differences in the time course of the processing of contrast depending on the grammatical and pragmatic properties of the matrix clause.

Moving on, three-way interactions between Word Order, Remnant Type and Polarity are observed on some of the regions in first pass times and go-past times. Firstly, there is what looks like a preview effect in first pass times on the *Matrix Object* region, t = -2.164, p<.05. Although the remnant clause has not yet been encountered, there are differences in how the Object CF remnant conditions pattern in items with positive and negative polarity. In negative matrix clauses with Object CF remnants, there is a V3 order penalty over V2 clauses on this region (diff = 48ms), but this penalty is not seen in affirmative matrix clauses with Object CF remnants (diff = -19ms). These effects likely arose from parafoveal preview to the contrastive particles *mitte*, "not" and *vaid*, "but" at the left edge of CF remnants. Particularly, preview to the corrective particle *vaid* (which occurred in Object CF remnant ellipsis following negative clauses) appears to have produced processing difficulty following V3 clauses, perhaps due to an expectation of a CT-alternative to the subject arising from the use of V3 word order along with negation.[9]

Secondly, a three-way interaction between Word Order, Remnant Type and Polarity is also seen in go-past times on the post-remnant *Spillover* region, (t = -2.089, p<.05). Namely, there is an asymmetry in go-past times following V3 antecedent clauses. If the V3 antecedent clause is affirmative, we see a reading time penalty for Subject CT remnants over Object CF remnants (diff = 152ms). This is not the case following negative V3 clauses (diff = -16ms). This effect suggests that the polarity of the matrix clause does play a role when it comes to the time course of processing CTs, with some residual processing difficulty seen following affirmative clauses where contrast may have been less anticipated than in negative clauses, despite being syntactically marked through V3 order. Thus, it appears that contrast is not

[9]The grammatical properties of the particle *vaid* are also of potential relevance. This particle allows for a local (Object CF) correlate without that correlate being marked by overt constituent negation, but non-local correlates (Subject CF remnant ellipsis) must be overtly marked using constituent negation. This is not the case with *mitte*, which freely allows for local and non-local correlates in CF-remnant ellipsis. This preview effect may indicate that the processor is anticipating subject contrast in V3 clauses and is sensitive to the grammatical asymmetry between *vaid* and *mitte*. Interestingly, since *vaid* only marks CFs and not CTs, the unavailability of the non-local correlate using *vaid* in the remnant should be irrelevant, as the matrix subject does not match the information structure of the remnant. This raises the question of how fine-grained the computation of contrast is in the earlier stages of processing. Does the processor initially distinguish between CTs and CFs when processing non-canonical word order? Further work remains to be done to address this question as the finer details pertaining to subject Foci are beyond the scope of this dissertation.

assigned automatically based on V3 order, as pragmatic factors like negation also play a role during incremental processing (as was discussed in Section 4.2.1.1).

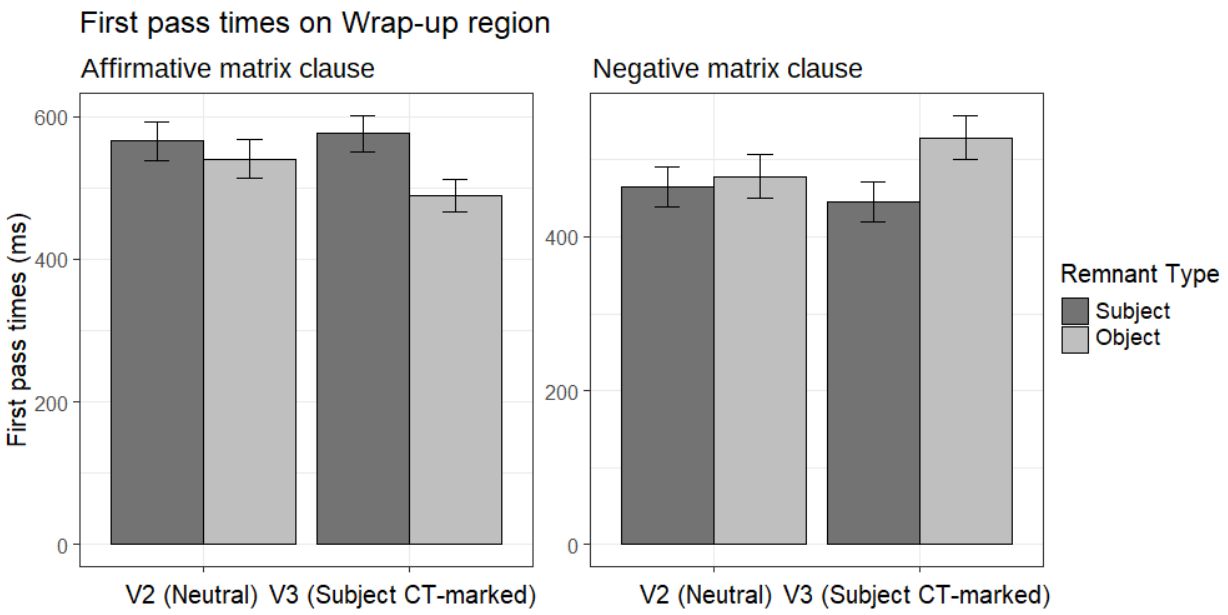


Figure 4.5: First pass times (ms) on the *Wrap-up* region by matrix clause polarity (affirmative, negative), word order (V2, V3) and remnant type (Subject, Object)

Finally, a three-way interaction is seen in first pass times on the sentence-final *Wrap-up* region (t = -2.310, p<.05). Here, differences arise in how Object CF remnants following V3 clauses pattern with respect to the other three conditions. The effects occurring in the processing of Object CF remnant ellipsis following V3 clauses are interesting, as these are the conditions where there is a presupposition failure – V3 order necessitates the presence of a CT alternative in the discourse representation, but in the case of the CF remnant conditions, there isn't one overtly present. As seen in Figure 4.2.4.6, there is an expected pattern following negative matrix clauses (right), as Object CF remnants with V3 antecedents M = 529 ms, SE = 29), i.e. the presupposition failure condition, are penalized compared to the other three conditions (which have means in the range of 446–478ms). Puzzlingly,[10] the

[10]There is a high proportion of regressions out of this region (approximately 50% per experimental condition), and it's possible that there are regression-contingent asymmetries in first-pass times, depending on the polarity of the matrix clause. However, the data would be too sparse at this point to run robust pairwise analyses to examine any potential three-way interactions between matrix clause Polarity, Word Order and

opposite pattern is seen following affirmative matrix clauses, where Object CF remnants with V3 antecedents (M = 490 ms, SE = 23) are advantaged compared to the other three conditions (with means in the range of 541–576ms). Why the pattern is reversed for affirmative matrix clauses is not immediately clear, but these results again indicate that syntactic CT-marking is processed more easily (and perhaps rapidly) when the clause is negative as opposed to affirmative.

To summarize, the Polarity analyses indicate that negative polarity in the matrix clause does indeed facilitate the processing of contrastive remnant ellipsis, including CTE.

4.2.5 Discussion

The results, on the whole, provide evidence against the Delayed Discourse Update hypothesis. We observed that the processing of Subject CT remnants (which otherwise incur a cost compared to clause-final, "local" Object CF remnants) is facilitated when the subject is marked as a CT in the matrix clause using V3 word order. If contrast-assignment in the matrix clause was delayed until encountering the CT alternative (the CTE remnant), we would have expected V2 and V3 clauses in the experimental manipulation to pattern similarly, as the linear position of the matrix subject and the lexical material intervening between the matrix subject and the remnant (which may influence retrieval) were kept constant in the two clause types. The reduced processing penalty for subject CT remnants following V3 clauses is explained if the processor marked the subject correlate in V3 clauses as contrastive, facilitating the pairing of the contrastive remnant and its correlate.

A novel aspect of this experiment compared to past work is that clause-initial subjects do not occur in an obviously non-canonical position. Previous work has looked at clause-initial objects in SVO languages (Kaiser and Trueswell, 2004; Weskott et al., 2011; Kristensen et al., 2014) and showed that comprehenders are sensitive to deviations from non-canonical word order and the discourse conditions that license object-fronting. Clause-initial subjects in

Remnant Type in regression-contingent subsets of the first-pass time data. The wrap-up effects occurring here might be better explored in a more targeted experimental design in the future.

Estonian are temporarily compatible with occurring in a canonical subject position (Spec-FinP). Therefore, encountering the clause-initial subject (or Nominative DP in the clause-initial position) is not expected to produce a disruption to syntactic structure-building that would force the processor to consider alternative structures. My findings here show that in determining information-structural relations, the processor is sensitive to the structure of the clause as a whole (and in the present case, to the linear placement of the verb).

While there is evidence for the computation of contrast being facilitated by V3 order, it appears that other factors like the polarity of the clause also influence CT processing. This suggests that CT-marking based on V3 order is not fully automatic and encapsulated from pragmatic and contextual factors. One explanation is that non-canonical word order (perhaps particularly in silent reading, in the absence of prosodic cues) incurs a processing penalty even when it conveys a particular information structure completely unambiguously. A pragmatic cue for contrast, such as negation, may then counter the processing difficulty introduced by parsing a non-canonical structure. This possibility is in line with previous work on the processing of non-canonical word order showing that context facilitates the comprehension of non-canonical structures (e.g. Weskott et al. 2011), although more work is needed in order to separate potential processing difficulty arising from parsing non-canonical clauses (i.e. building a syntactic representation for a less frequent structure) from slowdowns associated with deeper discourse processing, such as representing a particular constituent as contrastive and computing the associated inferences.

A general finding from the Polarity analyses was that the processing of contrast is eased when the matrix clause involves negation. This is compatible with negation activating contrastive alternatives more easily than affirmative statements. Still, Estonian has grammatical properties that may weaken the conclusions that can be drawn from the Polarity findings. There is a possible confound arising from the nature of polarity particles in CTE and CFE in Estonian. Following negative matrix clauses, contrastive remnant ellipsis requires a positive particle and following positive matrix clauses, contrastive remnant ellipsis requires a negative particle. The positive particles for CTE (*küll*) and CFE (*vaid*) are distinct, which makes

the two structures easy to distinguish from each other. The negative particle *mitte* is used for both CTE and CFE, which means that the two structures are only distinguished from each other by their word order. While we have seen evidence that the processor is rapidly sensitive to word order variations, having this additional cue in the form of two distinct positive particles following negative matrix clauses could still facilitate the online processing of contrastive remnant ellipsis. Along the same line, encountering the negative particle *mitte* could introduce a processing slowdown associated with determining the information-structural status (CT or CF) of the remnant. Thus, further work is needed to examine how fine-grained the processing of contrast is during incremental comprehension, and whether the parser rapidly distinguishes between CTE and CFE during incremental structure-building.

Barring potential complications with distinguishing between CTE and CFE during the reading of the remnant, let us consider what the Polarity effects could tell us about the incremental processing of the V3 clause. Considering that marking the subject as a CT is facilitated in the presence of negation, it is not clear how "immediate" the assignment of contrast is – sentential negation is encountered along with the verb, once the clause-initial subject and the adverb have altready been read. If the processor assigns contrast as rapidly as possible, we would expect the clause-initial subject to be marked as a CT once it is determined that (i) the verb does not appear in the second (V2) position, which should be licensed by a the presence of a preverbal CT, and (ii) the other preverbal constituent, the speaker-oriented adverb, cannot function as a CT. Thus, the subject could be marked as a CT before the verb is even encountered, in which case the appearance of sentential negation on the verb would not be expected to influence contrast-assignment much. One possibility is that the processor is initially briefly delaying assigning contrast to the clause-initial subject until the verb is encountered, as the subject-adverb sequence is temporarily compatible with being [-Focus, -Contrast], if followed by a CT constituent. As discussed in Chapter 2, multiple discourse-given constituents can precede a CT in the preverbal domain. Example (78) illustrates the temporary ambiguity, where the (78a) is a reproduction of the V3-SubjectCT condition from Experiment 1, and (78b) shows a temporarily string-identical

example where the subject is not a CT. The identical beginnings of the two clauses are underlined for convenience. A comparison of (78a) and (78b) shows that the information structure of the subject is not fully disambiguated until the verb has been encountered.

(78) a. Agnes$_{CT}$ tegelikult tunneb Joonast, Katrin$_{CT}$ mitte.
Agnes.NOM actually knows Joonas.PART Katrin.NOM NEG
'Actually Agnes knows Joonas, but Katrin doesn't.'

b. Agnes tegelikult Joonast$_{CT}$ tunneb, Katrinit$_{CT}$ mitte.
Agnes.NOM actually Joonas.PART knows Katrin.PART NEG
'Joonas, Agnes actually knows, but Katrin she doesn't.'

In Experiment 2 below, I explore how the processor deals with information-structural ambiguity in the preverbal domain in order to shed more light on how contrast is assigned in V3+ clauses during incremental processing.

4.3 Exp 2: Processing information-structural ambiguity

4.3.1 Motivation and Hypotheses

In the eye-tracking experiment, we saw evidence that CT-status is assigned to a preverbal element during the processing of the non-canonical clause itself, rather than contrast-assignment being delayed until grammatically necessitated by the presence of CT-remnant ellipsis. In Experiment 1, I disambiguated the information structure of V3 clauses to mark subjects as CTs by placing elements that are poor candidates for contrast (namely, speaker-oriented adverbs) in the preverbal domain. As a result, when readers encountered an adverb following the clause-initial subject (instead of a verb, as predicted by the canonical V2 order), they had sufficient information to place contrast on the clause-initial subject. These clauses were temporarily ambiguous as clause-initial subjects are compatible with a range of information-structural configurations, but the information structure of the subject was rapidly disambiguated when the adverb and the following verb were encountered.

As we saw in Chapter 2, there is flexibility in the placement of the CT in the preverbal

domain, as other discourse-given material may precede or follow it. This means that while declarative V3+ matrix clauses necessitate the presence of a CT, there can be ambiguity as to which of the preverbal constituents is contrastive. Consider the example in (79). The non-V2 order of the matrix clause ("Today Anna did see Liisa") signals that a preverbal constituent must be contrastive, but as the different possible ellipsis continuations show, contrast may be placed on the subject (79a), on the object (79b), on the temporal adverb (79c), or even on multiple constituents (79d).

(79) Anna täna Liisat nägi, ...
Anna.NOM today Liisa.PART saw
'Today Anna did see Liisa...'

a. ... Mari mitte.
Mari.NOM NEG
'Mari didn't.' (Subject CT)

b. ... Laurat mitte.
Laura.PART NEG
'Laura she didn't.' (Object CT)

c. ... eile mitte.
yesterday NEG
'Yesterday she didn't.' (Adverb CT)

d. ... Mari eile mitte.
Mari.NOM yesterday NEG
'Mari yesterday didn't.' (Subject CT, Adverb CT)

As we saw in Experiment 1, the processor can assign CT status to a preverbal element when encountering V3+ word order, rather than having to wait until a contrastive alternative is encountered. But what happens during incremental processing if multiple preverbal constituents are compatible with being CTs? Ambiguity resolution has been extensively studied in the syntactic processing literature (e.g. Frazier 1987a; Cuetos and Mitchell 1988; MacDonald et al. 1994; Spivey-Knowlton and Sedivy 1995; Hoeks et al. 2002) but less is known about potential processing biases when it comes to computing information structure (but see e.g. Carlson et al. 2009 for work on the processing of Focus).

One possibility is that when multiple candidates for contrast have been encountered, the assignment of CT status is initially underspecified. Namely, the processor could compute a CTopP structure (following the syntactic analysis proposed in Chapter 3) without specifying which preverbal constituent carries a [+contrast] feature. Alternatively, multiple representations of the information structure of the clause might be computed in parallel, with resolution delayed until sufficient (contextual) information biases the processor towards a single interpretation. The possibility of underspecifying the CT constituent during incremental processing does not necessarily mean that the constituent that acts as a CT cannot be marked rapidly. In Experiment 1, the processor was presented with a preverbal subject and a preverbal speaker-oriented adverb in V3 clauses. As speaker-oriented adverbs are incompatible with being CTs, there was only one candidate for CT status – the subject.

Under an opposing view, the computation of a CTopP would necessitate marking a particular constituent as a CT. In a language with feature-driven movement to the left periphery, feature-checking may be necessary in order to fully parse (and interpret) the input. In order for the language processing system to be able to deal with ambiguity and still rapidly arrive at a complete parse, the processor might appeal to a heuristic such as placing contrast at the edge of the clause, that is, in the clause-initial position (see Molnár and Winkler 2010, for cross-linguistic evidence for a preference for clause-edge contrast).[11] Under this view, only one information-structural representation would initially be computed, and encountering disambiguating information incompatible with the computed interpretation would be expected to give rise to comprehension difficulty.

Looking at the incremental processing of V3+ word order can also provide information about the time-course at which information-structural representations are computed. As discussed in Chapter 2, clause-initial subjects are compatible with a range of information-structural notions – they may be Topics, Foci, CTs, or be in the scope of broad Focus in

[11]The fact that past work on CT structures in Estonian has been on clause-initial CTs points to the possibility that clause-initial contrast is more frequent than second (or third) position contrast in Estonian, meaning that this heuristic may also be grounded in the processor's frequency of exposure to different constructions.

out-of-the-blue contexts. Fronted objects, on the other hand, cannot be Foci and in V2 clauses are more natural in the clause-initial position if they are CTs or have previously been highlighted as topical. The information structure of clause-initial objects is thus more constrained than the information structure of clause-initial subjects.[12] If comprehenders are immediately sensitive to the marked information-structural status of clause-initial objects (compared to clause-initial subjects), we would expect to see a bias towards object contrast in object-initial clauses, while any effects would be reduced in temporarily canonical subject-initial clauses.

Building on the finding from Experiment 1 that CT status is assigned to a preverbal element during incremental processing of V3 clauses, the goal of Experiment 2 is to further test the Immediate Discourse Update hypotheses, which was formulated as "The processor rapidly commits to an information-structurally marked status for clauses that are not compatible with a simple topic-comment structure" in Section 4.2.1. The question then is whether the clause is marked as contrastive as a whole, or whether a single constituent must be marked as a CT, in order to anticipate upcoming contrast.

The two theoretical options explored here are as follows:

(i) During the processing of V3+ clauses, the processor obligatorily assigns CT status to a single constituent.

(ii) In the absence of biasing information, the identity of the CT in V3+ clauses may be left underspecified until a contrastive alternative is encountered.

Under the first option, the processing of preverbal contrast is obligatorily associated with marking a particular constituent as a CT. Factors such as the discourse context and prosody

[12]This view is slightly simplified, as I assume that comprehenders take a clause-initial Nominative DP to be a subject and a Partitive DP to be an object. It is worth keeping in mind that the subjecthood or objecthood of a DP in Estonian is not fully determined by its case, as certain verbs (e.g. *häirima*, "to annoy") take Partitive subjects. Thus, a portion of clause-initial Partitive objects may be misinterpreted as subjects during incremental comprehension, but seeing that subjects are less marked than objects, this would potentially reduce any asymmetries observed rather than acting as a confound. Estonian speakers' interpretation of case in different sentential positions is discussed in Kaiser et al. (2020).

play a role in which constituent is CT-marked, and in the absence of biasing information, the processor may use a heuristic such as assigning contrast to the leftmost, clause-edge constituent (see e.g. Molnár and Winkler 2010, although they do not present processing hypotheses). If the initial analysis turns out to be incompatible with the broader discourse, it can be revised.

Under the second option, the processor assigns CT status in V3+ clauses if there is sufficient bias towards a particular preverbal constituent being contrastive. In the absence of bias (from e.g. the discourse context or prosody), upcoming contrast can be anticipated while leaving the identity of the CT in the target clause underspecified. This means that the features of the contrastive alternative being anticipated (e.g. thematic role, grammatical case) remain underspecified until a suitable candidate for a CT alternative is encountered (see Chapter 3 for a discussion of how CT alternatives could be partially activated).

In this experiment, I compare the processing of SOV and OSV clauses, as SOV clauses are temporarily canonical (being compatible with the canonical SVO order when only the subject has been encountered) while OSV clauses can immediately be identified as non-canonical. If multiple constituents remain as possible candidates for CT status in the temporarily canonical SOV clauses but not in OSV clauses, then we would expect to see diminished preferences for a particular remnant in SOV clauses compared to OSV clauses.

If OSV clauses are likewise initially (i.e. when only the clause-initial object has been encountered)postulated to have V2 order, the processor may take the object to be more salient than the subject in order to have raised to Spec-FinP. This means that the object is a good candidate for being a (Contrastive) Topic in OVS clauses, although discourse-given constituents may precede the CT in V3+ clauses without being contrastive, so a clause-initial object does not need to be a CT to be grammatical. In OSV clauses, the processor simply has more motivation for assigning CT status to the clause-initial constituent than in SOV clauses. Of course, if the computation of CTopP structure is obligatorily accompanied by marking a constituent as a CT, we would expect SOV clauses to pattern like OSV clauses, and show a preference for clause-initial contrast.

Asymmetries between CT-assignment in these two clause types would thus indicate whether CT status must be assigned to a particular constituent, or can initially be underspecified, while still being compatible with the clause being marked as contrastive (i.e. syntactically a CTopP). Due to the design of Experiment 1 (where potential ambiguities were ruled out by the use of speaker-oriented adverbs), the previously preseted results are compatible with both of these hypotheses. Placing an object, which is a felicitous carrier of contrast, in the preverbal domain allows us to test whether information-structural relations must be fully resolved during incremental processing.

4.3.2 Materials and Method

I conducted a speeded acceptability experiment, investigating how comprehenders assign CT status in verb-third clauses. In order to examine which constituent is marked as contrastive in the absence of biasing discourse context, I used indicators of contrast in the target sentence itself. As negation was found to facilitate the processing of contrast in Experiment 1, negative matrix clauses were used throughout. Additionally, CT remnants were marked using the contrastive particle *aga* "but" (compare to the German topic particle *aber*, Sæbø 2003). This was expected to further facilitate the pairing of the CT remnants with their correlates in the preceding clause.

In a 2x2 design, SOV and OSV clauses were followed by CTE clauses, containing either a subject or object remnant and an affirmative focus particle (see Table 4.6). Subjects and objects, both Estonian proper names, were disambiguated by case marking. The assumption underlying the grammaticality judgment data was that in order to render the V3+ clauses grammatical, the CT element in the first clause had to have the same grammatical function as the CT remnant in the second clause, thus giving us a window to which preverbal element was preferentially marked as a CT during silent reading.

The experiment was conducted in a quiet room, with the participant sitting opposite the experimenter who was not able to see the participants' screen. The sentences were presented word-by-word in a rapid serial visual presentation paradigm (RSVP) using the

Condition	*Matrix clause*	*Remnant*
SOV	**Ants** Jaanikat ilmselt ei armasta,	**Margus** aga küll
Subject	Ants.NOM Jaanika.PART apparently NEG love	Margus.NOM but AFF
	'Apparently Ants doesn't love Jaanika, but Margus does.'	
SOV	Ants **Jaanikat** ilmselt ei armasta,	**Hellet** aga küll
Object	Ants.NOM Jaanika.PART apparently NEG love	Helle.PART but AFF
	'Apparently Ants doesn't love Jaanika, but Helle he does.'	
OSV	Jaanikat **Ants** ilmselt ei armasta,	**Margus** aga küll
Subject	Jaanika.PART Ants.NOM apparently NEG love	Margus.NOM but AFF
	'Apparently Ants doesn't love Jaanika, but Margus does.'	
OSV	**Jaanikat** Ants ilmselt ei armasta,	**Hellet** aga küll
Object	Jaanika.PART Ants.NOM apparently NEG love	Helle.PART but AFF
	'Apparently Ants doesn't love Jaanika, but Helle he does.'	
Comprehension question: Does Ants love Jaanika?	YES	NO

Table 4.6: A sample item from the speeded acceptability experiment. The Matrix clause material was followed by either Subject CT or Object CT remnant ellipsis. The CT remnant and its correlate in the matrix clause in each condition are marked in bold.

Linger program (Rohde, 2003) on a Windows PC with access to the Internet turned off. Each word appeared in the middle of the computer screen for 200 ms, with an inter-stimulus interval of 50 ms, which most participants reported to be a comfortable reading speed during post-experiment debriefing. During the experiment, participants were asked to respond as quickly as possible at sentence offset whether it was grammatical, using a button press on a PS-2 keyboard. Half of the items were followed by a comprehension question. A total of 24 experimental items were presented in a Latin square design along with 64 items from unrelated experiments and 20 additional fillers, with 50% of the sentences each participant saw estimated to be ungrammatical or severely marginal.

A half of the comprehension questions in the experimental items inquired about the matrix clause, and the other half about the ellipsis clause, so that participants were encouraged to read for comprehension and pay attention to both parts of the sentence . Each participant saw an equal number of questions requiring a "Yes" answer and questions requiring a "No"

answer in order to reduce answer bias.

4.3.3 Participants

A total of 46 native speakers of Estonian were recruited from the University of Tartu (Estonia) and the surrounding community. Data from a total of 36 participants remained in the analysis after excluding one participant's data for their responses to catch items (accepting 20% or more of ungrammatical catch items), three participants' data based on comprehension question accuracy (below 80% across experimental and filler items), four participants' data for slow response times (a mean of 2000 milliseconds or above across experimental and filler items)[13] and further two participant's data for counterbalancing reasons.

4.3.4 Results and discussion

I analyzed data from three measures, as seen on Figure 4.3.4. The data were analyzed in lmer and glmer models (as appropriate) using the *lme4* package (Bates et al., 2015) in R (R Core Development Team, 2019). All models reported below include Word Order and Remnant Type as fixed effects, with random intercepts for Participants and Items. Deviation coding was used throughout. Effects at $p<.05$ were considered statistically significant.

Firstly, let us look at acceptance rates for the four conditions (i.e. the proportion of trials where participants chose a Yes response). As seen on the left panel of Figure 4.3.4, overall acceptance rates for the experimental items were high ($M = 85.5\%$, $SE = 1.2$). The glmer model showed an interaction between Word Order and Remnant Type ($z = 3.953$, $p<.01$), with OSV clauses with Subject CT remnants ($M = 77.8\%$, $SE = 2.8$) accepted at lower rates than the other three conditions. There were no significant main effects of either Word Order or Remnant type. Pairwise analyses conducted using the *emmeans* package (Lenth,

[13]The mean response time across all items prior to exclusions was 1256 ms. The motivation for excluding slower responders' data from the analysis was two-fold – firstly, to reduce variance in the statistical analysis, and secondly, to reduce the amount of prescriptive judgments. I hypothesized that prescriptive judgments, being conscious, would generally take longer to compute than acceptability judgments based on the participant's personal grammar.

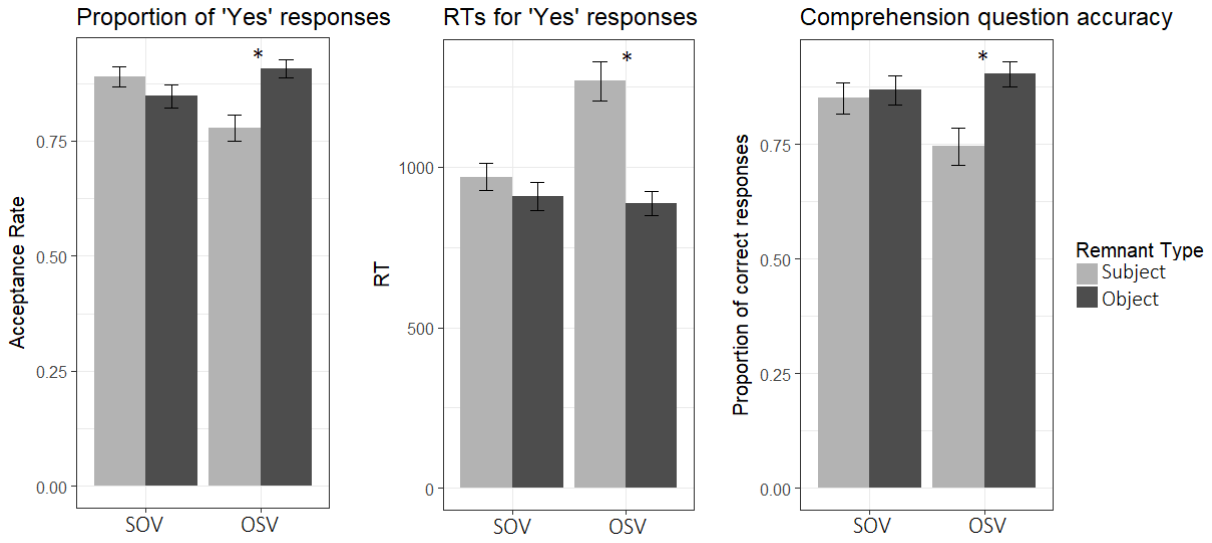


Figure 4.6: Results from the speeded acceptability experiment. Differences significant at p<.05 are marked with an asterisk.

2019) with Tukey adjustments confirmed that there was a Remnant type effect for OSV clauses (z = 4.130, p <.01) but not for SOV clauses (z = -1.479, p = 0.4505). Following the assumption of information-structural parallelism between remnants and their correlates (that is, that contrastive remnant ellipsis disambiguates the information structure of its antecedent clause), this finding indicates that SOV clauses are as acceptable with CT status assigned to the Subject as they are with CT status assigned to the object, while in OSV clauses, CT status is more naturally applied to the clause-initial object.

I take the relatively high rates of acceptance for the experimental items as evidence that word order and contrast placement in V3+ clauses is flexible, in line with the syntactic analysis proposed in Chapter 2 (contrary to the assumptions presented in previous theoretical literature on Estonian, e.g. Henk 2010). There is some inter-participant variability in the acceptability of the four conditions. 19.4% of participants consistently accepted all experimental items while only 5.6% of participants showed a clause-initial CT preference in both SOV and OSV clauses.

Secondly, let us examine whether any of the four conditions were associated with a

processing penalty that would indicate a mismatch between the constituent marked as contrastive in the matrix clause and the CT remnant. I was interested in whether there is a processing penalty associated with any of the four conditions. I used response time (RT), or the time to make the acceptability judgment at the end of the sentence, as a proxy for processing difficulty. Considering the high acceptance rates for the experimental items overall, and possible differences between the cognitive processes behind "Yes" and "No" responses (e.g. erroneous "No" responses), only "Yes" responses were used for this analysis. Thus, RTs for the four conditions were compared on trials where participants accepted the sentence as grammatical.

Prior to statistical modeling, all RT data were winsorized (Dixon and Tukey, 1968), by replacing the top and bottom 5% of values in each experimental condition with the appropriate cut-off value. The center panel in Figure 4.3.4 depicts the RT findings. In the lmer model, there was a main effect of Word Order (t = -3.341, p<.01), with a penalty for OSV clauses (M = 1062 ms, SE = 36) compared to SOV clauses (M = 940 ms, SE = 30), and a main effect of Remnant Type (t = 6.507, p<.01), with a penalty for Subject remnants (M = 1108 ms, SE = 37) compared to Object remnants (M = 897 ms, SE = 29). However, these effects appear to be driven by OSV clauses with Subject remnants, as suggested by the significant interaction between Word order and Remnant Type (t = -4.622, p<.01). OSV clauses with Subject remnants (i.e. second-position CTs) were accepted as grammatical more slowly (M = 1267 ms, SE = 62)[14] than the other three conditions. Pairwise analyses (conducted as previously) confirmed that only the OSV Subject CT condition significantly differed from other conditions (ps <.05). The slower RTs for acceptance in subject-contrast OSV clauses could indicate a processing penalty associated with revising the computed information structure of the clause, when the processor has previously committed to assigning CT status to the clause-initial object.

Finally, as shown in the rightmost panel on Figure 4.3.4, I analyzed comprehension

[14]Interestingly, this condition is also associated with the highest variance (as shown by the standard error), but this was not explored further in the present analysis.

question accuracy as another measure of processing difficulty. Items in the disfavored OSV Subject CT condition showed lower comprehension question accuracy compared to the other three conditions, as shown by a trend towards an interaction between Word Order and Remnant Type in the glmer model (z = 1.915, p = .0555). There was also a main effect of Remnant Type (z = -2.489, p <.05) with responses to items with Subject CTs (M = 80% correct, SE = 3) being less accurate than responses to items with Object CTs (M = 89% correct, SE = 2). As seen in Figure 4.3.4, this effect is primarily driven by the OSV conditions, were Subject remnants impede comprehension. Interestingly, there is no main effect of Word Order (z = 0.622, p = 0.534). Readers are performing as well on OSV clauses with Object CTs as they do on SOV clauses. This suggests that the less canonical, object-initial OSV order (*cf.* Kristensen et al. 2014) is not comprehended more poorly than the more canonical SOV order. Rather, the processing profile of non-canonical word order is influenced by information structure.

In order to examine the source of lower comprehension question accuracy in the OSV Subject CT condition, let us compare comprehension question accuracy for questions about the matrix clause and for questions about the ellipsis clause. The examples in (80) show how the two types of question related to the target clause. As the matrix clause always contained negation, the correct answer to the *Matrix Clause Questions* was "No" and the correct answer to the *Ellipsis Clause Questions* was "Yes".

(80) Anna didn't meet Mari, but Kadi did.

a. *Matrix Clause Question:* Did Anna meet Mari?

b. *Ellipsis Clause Question:* Did Kadi meet Mari?

An overview of comprehension question accuracy for the two types of questions in the four conditions is shown in Table 4.7. Although the data are too sparse for a statistical analysis, we observe an interesting pattern in the descriptive data. The lowest accuracy is observed in response to questions inquiring about the ellipsis clause in the OSV conditions with a Subject remnant (67%). In the same experimental condition, participants were not

doing as poorly on questions about the matrix clause (82%). This suggests that readers were particularly struggling with disambiguating OSV clauses towards Subject contrast and parsing the ellipsis clause, while the computation of the basic argument structure of the matrix clause was not severely impeded by object-initial order.

Condition	All Qs	Matrix Clause Qs	Ellipsis Clause Qs
SOV, Subject CT	85%	95%	75%
SOV, Object CT	87%	89%	84%
OSV, Subject CT	75%	82%	67%
OSV, Object CT	90%	88%	93%

Table 4.7: Comprehension question accuracy in Experiment 2, for questions inquiring about the Matrix clause and for questions inquiring about the Ellipsis clause

All in all, in contrast to OSV clauses where Subject CT penalties were observed across experimental measures, there are no robust asymmetries between Subject and Object remnants following SOV clauses. The findings from OSV clauses overall suggest that contrast is rapidly assigned to the clause-initial Object, resulting in processing difficulty for Subject CT remnant ellipsis. Interestingly, SOV clauses pattern similarly to OSV clauses with Object CTs in the different experimental measures. Let us consider two possibilities for why SOV clauses (regardless of contrast placement) would not be penalized compared to OSV clauses with Object CTs, where the processor appears to commit to a single information-structural representation early.

The first possibility is that in SOV clauses, the processor commits to a single interpretation for contrast assignment (perhaps stochastically, in the absence of biasing context). In the present experimental manipulation, this would result in that interpretation being revised in about a half of the trials when the remnant is encountered. All else being equal, this would be expected to yield an overall processing penalty in SOV clauses compared to OSV clauses with Object CTs, driven by trials where the initial interpretation had to be revised. The lack of this penalty could arise from an overall preference for SOV order over OSV order, perhaps due to a preference for independently more salient subjects preceding

less salient objects.[15] However, an independent penalty for object-initial structures might be expected to show up in comprehension, with lower comprehension question accuracy for OSV conditions compared to SOV conditions. There was no main effect of Word Order in the statistical analysis of comprehension question accuracy.

The second possibility is that the placement of contrast remains underspecified until contextually disambiguated, and in this case, until the disambiguating remnant is encountered. We observe no penalty for the SOV clauses upon disambiguation as the processor is anticipating upcoming contrast. If it was the case that an ambiguity pertaining to which constituent is contrastive prevents the processor from using V3+ order to anticipate upcoming contrast, we would expect to see a penalty when a CT alternative is encountered in contrastive remnant ellipsis (as was the case for Subject remnants following V2 clauses in Experiment 1). The data discussed here are compatible with the processor temporarily entertaining multiple possibilities for the assignment of contrast when the placement of the verb necessitates the presence of a CT but there isn't sufficient contextual information to bias towards CT-marking on a particular constituent.

4.4 General discussion

To summarize, the two experiments provide evidence that V3+ order in Estonian is used to rapidly anticipate upcoming contrast, as evidenced by the processing of contrastive remnant ellipsis following canonical and non-canonical clauses. In Experiment 1, we saw evidence compatible with the assignment of CT status to a preverbal constituent in subject-initial V3 clauses being delayed until the verb is encountered. Namely, when the verb was accompanied by the sentential negation clitic *ei*, the processing of the following contrastive remnant ellipsis clause (and detection of presupposition failure in the absence of a CT alternative in the sentence) was facilitated. Thus, CT-marking was not immediate and completely automatic but rather, the processor appeared to allowing for the accumulation of additional contextual

[15]Further work using common nouns in addition to proper names and inanimate DPs in addition to animate ones could shed light on the role of salience in word order preferences in Estonian V3+ clauses.

material to fine-tune the information-structural representation of the clause. Experiment 2 provides further evidence that the processor does compute contrast in non-V2 constructions rather than leaving the information structure of the clause completely underspecified.

The temporary underspecification in which preverbal element is marked as [+contrast] could arise from the structure of the left periphery in Estonian, which I argued in Chapter 2 to contain multiple CTopP projections. While encountering two constituents (e.g. DPs, adverbs) in the preverbal domain signals that the clause contains a CT, the structure is temporarily compatible with both of these constituents being discourse-given, with contrast falling on an upcoming preverbal constituent. It is therefore likely that there is cross-linguistic variability in the extent to which information-structural representations are fully specified during incremental processing, as the processor is sensitive to the grammar (i.e. the set of structures that are possible and impossible in the particular language). Previous work on Germanic languages by Molnár and Winkler (2010) shows evidence for a crosslinguistic pattern whereby contrast licenses movement to clause-edge positions. While it is of theoretical interest that non-initial contrast is grammatical in the Estonian left periphery, the present findings (on SOV clauses in Experiment 2) also indicate that clause-edge contrast is not a universal heuristic for language processing.

We have also seen evidence that the assignment of CT status is not always delayed in silent reading.[16] Experiment 2 showed that when the clause-initial constituent in a V3+ clause is an object, readers preferentially assign CT status to that clause-initial object rather than to a second-position subject. While clause-initial objects are not necessarily CTs in V3+ clauses, which appear to exhibit flexibility when it comes to preverbal word order, it is likely that the processor initially postulates a FinP (rather than a larger constituent), which would give rise to a V2 clause. In V2 clauses, movement to the single preverbal Spec-FinP position may be driven by relative salience. As the speaker has the option to move the subject to this position, regardless of its information-structural status, fronting an object in a V2 clause

[16]Of course, disambiguation using a contrastive pitch accent on the intended CT is expected to yield a different processing profile from what is observed in silent reading.

must be associated with the object having an information-structurally marked status (such as Aboutness Topic or CT). In the present case, object-initial clauses were presented without preceding context, but as we saw in Chapter 2, fronting CTs is generally more natural than fronting non-contrastive Topics. Thus, in the absence of biasing information in the context, and with a bias towards building a V2 structure, the processor likely assigns CT-status to the clause-initial object in OSV clauses (but not to the clause-initial subject in SOV clauses). In incrementally reading an OSV clause, when it becomes clear that CT-structure is necessitated by V3+ order, then rather than underspecifying which constituent is marked as a CT, the initial interpretation with CT-assignment to the object can be maintained as it is compatible with the further input the processor has received. In SOV clauses, by the time the clause is identified as being non-canonical, there are multiple candidates for CT status (the subject and the object) and in the absence of biasing information, an underspecified parse is maintained. The observation from Experiment 2 that subjects and objects are equally good candidates for contrast in SOV clauses during incremental processing suggests that the discourse representation (and supposedly, the syntactic representation, with features like [+contrast] having a syntactic realization) may remain temporarily underspecified. At the same time, V3+ clauses necessitate the presence of a CT in the clause, much like at-issue status necessitates the presence of Focus in a clause. The assignment of CT-status in Estonian V3+ clauses could thus hold similarities to focus-marking in languages like English, where prosody can underdetermine the scope of Focus (Selkirk, 1986; Cinque, 1993).

The experiments presented here raise interesting conceptual questions pertaining to the interplay between syntactic and discourse processing. Throughout this chapter, I have assumed that the processor marks V3+ clauses as CTopPs. However, as discussed in Chapter 2, CTopPs do not necessarily have V3+ order as the raising of non-contrastive constituents to the left periphery in the presence of a CT is optional. Following my syntactic assumptions, all clauses containing a CT are CTopPs. Thus, when a subject CT occurs in a canonical clause (as was the case for CT subjects in SVO clauses in Experiment 1) and is not initially

marked as a CT, the processor would need to restructure[17] the parse upon encountering evidence for the subject being a CT, by adding a CTopP layer above FinP. This revision process is likely not as costly as syntactic "reanalysis" (see e.g. Frazier 1987a) as no thematic role reassignment is necessary. The syntactization of information structure in languages like Estonian[18] raises the question of whether syntactic representations must feed discourse representations – does the processor need to have constructed a parse containing a CTopP before, say, initiating a search for a CT-alternative (what I dubbed "Contrast Resolution" in Chapter 3)? While it is difficult to diagnose the structure of the left periphery in incremental processing – particularly when only a single syntactic position is filled – I touch on the interplay between syntactic and information-structural representations in the following chapter, where the assignment of CT status to a constituent is correlated with thematic processing (the resolution of a case ambiguity), giving rise to measurable experimental effects.

While the experiments reported here used either neutral contexts (Experiment 1) or no context at all (Experiment 2), it is likely that in addition to grammatical biases like clause-initial objects being contrastive, the broader discourse context could play a role in CT-assignment in silent reading as well. I will discuss contextual effects in computing information-structural relations in the next chapter, which focuses on the effect of information structure in structural ambiguity resolution.

[17] Also see the discussion on focus-structural revision in Bader and Meng (1999) and Stolterfoht et al. (2007).

[18] Although note that some linguists have proposed that exhaustivity and prosody-related operators, including in languages like English, also occur in the syntactic representation (Constant, 2014). In this sense, information structure is not uniquely syntacticized in flexible word order languages, but the difference between languages arises in the transparency of mappings between the spelled out structure and the information structure of the clause.

CHAPTER 5

Information Structure and Syntactic Parsing

As the experiments on the processing of ellipsis structures in Chapter 4 show, non-canonical word order in Estonian facilitates the assignment of contrast during online comprehension. Namely, we saw that non-V2 word order facilitates the assignment of contrast between a preverbal argument (particularly for clause-initial subjects and objects) and an unambiguously case-marked ellipsis remnant. In the present chapter, I explore whether CT structure, as communicated through non-canonical word order in Estonian, can also influence parsing decisions in ambiguity resolution. I will explore this question by looking at the processing of temporarily ambiguous coordination. In the terms laid out in Chapter 3, the previous chapter dealt with Contrast Marking and this chapter deals with Contrast Resolution. More specifically, I look at whether the marking of contrast (in syntactic terms, parsing the input as a CTopP) leads to the processor actively anticipating a contrastive alternative to a CT-marked constituent. This gives us a window into information-structural processing beyond the syntactic representation – as discussed in Chapter 2, CT structure presupposes the existence of a contextually salient contrastive alternative. The findings from Chapter 4 are compatible with the rapid processing of CTs in non-canonical Estonian V3+ clauses being primarily syntactic in nature (until discourse updating is necessitated by the presence of a contrastive alternative, e.g. a contrastive ellipsis remnant). Evidence for the processor actively searching for a CT alternative would confirm that the syntactic processing of CT-clauses is accompanied by discourse updating and computing the presuppositions associated with the use of non-canonical word order (see also Kaiser and Trueswell 2004).

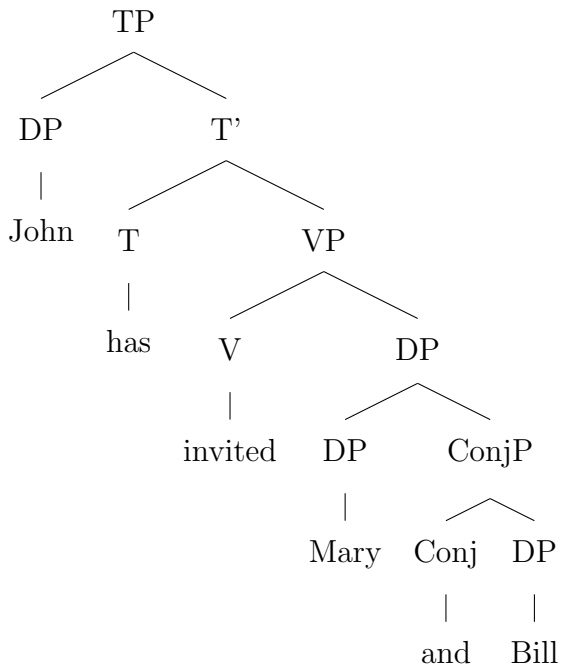
In order to determine whether a constituent is marked as a CT alternative during incremental processing, I look at temporarily ambiguous coordination constructions where

marking a case-ambiguous noun as a CT would result in a more complex, generally dispreferred clausal coordination parse. To set the stage for my work, the chapter begins with an overview of contextual and pragmatic effects on syntactic ambiguity resolution, after which I present my hypotheses for the effect of CT structure on syntactic ambiguity resolution in Estonian. Then, I present findings from two experiments. We will proceed by first considering the results of a sentence completion experiment looking at temporary coordination ambiguity in Estonian and whether syntactic CT-marking in the absence of a supporting discourse context biases speakers towards the more syntactically complex Clausal coordination over DP coordination. After establishing a general DP coordination preference for Estonian, I will discuss the findings from an eye-tracking during reading experiment looking at coordination ambiguity resolution in CT-biasing and syntactically CT-marking contexts, showing evidence for a strong effect of information structure on parsing.

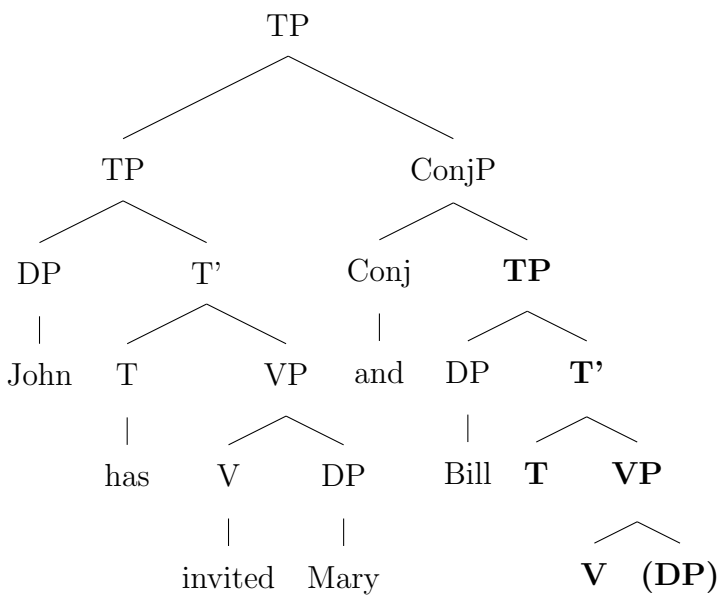
5.1 Minimal Attachment and coordination

There is extensive psycholinguistic work looking at the effects of syntactic complexity on incremental structure-building. Frazier (1987a) proposed the principle of Minimal Attachment, whereby the parser preferentially assigns its input (a sequence of morphemes) the least complex syntactic structure compatible with it. Under this view, syntactic complexity is operationalized as the number of nodes in a syntactic tree structure. While this makes the complexity of different syntactic constructions dependent on syntactic theory, temporarily ambiguous coordination is often used as a canonical example in support of the Minimal Attachment principle. As the simplified trees in (81) and (82) show, Clausal coordination, where the temporally ambiguous post-coordinator noun ("Bill") is taken to be a subject, is associated with increased syntactic complexity compared to DP object coordination. This is because the introduction of a second subject necessitates the presence of a verb (and any of its associated projections) in the second clause. When the ambiguous post-coordinator noun is taken to be an object, no further structure needs to be projected by the parser.

(81) DP coordination



(82) Clausal coordination (additional structure compared to DP coordination bolded)



Studies on languages like English (Staub and Clifton, 2006; Engelhardt and Ferreira, 2010) and Dutch (Frazier, 1987b; Hoeks et al., 2002, 2006) have shown that readers prefer the syntactically simpler DP coordination over the syntactically more complex Clausal coordination when the structure is temporarily ambiguous. Interestingly, this pattern holds even when the syntactically simpler structure has a low corpus frequency compared to the alternative (Engelhardt and Ferreira, 2010).

Serial, strict syntax-first models (Frazier, 1987a) postulate that the syntactically simplest structure is computed automatically, and that the more complex structure can only be arrived at through reanalysis, whereby the initial interpretation is discarded and the processor computes an alternative more compatible with the lexical input and contextual factors. This reanalysis contributes towards processing difficulty, often experimentally operationalized as a slowdown in reading or response times.

Alternatively, under parallel models (e.g. Altmann and Steedman 1988), where multiple sources of information are considered in tandem in making parsing decisions, a preference for syntactically simpler structures may be weighted against other (e.g. lexical or contextual) considerations. All else being equal, the syntactically simplest structure is still expected to be preferred (or to be the fastest to be computed) by the parser, but differences in predictions between the two types of models emerge when extrasyntactic sources of information support disambiguation towards a more syntactically complex structure.

5.2 Contextual effects on temporary ambiguity resolution

Below, I discuss some classic evidence that the pragmatic context in which an utterance is presented influences the syntactic representation(s) built during incremental processing. Then, I discuss a more recent study by Hoeks et al. (2002) on the processing of clausal coordination, which I will be building on in the work presented in this chapter.

5.2.1 Pragmatic effects on parsing

Against the serial view of processing where syntactic parsing is initially encapsulated, there is accruing evidence pointing to the parser using non-syntactic information (such as visual or discourse context) in ambiguity resolution. In particular, the referential context in which an utterance occurs has been shown to influence the syntactic structure that is (initially) built. For instance, Tanenhaus et al. (1995) showed using a visual display manipulation that the presence or absence of a referential alternative influences syntactic attachment decisions, whereby an NP modification interpretation (which has been argued to violate Minimal Attachment) is more likely when the referent of the definite DP is not unique in the absence of the modifier. Namely, they found that temporarily ambiguous sentences like "Put the apple on the towel on the napkin" were more likely interpreted with "on the towel" as a destination when only one apple was present in the display, as opposed to when two apples were present. The presence of a second apple, making the definite DP "the apple" pragmatically infelicitous on its own, increased eye movements compatible with "on the towel" being interpreted as a modifier to the NP "apple", rather than to the verb "put".

Similarly, Altmann and Steedman (1988) explored sentences with a structural ambiguity like "The burglar blew up the safe with the rusty lock" that usually produce comprehension difficulty due to the syntactically simpler interpretation ("The burglar used the rusty lock to blow up the safe") being semantically anomalous. They found evidence that processing difficulty is reduced (i.e. the processor is less likely to compute the anomalous, syntactically simplest parse) when the sentence is presented in a story context that highlights two relevant referents. When there are two safes in the discourse representation (i.e. "the safe" is not a unique description, again violating the presupposition on the definite determiner), the processor interprets the modifier "with a rusty lock" as attaching to the NP "safe" rather than to the verb "blew up".

Referential context effects are pragmatic in nature, as they show that the processor is sensitive to the presupposition of uniqueness of the definite determiner in English. A comprehender may reason that a definite determiner *the* would not have been chosen by the

speaker if the expression *the* occurred in picked out more than one referent.

5.2.2 Information structure and coordination

In addition to definiteness and referential context, there is also evidence that topicality influences ambiguity resolution. Hoeks et al. (2002) point out that in addition to being syntactically more complex than DP coordination, Clausal coordination is also associated with increased discourse complexity. When a post-coordinator noun acts as a subject of the second clause, it is also construed as a Topic of that clause (see Reinhart 1981, for a discussion of topicality and subjecthood), meaning that the discourse structure contains two topical entities (as opposed to a single subject Topic in the corresponding object DP coordination structure). Much as the language processor favors syntactically simple structures, it is postulated to favor the simplest discourse structure. When a temporarily ambiguous coordination structure is disambiguated as Clausal coordination (i.e. the post-coordinator noun is revealed to be a subject), the additional work associated with revising the discourse representation from a default single Topic structure is proposed to impose processing difficulty on the processor.

Accordingly, Hoeks et al. hypothesized that marking the post-coordinator as topical in the preceding discourse would facilitate the processing of Clausal coordination. They used short story contexts (like the one in Table 5.1), in order to highlight the two subjects of the Clausal coordination target sentence as topical (bolded). This was done by referring to the two discourse entities using a pronoun to highlight their topicality. The biasing Two-topic context was compared to a neutral context that mentioned neither of the two subjects. Hoeks et al. conducted an eye-tracking during reading experiment, finding support for faster reading times for the target sentence in the biasing context, compared to the neutral context. Namely, when a preceding context sentence highlighted two entities as being topical, the two entities were easier to parse as subjects in a biclausal structure, compared to when presented following a neutral context. Additionally, following a two-Topic context, a disambiguation towards Clausal coordination did not incur a penalty compared to an

orthographically disambiguated baseline condition.

Lead-in sentence:
The new collection of evening dresses that was presented that night, really struck home in the fashion world of Paris

Neutral context:	*Biasing context:*
It was therefore not surprising that the party afterwards was exhilarating.	When **they** met the fashion designer at the party afterward, **the model and the photographer** were very enthusiastic.

Target sentence:
The model embraced the designer(,) and the photographer opened smilingly a bottle of champagne.

Exit sentence:
This surely was a memorable evening.

Table 5.1: Sample item from Hoeks et al. (2002), translated from Dutch

The findings from Hoeks et al. (2002) suggest that information-structural representations can be involved relatively early in the time course of language comprehension. Still, their results are compatible with multiple models of sentence processing. Namely, the reduction in reading times for Clausal coordination in the multiple topic context could arise from:

(i) the processor predicting a Clausal coordination structure and not computing the DP coordination structure at all,

(ii) the processor computing both structures but having more support for the Clausal coordination structure, allowing for the DP coordination structure to be downweighted, or

(iii) the processor initially computing the DP coordination structure regardless of context, but reanalyzing the parse as Clausal coordination more easily in the presence of contextual support for the latter structure.

Thus, we do not know if the syntactically simpler DP coordination structure is computed automatically and at which point the Clausal coordination structure is entertained. The extent to which information structure plays a predictive role (in the sense of pre-updating higher levels of linguistic representation as discussed in Kuperberg and Jaeger 2016) in making parsing decisions is still very much an open research question.

Since the researchers did not look at instances of DP coordination following a multiple Topic context, they can only provide weak evidence for the view that discourse simplicity guides parsing. Importantly, the study was not designed to test whether structural preferences are fully reversed when information structure supports the more syntactically complex parse, i.e. whether processing the syntactically simpler DP coordination in a multiple Topic context would in fact incur a processing penalty, as the second conjunct ("the photographer") would no longer be naturally interpreted as being topical, thus prompting an update to the discourse representation.

Additionally, some of the processing difficulty associated with the neutral context condition in Hoeks et al. may have arisen from the post-coordinator noun being completely new to the discourse. In my eye-tracking experiment (Experiment 4) I thus ensure that the contextual manipulation controls for the prior mention of the post-coordinator noun, allowing for the independent effect of topicality to be examined.

While Hoeks et al. do not explicitly mention contrast or CT structure in their study, their multiple Topic contexts are compatible with the two subjects being CTs, assuming an implicit QUD like "What did the model and the photographer do when they met the fashion designer?". As shown in Chapter 2, CTs can (but do not need to be) Topics. While Hoeks et al. mark the post-coordinator noun as a Topic by including it in the preceding discourse, I will signal CT structure to readers by using an explicit QUD manipulation and non-canonical V3 word order that marks the subject of the first clause as a CT.

5.3 Syntactically demarcated information structure

As discussed above, previous experimental findings point to contextual factors (including topic structure conveyed in preceding discourse) affecting parsing decisions during incremental sentence processing. None of these studies have been conducted in flexible word order languages that allow information-structural notions to be conveyed through syntactic means. The fact that Estonian has specialized syntactic constructions (as evidenced on the surface by V3+ word order in an otherwise V2 language) for demarcating CT structure adds to the growing literature on contextual effects on parsing in multiple ways. Firstly, the use of non-canonical word order requires certain discourse conditions to be met (see e.g. Weskott et al. 2011, which means that it acts as a cue to the intended information structure of the clause. This results in the information structure of a non-canonical clause being more tightly controlled than the information structure of a canonical clause, allowing for the intended information structure to be conveyed in a less ambiguous manner (but see Experiment 3 in Chapter 4). Secondly, the syntactic encoding of information structure raises interesting questions pertaining to how the language processing system uses syntactic and non-syntactic information in resolving structural ambiguities. Traditional two-stage models of sentence processing (e.g. Frazier 1987a proposed that during initial structure-building, the processor only has access to syntactic information, with the checking of the parse against non-syntactic information being delayed. Under this approach, we might expect to see particularly strong information-structural effects on parsing in constructions (or languages) where information structure is encoded using non-canonical word order. While the past couple of decades of work have shown that non-syntactic information can rapidly weigh in on parsing decisions, the question of whether the parser is more sensitive to certain kinds of information (such as syntactic information) than others still remains relevant.

In laying out the present hypotheses below, I focus on whether the search for a CT-alternative is active (i.e. predictive). This assumes that a constituent has already been marked as a CT, whether this has arisen as a result of syntactic marking or through other means (such as based on contextual support for a CT structure). As discussed in Section

3.6, pulling apart word order effects on contrast encoding and word order effects on contrast resolution can be difficult, and we will return to this issue in Chapter 6.

5.4 The present hypotheses

Looking at the processing of DP/Clausal coordination ambiguity offers a way to investigate whether the processor is actively searching for an alternative to a previously CT-marked element. If the previously CT-marked constituent is a subject and the processor is presented with a post-coordinator constituent that is ambiguous between being a subject and an object (giving rise to Clausal coordination and DP coordination, respectively), resolving the ambiguity towards a subject interpretation would allow for that disambiguated constituent to act as a CT alternative. This would violate Minimal Attachment, but allow for contrast resolution and the presupposition for the existence of an alternative to a CT-marked constituent would be met. Let us consider this mechanism in more detail below.

I set forward the following hypothesis (83), under which the resolution of contrast, once a CT structure is encoded, is predictive in nature, meaning that the processor actively anticipates a contrastive alternative to the previously CT-marked constituent. A moment-by-moment illustration of PCR will be shown below in Section 5.4.2.

(83) **Predictive Contrast Resolution (PCR):** When the first element in a set of CTs is marked as a CT, the processor rapidly identifies the first available candidate for a contrastive alternative during incremental sentence processing.

What it means for contrast resolution to be predictive is that the processor is sensitive to the presupposition that a CT-marked element is a member of a non-singleton set of contextually salient elements of the same type. For instance, a CT-marked DP may be contrasted with another DP, a CT-marked adverb may be contrasted with another adverb and so on. Since the syntactic and semantic properties of the CT-marked element are relevant for the evaluation of potential contrastive alternatives, it is actively maintained in memory (much like *wh*-words in filler-gap dependencies, as discussed in Chapter 3).

I assume a principle of structural parallelism, whereby elements that belong to a set of focus (or contrast) alternatives are preferentially expressed in the same structural positions (Carlson, 2001). In a structure where a matrix subject acts as a CT, such as the V3 clause (84) in Estonian, the language processor would initiate a search for another, typically Nominative subject (but see e.g. Hiietam 2004 for a discussion of the variability in case marking in the subject position in Estonian). When encountering the case-ambiguous post-coordinator noun "Kadri" in (84), and determining that it is compatible with being in a subject position and satisfies semantic and contextual requirements for contrast (i.e. is semantically parallel to "Marleen"), the post-coordinator noun is marked as a CT as well. I hypothesize that if there is partial activation for CT2 and an element compatible with being CT2 is encountered, it is assigned any additional properties required for it to function as a contrastive alternative to CT1. In particular, if CT1 is a Nominative subject and a case-ambiguous DP is marked as CT2, this DP would also preferentially be taken to be a Nominative subject as well. This in turn would have an effect on parsing. If the processor aims to satisfy the presupposition carried by V3 order as soon as possible, the likelihood of a case-ambiguous noun being marked for Nominative case and consequently computing Clausal coordination rather than DP coordination would be expected to increase following a V3 matrix clause, compared to a canonical V2 matrix clause.

(84) MarleenCT täna kutsus Jaani ja ...
Marleen.NOM today invited Jaan.ACC and
'Today MarleenCT invited Jaan and ...'

a. KadriCT kutsus Jussi.
Kadri.NOM invited Juss.ACC
'KadriCT invited Juss.' (CT alternative: Kadri)

b. Kadri külla.
Kadri.ACC to.visit
'Kadri to visit.' (# no CT alternative)

Here, I consider forward-looking contrast – if a CT-alternative to a marked constituent has already been encountered, the processor does not need to actively anticipate upcoming

contrast, as the presupposition for *at least one* contrastive alternative has already been met. Note that there isn't a grammatical reason for why a post-coordinator DP should act as a CT alternative to the previously encountered subject. As shown in (85), contrast may be resolved in the same sentence (85a) or later in the discourse (85b). Going against Minimal Attachment to construct a Clausal Coordination structure and resolve contrast early would thus be motivated by the processor's urgency to resolve information-structural dependencies, and in the case of Estonian, rapidly satisfy the presupposition governing the use of non-canonical V3+ word order.

(85) a. Mary_{CT} met Anna and Susan_{CT} met Bill.

b. Mary_{CT} met Anna and Susan. Harry_{CT} met Bill.

Following previous work on contextual effects on parsing (Section 5.2), PCR assumes a model of parsing that allows for non-syntactic information to influence parsing decisions at early stages of processing. Under this hypothesis, maintaining a CT-marked constituent in memory when the presupposition for the use of CT structure has not yet been met is more costly for the parser than computing a Clausal coordination parse.

Information-structural effects on parsing are less straight-forward to capture in serial, syntax-first models,[1] where semantic and pragmatic representations do not bear on initial structure building and syntactic ambiguity resolution. Under a serial model of parsing, syntactic considerations like structural simplicity (in this case, the preference for DP object coordination over Clausal coordination) would be expected to initially take precedence over resolving the semantic dependency between the CT and its contrast alternative(s). Measuring (and interpreting) time-course effects in syntactic processing is, of course, not always

[1] I use the terms "serial" and "syntax-first" interchangeably, as models that postulate that multiple parses can be constructed in parallel (e.g. Altmann and Steedman 1988) typically assume that non-syntactic factors such as plausibility are used to assign relative weight to different parses in real time. While theoretically possible, a processing mechanism that constructed multiple syntactic representations in parallel without access to non-syntactic information would need to construct all possible parses and thus result in being cognitively taxing and, as a consequence, psychologically implausible. It appears that a parallel model would need to minimally have access to some frequency information associated with different parses in order to optimize which parses are computed. Whether syntactic representations include frequency information is an open research question (see e.g. Bybee and Thompson 1997).

straightforward, which has been a long-standing issue in the field. For instance, traditional serial models of sentence processing (such as the Garden Path Model introduced by Frazier 1987a) allow for rapid reanalysis when the parser is confronted with information that conflicts with the previously computed analysis. This reanalysis may be rapid, making it difficult to distinguish based on behavioral measures whether a single analysis was initially computed and subsequently revised, or whether multiple competing analyses were activated at the same time (see Clifton and Ferreira 1989, for a discussion). Further, as briefly discussed at the end of Chapter 3, rapid contrast resolution in Estonian is also compatible with serial, syntax-first models when CT structure is conveyed through syntactic means. We will revisit this option in the light of the experimental findings presented in this chapter.

As discussed in Chapter 3, contrast resolution involves activating a contrastive alternative to a previously CT-marked constituent. In principle, CT-marking can be purely syntactic – the processor may construct a parse for a clause that contains a CTopP structure above FinP (see Chapter 2 for my analysis of the left periphery of Estonian), without necessarily updating the discourse representation. At the point of contrast resolution, the discourse representation must be accessed, as the comprehender draws the inference that the QUD is not fully resolved by the clause containing CT1. Thus, in addition to syntactic processing, semantic and pragmatic processing play a role in the online comprehension of CT structures as well. Note that the question of whether semantic and pragmatic processing is serial or parallel (i.e. whether literal meanings and inferences can be computed simultaneously) is independent of whether *syntactic* processing is serial or parallel.[2]

Below, I briefly discuss insights from work on the processing of scalar implicatures to how the processor may deal with contrast resolution during incremental processing. This allows us to consider how PCR fits with models of semantic and pragmatic processing, and what its conceptual alternatives are.

[2]Or to paraphrase, grammatical (syntactic and semantic) and pragmatic (discourse) processing may have different architectures.

5.4.1 The time course of resolving contrast

Previous work on the relative time course of processing semantic (entailed) and pragmatic (inferred) meaning has centered around the processing of scalar implicatures. Scalar implicatures are drawn when a proposition has a stronger alternative that the speaker could have uttered instead. For instance, in (86) the statement "Mary ate some of the candy" is compatible with a scenario where Mary ate all of the candy, but the choice of the weaker form *some* over its stronger scale-mate *all* typically leads comprehenders to draw the inference that Mary did not eat all of the candy.

(86) Mary ate some of the candy.

a. *Literal meaning:* Mary ate at least some and possibly all of the candy.

b. *Scalar implicature:* Mary ate some but not all of the candy.

The time course of implicature computation is an open question in the experimental pragmatics literature. There is some previous experimental evidence that drawing inferences is costly, compared to processing literal meaning. For instance, Bott and Noveck (2004) showed in a series of experiments that participants provide slower responses to evaluative statements that require them to draw a scalar implicature. Additionally, research in language acquisition indicates that children as old as nine do not draw scalar inferences as consistently as adults (Noveck, 2001). This has led to some researchers proposing that semantic computations precede pragmatic computations during language comprehension (e.g. Huang and Snedeker 2009). Others have found evidence that the computation of literal meaning does not need to precede the computation of scalar implicatures (e.g. Degen and Tanenhaus 2015). Let us consider how each of these two approaches fits with PCR (repeated in 87).

(87) **PCR:** When the first element in a set of CTs is marked as a CT, the processor rapidly identifies the first available candidate for a contrastive alternative during incremental sentence processing.

Under PCR, marking a constituent as CT1 is followed by the processor partially acti-

vating CT2 based on the properties of CT1 and on what is in the common ground (e.g. a previously established discourse topic). When an overt element compatible with being a CT2 is encountered, it is marked for contrast as well. This hypothesis is compatible with serial models of semantic processing, as a delay in the drawing of inferences (or fully activating a CT alternative) is compatible with a preference for CT alternatives being overt in the discourse – encountering an overt candidate for CT2 could facilitate processing when inferring that contrastive alternative (and the proposition that applies to it) is costly.

PCR could also be implemented under parallel accounts of semantic processing, given that the implicatures drawn in CT processing introduce uncertainty compared to an overt CT alternative (as discussed in Chapter 3). Under this view, inferences can be computed at the same time as other semantic relations are, but the uncertainty about the proposition applying to CT2 means that the final computation of the CT alternative is supported by CT2 and the proposition applying to it being overtly present.

A logical alternative to PCR is a view under which an overt contrastive alternative is not actively anticipated during sentence processing, but rather the contrastive relationship between two elements is accommodated once both have been unambiguously identified as CTs based on the discourse context and syntactic configuration they occur in. Let's call this the Integration hypothesis (88).

(88) **Contrast Integration:** CT1 and CT2 are marked independently, and they are evaluated for whether they stand in a contrastive relationship at a delay.

The Integration hypothesis does not necessarily commit us to a particular architecture for pragmatic processing. The simplest mechanism for contrast being integrated rather than predicted would be compatible with serial models of pragmatic processing where pragmatic processing is delayed relative to grammatical operations (as proposed by Huang and Snedeker 2009) – encountering CT1 simply does not initiate a search for CT2. Alternatively, a CT2 could be rapidly activated (along with any contrastive inferences, *á la* theoretical proposals by e.g. Oshima 2005), resulting in the conditions on the use of CT structure being satisfied,

with the processor not needing to anticipate an upcoming CT2. The latter view is compatible with parallel models of pragmatic processing, as inferences associated with the use of CT structure are rapidly accessed. In either case, we wouldn't expect to see the processor overriding its preference for syntactically simpler structures (Minimal Attachment) in favor of marking an ambiguous constituent as CT2. As my experiments do not directly probe the activation of contrastive inferences, I do not explore the nature of Integration further, but rather focus on the question of whether the search for a CT alternative is active (i.e. predictive) below, contrasting PCR with Contrast Integration, broadly construed.

Below, let us work through a step-by-step example for our hypotheses.

5.4.2 A step-by-step example

In (89), there is a contextually salient question that highlights "the dogs" as a Topic. At Point 1, a DP is encountered in a clause-initial position[3], which makes it a subject. Since the establised Topic "the dogs" is plural, and "Peppy" is singular, the processor recognizes a mismatch between the Topic of the question and the Topic of the clause and realizes that a partial answer to a salient discourse question is being provided (see Büring 2003). This prompts marking the initial subject as a CT, and predicting an upcoming CT alternative (which, based on the context, needs to fit the criterion of being a dog).

(89) Q: What did the dogs eat?

1. Peppy ate ... CT alternatives: {Peppy, x s.t. x is a dog}
2. Peppy ate cheese ... CT alternatives: {Peppy, x s.t. x is a dog}
3. Peppy ate cheese and Sammy ... CT alternatives: {Peppy, Sammy}
4. Peppy ate cheese and Sammy had popcorn. CT alternatives: {Peppy, Sammy}
5. Luna ate kibble. CT alternatives: {Peppy, Sammy, Luna}

At Point 2, the processor encounters another DP, "cheese". Under PCR, the processor

[3]And supposedly, the processor would have access either to parafoveal preview or prosodic information to discern that this DP is not a fragment answer to the question, i.e. "The dogs ate Peppy".

would evaluate it against a set of stuctural criteria in order to determine whether it belongs in the CT set. As CT alternatives occur in a set of propositions that function as partial answers to a QUD (Büring, 2003), they must be syntactically realized as occurring in different clauses. Although "eat" is optionally intransitive, an intransitive parse is incompatible with the input (factoring in punctuation), so the DP "cheese" is assigned to be the object of "eat". Additionally, the question "What did the dogs eat?" focuses the object of the verb (as the object corresponds to the *wh*-word in the question). It is infelicitous to elide a focused object in the answer (Tancredi, 1992). With no DP being grammatically compatible with being a contrastive alternative to "Peppy", the search for a CT alternative at this point continues.

At Point 3, another DP "Sammy" is encountered. Following the coordinator "and", "Sammy" is structurally compatible with occurring in a clause separate from CT1 "Peppy" and being a subject[4]. "Sammy" is also a proper name, making it parallel to "Peppy" (see e.g. Frazier et al. 2000; Carlson 2013, for a discussion of parallelism effects in coordinated structures). "Sammy" is marked as CT2.

At Point 4, as more lexical material is encountered, the processor confirms that CT1 and CT2 belong to parallel clauses that act as partial answers to the question presented in (89). While additional elements may function as CT alternatives to "Peppy" and "Sammy", the minimal condition of each of the CTs having at least one contextually salient alternative is met, so the processor does not anticipate further CT alternatives in the discourse. If another CT candidate was to be encountered (e.g. as shown at Point 5, particularly if there is world knowledge to suggest that "Luna" is a dog), it could be integrated as an additional CT alternative.

According to PCR, the processor prefers to resolve contrast as rapidly as possible, meaning that the prediction (x s.t. x is a dog in 89) is held in memory for the shortest time possible. As I pointed out in Section 3.5.1, this is analogous to the processor actively filling potential gaps in *wh*-constructions, before encountering confirming lexical input. Assuming a preference for structural parallelism between CT alternatives (e.g. both occurring at the

[4]In the absence of case-marking in English.

left edge of the clause; see Molnár and Winkler 2010, for a discussion of clause-edge contrast), this prediction would involve a syntactic component – contrastive alternatives are only licensed in certain structural positions, and require the presence of a clausal boundary between them. At the point of identifying CT2, the processor also needs to evaluate that a condition on contrastiveness is met, that is, the proposition p applying to CT1 is distinct from the proposition p' applying to CT2.[5]

Under the Integration hypothesis (when a CT alternative is not actively anticipated), parsing decisions at Point 3 in (89) would be motivated by other considerations, including syntactic preferences and plausibility. Therefore, a crucial aspect in deciding between the PRC and Integration hypotheses is determining whether the processor shows an independent bias towards DP coordination over Clausal coordination. While a DP coordination preference has been established for languages like English and Dutch (Frazier, 1987b; Staub and Clifton, 2006; Hoeks et al., 2006; Engelhardt and Ferreira, 2010), Minimal Attachment effects have previously not been studied in Estonian. I therefore conducted a sentence completion experiment with sentence fragments truncated at the post-coordinator DP, in order to establish whether Estonian shows a general preference for syntactically simpler DP coordination over Clausal coordination. This experiment is outlined below.

5.5 Exp 3: Sentence completion experiment

This experiment was carried out in order to establish which structure (DP coordination or Clausal coordination) is independently preferred by native speakers of Estonian. Estonian uses case marking in order to distinguish between subjects and objects (see Kaiser et al. 2020), but case ambiguities also arise, particularly for vowel-final nouns. A post-coordinator noun can thus be optionally disambiguated as being a subject or an object. This experiment also involved a preliminary word order manipulation, in order to mark the sentence-initial subject as a CT. If CT-structure is successfully conveyed to readers, we might expect to see

[5]But see e.g. Krifka (1998) for arguments that stressed additive particles in German associate with a CT, which means that p = p'.

the post-coordinator noun taken to be a CT-alternative to the initial subject, resulting in it being disambiguated as a subject of a second clause at higher rates than in the absence of CT-marking.

5.5.1 Participants

24 self-identified adult native speakers of Estonian remotely participated in the experiment on the Ibex Farm platform (Drummond, 2013). The median age of the participants was 28 years. 79% reported residing in Estonia at the time of the experiment.

5.5.2 Materials and Method

Each experimental trial consisted of two parts. First, participants were asked to provide a natural and grammatical continuation to sentence fragments truncated after the post-coordinator noun, as shown in Figure 5.1. After completing the sentence, they were asked to rate the difficulty of providing a completion on a 7-point scale (1 = Very easy, 7 = Very hard). The experiment started with four guided practice trials.

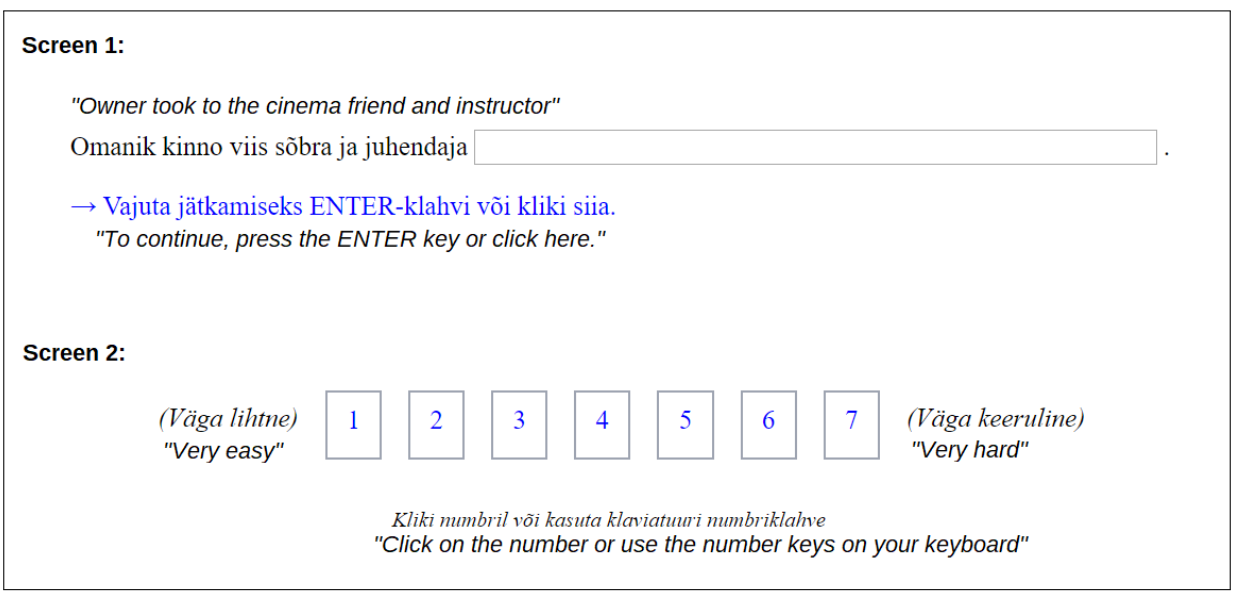


Figure 5.1: Experimental display to participants, with English translations (in quotation marks) added

A total of 30 experimental sextets were constructed. As illustrated by the sample item in Table 5.2, the experimental materials crossed the Case of the post-coordinator noun (PCN) and the Word order of the first clause. The post-coordinator nouns were matched for length (in number of letters) across the conditions. The pre-coordinator nouns were always unambiguously marked for Accusative case (but see issues with an inherent ambiguity between Accusative and Genitive case in Estonian below). Estonian also allows for Partitive objects (and some verbs take Accusative or Partitive objects depending on event semantics), but Partitive noun forms are much more limited in the extent to which they allow for case ambiguity. Thus, only verbs that always take Accusative objects were used.[6]

		Post-coordinator noun		
Initial fragment		Acc.	Ambiguous	Nom.
V2	Marleen kutsus täna Jaani ja Marleen.NOM invited today Jaan.ACC and	Inese Ines.ACC	Kadri Kadri.ACC/NOM	Piret Piret.NOM
V3	Marleen täna kutsus Jaani ja Marleen.NOM today invited Jaan.ACC and	Inese Ines.ACC	Kadri Kadri.ACC/NOM	Piret Piret.NOM

Table 5.2: Sample item for the completion experiment. A V2 or V3 initial fragment was followed by an Accusative, Ambiguous (Accusative/Nominative), or Nominative PCN

The case-disambiguated post-coordinator noun conditions were used in order to mark the post-coordinator noun as either a subject or an object, and thus bias the participants towards writing a completion yielding Clausal coordination or DP coordination, respectively. This way, participants were used to typing both DP and Clausal coordination completions, rather than using one of the two structures repeatedly throughout the experiment. In this manner, participants are less likely to show a bias towards one or the other structure (meaning that the results likely do not reflect the strength of any bias observed), however these conditions served to reduce potential task effects arising from the presentation format.

The unambiguous conditions also acted as a way to ensure that enough completions of

[6]The list of verbs that only take Accusative objects (rather than allowing for an Accusative-Partitive alternation based on aspectual distinctions) is limited, which is why the verbs in the experimental items repeat. See the Appendix for more details.

each type were collected in order to statistically compare difficulty ratings across conditions. This allows us to look at whether providing Clausal coordination completions is associated with an increased perception of difficulty compared to DP coordination completions.

The word order manipulation was used in order to collect preliminary data on whether syntactic cues marking the first-clause subject as a CT would bias participants towards providing Clausal coordination completions. This was achieved by manipulating the relative order of the verb and another element (such as an adverb, indirect object or preposition) to yield either canonical V2 clauses or non-canonical V3 clauses.

I also included a secondary manipulation of noun class. In a half of the items, all DPs were Estonian proper names. In the other half of the items, common nouns (e.g. professions) were used throughout. In the common noun items, post-coordinator nouns were matched on their lexical frequency, based on a list of 10,000 most common lemmas in written Estonian (Kaalep and Muischnek, 2002). The purpose of this manipulation was two-fold. Firstly, proper names, being definite, may be better candidates for topichood (Reinhart, 1981) than bare common nouns, which are ambiguous between being definite and being indefinite in Estonian. Thus, a between-item comparison could reveal whether definiteness independently influences coordination type preferences. Secondly, varying noun types across items introduces some variability to the experiment, which is helpful for distracting participants from the case manipulation.

The 30 experimental items were presented along with 36 filler items from unrelated experiments and 10 catch items, in a random order following a Latin Square design.

5.5.3 Results and discussion

All participants provided predicted continuations to idiomatic catch items, and grammatical and sensical continuations to grammatically complex catch items. The details of the analysis and results are provided below.

5.5.3.1 Completions

Participants' responses were coded using the coding scheme laid out in Table 5.3.

Label	Definition	Decision criteria / Options
dp	DP coordination	• The completion consists of an adverb or a locative • A period or a comma after the post-coordinator noun • The post-coordinator noun (or both nouns) possess(es) the DP provided in the completion
cpv	CP coordination with an overt verb in the second conjunct	• The post-coordinator noun is the subject of the verb in the second conjunct
cpe	CP coordination with verbal ellipsis in the second conjunct	• Gapping ellipsis in the second clause • The completion consists of an additive particle
amb	Ambiguous between DP coordination and CP coordination with ellipsis	• Ambiguous between a possessive structure (e.g. "Mary and Ann's mother") and a gapping structure (e.g. "and Ann <e> (her) mother")
?	Ungrammatical or uncodable completion	• The completion consists of a question mark • The participant ignores the case of the post-coordinator noun

Table 5.3: Coding labels for the sentence completion experiment

A couple of complications arose during coding. Firstly, instances where the participant added an Accusative ending to a Nominative post-coordinator noun were accepted as grammatical, as the experimental instructions did not explicitly prohibit this. Three such completions occurred in the data (each from a different participant). Secondly, an inherent ambiguity between the Accusative and Genitive cases led to there being a portion of continuations ambiguous between DP coordination (where the post-coordinator noun was a possessor of the noun provided in the completion) and Clausal coordination (gapping ellipsis

where the post-coordinator DP was a subject and the DP provided in the continuation was an object) when the post-coordinator noun was case-ambiguous. Where possible, I used plausibility to classify these continuations as either "dp" or "cpe" (erring on the side of caution, so a considerable number of "amb" tokens remain).

Below, I show examples of completions provided by participants. In (90–92), the sentence fragments participants saw are highlighted in boldface, followed by their completions. A clear example of a DP coordination completion is shown in (90). Note that the prompt has an ambiguous post-coordinator noun, and that the case information in the gloss is added as the only grammatically permissible option based on the completion.

(90) **Grupijuht kaasas projekti direktori ja laulja**, kellest
group.leader.NOM involved project.ILL director.ACC and singer.ACC who.ELA
kumbki polnud varem selles asutuses töötanud.
neither NEG.was earlier this.INE institution.INE work.PC
'The group leader involved the director and singer in the project, neither of whom had previously worked at this institution.'

A Clausal coordination completion with an overt verb (cpv) to the same item is seen in (91) below. Again, the case information on the post-coordinator noun is added based on the completion.

(91) **Grupijuht projekti kaasas direktori ja laulja** jäi
group.leader.NOM project.ILL involved director.ACC and singer.NOM stayed
sellest kõrvale.
this.ELA aside.ALL
'The group leader involved the director in the project, and the singer was left out of it.'

A Clausal coordination completion involving gapping ellipsis (i.e. the deletion of the verb from the second clause) is shown in (92). Examples like this are highly compatible with a CT interpretation for the two subjects – the second clause is parallel to the first clause with the exception of the post-coordinator noun and an overt object or focus particle.

(92) **Grupijuht projekti kaasas direktori ja laulja** omakorda koorijuhi.
group.leader.NOM project.ILL involved director.ACC and singer.NOM in.turn choir.leader.ACC

'The group leader involved the director in the project, and the singer, in turn, the choir leader.'

By-condition percentages of each of the continuation types listed in Table 5.3 are shown in Table 5.4. Upon initial inspection, we see higher rates of DP coordination completions compared to Clausal coordination completions in the Ambiguous PCN conditions, with no apparent influence of the word order manipulation.

Condition (Case, Matrix WO)	**dp**	**cpv**	**cpe**	**amb**	**?**
Accusative PCN, Matrix V2	87%	8%	5%	0%	1%
Accusative PCN, Matrix V3	78%	15%	5%	1%	2%
Ambiguous PCN, Matrix V2	50%	27%	8%	16%	0%
Ambiguous PCN, Matrix V3	52%	29%	10%	8%	1%
Nominative PCN, Matrix V2	2%	76%	17%	4%	1%
Nominative PCN, Matrix V3	1%	72%	18%	4%	5%

Table 5.4: Coded completion breakdown by experimental condition (in %), rounded to the nearest natural number; PCN = post-coordinator noun

For the purposes of the statistical analysis, "cpv" and "cpe" continuations were grouped together as Clausal coordination completions. Both "amb" and "?" completions were excluded from the analysis, as participants were presumed to be cooperative and to not be purposefully or strategically providing ambiguous or ungrammatical completions. This resulted in the exclusion of 6.9% of the data from the analysis.

The by-condition counts of DP and Clausal coordination responses following exclusions can be seen in Figure 5.2. The categorical data were analyzed in a generalized linear mixed effects regression model (glmer) in the *lme4* package (Bates et al., 2015) in R (R Core Development Team, 2019), using Case and WO as fixed effects, and random intercepts for participants and items (in order to allow for by-participant and by-item variation in DP coordination bias). Deviation coding was used for the Case factor, meaning that each

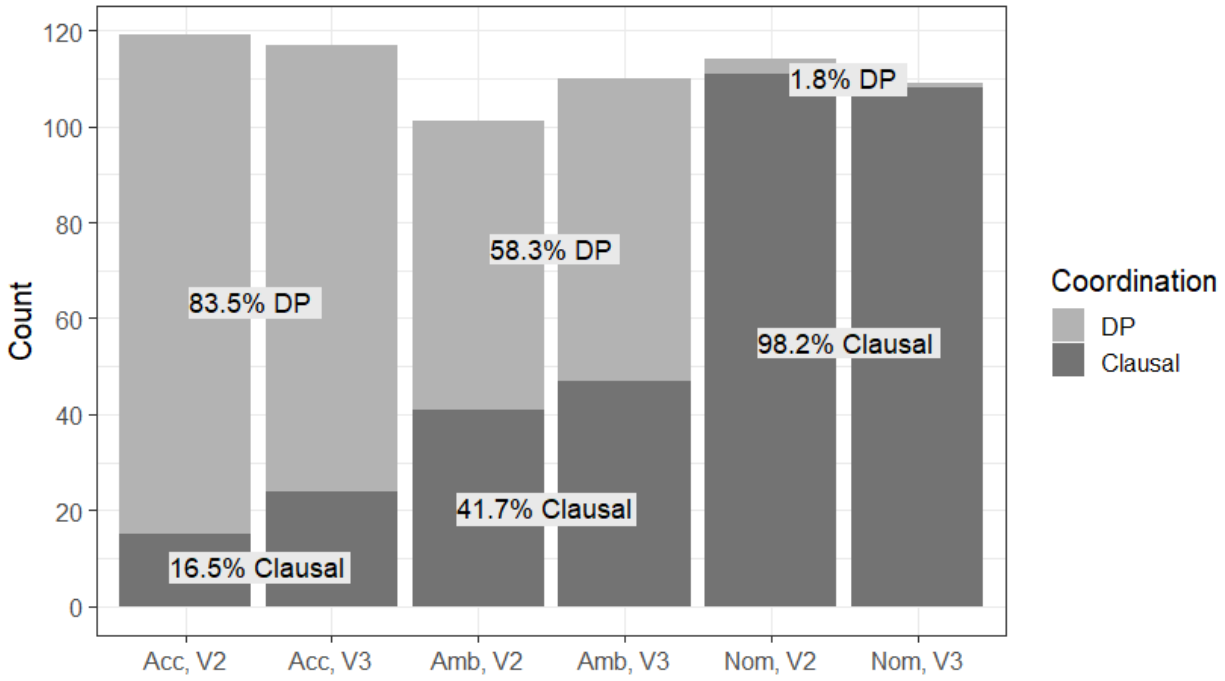


Figure 5.2: Proportions of DP and Clausal coordination completions, following exclusions

condition was compared to the grand mean of all Case conditions. For the WO factor, the canonical V2 acted as a baseline. The model output is shown in Table 5.5.

Only the case of the post-coordinator noun influenced the probability of DP coordination vs Clausal coordination completions. Both the Accusative post-coordinator noun conditions (with a DP coordination bias) and the Nominative post-coordinator noun conditions (with a Clausal coordination bias) deviated from the overall average as expected. Importantly, the Ambiguous post-coordinator noun conditions also significantly differed from the grand mean, showing a DP coordination bias.

There was no effect of word order on the type of completions provided. This was taken to indicate that the word order manipulation on its own (without a supporting discourse context) may not have been sufficient for readers to assign the intended information structure to the matrix subject. Accordingly, there was also no significant interaction between Case and word order.

This component of the analysis established a DP coordination completion bias for tem-

	Estimate	SE	z value	Pr(>|z|)
(Intercept)	-0.427	0.283	-1.511	0.131
Accusative case	2.602	0.300	8.680	<.001
Ambiguous case	0.886	0.268	3.307	0.001
V3 WO	-0.626	0.428	-1.463	0.143
Accusative case x V3 WO	-0.015	0.478	-0.031	0.975
Ambiguous case x V3 WO	0.508	0.462	1.100	0.271

Table 5.5: Output of binomial *glmer* model for coordination completion type. Effects at p <0.05 considered statistically significant.

porarily ambiguous coordination in Estonian, in the absence of discourse context. I additionally looked at the effect of the secondary manipulation of noun type (proper nouns vs common nouns) in the experimental items. A summary of the proportion of Clausal coordination completions in each condition (following the exclusion of ambiguous and uncodable completions) is given in Table 5.6. There is no indication that the use of proper names would have increased the proportion of Clausal coordination completions compared to common nouns.

Condition	**Common Nouns**	**Proper Names**
Accusative PCN, Matrix V2	11.7%	13.6%
Accusative PCN, Matrix V3	28.3%	12.3%
Ambiguous PCN, Matrix V2	40.0%	41.3%
Ambiguous PCN, Matrix V3	51.8%	33.3%
Nominative PCN, Matrix V2	100.0%	94.7%
Nominative PCN, Matrix V3	100.0%	98.1%

Table 5.6: Proportion of Clausal coordination completions by condition and noun type

Next, I analyzed difficulty ratings in the experiment, in order to determine whether Clausal coordination completions are dispreferred by Estonian speakers, and whether overt CT-marking ameliorates a potential cost associated with constructing a Clausal coordination structure.

5.5.3.2 Difficulty ratings

For difficulty ratings (which participants provided on a 7-point Likert scale), three categories of completions were considered – DP coordination ("dp"), Clausal coordination ("cpv" and "cpe") and Other ("amb" and "?").

As seen in Table 5.7, the type of continuation that the participant provided (DP, Clausal, Other) did not influence difficulty ratings overall, as DP coordination ($M = 3.10$, $SE = 0.05$), Clausal coordination ($M = 3.12$, $SE = 0.04$) and Other completions ($M = 3.06$, $SE = 0.11$) were almost identical in their difficulty judgments. We do see a consistent pattern[7] emerging as V3 clauses ($M = 3.39$, $SE = 0.09$) are judged to be more difficult to complete than V2 clauses ($M = 2.83$, $SE = 0.08$), potentially due to an added difficulty with accommodating the information structure conveyed by the non-canonical word order.

Condition	**DP**	**Clausal**	**Other**	**Condition overall**
Accusative, V2	2.93 (0.08)	3.03 (0.19)	1.50 (0.50)	2.93 (0.07)
Accusative, V3	3.31 (0.10)	3.69 (0.20)	4.08 (0.47)	3.41 (0.09)
Ambiguous, V2	2.75 (0.10)	2.89 (0.13)	2.54 (0.14)	2.77 (0.07)
Ambiguous, V3	3.37 (0.11)	3.78 (0.13)	3.60 (0.29)	3.55 (0.08)
Nominative, V2	3.50 (0.48)	2.74 (0.07)	3.08 (0.33)	2.77 (0.06)
Nominative, V3	3.00 (0.58)	3.21 (0.07)	3.34 (0.26)	3.22 (0.07)
Completion type overall	**3.10 (0.05)**	**3.12 (0.04)**	**3.06 (0.11)**	**Grand mean 3.11 (0.03)**

Table 5.7: Mean difficulty ratings (with standard errors in parentheses), depending on the continuation provided. 1 = "Very easy", 7 = "Very hard".

The data presented in 5.7 were subjected to *lmer* models crossing post-coordinator noun case, matrix word order and completion type, again excluding "Other" completions in order to make the results easier to interpret. Deviation coding was used for the post-coordinator noun Case manipulation. For WO, the canonical V2 was used as a baseline. For Completion type, DP coordination acted at the baseline. The full details of the model output are shown in Table 5.8.

[7]Note that SE is larger for subsets of data with fewer observations

	Estimate	SE	df	t value	Pr(>|t|)
(Intercept)	2.892	0.128	100.38	22.671	<.001
Accusative case	0.228	0.148	2658.68	1.539	0.124
Ambiguous case	-0.066	0.111	2657.89	-0.597	0.551
V3 WO	0.592	0.112	2660.25	5.292	<.001
Clausal	0.262	0.184	2653.14	1.425	0.154
Accusative case x V3 WO	-0.137	0.191	2662.78	-0.719	0.472
Ambiguous case x V3 WO	0.262	0.148	2650.25	1.770	0.077
Accusative case x Clausal	-0.470	0.226	2662.03	-2.081	<.05
Ambiguous case x Clausal	-0.330	0.204	2654.15	-1.616	0.106
V3 WO x Clausal	-0.398	0.336	2655.40	-1.184	0.236
Accusative case x V3 WO x Clausal	0.383	0.378	2660.55	1.014	0.311
Ambiguous case x V3 WO x Clausal	0.255	0.359	2655.48	0.709	0.478

Table 5.8: Output of *lmer* model for completion difficulty ratings. Effects at p <0.05 considered statistically significant.

As seen in Table 5.8, the statistical model confirms that there is a significant main effect of WO, as V3 order is associated with an increase in difficulty ratings (p<.001). No other main effects are statistically significant. We also see a significant interaction between PCN Case and Completion type, but for the Accusative condition which was not expected and may be a spurious effect.

I additionally looked at whether the manipulation of noun type (proper noun, common noun) in the items influenced difficulty ratings. An *lmer* model crossing completion type with noun type as main effects (with random intercepts for participants and items) revealed a main effect of noun type (p<.05) but no other significant effects. Namely, items including common nouns (M = 3.44, SE = 0.04) were judged to be more difficult to complete than items involving proper names (M = 2.77, SE = 0.04). This is likely due to common nouns contributing lexical content that makes establishing discourse coherence more effortful. There is no evidence, at least in this offline task, that noun type (and by assumption, definiteness) influenced the ease of resolving coordination ambiguity.

To summarize, the sentence completion experiment shows evidence for a preference for DP coordination over Clausal coordination in Estonian. The word order manipulation did not have a significant effect on coordination biases. This could be due to the experimental

materials having being presented in the absence of supporting context (Weskott et al., 2011; Kristensen et al., 2014), making it difficult for readers to compute the intended information structure for V3 clauses. This explanation for the lack of a word order effect on completions was supported by participants rating non-canonical clauses as more difficult to complete than canonical clauses. Let us now turn to the reading experiment.

5.6 Exp 4: Eye-tracking during reading

The aims of the present study are multifold. Firstly, I address open questions about the relative contribution of syntactic simplicity and discourse representations using an extended experimental design including both Clausal coordination and DP coordination, expanding on the design of Hoeks et al. (2002). This allows us to test whether information-structural relations influence parsing decisions, testing the Predictive Contrast Resolution hypothesis.

Secondly, as discussed at the end of Chapter 3, a flexible word order language like Estonian, where information structure can be optionally syntactically encoded, poses its own set of additional research questions. If the parser initially prioritizes syntactic information over contextual information during comprehension (as proposed by serial, syntax-first models), we might see processing asymmetries between syntactically encoded and purely contextually conveyed information structure manipulations. Temporarily ambiguous coordination may be resolved towards Clausal coordination faster if a multiple Topic structure (i.e. a CT structure for the present purposes) is conveyed through a word order manipulation, and the parser prioritizes this information as syntactic.

Further, the experiment also aims to replicate the observation in Chapter 4 that contrast is computed rapidly in incremental processing.

5.6.1 Participants

46 native Estonian speakers from the University of Tartu, Estonia and the surrounding community were recruited using flyers, social media and student mailing lists. All had

normal or corrected-to-normal vision. Participants were compensated with 5 Euros for the 40-minute experiment. The final analysis included a counterbalanced set of 42 participants. Three participants' data were excluded from the analysis for a high number of track losses due to blinking on the critical region. One participant's data were excluded due to below 80% accuracy on experimental comprehension questions.

5.6.2 Materials and Method

I conducted an eye-tracking during reading experiment with 30 experimental sextets following the pattern shown in Table 5.9. The items were based on the case-ambiguous condition of the sentence completion experiment, with a few modifications in items that appeared to be strongly semantically biasing towards one coordination type.[8] The items retained the secondary manipulation of noun type (proper names vs common nouns). A half of the items were followed by a forced choice comprehension question, which inquired about parts of the sentence not targeted by the experimental manipulation. A full list of materials is available in the Appendix. The 30 items were presented in a Latin square design along with 60 fillers (including 20 distractor items and 40 items from two unrelated experiments). The order of presentation was randomized for each participant.

As shown in Table 5.9, each trial consisted of an overt discourse question followed by a target sentence involving either DP coordination or Clausal coordination. The question and the target sentence appeared on the screen at the same time. The question highlighted either just the initial DP or both the initial DP and the post-coordinator noun as topical, while controlling for prior mention of the DPs (*cf.* Hoeks et al., 2002) by presenting the post-coordinator noun in a possessive construction in the Single Topic conditions. The Clausal coordination conditions all involved gapping ellipsis, as the only possible parse of the input involved an elided verb identical to the one in the first clause. Ellipsis constructions were chosen as they are unequivocally more complex than the object coordination constructions used,

[8] I aimed to reduce the effect of implicit heteronormative bias in instances involving gendered proper names and verbs expressing affection

Single Topic, Canonical

Question: Mida Kadri õde Marleen täna tegi?
'What did Kadri's sister Marleen do today?'

	Matrix Clause			PCN		Pre-disamb.	Disamb.
DP coor:	Marleen	kutsus	täna	Jaani	ja	Kadri	kellegi	peole
	Marleen.NOM	invited	today	Jaan.ACC	and	Kadri.ACC	someone.GEN	party.ALL

'Today Marleen invited [Jaan and Kadri] to someone's party'

CP coor:	Marleen	kutsus	täna	Jaani	ja	Kadri	kellegi	teise
	Marleen.NOM	invited	today	Jaan.ACC	and	Kadri.NOM	someone.ACC	else.ACC

'Today [Marleen invited Jaan] and [Kadri <~~invited~~> someone else]'

Two Topics, Canonical

Question: Mida Marleen ja Kadri täna tegid?
'What did Marleen and Kadri do today?'

	Matrix Clause			PCN		Pre-disamb.	Disamb.
DP coor:	Marleen	kutsus	täna	Jaani	ja	Kadri	kellegi	peole
	Marleen.NOM	invited	today	Jaan.ACC	and	Kadri.ACC	someone.GEN	party.ALL

'Today Marleen invited [Jaan and Kadri] to someone's party'

CP coor:	Marleen	kutsus	täna	Jaani	ja	Kadri	kellegi	teise
	Marleen.NOM	invited	today	Jaan.ACC	and	Kadri.NOM	someone.ACC	else.ACC

'Today [Marleen invited Jaan] and [Kadri <~~invited~~> someone else]'

Two Topics, CT-marked

Question: Mida Marleen ja Kadri täna tegid?
'What did Marleen and Kadri do today?'

	Matrix Clause				PCN		Pre-disamb.	Disamb.
DP coor:	Marleen	**täna**	kutsus	Jaani	ja	Kadri	kellegi	peole
	Marleen.NOM	today	invited	Jaan.ACC	and	Kadri.ACC	someone.GEN	party.ALL

'Today Marleen invited [Jaan and Kadri] to someone's party'

CP coor:	Marleen	**täna**	kutsus	Jaani	ja	Kadri	kellegi	teise
	Marleen.NOM	today	invited	Jaan.ACC	and	Kadri.NOM	someone.ACC	else.ACC

'Today [Marleen invited Jaan] and [Kadri <~~invited~~> someone else]'

	Spillover			Wrap-up	
For all:	ja	kõigil	oli	väga	lõbus.
	and	everyone.ADE	was	very	fun

'and everybody had lots of fun.'

Table 5.9: Sample item from the eye-tracking experiment. The second-position adverb in the CT-marked conditions is shown in bold. Analysis regions are labelled in small capitals.

while allowing to keep the length of the sentences constant across the manipulation. The single-word disambiguation regions were matched for length (in number of letters) between conditions in order to reduce the effect of lower-level reading processes on the data.

In each of the three context conditions (Single Topic Canonical, Two Topics Canonical, Two Topics CT-marked), the target sentences were string-identical until the disambiguation region. This was achieved through using temporarily case-ambiguous constructions (note the differences in glossing in the ambiguous regions of DP and Clausal coordination conditions). For instance, in Table 5.9 the sequence *Kadri kellegi* could be interpreted as the proper name *Kadri* being Accusative, making it an object, and the quantifier *kellegi* being Genitive, thus modifying the following locative noun. Alternatively, *Kadri* may be taken to be Nominative, making it a subject. In this case, there is no available parse where the following quantifier could be Genitive. It can, however be an Accusative object in gapping ellipsis. A full example of the Single Topic, Canonical condition with DP coordination is shown in (93) to illustrate what participants read in a typical trial.

(93) Mida Kadri õde Marleen täna tegi? Marleen kutsus
what.PART Kadri.GEN sister.NOM Marleen.NOM today did Marleen.NOM invited
täna Jaani ja Kadri kellegi peole ja kõigil oli
today Jaan.ACC and Kadri.ACC someone.GEN party.ALL and everyone.ADE was
väga lõbus.
very fun
'What did Kadri's sister Marleen do today? Today Marleen invited Jaan and Kadri to someone's party and everybody had lots of fun.'

I hypothesized that case ambiguities would be resolved by participants based on their coordination preferences, which would then be either confirmed or conflicted by the disambiguating material. Admittedly, case ambiguity resolution may also be governed by independent preferences or accessibility of Nominative and Accusative forms (see Kaiser et al. 2020, for recent work on the representation of case in Estonian). Since the case paradigms for Estonian often involve non-phonologically conditioned root alternations, it has been argued that rather than the Nominative acting as a base on which other cases are built, speakers

memorize collections of forms from the paradigm (Blevins, 2006), meaning that the Nominative is not necessarily a default during language comprehension. Even if Nominative forms are more accessible than Accusative forms for independent reasons, in the present materials an argument could be made for Accusative case being primed for the post-coordinator nouns due to the pre-coordinator nouns always being unambiguously Accusative.

The experimental procedure was identical to Experiment 1 (see Chapter 4).

5.6.3 Results and discussion

Following a brief background on eye-tracking measures, the presentation of results is organized to address three themes. Firstly, I will present data pertaining to the effect of the context question (Single Topic or Two Topic contexts) on the the processing of the temporary coordination ambiguity. Secondly, I will explore the effect of the word order manipulation, focusing on differences between V2 and V3 Two Topic conditions. Finally, I will report asymmetries between common noun and proper name items, discussing the possible role of definiteness in coordination ambiguity resolution.

The eyetracking measures reported below (Rayner, 1998) are similar to those used in Experiment 1 in Chapter 4, with an additional distinction made between first pass data from trials with and without regression out of the particular region (Altmann et al., 1992), where specified. First pass times with regressions are comprised of the sum of all first pass fixations on the particular region for trials where the reader has regressed to a previous region before progressing past the region and first pass times without regressions are comprised of the sum of all first pass fixations on the region for trials where the reader did not regress out of that region on first pass. Distinguishing between these two measures can be useful when there is a high proportion of regressive eye movements in first pass reading.

In order to reduce the effect of outliers (data points with extreme values) on the statistical analysis, first pass times were windsorized by condition for each region, replacing 10% of the data at either end of the distribution with the cut-off value. Total time data were trimmed manually, removing no more than 1% of the data per region. Statistical analyses were con-

ducted in R (R Core Development Team, 2019), using the *lme4* package (Bates et al., 2015), with the *emmeans* package (Lenth, 2019) used for pairwise analyses. First pass times and total times were analyzed using linear mixed effects regression (*lmer*) models crossing Context and Coordination type as fixed effects, with random intercepts for participants and items. Regression data were analyzed using binomial generalized mixed effects regression (*glmer*) models crossing Context and Coordination type as fixed effects, with random intercepts for participants and items. Coding details varied by analysis and are reported in the sections below.

5.6.3.1 Effects of the discourse context

As discussed in the Background section, observing contextual effects in eye-tracking experiments on coordination ambiguity resolution is not novel – Hoeks et al. (2002) observed a decrease in the processing difficulty associated with Clausal coordination when presented in a context marking the two subjects of the coordinated clauses as topics. The present experiment builds on this work by implementing the following differences to the experimental design. Firstly, I added DP coordination disambiguations to the design in order to assess whether a context biasing the reader towards Clausal coordination would in fact penalize the syntactically simpler DP coordination. Secondly, to address a potential confound, the contexts were set up so that the post-coordinator noun was discourse-old both in the Single Topic conditions and in the Two Topic conditions. For the following analyses, *lmer*/*glmer* models were used as appropriate. For the Context factor, the Single Topic condition acted as a baseline. For the Coordination factor, the DP condition acted as a baseline. Only data from the target sentence were analyzed.

There are some effects of the contextual manipulation that appear before ambiguity resolution. On the Matrix region (*Marleen invited today Jaan*), there was a significant effect of Context (p <.05), as there were fewer regressions out of the V2, Two Topic conditions (M = 16%, SE = 2), compared to the V2, Single Topic conditions (M = 11%, SE = 2). This could be due to the Single Topic context question being more difficult to process due

to the there being a relational term (e.g. "sister") present, prompting more looks back to the context question region. A penalty for the Single Topic context compared to the Two Topic context is also seen in first pass times on the PCN and Pre-disambiguation regions (ps $<.001$). On the PCN, there was a 39 ms penalty for the Single Topic V2 conditions compared to the Two Topic V2 conditions. On the Pre-disambiguation region, a 64 ms penalty in the same direction is seen. This first pass time effect could in part be due to the the PCN being more accessible in the Two Topic context (having previously been encountered as a subject), compared to the Single Topic context, where the PCN was previously encountered in a less salient, possessive position.

When the scope of coordination is disambiguated, we see evidence for context having a strong effect on the reading profile. As predicted by our hypotheses (and in line with previous experimental work), we see a Clausal coordination penalty in the Single Topic context in several measures (e.g. first-pass times), but due to asymmetries between the two Two Topic conditions, the details of those analyses will be discussed in later sections.

Regressions out of the Disambiguation region show an interaction between Context and Coordination ($p <.01$), as shown in Figure 5.3. Pairwise t-tests with the criterion for significance adjusted for three comparisons show no Coordination effect for the V2, Single Topic conditions in the proportion of regressions out (diff = 0.02, $p = 1$) but a Clausal coordination advantage is seen for both the V2, Two Topic condition (diff = 0.23, $p <.01$) and for the V3, Two Topic condition (diff = 0.1, $p <.05$).

On the following Spillover region, there are again significant interactions between Context and Coordination type in the probability of regressions, as both Two Topic conditions show a Clausal coordination advantage compared to the Single Topic condition (ps $<.001$). Thus, there is evidence for the language processor being immediately sensitive to mismatches between discourse context and coordination type.

These findings suggest that the Two Topic contexts were both easy for readers to comprehend (compared to the more complex Single Topic contexts where the PCN was mentioned as a possessor) and guided eye movements in coordination ambiguity resolution. Being

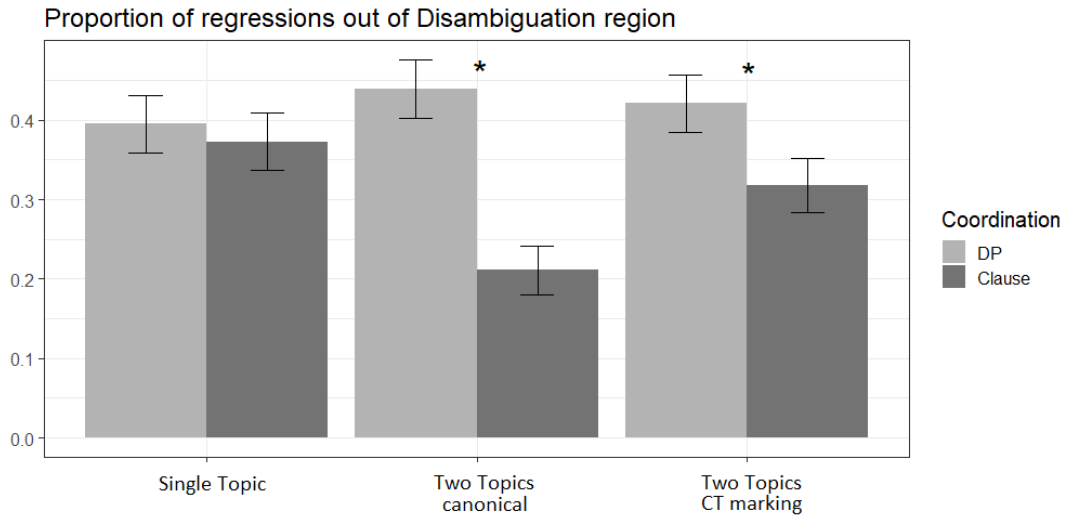


Figure 5.3: Proportion of regressions out of the Disambiguation region

presented with a DP coordination disambiguation, which marked the PCN as an Object, incurred a penalty in the probability of regressive eye movements if the PCN had previously been highlighted as a Topic.

5.6.3.2 Effects of syntactic CT-marking

In the following, I discuss three basic findings pertaining to the effect of non-canonical, CT-marking word order in online processing. Firstly, I discuss evidence that readers did in fact compute the discourse conditions licensing the use of V3 word order. Secondly, there is evidence for non-canonical word order being associated with differences to the reading profile, which bears on the interpretation of other effects. Thirdly, there is some limited evidence that non-canonical word order aids the processing of Clausal coordination. Here, the context conditions were coded with the V2, Two Topic condition as a baseline, in order to directly assess any differences between the V2 and V3 Two Topic context conditions. For the Coordination factor, DP coordination remained the baseline level for statistical comparisons.

I proposed that the use of the CT-marked V3 word order imposes strict conditions on the discourse context in which the utterance occurs. One of the preverbal constituents must be contrastive, that is, have a contrast alternative in the discourse. If V3 word order is

interpreted accurately by the reader, we would expect to see increased processing difficulty compared to the context-matched V2 condition when the PCN is disambiguated as an object and can thus not naturally contrast with the CT marked subject. Therefore, observing a DP coordination penalty for the V3 condition but not for the corresponding Two Topic V2 condition would support the claim that the word order manipulation was effective in conveying the intended discourse structure. Such an effect is seen in total times on the sentence-final Wrap-up region (Figure 5.4).

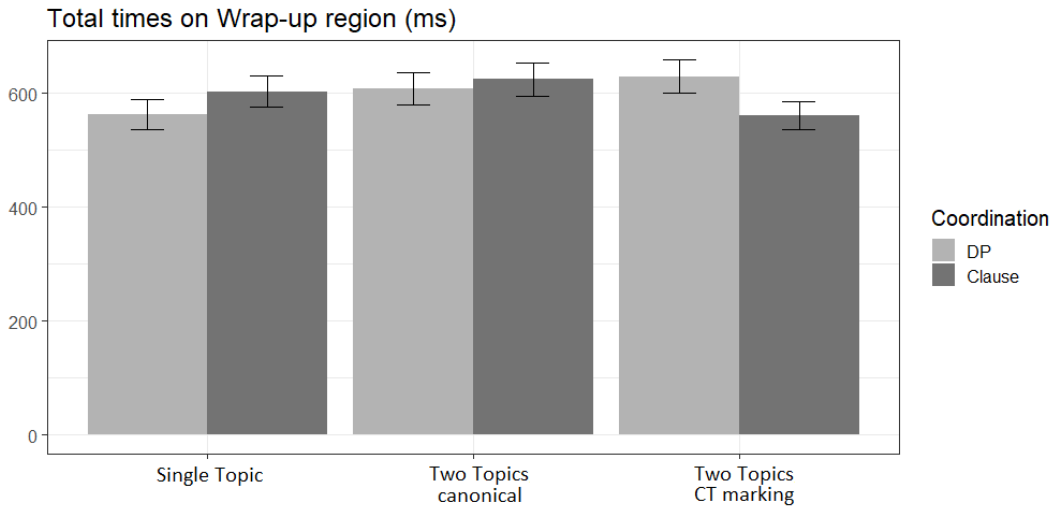


Figure 5.4: Total times on Wrap-up region

Here, there is an interaction between Context and Coordination type (p <.05) for the CT-marked Two Topic conditions, suggesting that these conditions are behaving differently compared to the canonical Two-Topic conditions on this region. Although the pairwise comparison between the two coordination conditions in the CT-marked Two Topic context does not reach statistical significance after adjusting for multiple comparisons, we see a numerical penalty for DP coordination over Clausal coordination (diff = 69 ms), which is not seen in canonical Two Topic conditions (diff = -16 ms) or in Single Topic conditions (diff = -41 ms). With no DP coordination penalty observed in total times on this region in the minimally different Two Topic V2 conditions, this interaction pointing towards a sustained

DP coordination penalty must be due to syntactic CT marking.[9] Having established that the V3 manipulation was effective in conveying CT structure, let us examine the time course of processing CT-marked clauses.

Despite the Two Topic context supporting a CT interpretation of the clause-initial subject, we see an early penalty for the use of non-canonical CT-marked word order following the Two Topic context sentence. First pass times times on the Matrix region showed a significant word order effect (p <.001), with longer reading times for the V3 conditions (M = 1288 ms, SE = 25) than the context-matched V2 conditions (M = 981 ms, SE = 15). Thus, readers were immediately sensitive to the word order being non-canonical, although the underpinnings of this slowdown are not immediately clear. Slower reading of the V3 clause could indicate a simple frequency effect – V3 clauses are encountered less frequently in the language than V2 clauses, making their parsing more effortful. Alternatively, the additional 307 ms spent on V3 clauses here could arise from the computation of the discourse conditions associated with the use of V3 order, and possibly predicting an upcoming contrast between the initial subject and another salient entity in the discourse (see Kaiser and Trueswell, 2004). Under the latter view, V2 clauses are read faster than V3 clauses because the processing of information-structurally ambiguous V2 clauses is more shallow than the processing of V3 clauses. It is therefore of interest whether the increased time spent on possibly computing discourse relations while reading the matrix clause translates to an additional advantage in the processing of Clausal coordination further downstream.

If non-canonical V3 order aids in the processing of contrast (and subsequently, Clausal coordination), we might expect to see a a three-step pattern in coordination preferences, depending on whether the Clausal coordination interpretation is supported by the context,

[9]Clause-final "wrap-up" effects have been argued to index difficulties with discourse integration (Hirotani et al., 2006), explaining the location and relative lateness of this asymmetry. As the effect on CT-marked conditions on the final region potentially indexes readers' realization of a presupposition failure, it was of interest whether reading times on the final region were influenced by familiarity with the experimental manipulation. I thus added presentation order as a main effect in the statistical model. Item order was found to influence total times on the final region (p <.001), with shorter reading times on this region as the experiment progressed, but the interaction between Context and Coordination type remained statistically significant (p <.05) and there was no three-way interaction between Trial order, Context and Coordination type. This suggests that the observed effect was robust and not due to strategic reading.

both by the context and by syntactic marking, or not at all. We would predict that Single Topic conditions strongly favor DP coordination over Clausal coordination, that Two Topic conditions with canonical V2 order show a reduction in the DP coordination penalty, and that Two Topic conditions with syntactic CT marking show the strongest preference for Clausal coordination over DP coordination. Such a pattern, at least numerically, is in fact observed in first pass times on the Disambiguation region, as shown in Figure 5.5. With the Single Topic conditions as a statistical baseline, we see an interaction between Context and Coordination type for the V3 conditions (p <.01) but not the context-matched canonical conditions (p = 0.396), suggesting that the CT-marked Two Topic conditions behave significantly differently from the Single Topic conditions with respect to coordination disambiguation, while the canonical Two Topic conditions do not.

While pairwise comparisons adjusting for three comparisons do not show significant coordination effects in any of the three conditions (ps >.1), the numerical patterns look quite interesting. As expected due to both syntactic and discourse simplicity considerations, there is a numerical Clausal coordination penalty in Single Topic contexts (diff = 25 ms). In Two Topic contexts with syntactic CT marking, we see longer first pass times associated with the DP coordination disambiguation (diff = -20 ms). Two Topic contexts with canonical word order do not show an asymmetry between the two coordination types (diff = 10 ms).

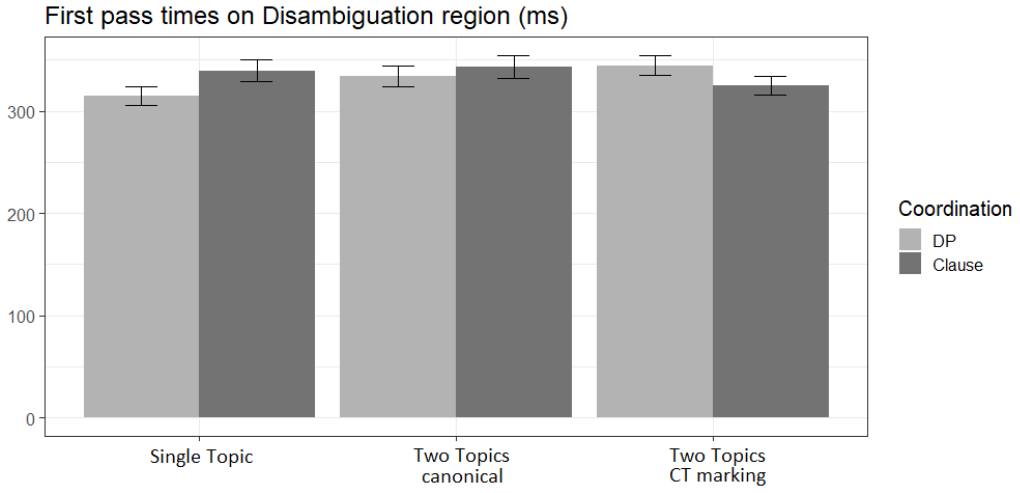


Figure 5.5: First pass times on Disambiguation region

At a first glance, this three-step pattern in first pass times on the disambiguation region might suggest independent contributions of the question context manipulation and the word order manipulation – when the post-coordinator noun is not highlighted as a Topic in the context sentence, there is a preference for the syntactically simpler DP coordination over Clausal coordination. When the post-coordinator noun is marked as a Topic in the context sentence, the Clausal coordination penalty disappears. With the addition of syntactic CT marking on the matrix Subject (necessitating the existence of another contrastive subject in the discourse), the post-coordinator noun is preferentially taken to be a subject in incremental processing, resulting in a preference for Clausal coordination over DP coordination. However, this interpretation is complicated by a high proportion of regressive eye movements out of this region, as previously shown in Figure 5.3. First pass times can be sensitive to regressions – when the reader returns to preceding text, fixations on the region the reader regressed out of are typically shorter than if they had continued forward in the text (Altmann et al., 1992; Altmann, 1994).

Looking at the subset of trials where regressive eye movements were made out of the Disambiguation region, we see a slightly different pattern of results. There is a significant interaction between Context and Coordination type (ps $<.01$), as shown in Figure 5.6. Pairwise t-tests with the criterion for significance adjusted for three comparisons show a Clausal coordination penalty for the V2, Single Topic conditions (diff = 52ms, $p <.05$), and a DP coordination penalty for the V3, Two Topic conditions (diff = -48ms, $p <.05$). Although the Clausal coordination penalty for the V2, Two Topic conditions (diff = -52ms) does not reach statistical significance in pairwise analyses ($p = .194$), the penalty is numerically comparable to the Clausal coordination penalty for the V3, Two Topic conditions (the lack of a pairwise effect could be due to less data being available in the V2, Two Topic conditions).

The validity of the three-step pattern on the Disambiguation region is further called into question by asymmetries observed on the Pre-disambiguation region. The Pre-disambiguation region is of interest due to the possibility of preview effects (even though the Disambiguation region is not at the focal point of the retina, some grammatical information may be taken in

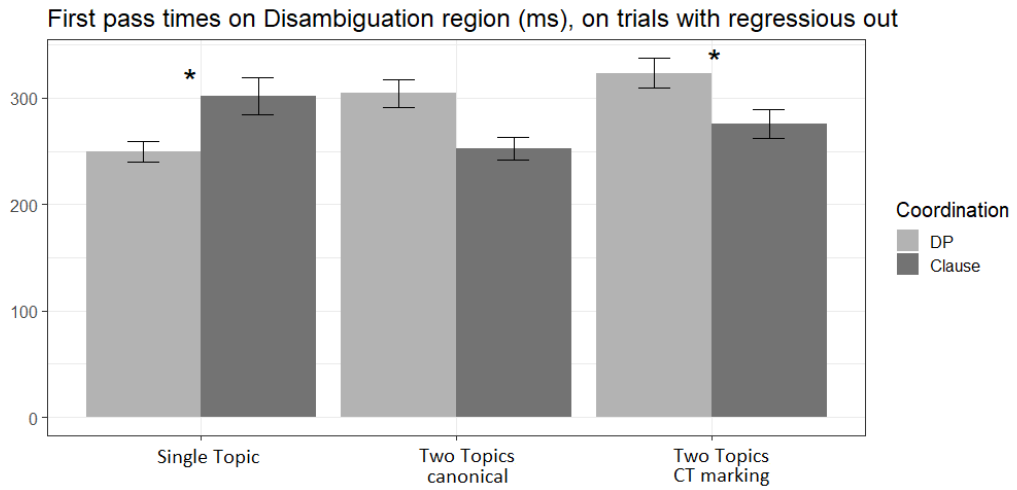


Figure 5.6: Regression-contingent first pass times on Disambiguation region

from parafoveal vision, Schotter et al. 2012). First pass times excluding trials with regressive eye movements (Figure 5.7) showed an interaction between Context and Coordination type (p <.05) – there was a DP coordination penalty for the V2, Two Topic conditions (diff = 46 ms, p <.05 in pairwise comparisons), but not for the V3, Two Topic conditions (diff = -6 ms). This pattern suggests that the processing of non-canonical word order may still be incurring a penalty at this point, as the increased cognitive load associated with information-structural processing may be limiting access to parafoveal preview. The reduced Clausal coordination advantage for the V2 Two Topic conditions on the Disambiguation region (as seen previously) could in part be due to the necessary grammatical dependencies having been resolved earlier, while fixating on the Pre-disambiguation region. Thus, the time course differences in processing V2 and V3 word order are making the independent contribution of CT-marking difficult to observe in this experimental paradigm.

On the whole, the first pass times and regressions out data indicate that the language processor is sensitive to the discourse representations when resolving temporarily ambiguous coordination, and these effects show up in relatively "early" eye-tracking measures on (or before) the critical region. The evidence for a particular advantage of syntactic encoding of topicality for Clausal coordination appears limited here, although the effect may to a certain

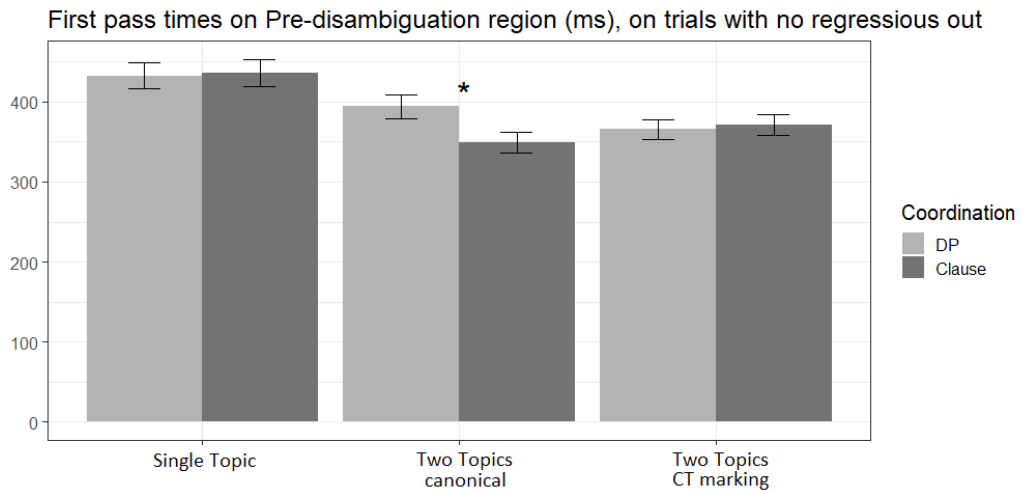


Figure 5.7: Regression-contingent first pass times on Pre-disambiguation region

extent be muted due to the added difficulty of processing non-canonical word order, even in the presence of supporting context.

Below, I explore additional contributions to coordination ambiguity resolution from lexical definiteness, which was manipulated by varying noun types throughout the experimental items.

5.6.3.3 Effects of noun type

As in the sentence completion experiment, the eye-tracking experiment manipulated noun type to assess any potential effects of definiteness. In any given experimental item, the matrix subject, object, and temporarily case-ambiguous post-coordinator noun were all either proper names or common nouns (e.g. professions). Proper names, being inherently definite, could be more easy to topicalize than bare common nouns, which do not encode definiteness in Estonian. Although noun type was not found to influence rates of DP and Clausal coordination completions offline, we saw a penalty for common nouns in completion difficulty ratings, suggesting that establishing discourse coherence with the more lexically contentful common nouns is costly. There are (at least) two mechanisms through which the noun type manipulation could influence the eye-tracking results.

Firstly, although proper names did not bias participants towards Clausal coordination completions offline, definite post-coordinator nouns might ease the processing of material disambiguating towards Clausal coordination, as definite DPs are better candidates for topichood (Reinhart, 1981). An advantage for Clausal coordination in proper name items compared to common noun items would be expected to span across the different contextual and word order conditions, as it is lexical in nature. Granted, the prior mention of the post-coordinator nouns in the context sentence could reduce the strength of any definiteness effects in the present paradigm.

Secondly, the difficulty with establishing discourse coherence in items with common nouns could increase the parser's preferences for simpler structures. There is prior evidence that individuals with low working memory capacity rely less on plausibility information in structural ambiguity resolution (Pearlmutter and MacDonald, 1995; Long and Prat, 2008) and are less able to maintain multiple interpretations in memory (Miyake et al., 1994). If the lexical processing of common nouns and the establishing of discourse coherence presents an increased cognitive load (and thus detracts from the memory resources available), we would expect to see a reduction in the extent to which the more syntactically complex Clausal coordination structure is considered, even if it is contextually supported. Thus, we might expect to see an increased penalty for the Clausal coordination disambiguation in items involving common nouns, compared to items involving proper names.

Both of the mechanisms outlined above predict a modulation of the general findings in the same direction – a stronger bias towards DP coordination in items with common nouns than in items with proper names. To test this prediction, I added Noun Type as a fixed effect in the previously reported analyses, in order to test whether Noun Type interacts with Coordination type on or after the disambiguation region.[10]

Probability of regressions out of and total times on the Disambiguation region show that proper names aid the processing of Clausal coordination compared to common nouns, but only when there is no contextual support for Clausal coordination. Figure 5.8 illustrates this

[10]Main effects of Noun type may inform us about lexical access, but do not bear on the question of interest

three-way interaction (p <.05.) between Context, Coordination and Noun type in the probability of regressive eye movements from this region. We mostly see DP coordination penalties in Two Topic contexts, regardless of noun type. In Single Topic conditions (although pairwise analyses adjusting for six comparisons don't show statistically robust effects), we see a slight numerical penalty for Clausal coordination over DP coordination in Single Topic conditions (diff = 6%) in items containing common nouns. In items containing proper names, the pattern is reversed, with a numerical advantage for Clausal coordination over DP coordination in the same conditions (diff = -10%).

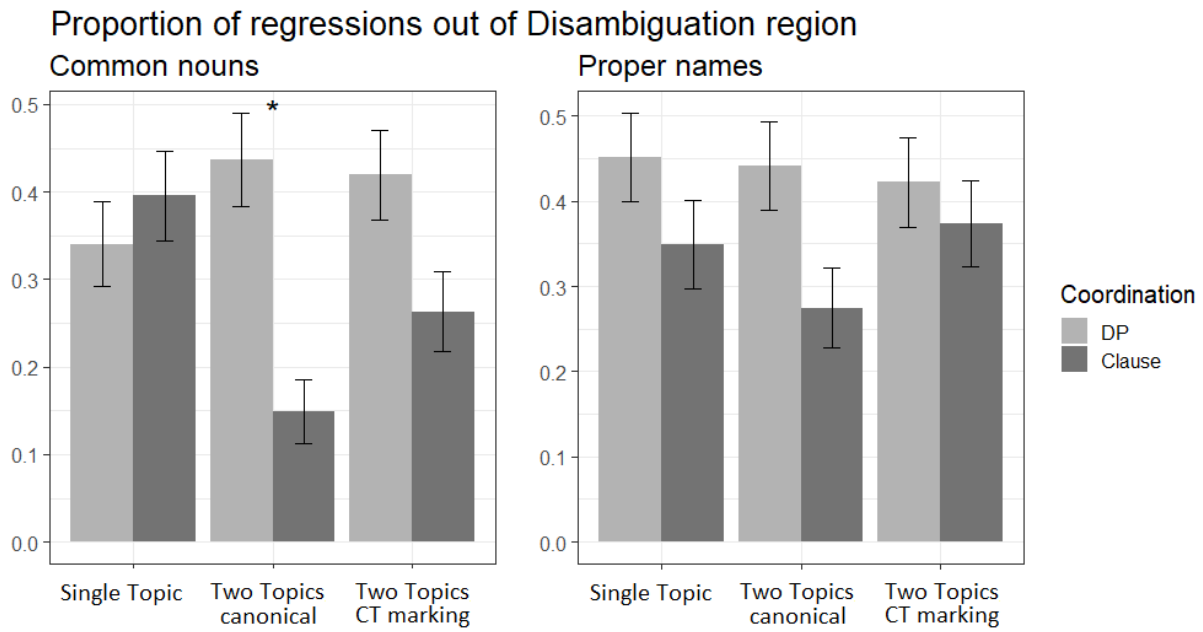


Figure 5.8: Proportions of regressions out of Disambiguation region, by Noun Type

As illustrated by Figure 5.9, a three-way interaction (p <.05.) is also seen in total times on the Disambiguation region. Pairwise comparisons with the criterion of significance adjusted for six comparisons show that in Two Topic contexts, there is always a DP coordination penalty in total times on this region (ps <.01.) Although the pairwise comparisons do not reach statistical significance, we observe differential patterns for the two noun types in Single Topic conditions. In the Single Topic conditions, there is a numerical penalty for Clausal coordination over DP coordination in items involving common nouns (diff = 96 ms) and a

numerical penalty for DP coordination over Clausal coordination in items involving proper names (diff = -77 ms). Still, the noun type effect in Single Topic contexts is not as strong as the effect of the contextual manipulation itself – we do not see a statistically reliable DP coordination penalty in Single Topic contexts in proper name items the way we do across the Two Topic contexts regardless of noun class.

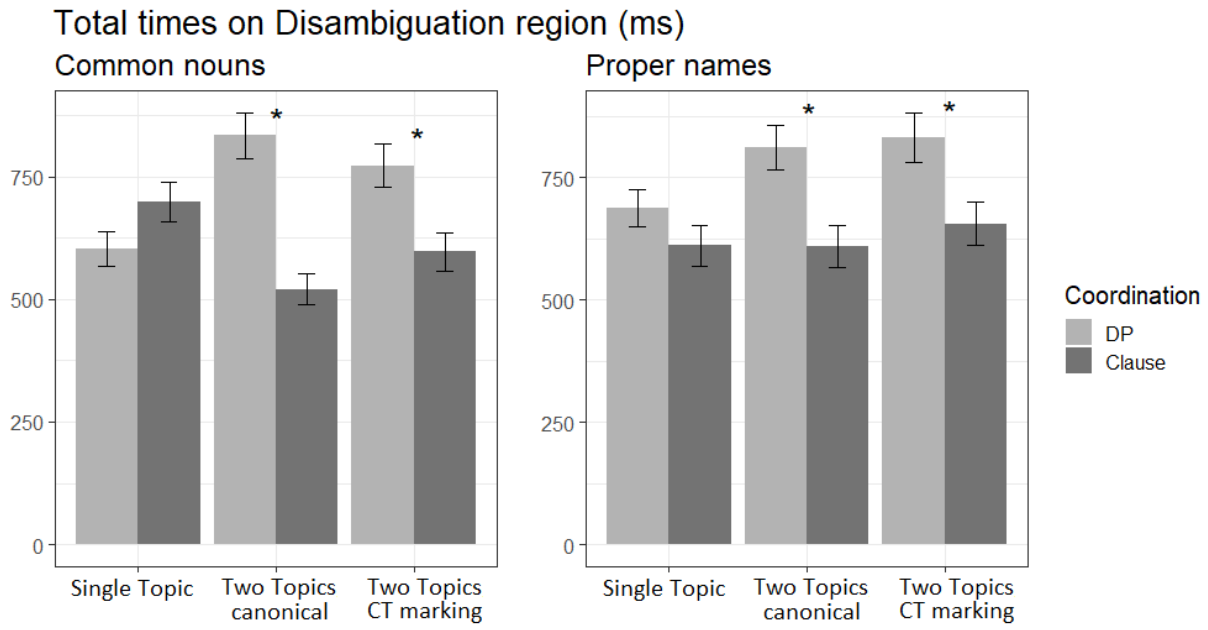


Figure 5.9: Total times on Disambiguation region, by Noun Type

The mechanism underpinning the noun type effect is not completely clear. As there was no two-way interaction between Noun type and Coordination type on the Disambiguation region in probability of regressions or total times (or any of the other eye-tracking measures analyzed), it is obvious that proper names did not aid the processing of Clausal coordination uniformly across contextual conditions. One possibility is that the Two Topic contexts unambiguously mark the bare nouns as definite (in a way that the Single Topic contexts do not), leaving no additional definiteness-marking work to be done by noun type in these conditions. Another possibility is that the Single Topic contexts make establishing discourse relations more difficult than Double Topic contexts, which would be even more pronounced with lexically contentful common nouns. This additional processing difficulty would then

have contributed to the readers' preference for the structurally simpler DP coordination specifically in the common noun items. Further empirical work is needed to better understand whether and how definiteness influences parsing decisions, but what the present findings show is further support for extrasyntactic factors bearing on the processing of temporarily ambiguous coordination.

5.7 General Discussion

To return to the hypotheses presented at the beginning of this chapter, we have obtained evidence that when there is sufficient (contextual) support for marking a constituent as a CT, the search for a CT alternative is active, overriding preferences for an otherwise preferred, syntactically simpler resolution to temporarily ambiguous coordination ambiguity. This is in line with the Predictive Contrast Resolution (PCR) hypothesis. If contrast resolution took place following the independent identification of contrastive alternatives, as proposed by the Contrast Integration Hypothesis, we would not expect to see penalties for DP coordination resolutions in CT-marking contexts, as was shown in the eye-tracking experiment.

The eye-tracking experiment showed robust evidence for discourse representations (in terms of topicality) having an early effect on coordination ambiguity resolution – while the Single Topic conditions show a Clausal coordination penalty in first pass times, the Two Topic conditions in fact show a Clausal coordination advantage. The latter is also seen in probabilities of regressions out of the critical region. There was, however, little evidence for an effect of syntactic CT marking over and above the effects of the contextual manipulation. This could be due to the strength of the contextual manipulation, whereby syntactic CT marking does little to strengthen the already established discourse representation. At the same time, despite the strongly biasing context, there was some evidence for a delay in ambiguity resolution following the non-canonical CT-marked clauses. This suggest that non-canonical word order is processed at a delay even in the presence of contextual support. It is possible that the processing profile and relative contribution of syntactic CT-marking would differ when topicality is less directly and unambiguously conveyed in the discourse

context.

In the sentence completion experiment, participants rated non-canonical V3 clauses to be more difficult to complete than canonical V2 clauses and syntactic CT marking was found to not influence rates of Clausal coordination completions. This is why in the eye-tracking experiment strongly biasing contexts were used. Either just the matrix subject or both the matrix subject and the post-coordinator noun were marked as topical in an overt discourse question. As a result, the processor was able to compute the discourse status of the relevant referents before non-canonical word order in the target clause was encountered, which may have reduced any effects of syntactic CT marking. Future work could manipulate the strength of the preceding context in order to better assess the relative contribution of syntactic CT-marking to parsing.

Looking at all four experiments jointly, I discuss open questions and potential further work in the next chapter.

CHAPTER 6

General Discussion and Conclusions

6.1 Revisiting the research questions

This dissertation adds to the growing literature on sentence processing in flexible word order languages, where information-structural notions like Topic, Focus and Contrast can be conveyed through syntactic means. How syntactic representations feed discourse representations and *vice versa* is a particularly exciting avenue of research in discourse-configurational languages. Past work has addressed the parsing of non-canonical clauses (e.g. Bader and Meng 1999; Kristensen et al. 2014) and the computation of information-structural representations based on non-canonical order (e.g. Kaiser and Trueswell 2004). More broadly, there is also accruing evidence that information-structural representations can influence parsing decisions (e.g. Hoeks et al. 2002; Carlson et al. 2009). In the present work, I looked at the processing of Contrast and how the processor's treatment of non-canonical order influences the processing of contrastive ellipsis and temporary syntactic ambiguity.

As proposed in Chapter 3, the processing of Contrast can be conceptualized as consisting of two steps – marking a constituent as contrastive (i.e. contrast encoding) and identifying a contrastive alternative to the contrast-marked constituent (i.e. contrast resolution). The latter step is necessary due to the use of Contrastive Topic (CT) and Contrastive Focus (CF) structures presupposing the existence of a salient alternative to the contrast-marked constituent in the discourse representation. Estonian provides an interesting case study for the processing of information structure, as it allows for optional CT marking through syntactic means. I explored the online processing of these CT-marking verb-third constructions in Estonian. I was interested in whether non-canonical word order leads to rapid compu-

tation of information-structural representations during online comprehension, whether the processor actively anticipates contrastive alternatives when a constituent has been marked as a CT, and the extent to which the computation of information-structural representations interacts with other aspects of sentence processing.

6.2 Summary of experiments

Below, to take stock, I summarize the main findings from the four experiments reported in this dissertation.

6.2.1 Experiment 1

Experiment 1 was an eye-tracking during reading experiment designed to explore whether syntactic CT-marking (i.e. V3 word order in Estonian) leads to the processor encoding contrast during incremental processing. Canonical Subject-Verb-Adverb-Object and V3 Subject-Adverb-Verb-Object clauses were followed by either Subject CT remnant ellipsis or Object CF remnant ellipsis. Several eye-tracking measures on the remnant region showed that word order in the matrix clause interacted with the remnant type. Object CF remnants showed no asymmetries based on the matrix clause they followed, likely due to the clause-final position that the correlate occurred in acting as a default Focus position, thus allowing for a straightforward pairing between the remnant and the correlate. This is in line with prior work showing a Locality bias for resolving contrastive ellipsis (Clifton and Frazier, 1998; Carlson et al., 2009; Harris, 2015, 2019; Harris and Carlson, 2018; Lawn, 2020). A different pattern was seen for Subject CT remnants. Following canonical clauses, which are compatible with a range of information-structural representations, the processing of Subject CT remnants was penalized compared to Object CF remnants. This penalty is best explained if comprehenders did not assign CT status to the preverbal Subject in V2 clauses. Crucially, following V3 matrix clauses there was no penalty for Subject CT remnants compared to Object CF remnants. This finding indicates that following V3 matrix clauses the

Subject CT correlate was accessible to the processor during the reading of the Subject CT remnant, in a way that it wasn't following V2 matrix clauses. As the experimental design controlled for the linear distance and the lexical material intervening between the Subject correlate and the Subject remnant, the asymmetry between V2 and V3 antecedents must be structural (syntactic and/or information-structural) in nature. Experiment 1 thus shows that V3 order in Estonian leads to the processor rapidly marking a preverbal constituent as contrastive.

6.2.2 Experiment 2

The time course of CT-marking was further explored in Experiment 2. This was a speeded acceptability experiment with rapid serial visual presentation, looking at the processing of Subject and Object contrast in ambiguous V3+ clauses. The information structure of SOV and OSV clauses was disambiguated by following the matrix clause with Subject or Object CT remnant ellipsis. All of the experimental measures (acceptance rates, RTs to "yes" responses, and comprehension question accuracy) showed an asymmetry between SOV and OSV clauses – while Subject and Object contrast were accepted equally often in SOV clauses, there was a penalty for Subject contrast compared to Object contrast in OSV clauses. This pattern indicates that upon encountering a clause-initial object, the processor rapidly assigns it an information-structurally marked status. Thus, the processor is immediately sensitive to deviations from the canonical subject-initial word order. Subject-initial clauses, on the other hand, are temporarily compatible with a broad range of discourse contexts so the assignment of contrast can be delayed. By the time both the Subject and the Object have been encountered, the input is no longer compatible with a simple topic-comment structure, as the later linear position of the verb necessitates the presence of a preverbal CT. Interestingly, SOV clauses followed by Subject or Object CT remnant ellipsis are not penalized compared to OSV clauses followed by Object CT remnant ellipsis. This means that we do not observe a resolution penalty at the point where CTE grammatically necessitates the SOV clause to contain a CT. I take these findings to indicate that in the absence of

biasing context, V3+ clauses are (syntactically) marked as more complex CTopPs, without the processor necessarily committing to which preverbal constituent carries the [+Contrast] feature. Experiment 2 provides further evidence that the processor rapidly constrains its representations of information structure based on the input, while allowing for temporary information-structural ambiguity in the process.

6.2.3 Experiments 3 and 4

As discussed in Chapter 2, CT structure (whether it is linguistically expressed using prosody or word order) presupposes the existence of a contextually salient alternative to that CT. Experiments 3 and 4 looked at contrast resolution during online processing – namely, whether marking a constituent as a CT leads to the processor anticipating a CT alternative to that constituent. The logic of these experiments was that predicting a CT alternative to a Nominative subject leads to preferentially taking a case-ambiguous noun compatible with being a CT alternative to be a Nominative subject as well. In a temporarily ambiguous coordination structure, marking the post-coordinator noun as Nominative leads to computing a more syntactically complex biclausal structure. The processing of information structure was thus hypothesized to influence syntactic processing by biasing the processor towards an otherwise dispreferred parse.

Experiment 3 was a sentence completion experiment designed to explore whether Estonian shows a general preference for DP coordination over Clausal coordination. Coordination structures were truncated following the post-coordinator noun, as shown in (94), and presented in the absence of biasing discourse context. There was evidence for an overall bias towards DP coordination (i.e. taking the post-coordinator noun to be an Accusative object rather than a Nominative subject), but a word order manipulation intended to mark the subject as a CT did not increase the rate of Clausal coordination completions. The findings from Experiment 3 confirm that a general preference for the syntactically simplest parse (as previously shown for languages like English and Dutch, Frazier 1987b; Hoeks et al. 2002, 2006; Staub and Clifton 2006; Engelhardt and Ferreira 2010) also holds in Estonian.

(94) Marleen kutsus täna Jaani ja Kadri...
Marleen.NOM invited today Jaan.ACC and Kadri.NOM/ACC
'Today Marleen invited Jaan and Kadri ...'

Experiment 4 was an eye-tracking during reading experiment looking at the processing of structures like (94) (and their V3 equivalents) in contexts biasing towards a Single Topic and Two Topic (CT) interpretation. Disambiguation towards the otherwise preferred DP coordination (with the post-coordinator noun *Kadri* being Accusative) was found to be penalized compared to Clausal coordination in Two Topic contexts, compatible with the hypothesis that the processor anticipates an upcoming CT alternative to a CT-marked constituent. This was the case for both canonical V2 and non-canonical V3 structures, as the biasing Two Topic discourse context was effective in overriding the processor's preference for syntactically simpler DP coordination structures. At the same time, there was evidence that the processor is sensitive to the fact that syntactic CT marking (V3 order) has to be licensed by the presence of contrast. Namely, there was a presupposition failure effect when no CT alternative was present after V3 clauses. This effect emerged at a delay, suggesting that the search for a CT alternative continued after the post-coordinator noun was disambiguated as being an object rather than a subject.

Jointly, Experiments 3 and 4 indicate that once the processor has marked a constituent as a CT, the search for a CT alternative is active and can override default structural preferences. However, the lack of a word order effect in Experiment 3 (where V2 and V3 structures were presented in the absence of biasing context) suggests that contextual support may be necessary to assign CT status to preverbal subjects.

Overall, we have seen evidence that the language processor is rapidly sensitive to variations in word order and computes CT structures during incremental comprehension. Further, information-structural representations influence parsing decisions, as evidenced by my findings on processing clausal ellipsis (Chapter 4) and resolving (morpho)syntactic ambiguities (Chapter 5). Below, I discuss a couple of overarching themes arising throughout the experimental portion of this dissertation, after which I lay out potential future extensions to this

work.

6.3 The role of syntactic CT-marking

Previous work (e.g. Kaiser and Trueswell 2004; Weskott et al. 2011; Kristensen et al. 2014) has shown that the processing of non-canonical word order is facilitated in the presence of a supporting discourse context. This is seen in reduced reading times and improved comprehension question accuracy. While psycholinguists working on flexible word order languages have been interested in the source of processing difficulty associated with non-canonical structures, to my knowledge previous work has not addressed whether discourse context simply facilitates parsing non-canonical structures (for instance, assigning Case and determining argument structure) or also aids in the computation of the information-structural representations that non-canonical word order intends to convey. We saw in Experiment 3 (where participants also rated V3 clauses as more difficult to complete than V2 clauses) that the word order manipulation did not influence the probability of treating the post-coordinator noun as a subject (and a CT-alternative to the first subject) in the absence of supporting context, but Experiment 4 (where explicit discourse contexts were used) showed that CT structure did influence how the DP/Clausal coordination ambiguity was resolved. This raises the question of whether non-canonical word order on its own is sufficient to compute the intended information structure, and what it contributes over and above contextual (or prosodic) cues to information structure.

Traditional syntax-first models of sentence processing (e.g. Frazier 1987a) postulate that syntactic information holds a special status in sentence processing and that morphosyntactic processing is initially encapsulated from other linguistic (and non-linguistic) sources of information. Although they do not discuss syntactic encoding of information structure, these models might predict that word order information takes precedence over contextual information in exerting an influence in parsing decisions. This possibility was explored in Chapter 5. However, controlling for context in Experiment 4, we did not observe early asymmetries between V2 and V3 word order in coordination ambiguity resolution. One possibility for

this lack of an effect could be the strength of the contexts used in that experiment, as the post-coordinator noun was explicitly highlighted as topical by the context, which would have improved its naturalness as a subject (see also Hoeks et al. 2002). If this is the case, then figuratively speaking there wasn't much "work" left to be done by syntactic CT-marking – the DP was already predicted to occur in the upcoming discourse as a CT based on the discourse context. Another possibility is that discourse context and the use of non-canonical word order strengthen each others' effects in computing information-structural representations. Under this view, CT structure is actually computed more easily when both the preceding discourse context and the syntactic form bias the processor towards a CT interpretation of a constituent. The results of Experiment 4 are then best explained by this "double cue" advantage being canceled out by an independent penalty for non-canonical word order.[1] For instance, Kristensen et al. (2014) found that comprehension accuracy was lower for non-canonical clauses than for canonical clauses in Danish, even when non-canonical word order was presented in a supporting context. The possibility of a sustained non-canonical order penalty also raises the question of whether experimental trials with non-canonical word order (or study participants reading non-canonical structures) fall into a bimodal distribution, or whether the slowdown associated with reading non-canonical structures and their potential advantage in information-structural processing can co-occur in a single trial. Further work exploring the processing of contrast in a broader range of preceding discourse contexts could shed light on this issue.

One place where syntactic CT-marking seems to have a stronger effect than the preceding discourse context in the present studies is sentence-final wrap-up, which I discuss below.

[1]But, interestingly, there was no penalty for non-canonical antecedent clauses on the Remnant region of Experiment 1, although the linear distance between the non-canonical material and the disambiguating material was roughly comparable in Experiment 1 and Experiment 4.

6.4 Wrap-up effects and presupposition failure

Previous sentence processing work has shown effects of punctuation, whereby readers slow down at clause boundaries (Just and Carpenter, 1980; Rayner et al., 2000; Hirotani et al., 2006). This slowdown has been ascribed to finalizing semantic processing (e.g. pronoun resolution) and integrating the proposition conveyed by the clause with the broader discourse context (see Stowe et al. 2018, for a recent overview and discussion), and is also though to involve a prosodic component (Warren et al., 2009).

Interestingly, both of the eye-tracking experiments showed evidence of wrap-up effects on the sentence-final analysis region when the sentence contained no grammatically possible CT-alternative to a preverbal constituent in a V3 clause. In Experiment 1, this occurred when a V3 antecedent clause that marked the subject as a CT was followed by CF object remnant ellipsis. In Experiment 4, the effect was seen when clauses beginning in V3 order contained object DP coordination rather than having the case-ambiguous post-coordinator noun function as a subject of another clause (and a CT alternative). In the latter case, I compared context-matched V2 and V3 clauses and found that the wrap-up effect was unique to V3 clauses.

What could underlie this wrap-up effect? CT-structure, and by hypothesis V3+ word order in Estonian, introduces a presupposition for the existence of an accessible contrastive alternative to the CT-marked constituent. Longer first pass reading times on the sentence-final regions in the particular experimental conditions in these experiments are compatible with the idea that the processor is sensitive to this presupposition failure. The reason why the presupposition failure effect appears on the sentence-final region may not have to do with sentence wrap up *per se*.[2] That is, there is no principled reason why presuppositions should be satisfied within a sentence. Rather, readers likely realize that no further material will be provided in the experimental trial, and the processor terminates the search for a CT

[2]See Stowe et al. (2018) for the argument that clause-end positions might not hold a special status in language processing.

alternative.[3]

But why is this effect seen for V3 clauses and not for context-matching V2 clauses that express the same information structure and similarly set up a preference for Clausal coordination, as seen in Experiment 4? I touched on this question briefly in Chapter 3, in Section 3.6. To me, the most plausible explanation is that the use of non-canonical word order commits the processor to a particular discourse representation, which in the case of Estonian V3 clauses is a CT structure. If the discourse context biases a constituent in a canonical clause to be interpreted as contrastive (as was the case for V2 clauses in Two Topic contexts in Experiment 4), the processor may initially mark that constituent as being contrastive. However, when the presupposition of having a salient contrastive alternative to that constituent is not met, the processor is able to revise the discourse representation as it is able to map the canonical string to a grammatical parse without invoking information-structurally marked projections (such as CTopP). In the case of non-canonical structures, we see a processing penalty on the sentence-final region when the presupposition for a contrastive alternative is not met and there is no grammatical parse available for the input.

This explanation of the wrap-up effects observed in the present studies is in line with proposals linking longer reading times at clause boundaries to discourse integration (e.g. Just and Carpenter 1980; Rayner et al. 2000; Hirotani et al. 2006). Interestingly, the asymmetry between V2 and V3 clauses observed in Experiment 4 suggests that these integration processes can target not only discourse representations but also syntactic representations. The information-structural ambiguities in Estonian V3+ clauses (as discussed in Chapter 2 and experimentally examined in Experiment 2) offer an interesting future avenue to exploring the nature of integration and revision processes at the syntax-discourse interface.

[3]This is not to say that the search for a CT alternative would continue indefinitely in a more naturalistic setting – if this were the case, human communication would simply break down whenever a contrastive structure was presented in a context where the interlocutors did not share sufficient common ground for the listener to accommodate or infer the intended contrastive alternative.

6.5 More directions for future work

6.5.1 Effects of prosody

The experiments reported here all used written (rather than auditory) materials, but as shown in Section 2.2.4, CTs in V3+ structures are also marked through prosodic means (also see Sahkai and Mihkla 2017) and prosody disambiguates V3+ structures that are potentially information-structurally ambiguous. Previous work looking at overt prosody in CF structures (e.g. Carlson 2001, 2014; Gotzner et al. 2013; Washburn 2013; Carlson and Tyler 2018) has shown that comprehenders are rapidly sensitive to the placement of pitch accents and use prosodic information to activate potential focus alternatives. Prosody also plays a role in syntactic processing during silent reading (e.g. Slowiaczek and Clifton 1980; Fodor 1998, 2002; Breen and Clifton 2011; Harris et al. 2016; also see Breen 2014 for review). It is likely that readers assign their own implicit prosody when silently reading V3 clauses. Past work shows that default pitch accent assignment influences language processing (e.g. Bader 1998; Harris and Carlson 2018) and it would therefore be interesting to examine which constituent(s) readers preferentially pitch accent in (ambiguous) V3 structures and how those preferences bear on information-structural computations, syntactic ambiguity resolution, and integration with the discourse context.

We also saw in the present work (particularly in Experiment 3) that interpreting the information structure of V3 clauses can be difficult in the absence of supporting context. This could in part be due to difficulties with assigning a prosodic contour to the input string. Future work comparing the processing of CT structures using auditory and written materials could shed light on the relative contributions of (and interactions between) syntactic and prosodic marking of contrast in online processing. There is evidence that in Focus constructions the processor can downweight the information provided by overt prosody in favor of default information-structural preferences (Harris and Carlson, 2018; Potter and Carlson, 2019). However, it is not clear whether the processor holds default preferences for prosody in CT structures (but see Molnár and Winkler 2010, for cross-linguistic evidence for

a preference towards clause-edge contrast). There is an asymmetry between Focus and CT – every at-issue clause must contain a Focus (and relatedly, a nuclear pitch accent), while CTs are less frequent. As a result, overt prosody may exert more influence during the online comprehension of CT structures than CF structures, with the processor having less prior experience to draw from. The findings in Experiment 2 regarding information-structural underspecification in SOV clauses is compatible with overt prosody playing an important role in comprehending CT constructions in Estonian, especially in the absence of biasing context that may aid the processor in assigning a prosodic contour to its input.

The possibility of information-structural underspecification in V3+ structures raises further questions for sentence processing.

6.5.2 Underspecification in online processing

Models of sentence processing differ, among other aspects, in the amount of underspecification they allow during online comprehension. While some postulate that at any given time, the processor holds at least one grammatical parse of the input string (Frazier, 1987a; Altmann and Steedman, 1988), others propose that relations not part of the argument structure of the clause are resolved at a delay (Frazier and Clifton, 1996). Support for the latter view has come from work on the resolution of attachment ambiguities, particularly on the processing of non-restrictive relative clauses (Dillon et al., 2018; Kaps et al., 2019). While, intuitively, syntactic structure greatly underdetermines information structure (particularly in fixed word order languages like English), to my knowledge the extent to which information-structural representations are underspecified by the processor during online processing has not received a lot of attention, perhaps due to these representations not being (seen as) syntactic in nature. Future work on flexible word order languages like Estonian, and particularly V3 constructions that necessitate the presence of preverbal contrast but can underdetermine its placement, could shed more light on the nature of (syntactic) underspecification in sentence and discourse processing.

6.6 Conclusion

The present dissertation provides novel evidence for the processor using non-canonical word order to compute information-structural relations and shows that in a flexible word order language like Estonian, information-structural and syntactic processing are closely linked. The findings raise interesting questions pertaining to the interplay between discourse context, syntax, prosody and the processor's default preferences, as well as to the nature of the human language processing system more broadly.

APPENDIX A

Experiment 1 Items

The items below are shown in V2 order, with the CTE and CFE remnnants in curly brackets. Comprehension questions shown in capital letters.

1. Mis sinu sõprade elus uut on? Ants ei armasta ilmselt Jaanikat, {Margus küll / vaid Hellet}, kuigi keegi ei taha seda endale tunnistada.
   KAS ANTS ARMASTAB JAANIKAT? EI JAH
   What's new in your friends' lives? Ants probably doesn't love Jaanika, {Margus AFF / but Helle}, but nobody wants to admit it to themselves.
   DOES ANTS LOVE JAANIKA? NO YES

2. Keda peaks üksteisele tutvustama? Agnes tunneb tegelikult Joonast, {Katrin mitte / mitte Kaupot}, kuigi kõik on omavahel korduvalt kohtunud.
   KAS AGNES TUNNEB JOONAST? EI JAH
   Who should be introduced to each other? Agnes actually knows Joonas, {Katrin NEG / NEG Kaupo}, although everybody has repeatedly met each other.
   DOES AGNES KNOW JOONAS? NO YES

3. Kas kõigil õnnestus peol uue õpilasega kohtuda? Madis ei kohanud tegelikult Brittat, {Gustav küll / vaid Laglet}, nii et peaksime uuesti midagi korraldama.
   KAS KÜSIMUSES MAINITI PIDU? JAH EI
   Did everybody manage to meet the new students at the party? Madis actually didn't meet Britta, {Gustav AFF / but Lagle}, so we should arrange something again soon.
   DID THE QUESTION MENTION A PARTY? YES NO

4. Mis pärast hääletuse tulemuste avaldamist juhtus? Dagmar hoiatas muidugi Tanelit, {Ester mitte / mitte Ahtot}, kuid häältetulemusi ei olnud enam võimalik muuta.
   KAS KÕIK OLID HÄÄLETUSTULEMUSTEGA RAHUL? JAH EI
   What happened after announcing the results of the vote? Dagmar of course warned Tanel, {Ester NEG / NEG Ahto}, but the results of the vote could no longer be changed.
   WAS EVERYBODY HAPPY WITH THE RESULTS OF THE VOTE? YES NO

5. Kuidas seriaali viimane osa lõppes? Robin ei solvanud tõesti Margitit, {Paavel küll / vaid Tuulit}, kuigi see selgus alles hiljem.
   MILLE KOHTA KÜSIMUS OLI? SEEBIKA FILMI
   How did the last episode of the show end? Robin reallly didn't offend Margit, {Paavel AFF / but Tuuli}, but this only became clear later.
   WHAT WAS THE QUESTION ABOUT? A SOAP OPERA A MOVIE

6. Kes eile aktusel kohtusid? Riin nägi vist Indrekut, {Karolin mitte / mitte Meelist}, sest aktusel oli väga palju rahvast.
   KUIDAS AKTUS OLI? VAIKNE RAHVAROHKE
   Who met at the reception yesterday? Riin probably saw Indrek, {Karolin NEG / NEG Meelis}, because there were lots of people at the reception.
   HOW WAS THE RECEPTION? QUIET CROWDED

7. Mis täna lõunapausil välja tuli? Kalev ei kartnud ilmselgelt Annikat, {Maksim küll / vaid Terjet}, või vähemalt nii ma kuulsin.
   MILLAL SEDA ARUTATI? LÕUNAPAUSIL PEALE TÖÖD
   What was revealed at the lunch break today? Kalev probably wasn't afraid of Annika, {Maksim AFF / but Terje}, or at least this is what I heard.
   WHEN WAS THIS DISCUSSED? AT LUNCH AFTER WORK

8. Miks kõik hommikul nii pahas tujus olid? Ines teretas nähtavasti Silverit, {Helerin mitte / mitte Oskarit}, kuigi meil on tavaks, et kõik tervitavad üksteist.

KUIDAS INIMESTE MEELEOLU OLI? RÕÕMUS KEHVAVÕITU

Why was everybody in such a bad mood in the morning? Ines apparently greeted Silver, {Helerin NEG / NEG Oskar}, although it is customary for us for everybody to greet each other.

HOW WAS PEOPLE'S MOOD? HAPPY POOR

9. Mida sa oma sõprade kohta kuulsid? Allar ei emmanud võib-olla Kristit, {Toomas küll / vaid Niinat}, kuigi see on muigugi ainult kuulujutt.

   MIDA LAUSES MAINITI? KALLISTAMIST MUSITAMIST

   What did you hear about your friends? Allar maybe didn't hug Kristi, {Toomas AFF / but Niina}, but this is of course only a rumor.

   WHAT WAS MENTIONED IN THE SENTENCE? HUGGING KISSING

10. Mida naabrinaine eile nii innukalt arutas? Triin vihkab usutavasti Jörgenit, {Kerstin mitte / mitte Vahurit}, kuigi ma ei ole päris kindel, kas see tõsi on.

    KES ARUTAS SEDA TEEMAT? JöRGEN NAABRINAINE

    What did the neighbor woman discuss so enthusiastically yesterday? Triin possibly hates Jorgen, {Kerstin NEG / NEG Vahur}, but I'm not entirely sure if this is true.

    WHO WAS DISCUSSING THIS TOPIC? JORGEN THE NEIGHBOR WOMAN

11. Mis etenduse esimeses vaatuses juhtus? Marek ei märganud muidugi Emiliat, {Alvar küll / vaid Piiat}, mistõttu arenes sellest väga romantiline armastuslugu.

    What happened in the first act of the play? Marek of course did not notice Emilia, {Alvar AFF / but Piia}, which is why it developed into a very romantic love story.

12. Mida eelmisel nädalal korteriühistu koosolekul arutati? Merilin segas väidetavalt Antonit, {Kätlin mitte / mitte Olarit}, aga kõigil paluti vähem lärmi teha.

    What was discussed at the housing association meeting last week? Merilin apparently bothered Anton, {Katlin NEG / NEG Olari}, but everybody was asked to make less noise.

13. Mida sul uue töötaja kohta öelda on? Kristjan ei palganud tõesti Siretit, {Jaanus küll

/ vaid Juliat}, kuid kellelgi ei olnud selle kohta midagi arvata.
What do you have to say about the new employee? Kristjan really didn't hire Siret {Jaanus AFF / but Julia}, but nobody had any opinion on this.

14. Miks naabrid nii valjusti omavahel vaidlesid? Susann usaldab vist Kasparit, {Vivian mitte / mitte Raimot}, aga ma ei taha nende eraelu kohta midagi teada.
Why were the neighbors arguing so loudly amongst each other? Susann probably trusts Kaspar, {Vivian NEG / NEG Raimo}, but I don't want to know anything about their private life.

15. Kellest eile juttu oli? Hendrik ei maininud ilmselt Katret, {Oliver küll / vaid Dianat}, aga ma ei olnud terve vestluse ajal seal.
Who was being talked about yesterday? Hendrik probably didn't mention Katre, {Oliver AFF / but Diana}, but I wasn't there for the whole conversation.

16. Kes on juba omavahel kohtunud? Marleen teab vist Villemit, {Kärt mitte / mitte Ivot}, kuigi iseenesest peaksid kõik omavahel tuttavad olema.
Who has already met each other? Marleen probably knows Villem, {Kart NEG / NEG Ivo}, but technically everybody should be familiar with each other.

17. Millest teie peres tavaliselt tülid tekivad? Eerik ei kuula ilmselgelt Kerlit, {Marten küll / vaid Lillit}, aga õnneks jääb ema sõna alati peale.
What is typically the source of fights in your family? Eerik clearly doesn't listen to Kerli, {Marten AFF / but Lilli}, but luckily mom's word always prevails.

18. Kas uued tiimiliikmed on varem kohtunud? Kristel mäletab nähtavasti Jarmot, {Evelin mitte / mitte Henrit}, sest nende kohtumisest on väga palju aega möödas.
Have the new team members met before? Kristel apparently remembers Jarmo, {Evelin NEG / NEG Henri}, because it's been a while since they met.

19. Mis eile kontoris toimus? Mehis ei kiusanud muidugi Annelit, {Robert küll / vaid Lindat}, aga see oli kõik naljaga pooleks.

What happened at the office yesterday? Mehis of course did not mock Anneli, {Robert AFF / but Linda}, but it was all meant as a joke.

20. Mis kuulujutt hetkel liikvel on? Hedvig suudles usutavasti Mattiast, {Lilian mitte / mitte Kustit}, aga ma ei mäleta täpselt, kellelt ma seda kuulsin.
    What rumor is going around right now? Hedvig possibly kissed Mattias, {Lilian NEG / NEG Kusti}, but I don't remember exactly who I heard it from.

APPENDIX B

Experiment 2 Items

Comprehension questions shown in capitals. All comprehension questions were yes/no questions.

1. {Ants Jaanikat / Jaanikat Ants} ilmselt ei armasta, {Margus / Hellet} aga küll.
   KAS ANTS ARMASTAB JAANIKAT?
   Ants probably doesn't love Jaanika, but {Margus does / he does Helle}.
   DOES ANTS LOVE JAANIKA?

2. {Agnes Joonast / Joonast Agnes} tegelikult ei tunne, {Katrin / Kaupot} aga küll.
   KAS AGNES TUNNEB JOONAST?
   Agnes doesn't actually know Joonas, but {Katrin does / she does Kaupo}.
   DOES AGNES KNOW JOONAS?

3. {Madis Brittat / Brittat Madis} tõesti ei kohanud, {Gustav / Laglet} aga küll.
   KAS MADIS KOHTAS BRITTAT?
   Madis really didn't meet Britta, but {Gustav did / he did Lagle}.
   DID MADIS MEET BRITTA?

4. {Dagmar Tanelit / Tanelit Dagmar} muidugi ei hoiatanud, {Ester / Ahtot} aga küll.
   KAS DAGMAR HOIATAS TANELIT?
   Of course Dagmar did not warn Tanel, but {Ester did / she did Ahto}.
   DID DAGMAR WARN TANEL?

5. {Robin Margitit / Margitit Robin} tõesti ei solvanud, {Paavel / Tuulit} aga küll.
   KAS ROBIN SOLVAS MARGITIT?

Robin really didn't insult Margit, but {Paavel did / she did Tuuli}.
DID ROBIN INSULT MARGIT?

6. {Riin Indrekut / Indrekut Riin} vist ei näinud, {Karolin / Meelist} aga küll.
KAS RIIN NäGI INDREKUT?
Riin probably didn't see Indrek, but {Karolin did / she did Meelis}.
DID RIIN SEE INDREK?

7. {Kalev Annikat / Annikat Kalev} ilmselgelt ei kartnud, {Maksim / Terjet} aga küll.
{KAS MAKSIM KARTIS ANNIKAT / KAS KALEV KARTIS TERJET}?
Kalev clearly wasn't afraid of Annika, but {Maksim was / he was of Terje}.
{WAS MAKSIM AFRAID OF ANNIKA / WAS KALEV AFRAID OF TERJE}?

8. {Ines Silverit / Silverit Ines} nähtavasti ei teretanud, {Helerin / Oskarit} aga küll.
{KAS HELERIN TERETAS SILVERIT / KAS INES TERETAS OSKARIT}?
Ines apparently didn't greet Silver, but {Helerin did / she did Oskar}.
{DID HELERIN GREET SILVER / DID INES GREET OSKAR}?

9. {Allar Kristit / Kristit Allar} võib-olla ei emmanud, {Toomas / Niinat} aga küll.
{KAS TOOMAS EMBAS KRISTIT / KAS ALLAR EMBAS NIINAT}?
Allar maybe didn't hug Kristi, but {Toomas did / he did Niina}.
{DID TOOMAS EMBRACE KRISTI / DID ALLAR EMBRACE NIINA}?

10. {Triin Jörgenit / Jörgenit Triin} usutavasti ei vihka, {Kerstin / Vahurit} aga küll.
{KAS KERSTIN VIHKAB JöRGENIT / KAS TRIIN VIHKAB VAHURIT}?
Possibly Triin doesn't hate Jorgen, but {Kerstin does / she does Vahur}.
{DOES KERSTIN HATE JORGEN / DOES TRIIN HATE VAHUR}?

11. {Marek Emiliat / Emiliat Marek} ehk ei märganud, {Alvar / Piiat} aga küll.
{KAS ALVAR MäRKAS EMILIAT / KAS MAREK MäRKAS PIIAT}?
Marek perhaps didn't notice Emilia, but {Alvar did / he did Piia}.
{DID ALVAR NOTICE EMILIA / DID MAREK NOTICE PIIA}?

12. {Merilin Antonit / Antonit Merilin} tegelikult ei seganud, {Kätlin / Olarit} aga küll.
    {KAS KäTLIN SEGAS ANTONIT / KAS MERILIN SEGAS OLARIT}?
    Merilin actually didn't bother Anton, but {Katlin did / she did Olari}.
    {DID KATLIN BOTHER ANTON / DID MERILIN BOTHER OLARI}?

13. {Kristjan Siretit / Siretit Kristjan} tõesti ei palganud, {Jaanus / Juliat} aga küll.
    Kristjan really didn't hire Siret, but {Jaanus did / he did Julia}.

14. {Susann Kasparit / Kasparit Susann} ehk ei usalda, {Vivian / Raimot} aga küll.
    Susann perhaps doesn't trust Kaspar, but {Vivian does / she does Raimo}.

15. {Hendrik Katret / Katret Hendrik} ilmselt ei maininud, {Oliver / Dianat} aga küll.
    Hendrik apparently didn't mention Katre, but {Oliver did / he did Diana}.

16. {Marleen Villemit / Villemit Marleen} vist ei tea, {Kärt / Ivot} aga küll.
    Marleen probably doesn't know Villem, but {Kart does / she does Ivo}.

17. {Eerik Kerlit / Kerlit Eerik} ilmselgelt ei kuula, {Marten / Lillit} aga küll.
    Eerik clearly doesn't listen to Kerli, but {Marten does / he does to Lilli}.

18. {Kristel Jarmot / Jarmot Kristel} nähtavasti ei mäleta, {Evelin / Henrit} aga küll.
    Kristel apparently doesn't remember Jarmo, but {Evelin does / she does Henri}.

19. {Mehis Annelit / Annelit Mehis} muidugi ei kiusanud, {Robert / Lindat} aga küll.
    Mehis of course didn't tease Anneli, but {Robert did / he did Linda}.

20. {Hedvig Mattiast / Mattiast Hedvig} usutavasti ei suudelnud, {Lilian / Kustit} aga küll.
    Hedvig possibly didn't kiss Mattias, but {Lilian did / she did Kusti}.

21. {Artur Teelet / Teelet Artur} vist ei tänanud, {Janar / Katit} aga küll.
    Artur probably didn't thank Teele, but {Janar did / he did Kati}.

22. {Mariin Tobiast / Tobiast Mariin} ilmselt ei uskunud, {Karmen / Veikot} aga küll.
    Mariin apparently didn't believe Tobias, but {Karmen did / she did Veiko}.

23. {Sander Pilvit / Pilvit Sander} tegelikult ei külasta, {Tõnis / Keiut} aga küll.
    Sander actually doesn't visit Pilvi, but {Tonis does / he does Keiu}.

24. {Eliis Riivot / Riivot Eliis} muidugi ei vältinud, {Mirjam / Taavit} aga küll.
    Eliis of course wasn't avoiding Riivo, but {Mirjam was / she was Taavi}.

APPENDIX C

Experiment 3 Items

The items below are shown in V2 order. In the curly brackets, the first DP is case-ambiguous, the second DP unambiguously Nominative and the third DP unambiguously Accusative/Genitive. Note that even though the common nouns are translated uniformly as definite here for convenience, they are actually bare and not marked for definiteness.

1. Marleen kutsus täna Jaani ja {Kadri / Piret / Inese} ...
   Today Marleen invited Jaan and {Kadri / Piret / Ines} ...

2. Ajakirjanik kutsus alustuseks advokaadi ja {tuletõrjuja / politseinik / jalgratturi} ...
   To begin with, the journalist invited the lawyer and {the fireman / the policeman / the cyclist} ...

3. Ülemus leidis kohe assistendi ja {näitleja / elektrik / juuksuri} ...
   The boss immediately found the assistant and {the actor / the electrician / the hairdresser} ...

4. Kaspar leidis lõpuks Liliti ja {Raimo / Aivar / Hansu} ...
   Eventually Kaspar found Lilit and {Raimo / Aivar / Hans} ...

5. Kerstin palkas vist Katrini ja {Maarika / Liisbet / Hedvigi} ...
   Kerstin probably hired Katrin and {Maarika / Liisbet / Hedvig} ...

6. Firmaomanik palkas kõhklemata sekretäri ja {ehitaja / insener / juristi} ...
   Without doubting, the company owner hired the secretary and {the builder / the engineer / the lawyer} ...

7. Grupijuht kaasas projekti direktori ja {laulja / tudeng / autori} ...
   The group leader involved in the project the director and {the singer / the student / the author} ...

8. Markus kaasas õnneks Hannese ja {Andrei / Joosep / Juhani} ...
   Luckily Markus involved Hannes and {Andrei / Joosep / Juhan} ...

9. Agnes unustas kahjuks Marteni ja {Enriko / Jürgen / Madise} ...
   Unfortunately Agnes forgot Marten and {Enriko / Jurgen / Madis} ...

10. Üürnik unustas ära kelneri ja {koristaja / fotograaf / kunstniku} ...
    The tenant forgot the server and {the cleaner / the photographer / the artist} ...

11. Administraator saatis koju taksojuhi ja {vanaema / talunik / õpilase} ...
    The administrator sent home the taxi driver and {the grandmother / the farmer / the student} ...

12. Olev saatis minema Kärdi ja {Maarja / Sigrid / Heleni} ...
    Olev sent away Kart and {Maarja / Sigrid / Helen} ...

13. Evelin pani paika Alvari ja {Luisa / Iiris / Reeda} ...
    Evelin berated Alvar and {Luisa / Iiris / Reet} ...

14. Klient pani muretsema turvamehe ja {müüja / tütar / lapse} ...
    The client worried the security guard and {the salesperson / the daughter / the child} ...

15. Kirjanik palus appi tudengi ja {ettekandja / klassivend / koolivenna} ...
    The writer asked for help the student and {the server / the classmate / the schoolmate} ...

16. Peeter palus tantsima Dagmari ja {Taavi / Eerik / Reinu} ...
    Peeter asked for a dance Dagmar and {Taavi / Eerik / Rein} ...

17. Üllar viskas välja Vahuri ja {Dmitri / Robert / Tõnise} ...
    Ullar kicked out Vahur and {Dmitri / Robert / Tonis} ...

18. Baarmen viskas välja joodiku ja {punapea / ärimees / turisti} ...
    The barman kicked out the drunk and {the redhead / the businessman / the tourist} ...

19. Minister võttis vastu teadlase ja {linnapea / filosoof / apteekri} ...
    The minister welcomed the scientist and {the mayor / the philosopher / the pharmacist} ...

20. Epp võttis vastu Birgiti ja {Karina / Karmen / Marise} ...
    Epp welcomed Birgit and {Karina / Karmen / Maris} ...

21. Viktor ajas vihaseks Mirjami ja {Johanna / Helerin / Kätlini} ...
    Viktor angered Mirjam and {Johanna / Helerin / Katlin} ...

22. Torumees ajas hulluks aedniku ja {tädi / vend / koka} ...
    The plumber drove mad the gardener and {the aunt / the brother / the cook} ...

23. Praktikant nakatas grippi lapsevanema ja {korrapidaja / ajakirjanik / stjuardessi} ...
    The intern infected with the flu the parent and {the steward / the journalist / the stewardess} ...

24. Eliis nakatas leetritesse Gustavi ja {Eero / Märt / Atsi} ...
    Eliis infected with measles Gustav and {Eero / Mart / Ats} ...

25. Reet viis restorani Hendriku ja {Anneli / Maiken / Airini} ...
    Reet took to the restaurant Hendrik and {Anneli / Maiken / Airin} ...

26. Omanik viis kinno sõbra ja {juhendaja / pensionär / firmajuhi} ...
    The owner took to the movies the friend and {the instructor / the retiree / the director} ...

27. Nooruk sõimas läbi postiljoni ja {ujuja / pagar / tõlgi} ...

    The youth berated the postman and {the swimmer / the baker / the translator} ...

28. Kristjan peksis läbi Oliveri ja {Paavo / Priit / Pauli} ...

    Kristjan beat up Oliver and {Paavo / Priit / Paul} ...

29. Doris päästis uppumast Johannese ja {Henri / Aleks / Koidu} ...

    Doris saved from drowning Johannes and {Henri / Aleks / Koit} ...

30. Kohtunik päästis hädast vanuri ja {kasvataja / inspektor / turvamehe} ...

    The judge saved from trouble the old person and {the kindergarten teacher / the inspector / the security guard} ...

APPENDIX D

Experiment 4 Items

The items below are shown in V2 order, and include both a Single Topic and Two Topic context question. Only one context question was shown per trial. Note that even though the common nouns are translated uniformly as definite here for convenience, they are actually bare and not marked for definiteness. Comprehension questions shown in capital letters.

1. *Single Topic:* Mida Kadri õde Marleen täna tegi?

   Two Topics: Mida Marleen ja Kadri täna tegid?

   Marleen kutsus täna Jaani ja Kadri kellegi {peole / teise} ja kõigil oli väga lõbus.

   KAS NEIL OLI HEA PÄEV? JAH EI

   Single Topic: What did Kadri's sister Marleen do today?

   Two Topics: What did Marleen and Kadri do today?

   Today Marleen invited Jaan and Kadri {to someone's party / someone else} and everybody had lots of fun.

   DID THEY HAVE A GOOD DAY? YES NO

2. *Single Topic:* Kelle onu soovitatud ametnik vestlusele kutsus?

   Two Topics: Kelle ametnik ja onu vestlusele kutsusid?

   Ametnik kutsus alustuseks advokaadi ja onu selle firma {kontorisse / esindaja} ja nad rääkisid pikalt.

   KAS KEEGI KUTSUTI VESTLUSELE? EI JAH

   Single Topic: Who did the official that was recommended by the uncle invite to the discussion?

   Two Topics: Who did the official and the uncle invite to the discussion?

To begin with, the official invited the lawyer and the uncle {to the company's office / this company's representative} and they talked for a while.

WAS SOMEONE INVITED TO A DISCUSSION? NO YES

3. *Single Topic:* Keda näitleja ülemus esimesel tööpäeval kohtas?

   Two Topics: Keda ülemus ja näitleja esimesel tööpäeval kohtasid?

   ülemus leidis kohe assistendi ja näitleja selle teatri {kohvikus / koristaja} ja nad said hästi läbi.

   KAS ESIMENE TÖÖPÄEV MÖÖDUS ÜKSIKULT? EI JAH

   Single Topic: Who did the actor's boss meet on the first workday?

   Two Topics: Who did the boss and the actor meet on the first workday?

   The boss immediately found the assistant and the actor {in the theater's cafe / the theater's janitor} and they got along well.

   WAS THE FIRST DAY AT WORK LONELY? NO YES

4. *Single Topic:* Kelle Annika vend Kaspar lasteaias peitusemängus üles leidis?

   Two Topics: Kelle Kaspar ja Annika lasteaias peitusemängus üles leidsid?

   Kaspar leidis üles Liliti ja Annika selle rühma {tualetist / pesamuna} ja mäng saigi läbi.

   KAS NAD MÄNGISID PIKKA AEGA? JAH EI

   Single Topic: Who did Annika's brother Kaspar find during hide and seek at the kindergarten?

   Two Topics: Who did Kaspar and Annika find during hide and seek at the kindergarten?

   Kaspar found Lilit and Annika {in the playgroup's toilet / this playgroup's youngest} and the game was over.

   DID THEY PLAY FOR A LONG TIME? YES NO

5. *Single Topic:* Kelle Maarika nõbu Kerstin juubelit korraldama palkas?

   Two Topics: Kelle Kerstin ja Maarika juubelit korraldama palkasid?

   Kerstin palkas vist Katrini ja Maarika selle juubilari {üllatuseks / kolleegid} ja sündmus

oli edukas.

MIDA NAD KORRALDASID? JUUBELIT PULMI

Single Topic: Who did Maarika's niece Annika hire to organize the jubilee?

Two Topics: Who did Kerstin and Maarika hire to organize the jubilee?

Kerstin probably hired Katrin and Maarika {to the birthday person's surprise / the birthday person's colleagues} and the event was a success.

WHAT WERE THEY ORGANIZING? A JUBILEE A WEDDING

6. *Single Topic:* Kelle ehitaja sõbrast firmaomanik tööle palkas?

   Two Topics: Kelle firmaomanik ja ehitaja tööle palkasid?

   Firmaomanik palkas tööle sekretäri ja ehitaja kellegi {soovitusel / sugulase} ja mõlemad olid väga töökad.

   KES PALGATI TÖÖLE? FIRMAOMANIK SEKRETÄR

   Single Topic: Who did the builder's friend the company owner hire for the job?

   Two Topics: Who did the company owner and the builder hire for the job?

   The company owner hired the secretary and the builder {based on somebody's recommendation / somebody's relative} and both were good workers.

   WHO WAS HIRED? THE COMPANY OWNER THE SECRETARY

7. *Single Topic:* Keda laulja tuttav grupijuht projektis osalema kutsus?

   Two Topics: Keda grupijuht ja laulja projektis osalema kutsusid?

   Grupijuht kaasas projekti direktori ja laulja kellegi {algatusel / abikaasa} ja asjad laabusid hästi.

   KES OSALES PROJEKTIS? LAULJA VIIULDAJA

   Single Topic: Who did the singer's acquaintance the group leader invite to participate in the project?

   Two Topics: Who did the group leader and the singer invite to participate in the project?

   The group leader involved the director and the singer {based on somebody's initiative / somebody's spouse} in the project and things worked out well.

WHO PARTICIPATED IN THE PROJECT? A SINGER A VIOLINIST

8. *Single Topic:* Kelle Andrei sõber Markus intervjuu filmimisse kaasas?

   Two Topics: Kelle Markus ja Andrei intervjuu filmimisse kaasasid?

   Markus kaasas õnneks Hannese ja Andrei selle saate {lindistamisse / helitehniku} ja neist oli palju abi.

   MIS SÕNAGA VÕIKS FILMIMIST KIRJELDADA? EBAÕNNESTUNUD EDUKAS

   Single Topic: Who did Andrei's friend Markus involve in filming the interview?

   Two Topics: Who did Markus and Andrei involve in filming the interview?

   Luckily Margus involved Hannes and Andrei {in taping the show / this show's sound technician} and they were of great help.

   WHICH WORD DESCRIBES THE FILMING? FAILED SUCCESSFUL

9. *Single Topic:* Keda Enriko abikaasa Agnes tänada unustas?

   Two Topics: Keda Agnes ja Enriko tänada unustasid?

   Agnes unustas kahjuks Marteni ja Enriko selle peo {meeleolus / korraldaja} ja see oli väga kahetsusväärne.

   MIS SÕNAGA VÕIKS TOIMUNUT KIRJELDADA? KURB SUUREPÄRANE

   Single Topic: Who did Enriko's wife Agnes forget to thank?

   Two Topics: Who did Agnes and Enriko forget to thank?

   Agnes unfortunately forgot Marten and Enriko {in the business of the party / this party's organizer} and it was extremely regrettable.

   WHICH WORD DESCRIBES WHAT HAPPENED? SAD GREAT

10. *Single Topic:* Kellele koristaja leitud üürnik maksta unustas?

    Two Topics: Kellele üürnik ja koristaja maksta unustasid?

    üürnik unustas ära kelneri ja koristaja kellegi {sõnul / teise} ja nad olid üsna pahased.

    MIDA UNUSTATI TEHA? KORISTADA MAKSTA

    Single Topic: Who did the tenant found by the cleaner forget to pay?

    Two Topics: Who did the tenant and the cleaner forget to pay?

    The tenant forgot the waiter and the the cleaner {according to someone / someone

else} and they were quite upset.

WHAT DID THEY FORGET TO DO? CLEAN PAY

11. *Single Topic:* Kelle vanaemaga rääkinud administraator koju saatis?

    Two Topics: Kelle administraator ja vanaema koju saatsid?

    Administraator saatis koju taksojuhi ja vanaema kellegi {autoga / lapsed} ja peagi läkski pimedaks.

    KUHU TAKSOJUHT LÄKS? KOJU TÖÖLE

    Single Topic: Who did the administrator that had spoken to the grandmother send home?

    Two Topics: Who did the administrator and the grandmother send home?

    The administrator sent home the taxi driver and the grandmother {on somebody's car / somebody's children} and it soon got dark.

    WHERE DID THE TAXI DRIVER GO? HOME WORK

12. *Single Topic:* Kelle Maarja tuttav Olev minema saatis?

    Two Topics: Kelle Olev ja Maarja minema saatsid?

    Olev saatis minema Kärdi ja Maarja selle grupi {koosolekult / eestvedaja} ja terve grupp lahkus.

    KUIDAS GRUPP KÄITUS? TÄHELEPANEMATULT SOLIDAARSELT

    Single Topic: Who did Maarja's acquaintance Olev send away?

    Two Topics: Who did Olev and Maarja send away?

    Olev sent away Kart and Maarja {from the group's meeting / this group's leader} and the whole group left.

    HOW DID THE GROUP BEHAVE? ABSENTMINDEDLY IN SOLIDARITY

13. *Single Topic:* Kellele Luisa kolleeg Evelin halvasti ütles?

    Two Topics: Kellele Evelin ja Luisa halvasti ütlesid?

    Evelin pani paika Alvari ja Luisa kellegi {kuuldes / abilise} ja sellest tuli suur skandaal.

    MIDA LAUSES KIRJELDATI? EBAVIISAKAT KÄITUMIST MEELDIVAT VESTLUST

    Single Topic: Who did Luisa's colleague Evelin insult?

Two Topics: Who did Evelin and Luisa insult?

Evelin gave a piece of her mind to Alvar and Luisa {with someone overhearing / someone's assistant} and it gave rise to a big scandal.

WHAT WAS DESCRIBED IN THE SENTENCE? IMPOLITE BEHAVIOR A PLEASANT CONVERSATION

14. *Single Topic:* Kelles müüja klient muret tekitas?

    Two Topics: Kelles klient ja müüja muret tekitasid?

    Klient pani muretsema turvamehe ja müüja selle poe {sabas / omaniku} ja kogu kaup tuli riiulitele tagasi laduda.

    KUS KIRJELDATU TOIMUS? TÄNAVAL POES

    Single Topic: Who did the client of the salesperson upset?

    Two Topics: Who did the client and the salesperson upset?

    The client worried the security guard and the salesperson {in the line of the store / this store's owner} and all of the products had to be put back on the shelves.

    WHERE DID THIS HAPPEN? ON THE STREET IN THE STORE

15. *Single Topic:* Kellelt ettekandja sõbrast kirjanik abi palus?

    Two Topics: Kellelt kirjanik ja ettekandja abi palusid?

    Kirjanik palus appi tudengi ja ettekandja selle restorani {fuajees / peakoka} ja probleem lahendati koos.

    MIDA KIRJANIKUL VAJA OLI? ABIKÄSI RAHU JA VAIKUST

    Single Topic: Who did the server's friend the writer ask for help?

    Two Topics: Who did the writer and the server ask for help?

    The writer asked for help the student and the server {in the foyer of the restaurant / this restaurant's head chef} and the problem was solved together.

    WHAT DID THE WRITER NEED? HELP PEACE AND QUIET

16. *Single Topic:* Kelle Jaana vend Peeter tantsima palus?

    Two Topics: Kelle Peeter ja Jaana tantsima palusid?

    Peeter palus tantsima Dagmari ja Jaana kellegi {nähes / teise} ja lõpuks tuli ka muud

rahvast tantsima.

Single Topic: Who did Jaana's brother Peeter ask for a dance?

Two Topics: Who did Peeter and Jaana ask for a dance?

Peeter invited to dance Dagmar and Jaana {in front of someone / someone else} and eventually other people came to dance too.

17. *Single Topic:* Kelle Dmitri semu üllar loengust välja viskas?

    Two Topics: Kelle üllar ja Dmitri loengust välja viskasid?

    üllar viskas välja Vahuri ja Dmitri kellegi {nõudmisel / lobiseja} ja siis said kõik paremini keskenduda.

    Single Topic: Who did Dmitri's buddy Ullar kick out of the lecture?

    Two Topics: Who did Ullar and Dmitri kick out of the lecture?

    Ullar kicked out Vahur and Dmitri {upon somebody's request / somebody who was chatting} and then everybody was able to focus much better.

18. *Single Topic:* Kelle pidi punapeaga rääkinud baarmen baarist välja viskama?

    Two Topics: Kelle pidid baarmen ja punapea baarist välja viskama?

    Baarmen viskas välja joodiku ja punapea selle õhtu {lõpus / esineja} ja vägagi diskreetselt.

    Single Topic: Who did the barman who spoke to the redhead have to kick out of the bar?

    Two Topics: Who did the barman and the redhead have to kick out of the bar?

    The barman kicked out the drunk and the redhead {at the end of this night / this night's performer} and rather discreetly.

19. *Single Topic:* Keda linnapea kolleegist minister vastu võttis?

    Two Topics: Keda minister ja linnapea vastu võtsid?

    Minister võttis vastu teadlase ja linnapea selle linna {raekojas / pensionäre} ja üritust kajastati meedias.

    Single Topic: Who did the colleague of the mayor the minister welcome?

    Two Topics: Who did the minister and the mayor welcome?

The minister welcomed the scientist and the mayor {in the town hall of the city / this city's retirees} and the event was covered by the media.

20. *Single Topic:* Keda Karina sõbranna Epp lennujaamas vastu võttis?

    Two Topics: Keda Epp ja Karina lennujaamas vastu võtsid?

    Epp võttis vastu Birgiti ja Karina kellegi {palvel / vanemad} ja neil oli hea meel üksteist näha.

    Single Topic: Who did Karina's friend Epp greet at the airport?

    Two Topics: Who did Epp and Karina greet at the airport?

    Epp welcomed Birgit and Karina {upon somebody's request / somebody's parents} and they were happy to see each other.

21. *Single Topic:* Keda Johanna abikaasa Viktor vihastas?

    Two Topics: Keda Viktor ja Johanna vihastasid?

    Viktor ajas vihaseks Mirjami ja Johanna selle pere {suvilas / lapsed} ja kõik mossitasid pikka aega.

    Single Topic: Who did Johanna's husband Viktor anger?

    Two Topics: Who did Viktor and Johanna anger?

    Viktor angered Mirjam and Johanna {at the family's summer home / the family's children} and everybody was upset for a long time.

22. *Single Topic:* Keda tädi palgatud torumees ärritas?

    Two Topics: Keda torumees ja tädi ärritasid?

    Torumees ajas hulluks aedniku ja tädi kellegi {nähes / tütre} ja remont jäigi pooleli.

    Single Topic: Who did the plumber hired by the aunt annoy?

    Two Topics: Why did the plumber and the aunt annoy?

    The plumber drove mad the gardener and the aunt {in front of somebody / somebody's daughter} and the repairs went unfinished.

23. *Single Topic:* Kelle korrapidaja praktikant grippi nakatas?

    Two Topics: Kelle praktikant ja korrapidaja grippi nakatasid?

Praktikant nakatas grippi valvuri ja korrapidaja selle kooli {aktusel / direktori} ja kogu kool haigestus.

Single Topic: Who did the steward's intern give the flu to?

Two Topics: Who did the intern and the steward give the flu to?

The intern infected with the flu the guard and the steward {at the school's reception / the school's headmaster} and the whole school got sick.

24. *Single Topic:* Keda Eero sõber Eliis leetritesse nakatas?

    Two Topics: Keda Eliis ja Eero leetritesse nakatasid?

    Eliis nakatas leetritesse Gustavi ja Eero kellegi {sünnipäeval / vanavanemad} ja see oli üsna tõsine.

    Single Topic: Who did Eero's friend Eliis give measles to?

    Two Topics: Who did Eliis and Eero give measles to?

    Eliis infected with measles Gustav and Eero {at someone's birthday party / someone's parents} and it was quite serious.

25. *Single Topic:* Kelle Anneli õde Reet sünnipäeva puhul restorani viis?

    Two Topics: Kelle Reet ja Anneli sünnipäeva puhul restorani viisid?

    Reet viis restorani Hendriku ja Anneli kellegi {väitel / venna} ja kõik tellisid magustoitu.

    Single Topic: Who did Anneli's sister Reet take to a restaurant for a birthday?

    Two Topics: Who did Reet and Anneli take to a restaurant for a birthday?

    Reet took to the restaurant Hendrik and Anneli {according to someone / someone's brother} and everybody ordered dessert.

26. *Single Topic:* Kellega juhendaja tuttavast kohviku omanik kinos käis?

    Two Topics: Kellega kohviku omanik ja juhendaja kinos käisid?

    Omanik viis kinno sõbra ja juhendaja selle kohviku {sulgedes / töötajad} ja neil oli üsna lõbus.

    Single Topic: Who did the instructor's acquaintance the cafe owner go to the movies with?

Two Topics: Who did the cafe owner and the instructor go to the movies with?

The owner took to the movies the friend and the instuctor {when the cafe closed / this cafe's employees} and they had quite a bit of fun.

27. *Single Topic:* Kellega ujuja treenitud nooruk ebaviisakalt käitus?

    Two Topics: Kellega nooruk ja ujuja ebaviisakalt käitusid?

    Nooruk sõimas läbi postiljoni ja ujuja kellegi {kuuldes / külalise} ja kõigil oli äärmiselt ebamugav.

    Single Topic: Who did the youth trained by the swimmer act rudely with?

    Two Topics: Who did the youth and the swimmer act rudely with?

    The youth berated the postman and the swimmer {within someone's earshot / someone's guest} and it was extremely uncomfortable for everyone.

28. *Single Topic:* Kellele Paavo klassivend Kristjan kallale läks?

    Two Topics: Kellele Kristjan ja Paavo kallale läksid?

    Kristjan peksis läbi Oliveri ja Paavo kellegi {hoovis / teise} ja seepeale kutsuti politsei.

    Single Topic: Who did Paavo's classmate Kristjan attack?

    Two Topics: Who did Kristjan and Paavo attack?

    Kristjan beat up Oliver and Paavo {in someone's courtyard someone else} and the police were called.

29. *Single Topic:* Kelle Henri sõbranna Doris basseinist välja tõmbas?

    Two Topics: Kelle Doris ja Henri basseinist välja tõmbasid?

    Doris päästis uppumast Johannese ja Henri kellegi {toel / muu} ja õnneks oli kohal ka arst.

    Single Topic: Who did Henri's friend Doris pull out of the pool?

    Two Topics: Who did Doris and Henri pull out of the pool?

    Doris saved from drowning Johannes and Henri {with someone's assistance / someone else} and luckily a doctor was present too.

30. *Single Topic:* Keda kasvataja tuttavast kohtunik aitas?

Two Topics: Keda kohtunik ja kasvataja aitasid?

Kohtunik päästis hädast väravavahi ja kasvataja selle meeskonna {trennis / kapteni} ja kõik vigastused vaadati üle.

Single Topic: Who did the kindergarten teacher's acquaintance the referee help?

Two Topics: Who did the referee and the kindergarten teacher help?

The referee saved from trouble the goalkeeper and the kindergarten teacher {at the team's practice / the team's captain} and all injuries were checked out.

Bibliography

Altmann, G. T. M. (1994). Regression-contingent analyses of eye movements during sentence processing: Reply to Rayner and Sereno. Memory & Cognition, 22(3):286–290.

Altmann, G. T. M., Garnham, A., and Dennis, Y. (1992). Avoiding the garden path: Eye movements in context. Journal of Memory and Language, 31(5):685–712.

Altmann, G. T. M. and Steedman, M. (1988). Interaction with context during human sentence processing. Cognition, 30(3):191–238.

Arnold, J. E. (2010). How speakers refer: The role of accessibility. Language and Linguistics Compass, 4(4):187–203.

Asbach-Schnitker, B. (1979). The adversative connectors, however, but and but after negated sentences. The particles of the German language, pages 457–468.

Bader, M. (1998). Prosodic influences on reading syntactically ambiguous sentences. In Reanalysis in sentence processing, pages 1–46. Springer.

Bader, M. and Meng, M. (1999). Subject-object ambiguities in german embedded clauses: An across-the-board comparison. Journal of Psycholinguistic Research, 28(2):121–143.

Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. Journal of Statistical Software, 67(1):1–48.

Beaver, D. I. (1997). Presupposition. In Handbook of logic and language, pages 939–1008. Elsevier.

Beaver, D. I., Roberts, C., Simons, M., and Tonhauser, J. (2017). Questions under discussion: Where information structure meets projective content. Annual Review of Linguistics, 3:265–284.

Belletti, A. and Rizzi, L. (1988). Psych-verbs and θ-theory. Natural Language & Linguistic Theory, pages 291–352.

Bîlbîie, G. (2019). Ellipsis and information structure: Evidence from Romanian gapping. Bucharest Working Papers in Linguistics, 2(24):81–100.

Blevins, J. P. (2006). Word-based morphology. Journal of Linguistics, pages 531–573.

Bornkessel, I., Schlesewsky, M., and Friederici, A. D. (2002). Grammar overrides frequency: Evidence from the online processing of flexible word order. Cognition, 85(2):B21–B30.

Bott, L. and Noveck, I. A. (2004). Some utterances are underinformative: The onset and time course of scalar inferences. Journal of memory and language, 51(3):437–457.

Breen, M. (2014). Empirical investigations of the role of implicit prosody in sentence processing. Language and Linguistics Compass, 8(2):37–50.

Breen, M. and Clifton, C. (2011). Stress matters: Effects of anticipated lexical stress on silent reading. Journal of memory and language, 64(2):153–170.

Büring, D. (1997). The great scope inversion conspiracy. Linguistics and philosophy, pages 175–194.

Büring, D. (2003). On D-trees, beans, and B-accents. Linguistics and philosophy, 26(5):511–545.

Büring, D. (2016). Intonation and meaning. Oxford University Press.

Burmester, J., Spalek, K., and Wartenburger, I. (2014). Context updating during sentence comprehension: The effect of aboutness topic. Brain and language, 137:62–76.

Bybee, J. and Thompson, S. (1997). Three frequency effects in syntax. In Annual Meeting of the Berkeley Linguistics Society, volume 23, pages 378–388.

Carlson, K. (2001). The effects of parallelism and prosody in the processing of gapping structures. Language and Speech, 44(1):1–26.

Carlson, K. (2013). Parallelism and prosody in the processing of ellipsis sentences. Routledge.

Carlson, K. (2014). Predicting contrast in sentences with and without focus marking. Lingua, 150:78–91.

Carlson, K., Dickey, M. W., Frazier, L., and Clifton, C. (2009). Information structure expectations in sentence comprehension. Quarterly Journal of Experimental Psychology, 62(1):114–139.

Carlson, K. and Tyler, J. C. (2018). Accents, not just prosodic boundaries, influence syntactic attachment. Language and speech, 61(2):246–276.

Chafe, W. (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. Subject and topic.

Chomsky, N. (1982). Some concepts and consequences of the theory of government and binding. Cambridge, Massachusetts: M.I.T. Press.

Chomsky, N. (1993). Lectures on government and binding: The Pisa lectures. Number 9. Walter de Gruyter.

Chomsky, N. (2000). Minimalist inquiries: The framework. Step by step: Essays on minimalist syntax in honor of Howard Lasnik, pages 89–155.

Cinque, G. (1993). A null theory of phrase and compound stress. Linguistic Inquiry, 24(2):239–297.

Citko, B. (2018). On the relationship between forward and backward gapping. Syntax, 21(1):1–36.

Clifton, C. and Ferreira, F. (1989). Ambiguity in context. Language and cognitive processes, 4(3-4):SI77–SI103.

Clifton, C. and Frazier, L. (1998). Comprehension of sluiced sentences. Language and Cognitive Processes, 13(4):499–520.

Clifton, C. and Staub, A. (2008). Parallelism and competition in syntactic ambiguity resolution. Language and Linguistics Compass, 2(2):234–250.

Constant, N. (2014). Contrastive topic: Meanings and realizations. PhD thesis, University of Massachusetts Amherst.

Crain, S. and Steedman, M. (1985). On not being led up the garden path: The use of context by the psychological syntax processor. Natural language parsing: Psychological, computational, and theoretical perspectives, pages 320–358.

Cuetos, F. and Mitchell, D. C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the Late Closure strategy in Spanish. Cognition, 30(1):73–105.

Cutter, M. G., Martin, A. E., and Sturt, P. (2019). Capitalization interacts with syntactic complexity. Journal of Experimental Psychology: Learning, Memory, and Cognition.

Dascal, M. and Katriel, T. (1977). Between semantics and pragmatics: The two types of 'but' – Hebrew 'aval' and 'ela'. Theoretical linguistics, 4(1-3):143–172.

Davison, A. (1984). Syntactic markedness and the definition of sentence topic. Language, pages 797–846.

Degen, J. and Tanenhaus, M. K. (2015). Processing scalar implicature: A constraint-based approach. Cognitive science, 39(4):667–710.

Dillon, B., Frazier, L., and Clifton, C. (2018). No longer an orphan: evidence for appositive attachment from sentence comprehension. Glossa, 3(1).

Dixon, W. J. and Tukey, J. W. (1968). Approximate behavior of the distribution of Winsorized t (Trimming/Winsorization 2). Technometrics, 10(1):83–98.

Drummond, A. (2013). Ibex farm. Online server: http://spellout. net/ibexfarm.

Dryer, M. S. (2005). Order of subject, object, and verb. The world atlas of language structures, ed. by Martin Haspelmath et al.

Eberhard, K. M., Spivey-Knowlton, M. J., Sedivy, J. C., and Tanenhaus, M. K. (1995). Eye movements as a window into real-time spoken language comprehension in natural contexts. Journal of psycholinguistic research, 24(6):409–436.

Ehala, M. (2006). The word order of Estonian: Implications to universal language. Journal of Universal Language, 7(1):49–89.

Engelhardt, P. E. and Ferreira, F. (2010). Processing coordination ambiguity. Language and speech, 53(4):494–509.

Ferreira, F., Bailey, K. G., and Ferraro, V. (2002). Good-enough representations in language comprehension. Current directions in psychological science, 11(1):11–15.

Féry, C. and Ishihara, S. (2016). The Oxford handbook of information structure. Oxford University Press.

Filik, R., Paterson, K. B., and Liversedge, S. P. (2009). The influence of only and even on online semantic interpretation. Psychonomic Bulletin & Review, 16(4):678–683.

Fodor, J. D. (1998). Learning to parse? Journal of Psycholinguistic Research, 27(2):285–319.

Fodor, J. D. (2002). Psycholinguistics cannot escape prosody. In Speech Prosody 2002, International Conference.

Fraundorf, S. H., Watson, D. G., and Benjamin, A. S. (2010). Recognition memory reveals just how contrastive contrastive accenting really is. Journal of memory and language, 63(3):367–386.

Frazier, L. (1987a). Sentence processing: A tutorial review. Lawrence Erlbaum Associates, Inc.

Frazier, L. (1987b). Syntactic processing: evidence from Dutch. Natural Language & Linguistic Theory, 5(4):519–559.

Frazier, L. and Clifton, C. (1996). Construal. Cambridge, Massachusetts: M.I.T. Press.

Frazier, L., Clifton, C., and Randall, J. (1983). Filling gaps: Decision principles and structure in sentence comprehension. Cognition, 13(2):187–222.

Frazier, L. and Fodor, J. D. (1978). The sausage machine: A new two-stage parsing model. Cognition, 6(4):291–325.

Frazier, L., Munn, A., and Clifton, C. (2000). Processing coordinate structures. Journal of Psycholinguistic Research, 29(4):343–370.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. Cognition, 68(1):1–76.

Ginzburg, J. and Sag, I. (2000). Interrogative investigations. Stanford: CSLI publications.

Gorrell, P. (2000). The subject-before-object preference in German clauses. In German sentence processing, pages 25–63. Springer.

Gotzner, N. (2017). Alternative sets in language processing: How focus alternatives are represented in the mind. Springer.

Gotzner, N., Spalek, K., and Wartenburger, I. (2013). How pitch accents and focus particles affect the recognition of contextual alternatives. In Proceedings of the Annual Meeting of the Cognitive Science Society, volume 35.

Grice, H. P. (1975). Logic and conversation. In Speech acts, pages 41–58. Brill.

Grimshaw, J. (1990). Argument structure. Cambridge, Massachusetts: M.I.T. Press.

Gundel, J. K. (1988). Universals of topic-comment structure. Studies in syntactic typology, 17(1):209–239.

Hakulinen, A. and Keevallik, L. (2016). Suomen ja viron kyl(lä)/küll ja kieltolausen sanajärjestys.[Finnish and Estonian kyl(lä)/küll and the word order of negative clauses.]. Lähivõrdlusi. Lähivertailuja, 26:84–126.

Han, C.-H. (1998). Asymmetry in the interpretation of-(n)un in Korean. Japanese/Korean Linguistics, 7:1–15.

Hara, Y. (2006). Implicature unsuspendable: Japanese contrastive *wa*. Proceedings of Texas Linguistics Society, 8:35–45.

Harris, J. A. (2015). Structure modulates similarity-based interference in sluicing: An eye tracking study. Frontiers in psychology, 6:1839.

Harris, J. A. (2019). Alternatives on demand and locality: Resolving discourse-linked wh-phrases in sluiced structures. In Grammatical Approaches to Language Processing, pages 45–75. Springer.

Harris, J. A. and Carlson, K. (2018). Information structure preferences in focus-sensitive ellipsis: How defaults persist. Language and speech, 61(3):480–512.

Harris, J. A., Jun, S.-A., and Royer, A. J. (2016). Implicit prosody pulls its weight: Recovery from garden path sentences. In Speech Prosody, volume 2016, pages 207–211.

Harris, J. A., Lawn, A., and Kaps, M. (2019). Investigating sound and structure in concert: A pupillometry study of relative clause attachment. In CogSci, pages 1880–1886.

Hedberg, N. (2006). Topic-focus controversies. The architecture of focus, pages 373–397.

Henk, P. (2010). Information structure of Estonian – Compared to Finnish and Hungarian. Publications of the Institute of Cognitive Science, 6.

Hiietam, K. (2004). Case marking in Estonian grammatical relations. Leeds working papers in linguistics and phonetics, 10.

Hirotani, M., Frazier, L., and Rayner, K. (2006). Punctuation and intonation effects on clause and sentence wrap-up: Evidence from eye movements. Journal of Memory and Language, 54(3):425–443.

Hoeks, J. C., Hendriks, P., Vonk, W., Brown, C. M., and Hagoort, P. (2006). Processing the noun phrase versus sentence coordination ambiguity: Thematic information does not completely eliminate processing difficulty. Quarterly Journal of Experimental Psychology, 59(9):1581–1599.

Hoeks, J. C. J., Vonk, W., and Schriefers, H. (2002). Processing coordinated structures in context: The effect of topic-structure on ambiguity resolution. Journal of Memory and Language, 46(1):99–119.

Holmberg, A. (2015). Verb second. Syntax–theory and analysis. An international handbook of contemporary syntactic research, pages 342–383.

Holmberg, A., Sahkai, H., and Tamm, A. (2020). Prosody distinguishes Estonian V2 from Finnish and Swedish. In Proc. 10th International Conference on Speech Prosody 2020, pages 439–443.

Horvath, J. (1986). Focus in the Theory of Grammar and the Syntax of Hungarian. Foris. Dordrecht.

Huang, Y. T. and Snedeker, J. (2009). Online interpretation of scalar quantifiers: Insight into the semantics–pragmatics interface. Cognitive psychology, 58(3):376–415.

Hujanen, J. H. H. (1997). Effects of case marking and word order on sentence parsing in Finnish: An eye fixation analysis. The Quarterly Journal of Experimental Psychology: Section A, 50(4):841–858.

Husband, E. M. and Ferreira, F. (2016). The role of selection in the comprehension of focus alternatives. Language, Cognition and Neuroscience, 31(2):217–235.

Ippolito, M. (2008). On the meaning of *only*. Journal of Semantics, 25(1):45–91.

Jackendoff, R. S. (1972). Semantic interpretation in generative grammar. Cambridge, Massachusetts: M.I.T. Press.

Just, M. A. and Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. Psychological review, 87(4):329.

Kaalep, H.-J. and Muischnek, K. (2002). Eesti kirjakeele sagedussõnastik [The frequency dictionary of written Estonian]. Tartu Ülikool [University of Tartu].

Kaiser, E. (2006). Negation and the left periphery in Finnish. Lingua, 116(3):314–350.

Kaiser, E. (2010). Effects of contrast on referential form: Investigating the distinction between strong and weak pronouns. Discourse Processes, 47(6):480–509.

Kaiser, E., Miljan, M., and Vihman, V. (2020). Estonian speakers' representation of morphological case: Implications for Case/Agree. In Bárány, A. and Kalin, L., editors, Case, Agreement, and their Interactions: New perspectives on differential argument marking, pages 301–348. De Gruyter.

Kaiser, E. and Trueswell, J. C. (2004). The role of discourse context in the processing of a flexible word-order language. Cognition, 94(2):113–147.

Kaps, M. (2019). Licensing SOV in Estonian: A naturalness rating study. In Ronai, E., Stigliano, L., and Sun, Y., editors, Proceedings of the Fifty-Fourth Annual Meeting of the Chicago Linguistic Society, pages 211–224. CLS.

Kaps, M. (2020). Closest conjunct agreement in replacives: Experimental evidence from Estonian. Proceedings of the Linguistic Society of America, 5(1):643–654.

Kaps, M., Lawn, A., and Harris, J. A. (2019). Delayed attachment commitments for parenthetical relative clauses: An eye-tracking study. Talk presented at the 32nd CUNY Conference on Human Sentence Processing, Boulder, CO.

Keenan, E. L. (1971). Names, quantifiers, and the sloppy identity problem. Research on Language & Social Interaction, 4(2):211–232.

Kilgi, A. (2009). ESTONICA – Encyclopedia about Estonia. `http://www.estonica.org/en/Society/The_Estonian_Language/Estonian_in_a_world_context/`.

Kim, C. (2012). Generating alternatives: Interpreting focus in discourse. PhD thesis, University of Rochester.

Kim, C. S. (2019). Focus. In Cummins, C. and Katsos, N., editors, The Oxford Handbook of Experimental Semantics and Pragmatics, pages 418–435. Oxford University Press.

Kiss, K. É. (1998). Identificational focus versus information focus. Language, 74(2):245–273.

Kiss, K. É. (2002). The syntax of Hungarian. Cambridge University Press.

Knoeferle, P. and Crocker, M. W. (2007). The influence of recent scene events on spoken comprehension: Evidence from eye movements. Journal of Memory and Language, 57(4):519–543.

Knoeferle, P., Crocker, M. W., Scheepers, C., and Pickering, M. J. (2005). The influence of the immediate visual context on incremental thematic role-assignment: Evidence from eye-movements in depicted events. Cognition, 95(1):95–127.

Konietzko, A. and Winkler, S. (2010). Contrastive ellipsis: Mapping between syntax and information structure. Lingua, 120(6):1436–1457.

Kratzer, A. and Selkirk, E. (2020). Deconstructing information structure. Glossa: a journal of general linguistics, 5(1).

Krifka, M. (1992). A compositional semantics for multiple focus constructions. In Informationsstruktur und grammatik, pages 17–53. Springer.

Krifka, M. (1998). Additive particles under stress. In Semantics and Linguistic Theory, volume 8, pages 111–128.

Krifka, M. (2008). Basic notions of information structure. Acta Linguistica Hungarica, 55(3-4):243–276.

Kristensen, L. B., Engberg-Pedersen, E., and Poulsen, M. (2014). Context improves comprehension of fronted objects. Journal of Psycholinguistic Research, 43(2):125–140.

Kuno, S. (1973). The structure of the Japanese language. Cambridge, Massachusetts: M.I.T. Press.

Kuperberg, G. R. and Jaeger, T. F. (2016). What do we mean by prediction in language comprehension? Language, cognition and neuroscience, 31(1):32–59.

Lakoff, G. (1976). Pronouns and reference. In McCawley, J. D., editor, Syntax and Semantics, pages 275–335. Academic Press, New York, NY.

Lawn, A. (2020). The Varying Roles of Morphosyntax in Memory and Sentence Processing: Retrieval and Encoding Interference in Brazilian Portuguese. PhD thesis, UCLA.

Lee, C. (1999). Contrastive topic: a locus of the interface–evidence from Korean and English. The semantics/pragmatics interface from different points of view, 1:317–342.

Lee, C. (2003). Contrastive topic and/or contrastive focus. Japanese/Korean Linguistics, 12:352–364.

Lee, J.-M. and Lee, J.-H. (2005). Contrastive information processing in discourse comprehension. Korean Journal of Cognitive Science, 16(2):1–24.

Lenth, R. (2019). emmeans: Estimated Marginal Means, aka Least-Squares Means. R package version 1.3.4.

Lindström, L. (2001). Verb-initial clauses in narrative. Estonian: Typological studies V.(Tartu ülikooli eesti keele õppetooli toimetised 18), pages 138–168.

Lindström, L. (2005). Sõnajärg ja seda mõjutavad tegurid suulises eesti keeles. PhD thesis, University of Tartu, Estonia.

Long, D. L. and Prat, C. S. (2008). Individual differences in syntactic ambiguity resolution: Readers vary in their use of plausibility information. Memory & Cognition, 36(2):375–391.

MacDonald, M. C., Pearlmutter, N. J., and Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. Psychological review, 101(4):676.

McElree, B. and Bever, T. G. (1989). The psychological reality of linguistically defined gaps. Journal of Psycholinguistic Research, 18(1):21–35.

Merchant, J. (2001). The syntax of silence: Sluicing, islands, and the theory of ellipsis. Oxford University Press on Demand.

Merchant, J. (2009). Ellipsis: A survey of analytical approaches. In The Oxford Handbook of Ellipsis. Oxford University Press.

Miyake, A., Just, M. A., and Carpenter, P. A. (1994). Working memory constraints on the resolution of lexical ambiguity: Maintaining multiple interpretations in neutral contexts. Journal of memory and language, 33(2):175–202.

Molnár, V. (1998). On the syntax, phonology, semantics and pragmatics of the so-called "contrastive topic" in Hungarian and German. Acta Linguistica Hungarica, 45(1-2):89–166.

Molnár, V. (2002). Contrast – from a contrastive perspective. In Information structure in a cross-linguistic perspective, pages 147–161. Brill Rodopi.

Molnár, V. and Winkler, S. (2010). Edges and gaps: Contrast at the interfaces. Lingua, 120(6):1392–1415.

Momma, S. and Ferreira, V. S. (2019). Beyond linear order: The role of argument structure in speaking. Cognitive psychology, 114:101228.

Morris, A. (2008). Polarity ellipsis and negative stripping. Unpublished manuscript. `http://babel.ucsc.edu/~hank/PolarityEllipsisandNegStripping.pdf`.

Nakamura, C., Arai, M., and Mazuka, R. (2012). Immediate use of prosody and context in predicting a syntactic structure. Cognition, 125(2):317–323.

Nakamura, C., Harris, J. A., and Jun, S.-A. (2019). Listeners' beliefs influence prosodic adaptation: Anticipatory use of contrastive accent during visual search. In Proceeding of the 19th International Congress of Phonetic Sciences.

Ni, W., Crain, S., and Shankweiler, D. (1996). Sidestepping garden paths: Assessing the contributions of syntax, semantics and plausibility in resolving ambiguities. Language and Cognitive Processes, 11(3):283–334.

Noveck, I. A. (2001). When children are more logical than adults: Experimental investigations of scalar implicature. Cognition, 78(2):165–188.

Omaki, A., Lau, E. F., Davidson White, I., Dakan, M. L., Apple, A., and Phillips, C. (2015). Hyper-active gap filling. Frontiers in psychology, 6:384.

Oshima, D. (2005). Morphological vs. phonological contrastive topic marking. In Proceedings from the Annual Meeting of the Chicago Linguistic Society, volume 41, pages 371–384. Chicago Linguistic Society.

Özkan Grigoraş, S. (2020). Word Order and Information Structure in Turkish. PhD thesis, UCLA.

Pablos, L., Doetjes, J., Ruijgrok, B. J., and Cheng, L. L. S. (2019). Backward licensing of negative polarity items in Dutch: An ERP investigation. Journal of Neurolinguistics, 51:96–110.

Pajusalu, R. (2009). Pronouns and reference in Estonian. STUF-Language Typology and Universals Sprachtypologie und Universalienforschung, 62(1-2):122–139.

Park, S.-H. (2016). Towards a qud-based analysis of gapping constructions. In Proceedings of the 30th Pacific Asia Conference on Language, Information and Computation: Oral Papers, pages 297–305.

Paterson, K. B., Liversedge, S. P., Filik, R., Juhasz, B. J., White, S. J., and Rayner, K. (2007). Focus identification during sentence comprehension: Evidence from eye movements. Quarterly Journal of Experimental Psychology, 60(10):1423–1445.

Pearlmutter, N. J. and MacDonald, M. C. (1995). Individual differences and probabilistic

constraints in syntactic ambiguity resolution. Journal of memory and language, 34(4):521–542.

Perez-Jimenez, I. and Moreno-Quibén, N. (2012). On the syntax of *exceptions*. Evidence from Spanish. Lingua, 122(6):582–607.

Pierrehumbert, J. and Hirschberg, J. B. (1990). The meaning of intonational contours in the interpretation of discourse.

Potter, D. and Carlson, K. (2019). Focus scope marked by "only" influences syntactic attachment. Poster presented at the 32nd CUNY Conference on Human Sentence Processing, Boulder, CO.

R Core Development Team (2019). R: A language and environment for statistical computing (version 3.5. 3 (2019-03-11)). Vienna, Austria: R Foundation for Statistical Computing. Retrieved from www. R-project. org.

Rasekhi, V. (2018). Ellipsis and information structure: Evidence from Persian. PhD thesis, State University of New York at Stony Brook.

Rayner, K. (1998). Eye movements and information processing: 20 years of research. Psychological Bulletin, 124(3).

Rayner, K., Kambe, G., and Duffy, S. A. (2000). The effect of clause wrap-up on eye movements during reading. The Quarterly Journal of Experimental Psychology: Section A, 53(4):1061–1080.

Reinhart, T. (1981). Pragmatics and linguistics: An analysis of sentence topics in pragmatics and philosophy. Philosophica anc Studia Philosophica Gandensia Gent, 27(1):53–94.

Repp, S. (2009). Negation in gapping. Oxford University Press on Demand.

Repp, S. (2010). Defining 'contrast' as an information-structural notion in grammar. Lingua, 6(120):1333–1345.

Rickheit, G., Schnotz, W., and Strohner, H. (1985). The concept of inference in discourse comprehension. In Advances in Psychology, volume 29, pages 3–49. Elsevier.

Rizzi, L. (1997). The fine structure of the left periphery. In Elements of grammar, pages 281–337. Springer.

Rizzi, L. (2004). The Structure of CP and IP: The Cartography of Syntactic Structures Volume 2, volume 2. Oxford University Press on Demand.

Rizzi, L. (2013). Topic, Focus, and the cartography of the left periphery. The bloomsbury companion to syntax, page 436.

Rohde, D. (2003). Linger: A flexible platform for language processing experiments. Online: http://tedlab. mit. edu/˜ dr/Linger.

Rooth, M. (1992). A theory of focus interpretation. Natural language semantics, 1(1):75–116.

Sæbø, K. J. (2003). Presupposition and contrast: German 'aber' as a topic particle. In Proceedings of Sinn und Bedeutung, volume 7, pages 257–271.

Sahkai, H. and Mihkla, M. (2017). Intonation of Contrastive Topic in Estonian. In INTERSPEECH, pages 3181–3185.

Schotter, E. R., Angele, B., and Rayner, K. (2012). Parafoveal processing in reading. Attention, Perception, & Psychophysics, 74(1):5–35.

Selkirk, E. O. (1986). Phonology and syntax: the relationship between sound and structure. Cambridge, Massachusetts: M.I.T. Press.

Silverman, K., Beckman, M., Pitrelli, J., Ostendorf, M., Wightman, C., Price, P., Pierrehumbert, J., and Hirschberg, J. (1992). ToBI: A standard for labeling English prosody. In Second international conference on spoken language processing.

Slowiaczek, M. L. and Clifton, C. (1980). Subvocalization and reading for meaning. Journal of verbal learning and verbal behavior, 19(5):573–582.

Snedeker, J. and Trueswell, J. (2003). Using prosody to avoid ambiguity: Effects of speaker awareness and referential context. Journal of Memory and language, 48(1):103–130.

Spalek, K., Gotzner, N., and Wartenburger, I. (2014). Not only the apples: Focus sensitive particles improve memory for information-structural alternatives. Journal of Memory and Language, 70:68–84.

Speas, M. J. (1990). Phrase structure in natural language, volume 21. Springer Science & Business Media.

Spivey-Knowlton, M. and Sedivy, J. C. (1995). Resolving attachment ambiguities with multiple constraints. Cognition, 55(3):227–267.

Sridhar, S. (1988). Salience principles. In Cognition and Sentence Production, pages 33–42. Springer.

Staub, A. and Clifton, C. (2006). Syntactic prediction in language comprehension: Evidence from either... or. Journal of experimental psychology: Learning, memory, and cognition, 32(2):425.

Stolterfoht, B., Friederici, A. D., Alter, K., and Steube, A. (2007). Processing focus structure and implicit prosody during reading: Differential ERP effects. Cognition, 104(3):565–590.

Stowe, L. A., Kaan, E., Sabourin, L., and Taylor, R. C. (2018). The sentence wrap-up dogma. Cognition, 176:232–247.

Tamm, A. (2015). Negation in Estonian. Negation in Uralic languages. Typological Studies in Language, 108:399–432.

Tancredi, C. D. (1992). Deletion, deaccenting, and presupposition. PhD thesis, Massachusetts Institute of Technology.

Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., and Sedivy, J. C. (1995). Integration of visual and linguistic information in spoken language comprehension. Science, 268(5217):1632–1634.

Trueswell, J. C., Sekerina, I., Hill, N. M., and Logrip, M. L. (1999). The kindergarten-path effect: Studying on-line sentence processing in young children. Cognition, 73(2):89–134.

Trueswell, J. C., Tanenhaus, M. K., and Kello, C. (1993). Verb-specific constraints in sentence processing: Separating effects of lexical preference from garden-paths. Journal of Experimental psychology: Learning, memory, and Cognition, 19(3):528.

Vallduví, E. and Vilkuna, M. (1998). On rheme and kontrast. In The limits of syntax, pages 79–108. Brill.

Van Dijk, T. A. (1977). Sentence topic and discourse topic. Papers in Slavic philology, 1(1977):49–61.

Van Gompel, R. P., Pickering, M. J., and Traxler, M. J. (2000). Unrestricted race: A new model of syntactic ambiguity resolution. In Reading as a perceptual process, pages 621–648. Elsevier.

Vicente, L. (2010). On the syntax of adversative coordination. Natural Language & Linguistic Theory, 28(2):381–415.

Wang, L. and Schumacher, P. B. (2013). New is not always costly: Evidence from online processing of topic and contrast in Japanese. Frontiers in Psychology, 4:363.

Warren, T., White, S. J., and Reichle, E. D. (2009). Investigating the causes of wrap-up effects: Evidence from eye movements and E–Z Reader. Cognition, 111(1):132–137.

Washburn, M. B. (2013). Narrowing the Focus: Experimental studies on exhaustivity and contrast. PhD thesis, University of Southern California.

Weskott, T., Hörnig, R., Fanselow, G., and Kliegl, R. (2011). Contextual licensing of marked OVS word order in German. Linguistische Berichte, 2011(225):3–18.

Yabushita, K. (2008). A new approach to contrastive topic: Partition semantics and pragmatics. In Semantics and Linguistic Theory, volume 18, pages 747–764.

Yan, M. and Calhoun, S. (2020). Rejecting false alternatives in Chinese and English: The interaction of prosody, clefting, and default focus position. Laboratory Phonology: Journal of the Association for Laboratory Phonology, 11(1).

Yoshida, M., Nakao, C., and Ortega-Santos, I. (2015). The syntax of why-stripping. Natural Language & Linguistic Theory, 33(1):323–370.