

Binding in Finnish and the language-cognition interface

Manuscript, August 2022

Abstract. A comprehensive and systematic analysis of binding in Finnish is developed with a focus on the language-cognition interface. It is argued that binding regulates semantic assignment management at the language-cognition interface by blanking out portions of the transient discourse available for coreference computations at the hearer's end. Assignments that are marked for filtering are not deleted, however, but downgraded so that they may get resurrected downstream by global cognition under pragmatic conditions, creating a variety of exempt anaphors. The analysis is applied to Finnish (and English) sentences exemplifying the standard binding configurations, but also to binding in infinitivals, picture nouns, null subject sentences, sentences with noncanonical word orders and \bar{A} -chains, and whole conversations containing several sentences. Syntax-internal binding theories are considered redundant, and were rejected on such basis.

Keywords: Binding, Finnish, picture nouns, pro-drop

1 Introduction

Successful linguistic communication presupposes that both the speaker and hearer construct mutually consistent inventories of semantic objects corresponding to the subject matter under discussion. This allows the interlocutors to position themselves inside a common discourse space and share an implicit notion of what the conversation “is about.” The framework presupposes a cognitive mechanism at the hearer's end for deciding if an incoming expression denotes an object that already exists in the shared discourse space or if the speaker requested a new object to be assumed. For example, the first use of a proper name or an indefinite article invites the hearer to assume a new object, whereas an unstressed pronoun or the use of a definite article signals that the reference is discourse old. These restrictions can also be structure-dependent. Sentences (1-3) illustrate structure-dependent coreference patterns for reflexives (1), pronouns (2) and proper names (3) in English.

- (1) a. John₁ admires himself_{1,*2}.
- b. *John's₁ sister admires himself₁.

- 29 (2) a. John₁ admires him_{*1,2}.
 30 b. John's₁ sister admires him_{1,2}.

- 31 (3) a. He₁ admires John_{*1,2}.
 32 b. His_{1,2} sister hates John₁.

33 The reflexive *himself* must denote the same thing as the subject of its own clause (1), as shown
 34 by the shared subscript; *him* cannot denote the same object as the subject of its own clause (2);
 35 and a proper name like *John* must introduce a new semantic object (3). These rules, which
 36 restrict the way the discourse space is explored during language comprehension, are known as
 37 the binding conditions (Chomsky, 1981). Their ultimate nature is controversial, although the
 38 phenomenon has received considerable attention in linguistics (Büring, 2005; Chomsky, 1980,
 39 1981, 1982; Helke, 1971; Chomsky & Lasnik, 1977; Lebeaux, 2009; Lees & Klima, 1963;
 40 Reinhart, 1983; Postal, 1971; Reinhart & Reuland, 1993; Reuland, 2001) and psycholinguistics
 41 (Aoshima, Yoshida, & Phillips, 2009; Cunnings & Felser, 2013; Cunnings & Sturt, 2014; Sturt,
 42 2003)(for a general introduction, see Büring, 2005; Huang, 2000a; Safir, 2004 and Fischer,
 43 2015). Here we examine binding from the point of view of Finnish. I will argue that the Finnish
 44 binding patterns follow if we assume that binding takes place at the language-cognition
 45 interface, and is not internal to syntax. Specifically, the effects of the binding theory emerge
 46 when a language-external cognitive module responds to lexical assignment management
 47 features that hijack the system for linguistic purposes and “blanks out large portions of the
 48 discourse” (Hankamer & Sag, 1976, p. 425) making comprehension more efficient. I claim that
 49 this “blanking out of portions of discourse” is what we see in (1)-(3).

50 This article is organized as follows. Section 2 presents a minimal background required for the
 51 analysis. It explicates what it means for the speaker and hearer to construct a “discourse space”
 52 on the basis of linguistic communication, and also defines the core notions used throughout the
 53 analysis, such as *assignment*, *denotation* and *discourse inventory*. Section 3 describes the
 54 hypothesis. Section 4 reports a computational simulation where the hypothesis is tested against
 55 a dataset from Finnish (and English, for comparison).

56 2 Background

57 Let us assume that the language faculty maps linguistic inputs through a lexico-morphological
 58 component into syntactic parses that are interpreted semantically (e.g., Nicol & Swinney,
 59 2003). For example, the input string *the + horse + raced + past + the + barn* is mapped into

a syntactic parse, such as [s[_{DP} *the horse*] [_{VP} *raced* [_{PP} *past* [_{DP} *the barn*]]]], that feeds semantic interpretation and generates the reading ‘the horse raced past the barn’. To establish a connection between referential expressions in the parsed input and their meanings, we posit a *global discourse inventory* that holds all semantic objects and their known properties that have been mentioned during the ongoing conversation (e.g., Heim, 1982; Kamp, 1981). In the case of *the horse raced past the barn*, the inventory holds two spatiotemporal objects, the horse and the barn. The global discourse inventory is a language-external representational system that is accessed by general cognitive processes, such as thinking, decision making and problem solving.

Suppose the next sentence is *it was very fast*. The most likely interpretation for this continuation is one where the inanimate pronoun *it* refers to the horse, but it could also refer to the barn, a third entity, or to the whole event. When all referential expressions are provided with a denotation, we say, following the standard model theoretical nomenclature, that the sentence is provided with an *assignment*. Thus, under any particular assignment all referential expressions are assigned some denotation. Because expressions can often denote several semantic objects, each sentence will typically have several possible assignments. This is especially true for pronouns. Denotations, and therefore also assignments, are selected on the basis of what is contained in the discourse inventory at the moment the sentence is processed.

These assumptions presuppose at least two cognitive systems, one which provides the hearer cognitive access to possible denotations and assignments for any referential expression in the input sentence, given a context (system i), and another which evaluates the assignments for plausibility (system ii). I will call the system (i) *narrow semantics* in this article. System (ii) is part of global cognition. Consider again the conversation *the horse raced past the barn; it was very fast*. The referential expressions *the horse* and *the barn* project corresponding semantic objects ‘the horse’₁ and ‘the barn’₂ to the global discourse inventory. The pronoun *it* projects an inanimate third person object ‘it’₃. When the whole expression is interpreted, narrow semantics, system (i) in our analysis, provides each referential expression with a set of possible denotations, for example, *it* will be linked with {‘the horse’₁, ‘the barn’₂, ‘it, thing’₃ and ‘it, event’₄}, which generates assignments ‘the horse₁ raced past the barn₂; it_{1,2,3,4} was very fast’ (notice that pronouns like *it* also have nominal features, such as person, number and gender, which further limit the selection of denotations and assignments during language comprehension, see Kazanina et al., 2007; Nicol & Swinney, 2003; Parker, 2019; Parker &

Phillips, 2017). The list of assignments therefore provides the sentence with “all possible readings” when it comes to its referential expressions. Global cognitive processes (ii) rank these assignments and select the most plausible one(s) for consideration by drawing information from multiple sources (e.g., Asher & Wada, 1988; Badecker & Straub, 2002; Garrod & Sanford, 1994; Kaiser, 2011). In this case, the most plausible interpretation is one where *it* refers to the horse. An interpretation where *it* refers to the barn is possible but unlikely. These rankings are formalized by providing each assignment with a numerical *weight* corresponding to its plausibility (0=completely implausible, 1=very plausible).

This system presupposes a mechanism for separating referential expressions like *the horse* from the nonreferential ones such as *raced* or *past*. I use phi-features (e.g., number, person) as reference-anchoring devices in this study. Referential phi-features were further correlated with feature [REF] for ‘referential’, which excludes nonreferential phi-marking such as concord or DP predicates from the mechanism. This assumption need not be correct; it prevents the algorithm from projecting ‘thing objects’ for verbs, prepositions, mood, tense, complementizers, conjunctions and in general for any elements we do not fall into the domain of the binding rules. This assumption is stipulative, but perhaps not completely implausible.

3 The hypothesis

The core assumption of our hypothesis is that binding restricts the way global discourse inventory is harvested for assignment generation. The legitimate assignments for reflexive pronouns such as *himself*, for example, only include the denotations of its clause-mate subjects (under the same assignment). The legitimate assignments for ordinary pronouns exclude clause-mate subjects but include everything else. In this way, binding principles will “blank out” portions of the discourse inventory during language comprehension, as proposed by Hankamer & Sag (1976: 425). Viewed from this perspective, binding is neither syntax-internal nor syntax-external affair; rather, it emerges from the way language is anchored to general cognition at the language-cognition interface. We can perhaps say that it operates at the “edge of language.”

Let us express the hypothesis rigorously. Let us assume that global cognition contains a function EVAL which evaluates whether a cognitive object X is new or old in relation to a *reference set* of other cognitive objects. EVAL could perhaps be depicted as a basic attention mechanism that allows the cognitive system to focus selectively on some mental objects by

excluding others. Since EVAL is part of global cognition, it is not language-specific. It operates with semantic objects such as ‘the horse’ and ‘the barn’ accessed by general cognition, and is not aware of the linguistic properties (or even the existence) of expressions such as *the horse* and *the barn*. We will now develop an analysis according to which the binding theory expresses a “grammaticalization of EVAL.”

Specifically, let us assume that assignment computations (narrow semantics, component (i) in our model) can determine the reference set for EVAL on the basis of phrase structure objects it accesses at the syntax-semantics interface. Suppose EXP_i is a referential expression in a phrase structure object α denoting object i in the global discourse inventory. Then

(4) *Reference set*

the *reference set* for EXP_i is a set of cognitive objects accessed by narrow semantics from EXP_i in α by using an upward path (5), where

(5) *Upward path*

the *upward path* from EXP_i contains the nodes dominating EXP_i plus the heads of their daughters such that they can be reached from EXP_i without encountering a head with an *intervention feature*.

EXP_i is the expression (pronoun, reflexive, r-expression) that will be subjected to the binding principles; the reference set will contain objects that are relevant for determining its coreference possibilities. Because the reference set is computed on the basis of the syntax-semantic interface, its construction will be structure-dependent (notice the similarity between the notion of upward path and c-command). Psycholinguistic experimentation has shown, convincingly, that structure-dependent mechanisms limit the antecedent search during language comprehension (e.g., Aoshima et al., 2009; Asher & Wada, 1988; Clifton, Kennison, & Albrecht, 1997; Cummings & Felser, 2013; Cummings & Sturt, 2014; Dillon, Mishler, Sloggett, & Phillips, 2013; Fedele & Kaiser, 2014; Hankamer & Sag, 1976; Kazanina et al., 2007; Koornneef & Reuland, 2016; Nicol & Swinney, 1989; Sturt, 2003), further motivating these assumptions.

The intervention feature, essentially a reformulation of the lexical opacity factor of Manzini & Wexler (1987), will create locality domains for binding. Several possible intervention features for binding have been provided in the literature (e.g., Raposo, 1986), and there appears to be considerable crosslinguistic variation among the locality properties of anaphors, such as

reflexives (Déchaine & Wiltschko, 2012, 2017). Manzini and Wexler (1987) mention several options such as subject, Infl, tense, referential tense and root tense (see their (29), p. 422) and propose that the matter is subject to parametrization. It therefore makes little sense to limit the feature system *a priori* pending further crosslinguistic investigation. For Finnish and English, feature [REF] suffices. Recall from Section 2 that [REF] will be part of all referential lexical items, which will limit binding domains in our calculations on the basis of “subjects” and other argument-like expressions.

Finally, we assume that lexical items can contain the following features, explained below:

(6) *Binding features*

- a. [OLD:REF] (for reflexives),
- b. [NEW:REF] (for pronouns),
- c. [NEW:_] (for r-expressions),
- d. [OLD:_] (long-distance anaphors?).

These features are used during assignment computations. The label NEW/OLD tells EVAL whether the object X must be new or old in relation to a reference set and [REF] will be the intervention feature. Translated into English, these features read as follows: [OLD:REF] = ‘under any possible assignment, the denotation must come from a reference set restricted into a local domain by feature [REF]’, which captures the behavior of reflexives in our dataset; [NEW:REF] = ‘under any possible assignment, the denotation cannot come from the reference set restricted into a local domain by feature [REF]’, which captures the behavior of pronouns; [NEW:_] = ‘under any possible assignment, the denotation must differ from any object in the unrestricted reference set’, capturing the behavior of r-expression; [OLD:_] = ‘under any possible assignment, the denotation must be in the unrestricted reference set’, capturing the possible of long-distance anaphors (unattested in Finnish and excluded here). We then assume that assignment generation must satisfy EVAL when fed with a binding feature and a reference set.

To see how the rules work, consider (7a-b).

- (7) a. John₁ admires him_{*1,2}.
 b. John₁ admires himself_{1,*2}

The parser maps both sentences into [_S [_{DP} John] [_{VP} admires [_{DP} him/himself]]] and links *John* and *him/himself* with semantic objects ‘John’₁ and ‘he’₂ (=him/himself) in the global discourse

inventory. Since the discourse inventory holds two objects, accessible denotations will be *John*_{1,2} *admires him/himself*_{1,2} (if the sentence was part of a larger conversation, then many more possible denotations would emerge). Next we generate assignments *John*₁ *admires him*₁, *John*₁ *admires him*₂, *John*₂ *admires him*₁ and *John*₂ *admires him*₂. The proper name *John*₁ is associated with an empty reference set by rule (4). It has feature [NEW:_] (6)c which requires *John*₁ to refer to objects *not* in that set, hence *John* can denote any object in the global discourse inventory which matches with its lexical features (same name, masculine, singular etc.). The pronoun *him* has feature [NEW:REF] (6)b and can be assigned to an object that is not in the reference set {'John'_i} as defined by the upward path (5). Therefore, under any possible assignment, *John* and *him* cannot refer to the same object. The opposite result is calculated for *himself* (6)a. In sum, the assignment management features restrict the denotations for referential expressions.

The important empirical assumptions of this analysis are the following. First, referential expressions are not associated with syntactic referential indexes regulated by syntactic binding principles; rather, binding takes place at the language-cognition interface where assignments are generated and evaluated. There is no syntactic coindexing or syntactic binding mechanisms (contra Chomsky, 1981; Fiengo & May, 1994; Hicks, 2008; Reuland, 2001, 2006; Rooryck & Wyngaerd, 2011). I follow the style of analysis in (Chomsky, 1995; Culicover & Jackendoff, 1995; Schlenker, 2005) where binding regulates semantic interpretation at the outer edge of language.

Second, the way the assignments are constrained depends on the lexical features of the referential expressions. I am therefore assuming that pronouns, reflexives and r-expressions are distinguished from each other by their lexical feature compositions which regulate their assignment options. These lexical features, much like ordinary phi-features such as person and number, facilitate communication by limiting the set of possible denotations.

Third, notice that neither *he* nor *himself* is in any way defective in its capacity to refer. They are both assigned independent denotations. This could be seen as controversial in the case of reflexive pronoun *himself*, but the assumption is made due to the data reported by Pollard & Sag (1992), discussed later, which shows that reflexives can in fact sustain independent denotations under special pragmatic conditions. Since the operation takes place inside narrow semantics, component (i), the rankings can be adjusted downstream within the processing

pathway. This will capture situations where binding restrictions are ameliorated by pragmatic context (Section 4.4.3).

Fourth, the model is not limited to single sentences. It works, as defined above, with whole conversations modelled as sequences of sentences sharing the global discourse inventory. If the first sentence introduces objects into the discourse inventory, subsequent sentences will take those objects into account when evaluation assignments. Suppose that the first sentence is *John admires Mary*. This creates two semantic objects, John and Mary, into the discourse space. If the next sentence is *he likes her*, then John and Mary will appear as possible denotations for the pronouns *he* and *her*, respectively, and will be taken into account in all assignment computations. They are also taken into account when computing possible readings for sentences involving reflexives and r-expressions. The number of sentences any conversation can contain, hence also the number of possible objects of denotations in the discourse inventory, is not limited.

Fifth, long-distance anaphors and logophors do not follow the standard binding conditions (e.g., Clements, 1975; Hellan, 1988; Huang, 2000a: Ch. 2.3; Sells, 1987; Thráinsson, 1990, 1991), thus the mechanism posited here is unable to calculate them. On the other hand, it is assumed that pronouns can denote any objects in the global discourse inventory that are consistent with their lexical properties. This gives the model an in-principle access to discourse-based and/or long-distance anaphors. One possibility is to add semantic metadata corresponding to salience, source, self and point of view (e.g., Sells, 1987) to the conversations and use them to bias logophoric dependencies. A mechanism of this type might be required on independent grounds since there is linguistic (e.g., Ariel, 1990; Givón, 1983; Grosz, Joshi, & Weinstein, 1995; Huang, 2000b; Pollard & Sag, 1992; Schlenker, 2005; Sperber & Wilson, 1995; Thráinsson, 1991) and psycholinguistic (e.g., Almor, 1999; Cunnings & Sturt, 2014; Kazanina, Lau, Lieberman, Yoshida, & Phillips, 2007; Malt, 1985; Murphy, 1985a, b; Nicol & Swinney, 2003; Parker, 2019) evidence that assignment management utilizes context. This matter was left for future study.

Finally, I would like to offer a brief comment on what motivated the assumption that EVAL is part of general cognition, and is not part of narrow semantics. For the present author, the most puzzling aspect of binding is the question of *why* some classes of referential expressions are so limited in their assignment options. The intuitive idea pursued in this study is that this is because the output of the syntactic processing pathway and the input to EVAL are so closely

connected by our innate cognitive architecture that language can and will instinctively grammaticalize properties of EVAL. The lexical features [NEW:REF] etc. are considered (and modelled literally) as “instructions” for the language-external system. This is, of course, speculation on my part and only meant as clarifying the intended model behind the architecture.

4 Simulation experiment

4.1 Design and procedure

A test corpus containing Finnish and English binding constructions was fed to an algorithm implementing the hypothesis. Contents of the test corpus are elucidated in Section 4.2, and are available in the public domain.* A Python-based minimalist sentence processor (Brattico, 2019a) was used for the parsing task (Section 2) and was endowed with the post-syntactic interpretation mechanism elucidated in the previous sections (Sections 2, 3), also implemented in Python. The source code is at <http://www.github.com/pajubrat/parser-grammar>, maintained by its author. I will use the term *syntactic background theory* in this article to refer to the existing algorithm. The algorithm provided each input sentence with a grammaticality judgment and, if it was judged grammatical, also a syntactic derivation, syntactic analysis and semantic interpretation. Semantic interpretation contained the weighted/ranked assignments and the contents of the global discourse inventory, as predicated by the analysis specified in this article. The output was compared with native speaker judgments provided by the author. The whole output of the algorithm is in the public domain.†

4.2 Stimuli (test corpus)

The hypothesis was tested against a test corpus that contained binding constructions, both grammatical and ungrammatical, and both in Finnish and English. Some test sentences formed conversations, sequences of sentences which shared the global discourse inventory, others were isolated. The test sentences were selected to cover the core of the whole binding theory, including special constructions exhibiting null subjects, DP-internal syntax, picture nouns, noncanonical word orders and embedded infinitivals. Test sentences were written by the algorithm into a file, normalized and organized hierarchically.‡ No morphosyntactic tagging was used apart from few cases where the input item was disambiguated to facilitate the examination of the output. When two or more sentences were assumed to be part of the same conversation, they were separated by semicolon; otherwise, no special punctuation was used. The contents of the test corpus are summarized in Table 1.

278 **Table 1. Structure and contents of the test corpus.**

#	Category (sentence numbers)	examples and/or explanation
0	Core sentences from the article	
0.1	Binding conditions (1-19)	Sentences (8, 12-14, 17, 18, 19, 26, 27) from this article
0.2	Null pro subjects (20-25)	Sentences (31-34) from this article
0.3	DP-internal syntax (27-31)	Sentences (36, 38, 40, 41) from this article
0.4	Embedded infinitivals (32-37)	Sentences (45, 46, 47) from this article
1	Proper names (R-expressions)	
1.1	Grammatical, assignment possible (38-45)	John sleeps. John admires Mary. Pekka nukku-u. 'Pekka.NOM sleep-PRS.3SG' Pekka ihaile-e Merja-a. 'Pekka.NOM admire-PRS.3SG Merja-PAR'
1.2	Proper names inside that-clauses (46-47)	John said that Mary admires Bill. Pekka sano i että Merja ihaile-e Jukka-a. 'Pekka.NOM said that Merja.NOM admire-3SG.PRS Jukka-PAR'
1.3	Proper names inside embedded infinitival (48-49)	John wants Mary to admire Bill. Pekka sanoo Merja-n ihaile-van Jukka-a. 'Pekka.NOM says.PRS.3SG Merja-GEN admire-VA/INF Jukka-PAR'
1.4	Condition C (50-58)	He admires John. She admires John. He admires Mary. She admires Mary. He said that John admires Mary. He wants John to admire Mary. Hän ihaile-e Merja-a. 'He.NOM admire-3SG.PRS Merja-PAR' Hän sanoo että Pekka ihaile-e Merja-a. 'He.NOM says that Pekka.NOM admire-3SG.PRS Merja-PAR' Hänen siskonsa sanoo että Pekka ihaile-e Merja-a. 'His/her sister says that Pekka.NOM admire-3SG.PRS Merja-PAR'
1.5	Conversations (59-62)	John sleeps; John admires Mary. John sleeps; Mary sleeps.
1.6	Pro-drop sentences (63)	Ihaile-n Merja-a. 'admire-PRS.1SG Merja-PAR'
2	Regular pronouns	
2.1	Pronouns and proper names (64-83)	John admires him. John admires her. He admires Mary. She admires John. It admires John. It admires Mary. It admires him. It admires her. John admires it. Mary admires it.

		<p>He admires it. She admires it. It admires it. John admires his sister. John admires her sister.</p> <p>Pekka ihaile-e hän-tä. 'Pekka.NOM admire-3SG.PRS he-PAR'</p> <p>Pekka ihaile-e sitä. 'Pekka.NOM admire-.3SG.PRS it.PAR'</p> <p>Se ihaile-e Pekka-a. 'it.NOM admire-3SG.PRS Pekka-PAR'</p> <p>Se ihaile-e sitä. 'It.NOM admire-3SG.PRS it.PAR'</p> <p>Pekka ihaile-e hän-en sisko-a-an. 'Pekka.NOM admire-3SG.PRS he-GEN sister-PAR(Px/3sg)'</p>
2.2	Only pronouns (84-89)	<p>He admires him. She admires her. He admires her. She admires him.</p> <p>Hän ihailee häntä. 'He.NOM admire.3SG.PRS he.PAR'</p> <p>Se ihaile-e sitä. 'it.NOM admire-3SG.PRS it.PAR'</p>
2.3	*Pronouns with wrong case forms (90-97)	<p>*Him admires he. *Him admires she. *Him admires him. *Him admires her. *Her admires he. *Her admires she. *Her admires him. *Her admires her.</p> <p>Not applicable to Finnish due to free word order profile</p>
2.4	Pronouns inside that-clauses (98-107)	<p>John said that Mary admires Bill. John said that Mary admires him. John said that he admires Mary. John said that he admires him. He said that he admires him. He said that John admires Mary.</p> <p>Pekka sanoo että Merja ihaile-e Jukka-a. 'Pekka.NOM says that Merja.NOM admire-3SG.PRS Jukka-PAR'</p> <p>Pekka sanoo että Merja ihaile-e hän-tä. 'Pekka.NOM says that Merja.NOM admire-3SG.PRS he-PAR'</p> <p>Pekka sanoo että hän ihaile-e Jukka-a. 'Pekka.NOM says that he.NOM admire-3SG.PRS Jukka-PAR'</p> <p>Pekka sanoo että hän ihaile-e hän-tä. 'Pekka.NOM says that he.NOM admire-3SG.PRS he-PAR'</p>
2.5	Pronouns inside infinitivals (108-121)	<p>John wants Mary to admire him. Mary wants John to admire her. John wants John to admire him. Mary wants Mary to admire her. John wants Mary to admire it. Mary wants John to admire it. John wants him to admire Mary. John wants her to admire Mary. Mary wants him to admire Mary. Mary wants her to admire Mary.</p>

2.6	Possessive pronouns (122-124)	His sister sleeps. Her sister sleeps. Hänen siskonsa nukku-u. His/her sister sleep-PRS.3SG
2.7	Pronouns inside conversations (125-136)	John sleeps; he admires Mary. John admires Mary; he admires her. John admires Mary; his sister sleeps. It sleeps; he admires Mary. It sleeps; he admires her. It sleeps; it admires her.
2.8	Human vs. nonhuman pronouns (137-144)	John admires Mary; it sleeps. John admires Mary; he sleeps. Pekka ihaile-e Merja-a; se nukkuu. 'Pekka.NOM admire-PRS.3SG Merja-PAR; it sleeps' Pekka ihaile-e Merja-a; hän nukkuu. 'Pekka.NOM admire-PRS.3SG Merja-PAR; he sleeps'
2.9	C-command tests (145-146)	John's sister admires him. Peka-n sisko ihaile-e hän-tä. 'Pekka-GEN sister admire-PRS.3SG he-PAR'
2.10	Pronouns and null subject sentences (147-150)	Pekka sanoo että ihaile-e hän-tä. 'Pekka says that admire.3SG.PRS he-PAR' Pekka sanoo että ihaile-n hän-tä. 'Pekka says that admire.1SG.PRS he-PAR' Hän sanoo että ihaile-e hän-tä. 'He says that admire.3SG.PRS he-PAR' Hän sanoo että ihaile-n hän-tä 'He says that admire.1SG.PRS h.e-PAR'
3	Reflexive pronouns, anaphors	
3.1	Grammatical, assignment possible (151-155)	John admires himself. Mary admires herself. he admires himself. she admires herself. Pekka ihaile-e itse-ä-än. 'Pekka.NOM admire-3SG.PRS self-PAR-Px/3sg' Hän ihaile-e itse-ä-än. 'He.NOM admire-3SG.PRS self-PAR-Px/3sg'
3.2	*Gender mismatch (157-160)	John admires herself. Mary admires himself. He admires herself. She admires himself.
3.3	*Human mismatches (161-162)	It admires herself. It admires himself.
3.4	*Subject reflexives (163-176)	Himself admires John. Himself admires Mary. Himself admires he. Himself admires him. Himself admires she. Himself admires her. Himself admires it. Herself admires John. Herself admires Mary. Herself admires he. Herself admires him. Herself admires she. Herself admires her. Herself admires it.

3.5	Reflexives in conversations (177-182)	John admires Bill; he admires himself. John admires himself; he sleeps. John admires Mary; Bill admires himself.
3.6	C-command condition (183-184)	John's sister admires himself. Peka-n sisko ihaile-e itse-ä-än. 'Pekka-GEN sister.NOM admire-3SG.PRS self-PAR-Px/3sg'
3.7	Reflexives and control (185-201)	John wants Mary to admire herself. *John wants Mary to admire himself. John wants to admire himself. He wants to admire himself. Mary wants to admire herself. She wants to admire herself. *John wants to admire herself. *He wants to admire herself. John wants himself to admire Mary. *John wants herself to admire John. *Mary wants himself to admire John. Pekka halua-a Merja-n ihailevan itse-ä-än. 'Pekka.NOM want-3SG.PRS Merja-GEN admire.VA/inf self-PAR-Px/3SG' Pekka halu-si Merja-n ihaile-van itse-ä-än. 'Pekka.NOM want-3SG.PRS Merja-GEN admire-VA/inf self-PAR-Px/3SG' Pekka halua-a ihail-la itse-ä-än. 'Pekka.NOM want-3SG.PRS admire-A/inf self-PAR-Px/3SG' Hän halua-a ihail-la itse-ä-än. 'He.NOM want-3SG.PRD admire-A/inf self-PAR-Px/3sg' Pekka halua-a itse-nsä ihaile-van Merja-a. 'Pekka.NOM want-3SG.PRS self-GEN.Px/3SG admire-VA/inf Merja-PAR'
3.8	Ungrammatical reflexive inside that-clause (202-203)	John said that Mary admires himself. Mary said that John admires herself.
3.8	Reflexives and null subjects (204-207)	Pekka sanoo että ihaile-e itse-ä-än. 'Pekka says that admire-3SG.PRS self-PAR-.PX/3SG' Pekka sanoo että ihaile-n itse-ä-ni. 'Pekka says that admire-1SG.PRS self-PAR-PX/1SG'

279

280 4.3 Results

281 4.3.1 *Observational adequacy*

282 Observational adequacy (the extent to which native speaker and model grammaticality
283 judgments match) was verified by comparing native speaker grammaticality judgments against
284 the grammaticality judgments generated by the model. Comparison was done by mechanical
285 file-comparison tool. The model reached 100% accuracy. Notice that grammaticality
286 judgments as such do not include assignments and do not verify the correctness of the binding
287 principles; to do the latter we must consult the actual assignments generated by the algorithm
288 and recorded into external files at runtime.

289 4.3.2 Condition A

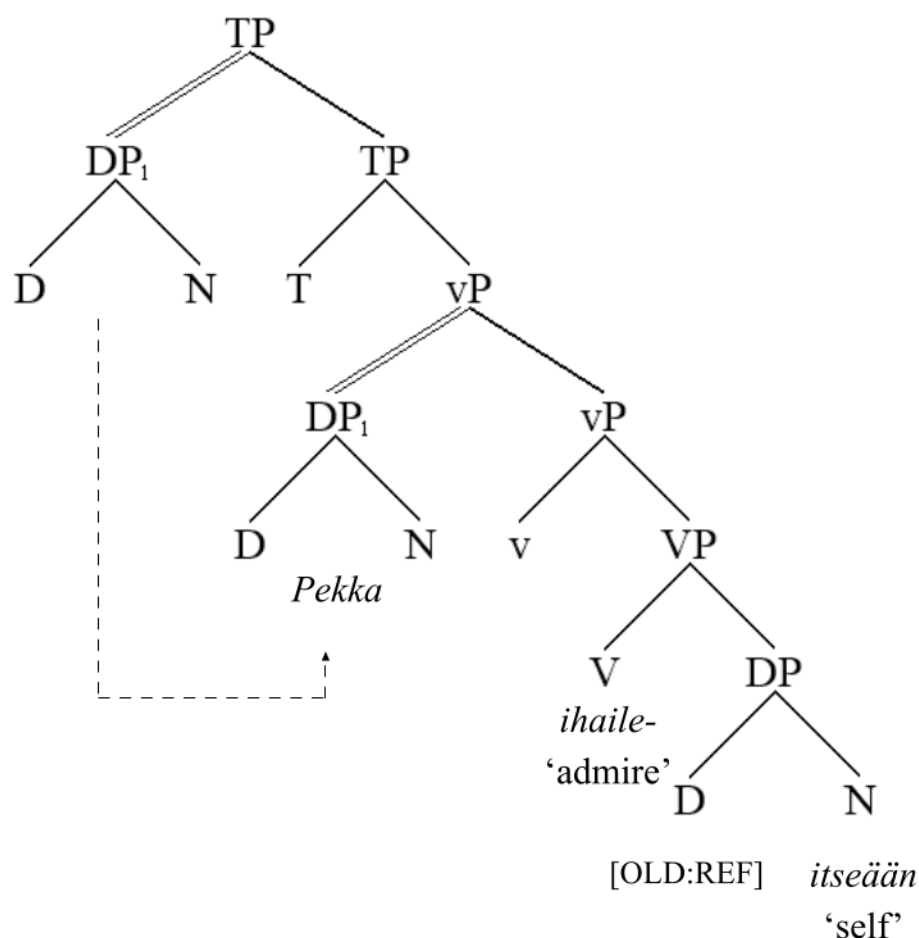
290 Binding condition A, illustrated by the example (1) from Finnish, requires reflexives to be
 291 bound locally. Symbol # refers to the same or equivalent sentence in the raw data generated by
 292 the algorithm (also Table 1).¹

- 293 (8) a. Pekka₁ ihaile-e itse-ä(-än)_{1,*2/} *itse-ä(-ni). (#1, 2)
 294 Pekka.NOM admire-3SG.PRS self-PAR(-PX/3SG) self-PAR(-PX/1SG)
 295 ‘Pekka admires himself/*myself.’
 296 b. Minä₁ ihaile-n *itse-ä(-än)/ itse-ä(-ni)_{1,*2} (#3, 4)
 297 I.NOM admire-1SG.PRS self-PAR(-PX/3SG)self-PAR(-PX/1SG)
 298 ‘I admire *himself/myself.’

299 The relevant assignments, calculated by the algorithm and available in the output files,[§] are
 300 marked by the subscripts. In (8a), the mechanism filters out all assignments where *Pekka* and
 301 *itseään* ‘self.PX/3SG’ do not refer to same entity in the discourse inventory. If the reflexive is
 302 marked for the first person singular, this solution is filtered out on the basis of the mismatching
 303 phi-features, and therefore no solutions are found. Example (8b) is calculated in the same way.
 304 The syntactic analysis calculated by the algorithm for (8) is (9)(all phrase structure images
 305 presented here were generated by the algorithm, the author added few illustrations; the original
 306 images are available online^{**}).

¹ Abbreviations: 1/2/3 = first, second and third person; A/INF = A-infinitival; ACC = accusative case, any form; GEN = genitive case; NOM = nominative case; PAR = partitive case; PL = plural; PST = past tense; PRS = present tense; PX = possessive suffix; Q = yes/no interrogative operator; REF = referential, a feature that all referential expressions have; SG = singular; VA/INF = VA-infinitival.

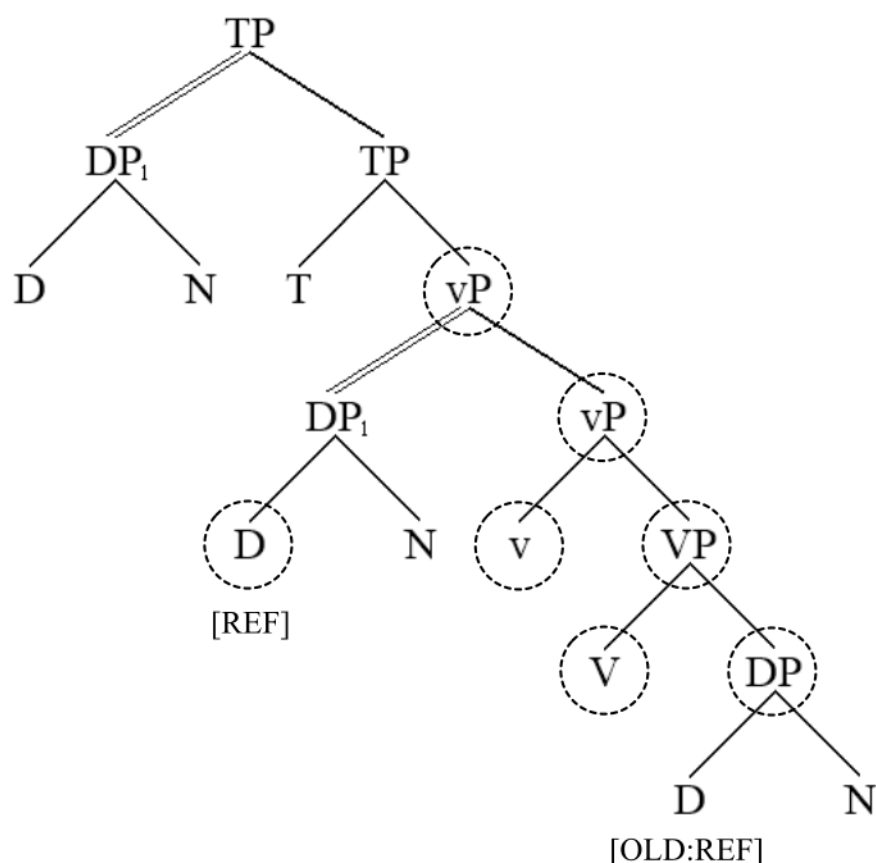
307 (9)



308

309 On the basis of the output of the syntactic processing pathway, shown in (9), narrow semantics,
 310 component (i) in our model, generates two semantic objects into the global discourse space,
 311 'Pekka'₁ and 'self'₂. Four possible assignments were considered: 'Pekka_{1,2} admires
 312 himself_{1,2}', and of these four, two are accepted by the principled proposed in Section 3:
 313 'Pekka₁ admires himself₁' and 'Pekka₂ admires himself₂'. For any assignment, feature
 314 [OLD:REF] at the reflexive (6)a requires that whatever denotation is provided for this element
 315 under the particular assignment considered must be found from the reference set that can be
 316 accessed by upward path (5) until the intervention feature [REF] is encountered. The following
 317 elements belong to the upward path and are included into the reference set and thus considered
 318 by the algorithm:

319 (10)



320

321 The intervention feature [REF] at the thematic agent DP halts the search at vP. It follows that
 322 under any assignment the denotation for the reflexive must be the same as the denotation of the
 323 higher DP at SpecvP. Reflexive binding also ignores all referential elements that are not inside
 324 the upward path from the reflexive pronoun, which derives (11) in our dataset.

325 (11) a. *[John's₁ sister] admires himself₁. (#183)

326 b. *[Peka-n₁ sisko] ihaile-e itse-ä-än₁. (#184)

327 Pekka-GEN sister admire-PRS.3SG self-PAR-PX/3SG

328 'Pekka's sister admires himself/*herself.'

329 *John* cannot be accessed from the reflexive by (5); the only option is coreference between
 330 *John's sister* and *himself* that is rejected on the basis of the gender feature mismatch.

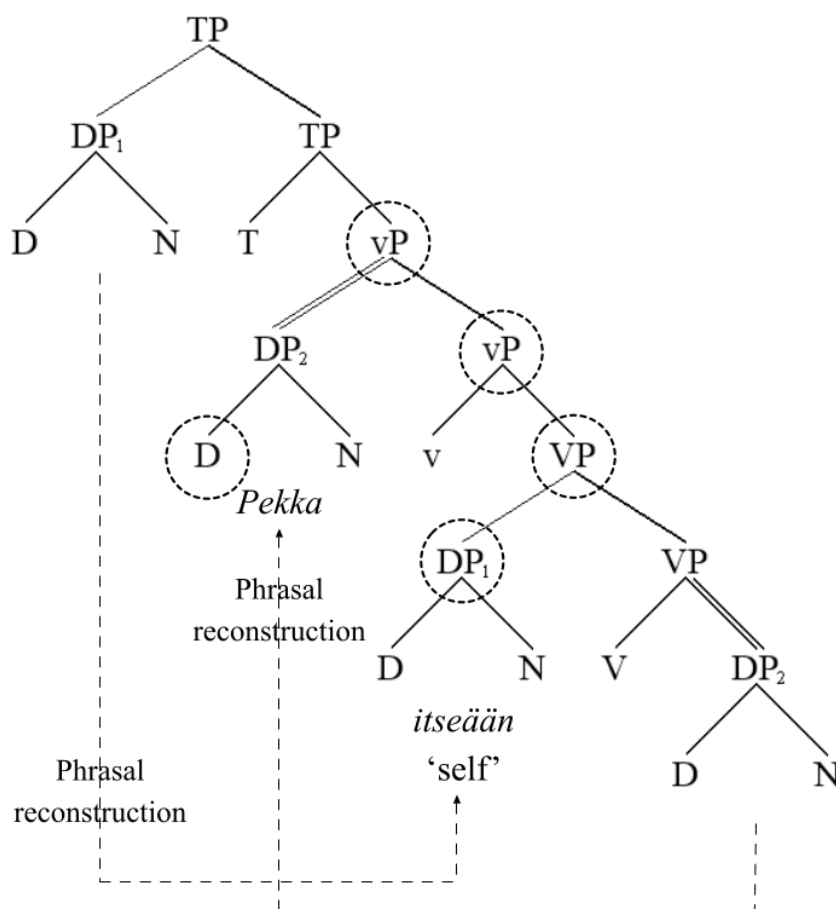
331 The morphological form of the Finnish reflexive pronoun merits a comment. The Finnish
 332 reflexive contains a SELF-pronoun *itse* 'self' suffixed with an infinitival agreement marker (also
 333 called "possessive suffix" in the literature), glossed as PX, that must match with the antecedent
 334 in person and number. There is some controversy over the syntactic nature of the Finnish

possessive suffix *ni/An/nsA* in the literature (Huhmarniemi & Brattico, 2015; Kaiser, 2003; Kanerva, 1987; Toivonen, 2000; Trosterud, 1990, 1993; Vainikka, 1989; van Steenberg, 1987, 1991). Because it is optional in these contexts and has a wide variety of other uses, I did not attempt to include it into the calculations as a separate morpheme. The reflexive *itse-nsä* ‘self-PX/3SG’ was represented as a reflexive pronoun with no further syntactic structure. Note that the binding possibilities for the SELF + PX construction and for the possessive suffix PX alone are not the same (Trosterud, 1990: 2.1.2; Vainikka, 1989, pp. 196–197, 213–216). This assumption might require revision in the future, but it was sufficient to calculate the present dataset.

The formal details of the parsing solutions generated by the algorithm (e.g., (9)) depend on the detailed of the Python formalization of the syntactic background theory used here as the starting point. I will not elucidate them in any detail in this paper, since the focus will be on binding and assignments which, according to the present hypothesis, are not part of the syntactic module. Moreover, the binding theory proposed here could be tested in connection with different grammatical formalisms. For a detailed description of the syntactic background theory and the parsing process, see Brattico (2019a).

Narrow semantics, component (i), works with the endpoint of syntax in our analysis. If we reverse the order of the arguments in the input, the syntactic component normalizes the expression first and only then calculates assignments on the basis of the normalized representation. The result is (12). Binding condition A indeed ignores discourse-based word order permutations, as shown by (13), so this assumption seems valid.

356 (12)



357

358 (13) Itse-ä-än₁ ihaile-e Pekka₁. (#5)

359 self-PAR-PX/3SG admire-3SG.PRS Pekka.NOM

360 'Pekka (information focus) admires himself (topic).'

361 The same reasoning applies to simple \bar{A} -dependencies such as interrogatives: operators are
 362 canonicalized inside the syntactic processing pathway (Brattico & Chesi, 2020) and only then
 363 considered for assignment according to our analysis (14).

364 (14) Itse-ä-än_{1,*2}-kö Pekka₁ ihailee __? (#6)

365 self-PAR-PX/3SG-Q Pekka.NOM admire-3SG.PRS

366 'Was it himself that Pekka admires?'

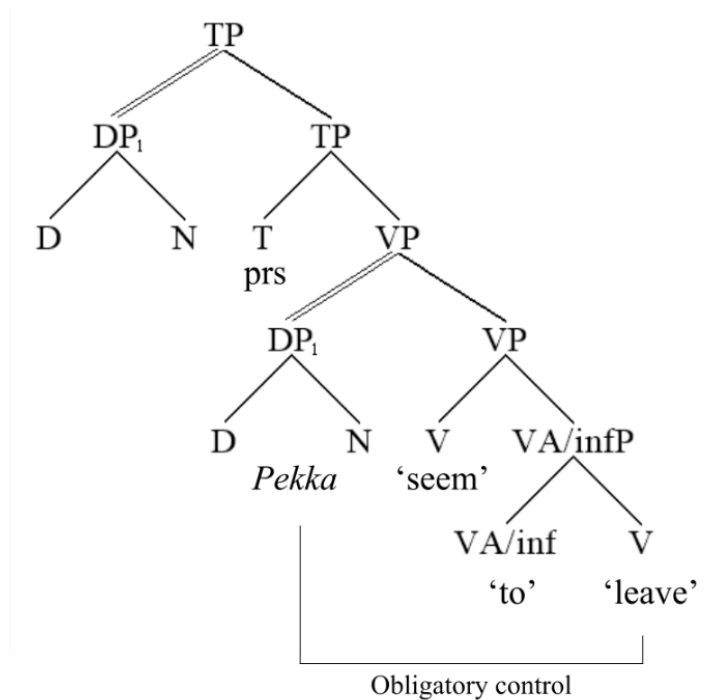
367 Q is a yes/no particle corresponding to yes/no interrogativization and an interrogative operator
 368 reading of the fronted reflexive direct object argument (see the translation). Data from Finnish
 369 \bar{A} -reconstruction and adjunct reconstruction therefore support the hypothesis that narrow
 370 semantics accesses only the endpoint of syntax. The case with successive-cyclic \bar{A} -

371 reconstruction and A-reconstruction is more complex (e.g., Barss, 1986; Hicks, 2008; Lebeaux,
 372 2009). To illustrate the issue in Finnish, I used Finnish equivalents of the A-reconstruction
 373 constructions discussed by Lebeaux (2009). They are provided in (15).

- 374 (15) a. Pekka_{1,i} näyttä-ä omasta mielestä-än₁ ____i ole-va-n(sa) valmis.
 375 Pekka.NOM seem-3SG.PRS own mind-PX/3SG be-VA/INF-(PX/3SG) ready
 376 ‘Pekka seems to his own mind to be ready.’
- 377 b. Pekka_{1,i} näyttä-ä opettaja-nsa₁ mielestä ____i ole-van älykäs.
 378 Pekka.NOM seem-3SG.PRS teacher-PX/3SG opinion be-VA/INF intelligent
 379 ‘Pekka seem to his teacher to be intelligent.’
- 380 c. Pekka_{1,i} näyttä-ä itse-nsä₁ mielestä ____i komealta.
 381 Pekka.NOM seem-3SG.PRS self-PX/3SG opinion handsome
 382 ‘Pekka seem to himself (to be) handsome.’

383 The subject constitutes a binder for an anaphoric and/or reflexive element inside the main
 384 clause. Many linguistic theories assume, however, that it is A-reconstructed into the trace
 385 position, marked by the gap ___, where the required interpretations can no longer be accessed.
 386 This is a potential problem. It does not arise here, however, because the syntactic background
 387 algorithm does not reconstruct the grammatical subject into the embedded infinitival; rather,
 388 these sentences are analysed as obligatory control constructions (16)(#7).

389 (16)



390

391 This is not of course self-evidently correct. If the control analysis of the Finnish raising
 392 construction is deemed as problematic, or perhaps incorrect, then I do not see any other option
 393 than to question the assumption that assignments are determined on the basis of the output of
 394 the syntax alone. In the case of (15), for example, assignment computations must access some
 395 type of “surface representations.” This would require some rethinking of the overall
 396 architecture and was left for future research, also because the binding *was* calculated correctly
 397 by the assumptions made here, making any adjustments irrelevant and untestable in the context
 398 of the present dataset.

399 English reflexives are processed in the same way, but involve an additional gender factor.
 400 Sentence **John admires herself* (#8, 157) receives no assignment because the gender feature
 401 of the reflexive does not match with the gender feature of any object that appears in its reference
 402 set (e.g., ‘John’). English reflexives and gender mismatches are tested by sentences #151-154
 403 and #157-162. Several additional English gender mismatches were tested by sentences in
 404 groups §3.2, 3.3. Finnish pronouns and reflexives do not exhibit gender distinctions; human
 405 and nonhuman distinction (*se* ‘it’ ~ *hän* ‘s/he’) was used for testing purposes (#9-11). Examples
 406 like (17)(#11) show that the system works correctly. Thus, in a context where some nonhuman
 407 object, such as a pet dog, is discussed, the following assignments are possible:

408 (17) Pekka₁ sanoi että Merja₂ ihaile-e sitä*_{1,*2,3} (#11)
 409 Pekka.NOM said that Merja.NOM admire-PRS.3SG it.PAR (e.g., a pet dog)
 410 ‘Pekka said that Merja admires it (a pet dog, for example).’

411 The test corpus has sentences testing inverse subject-reflexive constructions such as *himself*
 412 *admires John* (§3.4), which were correctly ruled out, and reflexives inside conversations (§3.5).
 413 Reflexive binding was also tested in connection with control constructions (§3.6). Examples
 414 (20) show the tested patterns in English, but the same constructions or equivalents were also
 415 tested in Finnish.

- 416 (18) a. John wants Mary₁ to admire herself₁/*himself. (#185, 187)
 417 b. John₁ wants to admire himself_{1,*2}/*herself (#189-192, 195-6)
 418 c. John₁ wants himself_{1,*2}/*herself to admire Mary (#197-201)

419 Presence of the infinitival subject, more specifically its [REF] feature, cuts the upward paths
 420 (18a); its absence allows the binding dependency to link an embedded object with the main
 421 clause subject (18b). On the other hand, infinitivals involve an extra complication because their
 422 grammatical analyses are controversial, and particularly so in Finnish. The syntactic analyses
 423 calculated by the syntactic background model, both Finnish and English, are visible in the
 424 output and must be assessed in a separate study; to me they do not appear completely
 425 implausible. I will ignore the issue here, because the infinitival data was calculated correctly
 426 and no change in the underlying assumptions was needed. Binding from an embedded *that*-
 427 clause into the main clause subject was correctly ruled out (group §3.7 in the dataset, Table 1).

428 4.3.3 Condition B

429 Condition B of the binding theory, tested systematically by sentences in group §2, restricts
 430 pronouns into positions where they are not locally bound in Finnish, as first discussed by van
 431 Steenbergen (1991). Pronouns are endowed with [NEW:REF] requiring an assignment that does
 432 *not* denote the same object as another expression inside the reference set. This assumption
 433 derives (19) in our dataset. Only the relevant assignments are shown.

- 434 (19) a. Pekka₁ ihaile-e hän-tä*_{1,2}. (#12, #79-80)
 435 Pekka.NOM admire-3SG.PRS he-PAR
 436 ‘Pekka₁ admires him*_{1,2}.’
 437 b. Pekka₁ sanoo että Merja₂ ihaile-e hän-tä*_{1,*2,3}. (#13)

- 438 Pekka.NOM says that Merja.NOM admire-3SG.PRS he-PAR
 439 ‘Pekka₁ said that Merja admires him_{1,2}.’
 440 c. [Peka-n₁ sisko]₂ ihaile-e hän-tä_{1,*2,3}. (#14, §2.9)
 441 Pekka-GEN sister admire-3SG.PRS he-PAR
 442 ‘Pekka’s sister admires him.’
 443 d. Pekka₁ ihaile-e [hän-en_{1,2} sisko-a-an.] (#83)
 444 Pekka.NOM admire-PRS.3SG he-GEN sister-PAR-PX/3SG
 445 ‘Pekka admires his sister.’

446 The assignments marked in (19) are calculated in this way because under no assignment can
 447 the pronoun refer to the same person as the subject. This condition does not prevent coreference
 448 in (19), because the embedded clause triggers intervention by [REF] at the head of the embedded
 449 subject. In example (19), the possessive DP *Peka-n* ‘Pekka-GEN’ does not occur inside the
 450 reference set calculated for the pronoun *hän-tä* ‘he-PAR’, because it is not visible in the upward
 451 path from the pronoun. Example (19b) will be discussed in detail in Section 4.4.4; the internal
 452 structure of the possessive constructions more generally is discussed in Section 4.4.5.
 453 Combinations of pronouns, proper names and various phi-features (gender, human) in English,
 454 formed from (20), are in the group §2.1 (sentences #64-78) and in group §2.2 (sentences #84-
 455 87). The case assignment patterns were tested in group §2.3, sentences #90-97. They were
 456 computed correctly.

457 (20) John/Mary/he/she/it admires John/Mary/him/her/it (all combinations).

458 The testing of English possessive constructions such as *John admires his sister* (#77, 78)
 459 requires a comment. The possessive sentence is represented by *John admires he=’s sister* in
 460 the test corpus, where symbol = denotes a clitic boundary and ’s is the possessive clitic. The
 461 syntactic model calculates (21), where *his* can share reference with the main clause subject due
 462 to the intervening referential constituent D(’s) and is [REF] feature. I will return to the internal
 463 analysis of DPs in Section 4.4.5.

- 464 (21) [*John*₁ [*admires* [_{DP} D(’s) [_{NP} *he*_{1,2} *sister*]]]
 465 [REF]

466 Pronouns can co-refer with the main clause subject if they occur inside embedded that-clauses
 467 (24), #98-103 for equivalent sentences in English. These tests are in group §2.4.

- 468 (22) a. Pekka₁ sano i että hän_{1,2} ihaile-e Jukka-a*_{1,*2,3}. (#106)
 469 Pekka.NOM said that he.NOM admire-PRS.3SG Jukka-PAR
 470 ‘Pekka said that he (Pekka, third party) admires Jukka.’
 471 b. Pekka₁ sano i että Merja₂ ihaile-e hän-tä_{1,*2,3}. (#105)
 472 Pekka.NOM said that Merja.NOM admire-PRS.3SG he-PAR
 473 ‘Pekka said that Merja admires him (Pekka, third party).’
 474 c. Pekka₁ sano i että hän_{1,2} ihaile-e hän-tä_{1,*2,3} (#107)
 475 Pekka.NOM said that he.NOM admire-PRS.3SG he-PAR
 476 ‘Pekka said that he (Pekka, third party) admires him (Pekka, fourth party).’

477 The calculated assignment possibilities for the second pronoun in (22c) depend on the
 478 assignments provided for the first pronoun. If the first pronoun *hän* ‘he’ denotes the same object
 479 as Pekka under some assignment, then under that same assignment the second pronoun cannot
 480 denote Pekka because the denotation is reserved by the first pronoun (*Pekka₁ – he₁ – him*_{1,2}*).
 481 If the first pronoun denotes somebody else, then coreference is again possible (*Pekka₁ – he₂ –*
 482 *him_{1,*2,3}*). These were calculated correctly by the algorithm (these data were important in
 483 convincing the author that binding must operate at the level of assignments).

484 These data suggest that the complementizer creates an intervention, which follows if it has
 485 [REF]. This is supported by the observation that infinitivals, such as (23), do not have the
 486 coreference reading (group §2.5). The complementizer is missing, hence no intervention.

- 487 (23) a. Pekka₁ halua-a [hän-en*_{1,2} ihaile-van Merja-a.]
 488 Pekka want-PRS.3SG he-GEN admire-VA/INF Merja-PAR
 489 ‘Pekka wants him (≠Pekka) to admire Merja.’
 490 b. John₁ wants him*_{1,2} to admire Mary.

491 Perhaps complementizers function like sentential D-elements. They will project propositional
 492 ‘thing objects’ into the discourse inventory that can function as antecedents of nonhuman
 493 pronouns (e.g., *Mary claimed that [the dog was dead]₁ and John believed it₁*). Projection of
 494 ‘propositional thing objects’ and propositional binding of this type was excluded from this
 495 study, however. If the phi-features match, coreference reading is available from the direct
 496 object position, as the embedded subject causes intervention (24)(#108-111, #118-120, #121).

- 497 (24) John₁ wants Mary₂ to admire him_{1,*2,3}/her*_{1,*2,3}.

498 Pronouns can refer to any object inside the global discourse inventory as long as the phi-
 499 features match. This feature was tested by embedding pronouns inside conversations (group
 500 §2.7). The model calculates these dependencies correctly, as shown by example (25).

501 (25) a. John₁ admires Mary₂; he_{1,3} admires her_{2,4}. (#127-128)

502 b. It₁ sleeps; he_{*1,2} admires Mary_{*1,*2,3}. (#131-132)

503 In (25a), the first sentence generates two objects ‘John’ and ‘Mary’ into the discourse
 504 inventory. This inventory is available when denotations are calculated for the pronouns in the
 505 second sentence. Taking the phi-features into account, both pronouns can refer either to an
 506 existing object in the discourse inventory (*he* = ‘John’, *her* = ‘Mary’) or to new objects
 507 generated while reading the second sentence. Phi-feature mismatches prevent all coreference
 508 readings in (25b). Systematic phi-feature tests are in group §2.8.

509 4.3.4 Condition C

510 Condition C of the binding theory, which was tested systematically by sentences in group §1.4,
 511 states that an r-expression (represented by proper names in the present study) cannot be bound.
 512 This condition was captured by feature [NEW:_] which requires that the denotation must be new
 513 in relation to its reference set calculated by assuming no intervention. This derives the dataset
 514 (26). All coreference readings are ruled out in these examples unless specifically marked as
 515 possible (e.g., example c).

516 (26) a. Hän₁ ihaile-e Merja-a_{*1,2}. (#15, #56)

517 he.NOM admire-3SG.PRS Merja-PAR

518 ‘He admires Merja.’

519 b. Pekka₁ sanoi että Merja₂ ihaile-e Jukka-a₃. (#16)

520 Pekka.NOM said that Merja.NOM admire-3SG.PRS Jukka-PAR

521 ‘Pekka said that Merja admires Jukka.’

522 c. [Hänen₁ siskonsa]₂ sanoi että Pekka_{1,3} ihaile-e Merja-a_{1,*2,*3}. (#17, #58)

523 S/he.GENSister said that Pekka.NOM admire-3SG.PRS Merja-PAR

524 ‘His/her₁ sister said that Pekka admires Merja_{1,2}.’

525 d. Hän₁ sanoi että Pekka₂ ihaile-e Merja-a₃. (#57)

526 S/he said that Pekka.NOM admire-PRS.3SG Merja-PAR

527 ‘He said that Pekka admires Merja.’

528 The corresponding English sentences are #50-55, group §1.4. Without intervention feature the
 529 dependency extends through the whole structure (26b) (group §1.2 in test corpus). These
 530 dependencies are regulated by the upward path mechanism (26c); hence it is possible to use a
 531 proper name to denote a discourse old object, as shown by (27) below.

532 (27) John₁ sleeps; John_{1,2} admires Mary. (#18-19, also group §1.5, #59-62)

533 The same logic extends to infinitivals (28)(group §1.3), where all proper names must be disjoint
 534 in reference.

535 (28) a. John₁ wants Mary_{*1,2} to admire Bill_{*1,*2,3}. (#48)

536 b. Pekka₁ sanoo Merja-n_{*1,2} ihaile-van Jukka-a_{*1,*2,3}. (#49)

537 Pekka says Merja-GEN admire-VA/INF Jukka-PAR

538 ‘Pekka says that Merja admires Jukka.’

539 Sentences (29) were also calculated correctly.

540 (29) a. John₁ admires Mary_{*1,2}. (#40)

541 b. John₁ admires John_{*1,2}. (#42)

542 The coreference reading in (29a) is ruled out both by the binding conditions and by gender
 543 mismatch; in (29b) it is ruled out only by binding. Thus, repetition of upward path connected
 544 proper names generates disjoint reference readings that can be resurrected downstream if
 545 prompted by pragmatic conditions. All sentences of this type, for English and Finnish, are in
 546 group §1.1 in the test corpus.

547 4.3.5 *Apparent violations of the Binding Conditions*

548 Previous literature has reported several examples where binding conditions are seemingly
 549 violated. The following examples were discussed by Reinhart (1983, pp. 168–169), who cites
 550 Evans (1980).

551 (30) a. I know what John and Bill have in common. John thinks that Bill is terrific and Bill
 552 thinks that Bill is terrific. (Example (55a), p. 168, in the original)

553 b. I know what Bill and Mary have in common. Mary adores Bill and Bill adores Bill /
 554 and Bill adores him too. (Example (57a), p. 169, in the original)

Example (30a) violates Condition C; example (30b) Condition B. A long list of similar exempt anaphors including reflexives were listed in Pollard & Sag (1992), reviewing and relying on much previous work, and then discussed by many others (see Charnavel 2021 for recent work). According to the model proposed here, violations of binding conditions reduce the weights of the corresponding assignments to zero instead of eliminating them, so that downstream cognitive processes can still resurrect them. These data motivated the cognitive architecture underlying the present hypothesis.

4.3.6 Null subject sentences

Finnish is a partial pro-drop language, which allows grammatical subject pronouns to be dropped in all person and number configurations with the exception of the third person (31a-b) (Vainikka, 1989; Vainikka & Levy, 1999).

- (31) a. Ihaile-n Merja-a. (#20, 63)
 admire-1SG.PRS Merja-PAR
 '(I) admire Merja.'
 b. *Ihaile-e Merja-a.
 admire-3SG.PRS Merja-PAR
 Intended: 'He admires Merja.'

The calculated output for (31a) is $[_{TP} T_{pro} [_{VP} v [_{DP} Merjaa]]]$ where the first person agreement suffix *-n* in the input projects a phi-set $\phi = [1SG]$ inside the tense node $T = T_{[3SG]}$. The pronominal agreement cluster then functions as a pro-element in syntax, generating T_{pro} . Because the assignment mechanism is triggered by nominal phi-features, T_{pro} projects the singular first person object (speaker) to the discourse inventory and derives (32), where the reflexive is bound by the pro-element inside the predicate.

- (32) Ihaile-n₁ itse-ä-ni_{1,*2}. (#21)
 admire-1SG.PRS self-PAR-PX/3SG
 'I admire myself.'
 $[_{T_{pro1}} [v [_{DP} self_1]]]$
 └────────┘

Notice that the model correctly calculates a disjoint reference reading for (31b) due to the Condition C of the binding theory: T_{pro} and the proper name cannot refer to the same thing

585 even though their phi-features match (#63). Up to this point, then, the system works as
 586 intended. A complication, however, comes from the fact that a third person embedded pro-drop
 587 clause is grammatical in Finnish if (and only if) the null pronoun can be paired with a c-
 588 commanding antecedent (33). As shown by the translation, the thematic subject of the
 589 embedded but subjectless clause must be the same as the subject of the main clause.

590 (33) Pekka sanoo että [ihaile-e Merja-a.] (#22)
 591 Pekka says that admire-3SG.PRS Merja-PAR
 592 'Pekka₁ says that he (=Pekka₁) admires Merja.'

593 This phenomenon has received much interest in the literature (Brattico, 2017; Holmberg, 2005;
 594 Holmberg & Sheehan, 2010; Vainikka, 1989; Vainikka & Levy, 1999), one view being that the
 595 third person pro-element is too 'weak' and requires semantic support from an antecedent
 596 (Holmberg & Sheehan, 2010). The syntactic background theory follows this analysis and
 597 assumes that the third person pro element lacks a fully specified D-feature, which triggers
 598 antecedent support (Brattico, 2021b). The problem is that *antecedent support does not*
 599 *constraint assignments*. What we need to do is to introduce an additional condition which
 600 makes it so that if a predicate is assigned an argument by antecedent support, as in (33), its own
 601 pro-element must be assigned the same interpretation. Once I added this restriction to the
 602 algorithm, the data comes out correctly (34)(also group §2.10). Also reflexive binding was
 603 tested inside these environments (§3.8, #204-207).

604 (34) a. Pekka₁ sanoo että pro_{1,*2} ihaile-e Merja-a*_{1,*2,3}. (#22, #147)
 605 Pekka says that admire-3SG.PRS Merja-PAR
 606 'Pekka says that he =(Pekka) admires Merja.'
 607 b. Pekka₁ sanoo että pro_{1,*2} ihaile-e itse-ä-än_{1,*2,*3}. (#23)
 608 Pekka says that admire-3SG.PRS self-PAR-PX/3SG
 609 'Pekka says that he (=Pekka) admires himself.'
 610 c. Pekka₁ sanoo että pro_{1,*2} ihaile-e hän-tä*_{1,*2,3}. (#24)
 611 Pekka says that admire-3SG.PRS he-PAR
 612 'Pekka says that he (=Pekka) admires him (≠ Pekka).'
 613 d. Pekka₁ sanoo että pro*_{1,2} ihaile-n hän-tä*_{1,*2,3}. (#25, #148)
 614 Pekka says that admire-1SG.PRS he-PAR
 615 'Pekka says that I admire him (Pekka or someone else).'

Pro-subject functions as an intervention element for the pronoun, allowing the pronoun to pair with the main clause subject. This is because it contains the intervention feature [REF]. This means that both the subject and an Agr head (here T_{pro}) can define a local domain for anaphors (Chomsky, 1981: 209–211). The results are the same if *Pekka* is replaced with *hän* ‘he’ (#149, 150).

When the input sentence contains both a grammatical subject and a T_{pro} -element, the model still creates impossible interpretations illustrated in (35).

(35) Hän₁ ihaille-e_{1,2,3} Merja-a₃.
 he.NOM admire-3SG.PRS Merja-PAR
 ‘He admires Merja.’

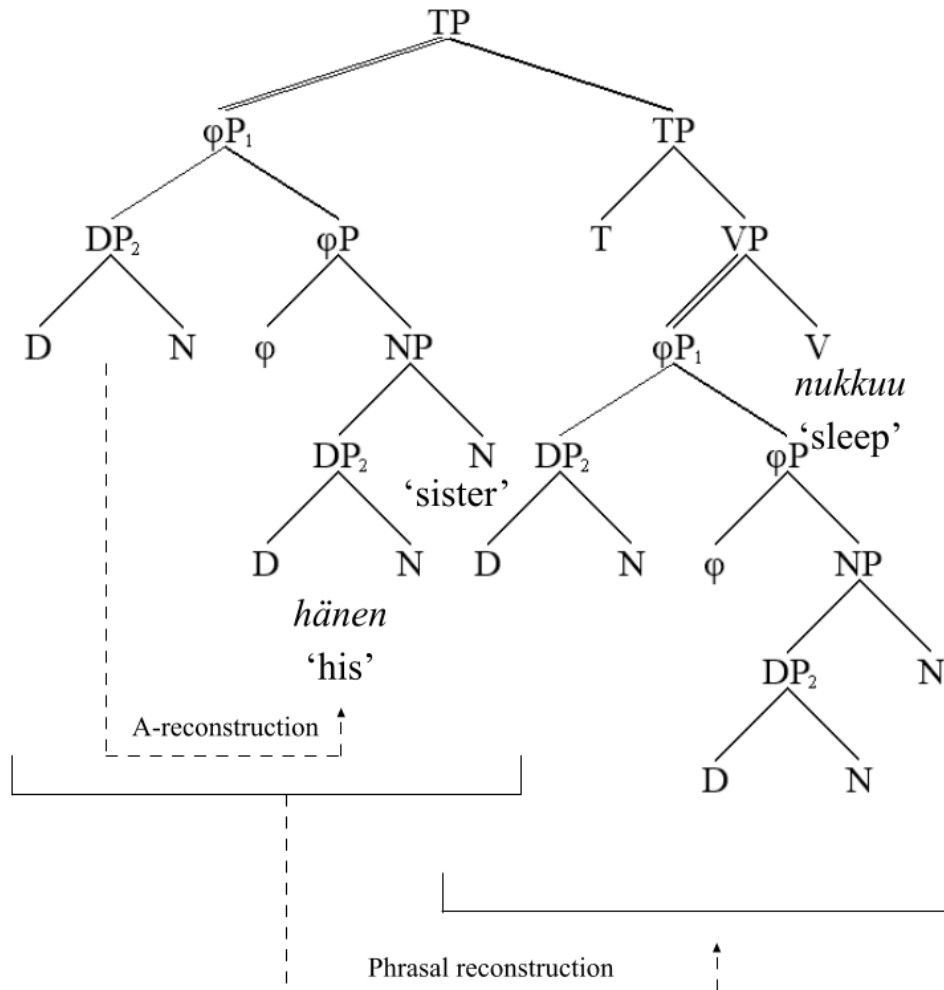
Again, the pro-element inside T_{pro} behaves as a rogue referential entity establishing its own denotations. The subject and the pro-element at T_{pro} cannot, however, refer to separate semantic objects. This problem was solved by assuming that the operation Agree, which checks the phi-features of the predicate against the properties of the grammatical subject, pre-empts both antecedent support and the projection of a separate pro-element into the discourse inventory. The fact that these connections had to be forced into the algorithm suggests that the three mechanisms – control, agreement and binding – share an underlying (to me also unknown) mechanism. What this shared resource might be was left for future study.

4.3.7 DP-internal binding

The syntax and semantics of full argument DPs and binding inside such constructions present special issues. In some earlier models that used the same syntactic background theory (Brattico, 2020, 2021b; Brattico & Chesi, 2020), full arguments were assumed to consist of [$_{DP}$ D NP] structures, following the DP-hypothesis (Longobardi, 1994). The problem is that Finnish lacks grammaticalized articles and D elements cannot be assumed to be present in the input. This issue was solved in this study by assuming, following the line of analysis by Déchaine & Wiltschko (2017), Déchaine & Wiltschko (2002) and van Steenbergen (1987, 1991), that full bare nominal arguments can be analyzed as [$_{\phi P}$ ϕ N] structures, where ϕ is a nominal agreement cluster carrying phi-features. All bare noun arguments in Finnish were analyzed in this way (e.g., *sisko* ‘sister’ → [$_{\phi P}$ ϕ sister]). The possessive argument is then generated to Spec ϕP and gets reconstructed to SpecNP (36-37).

- | | | | |
|-----|--------------------------|-------------------|----------------|
| 646 | (36) Hän-en | sisko-nsa | nukku-u. (#26) |
| 647 | S/he-GEN | sister.NOM-PX/3SG | sleep-3SG.PRS |
| 648 | 'His/her sister sleeps.' | | |

649 (37)



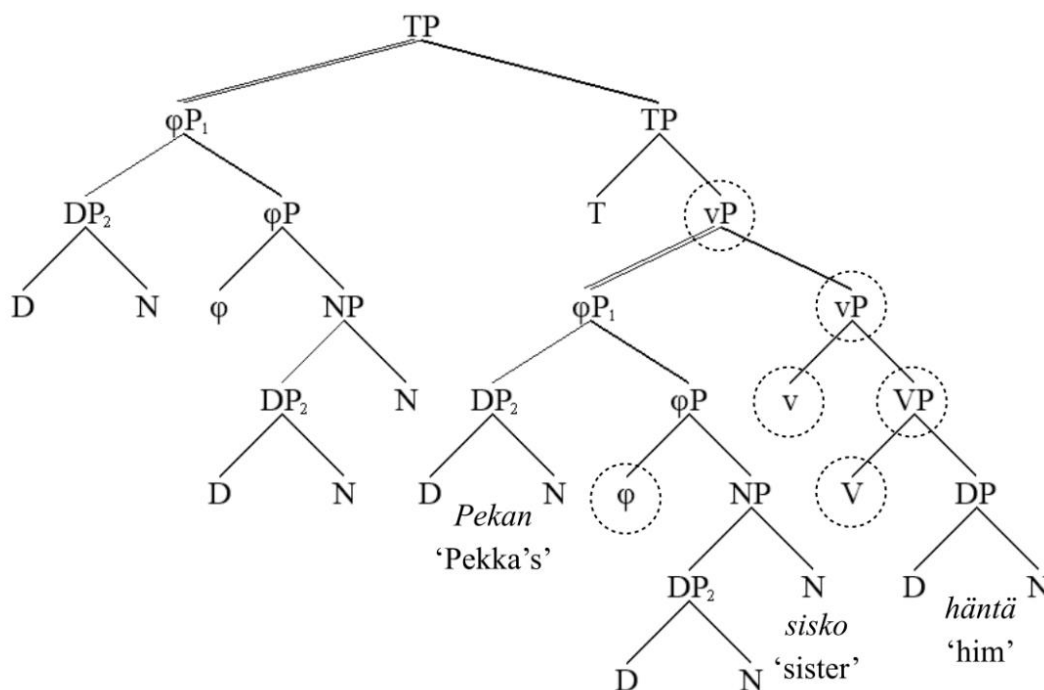
650

651 In English, 's is interpreted by the syntactic background theory as a clitic, projecting *his sister*
652 =_{[DP D('s) [[D he] N]]}, assuming that 's represents D. While this is controversial, what matters
653 is that the possessive DP is invisible for upward paths emerging from any element inside the
654 hosting clause. Such upward paths will see \varnothing but not the possessive pronoun:

- 655 (38) [_{φP} Peka-n₁ sisko]₂ ihaile-e hän-tä_{1,*2,3}. (#27)
656 Pekka-GEN sister admire-3SG.PRS s/he-PAR
657 ‘Pekka’s sister admires him.’

658 The analysis, showing the upward path calculations from the direct object pronoun, is (39).

659 (39)



660

661 Another consequence of this analysis is that both (40a-b) are calculated correctly. D^0 and φ^0
 662 intervene, allowing the pronoun to refer to the main clause subject.

663 (40) a. John₁ admires [_{DP} D his_{1,2} sister]₃. (#28)

664 b. Pekka₁ ihaile-e [_{φP} φ (hän-en₁) sisko-a(-an).] (#29)

665 Pekka.NOM admire-3SG.PRS (he-GEN) sister-PAR(-PX/3SG)

666 'Pekka admires his sister.'

667 The Finnish version (40b) with the coreference reading feels marginal but not ungrammatical.
 668 Chomsky (1981, p. 65) proposes that these constructions exhibit an "avoid pronoun" principle
 669 that prefers null pronouns when an overt pronoun would be redundant; see also Kaiser (2003),
 670 footnote 2, p. 9, who notices that her native speakers "permit" reading (41b) against "standard
 671 judgments." It is unclear to me what "standard judgments" means here; to me, (39b) is possible,
 672 but marginal.

673 A potential issue is that both pronouns and reflexives are possible in the complement positions
 674 of nouns (41).

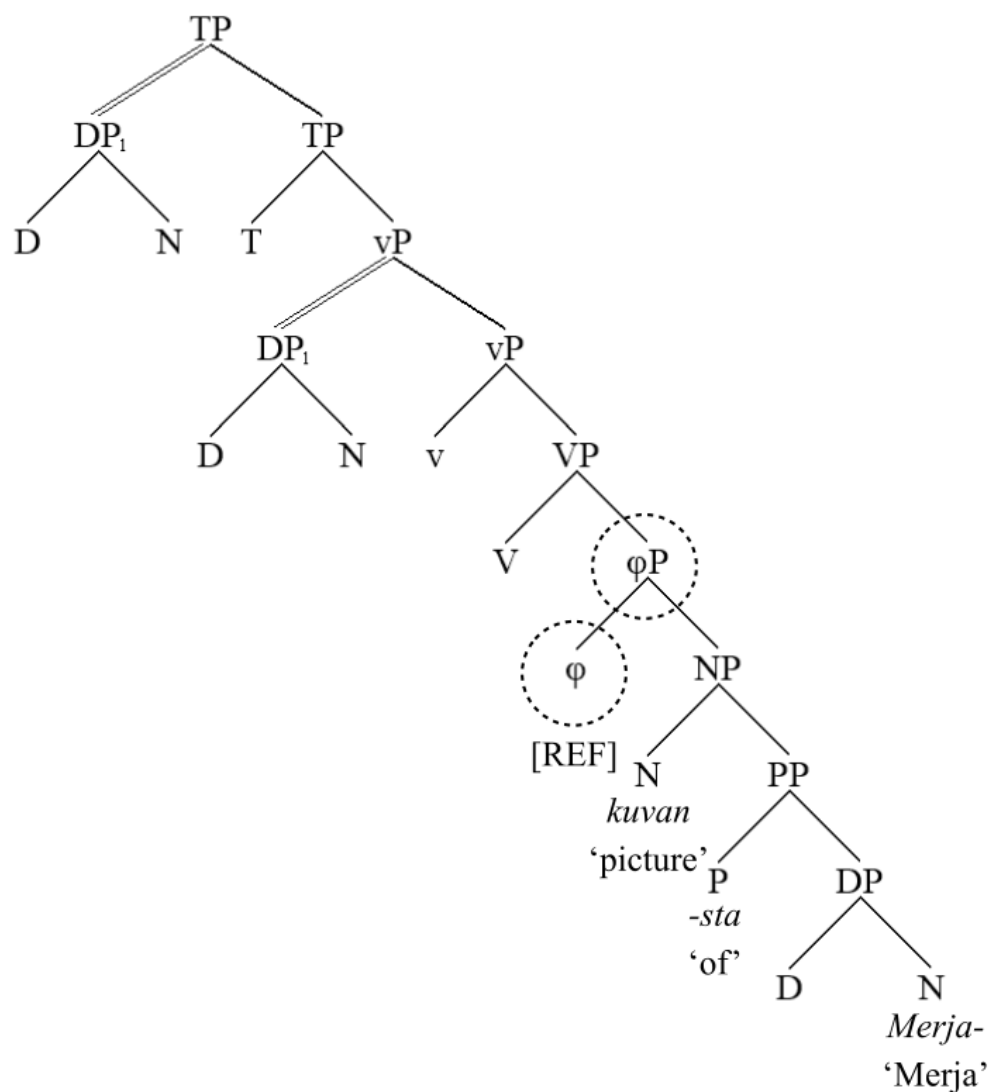
675 (41) a. Pekka₁ ott-i kuva-n itse-stä-än_{1,*2}

676 Pekka.NOM take-3SG.PST picture-ACC self-ELA-PX/3SG

- 677 'Pekka took a picture of himself.'
- 678 b. Pekka₁ ott-i kuva-n hän-estä_{??1,2}.
- 679 Pekka.NOM take-3SG.PST picture-ACC he-ELA
- 680 'Pekka took a picture of him.'
- 681 c. Pekka₁ ott-i kuva-n Merja-sta₂. (#31)
- 682 Pekka.NOM take-3SG.PST picture-ACC Merja-ELA
- 683 'Pekka took a picture of Merja.'

684 At first this data seems to contradict the present hypothesis, which predicts pronouns and
 685 reflexives to be complementary. Feeding these expressions to the syntactic background model
 686 reveals a different picture. Due to the discourse-configurationality of Finnish, the syntactic
 687 background model treats both the accusative-marked direct object and the preposition as
 688 adjuncts. This means that input sentences such as (41a-c) will have multiple ambiguities
 689 depending on the assumed position of both the direct object and the PP. The first solution found
 690 by the model is (42)(see #31).

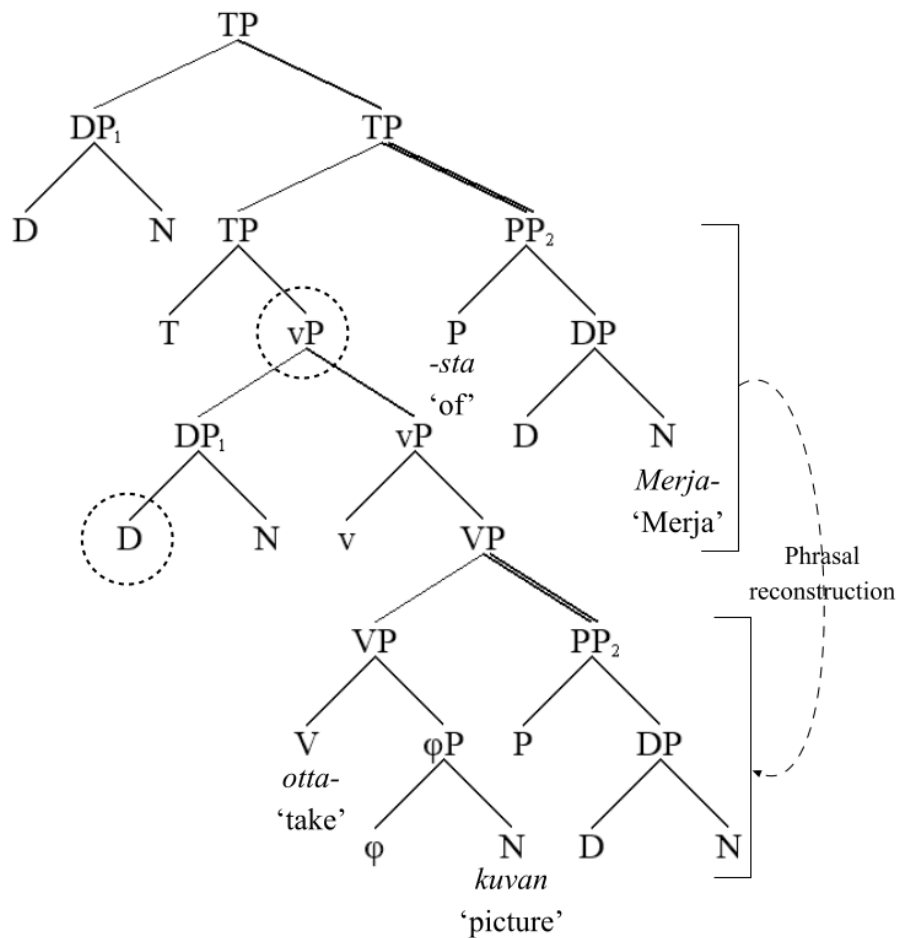
691 (42)



692

693 The PP 'of Merja' was analysed as the complement of the noun head 'picture' to create a
 694 complex DP with the meaning 'a picture of Merja'. Because ϕ causes intervention, shown by
 695 the circles in (42), upward path reaches ϕ , licensing 'Pekka₁ took a picture of him₁' but not
 696 'Pekka₁ took a picture of himself₁'. The second parse is (43), line 1398.

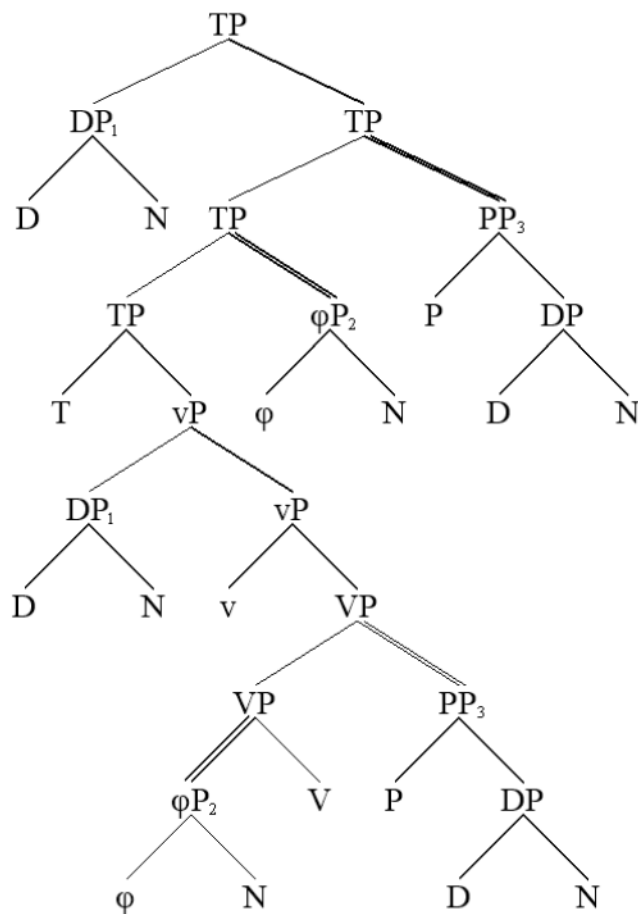
697 (43)



698

699 The parser assumed that the PP is right-adjoined to the TP, and reconstructed it as right-
 700 adjoined to VP. Under this interpretation, the sentence means roughly 'Pekka took a picture,
 701 and it was of Merja', so that 'of Merja' is interpreted as an argument of the verb or event and
 702 not as the complement of N. The reference set for the DP inside PP contains everything up to
 703 the subject and the direct object is invisible, thus we get 'Pekka₁ took a picture of himself₁' and
 704 not 'Pekka₁ took a picture of him₁'. This ambiguity derives the data in (41). The third analysis
 705 is (44).

706 (44)



707

708 Here both the direct object and the PP were initially analysed as being adjoined to the right of
 709 TP, and both were reconstructed. The binding possibilities are those of (43). If we assume that
 710 in English picture PPs can be adjoined while DPs can't, then we get (42) and (43) but not (44),
 711 which is sufficient to capture data from English.

712 These calculations are not uncontroversial. Some of the particulars do not matter, however.
 713 What does matter is that a right-adjoined PP can be analysed both as a complement of the noun
 714 and as an “extraposed” right-adjoined VP-modifier, and this ambiguity, when available, causes
 715 the complementarity between *him* and *himself* to break down.

716 4.3.8 Embedded infinitivals

717 Embedded infinitivals are transparent to upward paths. Embedded pronouns cannot co-refer
 718 with main clause subjects, while reflexives can. The model calculates these dependencies

719 correctly, both for English (45) and Finnish (46). Note that Finnish has several infinitival forms
 720 glossed as A/INF (A-infinitival) and VA/INF (VA-infinitival)(Koskinen, 1998; Vainikka, 1989).

721 (45) a. John₁ wants to admire him_{*1,2}. (#32)

722 b. John₁ wants to admire himself_{1,*2} (#33)

723 (46) a. Pekka₁ halua-a [ihail-la hän-tä_{*1,2}.] (#34)

724 Pekka.NOM want-3SG.PRS admire-A/INF he-PAR

725 ‘Pekka wants to admire him.’

726 b. Pekka₁ halua-a [ihail-la itse-ä-än_{1,*2}.] (#35)

727 Pekka.NOM want-3SG.PRS admire-A/INF self-PAR-PX/3SG

728 ‘Pekka wants to admire himself.’

729 An embedded subject, however, does cause intervention and reverses the pattern (47). These
 730 results again correspond to the effects of the Specified Subject Condition of the standard
 731 binding theory (Chomsky, 1977, 1981; Chomsky & Lasnik, 1977).

732 (47) a. Pekka₁ halua-a [Merja-n₂ ihaile-van hän-tä_{1,*2,3}.] (#36)

733 Pekka.NOM want-3SG.PRS Merja-GEN admire-VA/INF he-PAR

734 ‘Pekka wants Merja to admire him.’

735 b. Pekka₁ halua-a [Merja-n₂ ihaile-van itse-ä-än_{*1,2,*3}.] (#37)

736 Pekka.NOM want-3SG.PRS Merja-GEN admire-VA/INF self-par-PX/3SG

737 ‘Pekka wants Merja to admire herself/*himself.’

738 Positioning the pronouns to the embedded subject position calculates the expected results:
 739 pronouns cannot co-refer with the main clause subject while reflexives can. van Steenbergen
 740 (1991) suggests however that the binding domain for the Finnish reflexive is determined by
 741 tense and supports the generalization by citing the VA-infinitival construction (example (6a)
 742 in the original, p. 235, my glossing):

743 (48) Pekka₁ näki [VA/infP Mat-in₂ katso-van itse-ä-än_{1,2}.]

744 Pekka.NOM see.3SG.PST Matti-GEN look-VA/INF self-PAR-PX/3SG

745 ‘Pekka saw Matti watch himself.’

746 To me the long-distance binding configuration is marginal, and indeed van Steenbergen cites
 747 other infinitival constructions where she agrees with my judgment (e.g., example (8) in her

748 paper). This claim is not isolated, however; also Trosterud (1990, p. 69) judges (49)
 749 grammatical (=ex. 35b in the original).

750 (49) Maija₁ kask-i meidän pes-tä itse-nsä₁.
 751 Maija.NOM order-3SG.PST we.GEN wash-A/INF self-PX/3SG
 752 ‘Maija ordered us to wash herself.’

753 I find this marginal, and ungrammatical if the embedded subject and the reflexive agree in phi-
 754 features (*meidän* – *itse* ‘us – self.PX/1PL’ or *hänen* – *itsensä* ‘self.PX/3SG’). Trosterud
 755 reports the same result from Pyssyjoki Finnish (pp. 95-96), thus his informants did not accept
 756 long-distance binding when the intervening subject and the anaphor agreed. Long-distance
 757 binding was absent from the Finnmark dialect (pp. 93-94). Finally, Trosterud reported that
 758 there was between-speaker variation in the elicited judgments. This instability corresponds
 759 with my own intuition, equally unclear and marginal at best. Therefore, I think that a clear-cut
 760 conclusion cannot be reached without further data. The analysis proposed in this article allows,
 761 however, one to define locality on the basis of the minimal tense phrase (by feature [OLD:T]),
 762 but the hypothesis must be tested over several constructions in the dialect/language where it
 763 looks reasonable. In my Finnish, it does not.

764 5 Conclusions

765 Properties of binding in Finnish (and English) were calculated from a formal model which
 766 assumes that binding operates at the language-cognition interface. In addition to standard
 767 binding configurations, also picture nouns, noncanonical word orders, operator constructions,
 768 null subject clauses, and embedded infinitivals follow from the hypothesis. The hypothesis was
 769 formulated as a Python algorithm and tested against a dataset. Syntax-internal binding
 770 mechanisms were not needed in the calculations, and were rejected as redundant.

771

772 References

773 Almor, A. 1999. Noun-phrase anaphora and focus: The informational load hypothesis.
 774 *Psychological Review* 106(4), 748–765. <http://dx.doi.org/10.1037/0033-295X.106.4.748>

- 775 Aoshima, S., Yoshida, M., & Phillips, C. 2009. Incremental Processing of Coreference and
 776 Binding in Japanese. *Syntax* 12(2), 93–134. [http://dx.doi.org/10.1111/j.1467-](http://dx.doi.org/10.1111/j.1467-9612.2009.00123.x)
 777 9612.2009.00123.x
- 778 Ariel, M. 1990. *Accessing Noun-Phrase Antecedents*. London: Croom Helm.
- 779 Asher, N., & Wada, H. 1988. A computational account of syntactic, semantic and discourse
 780 principles for anaphora resolution. *Journal of Semantics* 6(1), 309–344.
 781 <http://dx.doi.org/10.1093/jos/6.1.309>
- 782 Badecker, W., & Straub, K. 2002. The Processing Role of Structural Constraints on the
 783 Interpretation of Pronouns and Anaphors. *Journal of Experimental Psychology: Learning*
 784 *Memory and Cognition* 28(4), 748–769. <http://dx.doi.org/10.1037/0278-7393.28.4.748>
- 785 Barss, A. 1986. *Chains and Anaphoric Dependencies*. Disseration, MIT.
- 786 Brattico, P. 2017. Null subjects and control are governed by morphosyntax in Finnish. *Finno-*
 787 *Ugric Languages and Linguistics* 6, 2–37.
- 788 Brattico, P. 2018. *Word Order and Adjunction in Finnish*. Aarhus: Aguila & Celik.
- 789 Brattico, P. 2019a. A computational implementation of a linear phase parser. Framework and
 790 technical documentation (version 13). Pavia.
- 791 Brattico, P. 2019b. Subjects, topics and definiteness in Finnish. *Studia Linguistica* 73, 1–38.
 792 <http://dx.doi.org/10.1111/stul.12129>
- 793 Brattico, P. 2020. Finnish word order: does comprehension matter? *Nordic Journal of*
 794 *Linguistics* 44(1), 38–70. <http://dx.doi.org/10.1017/S0332586520000098>
- 795 Brattico, P. 2021a. A dual pathway analysis of information structure. *Lingua* 103156.
 796 <http://dx.doi.org/10.1016/j.lingua.2021.103156>
- 797 Brattico, P. 2021b. Null arguments and the inverse problem. *Glossa: A Journal of General*
 798 *Linguistics* 6(1), 1–29.
- 799 Brattico, P. (to appear). Predicate clefting and long head movement in Finnish. *Linguistic*
 800 *Inquiry*.

- 801 Brattico, P., & Chesi, C. 2020. A top-down, parser-friendly approach to operator movement
802 and pied-piping. *Lingua* 233, 102760. <http://dx.doi.org/10.1016/j.lingua.2019.102760>
- 803 Brattico, P., & Huhmarniemi, S. 2016. *Finite and non-finite null subjects in Finnish*.
804 Manuscript.
- 805 Buring, D. 2005. *Binding Theory*. Cambridge: Cambridge University Press.
- 806 Charnavel, I. 2021. Logophoricity, Perspective, and Reflexives. *Annual Review of Linguistics*
807 7, 131–155. <http://dx.doi.org/10.1146/annurev-linguistics-030220-085846>
- 808 Chomsky, N. 1977. On wh-movement. In P. W. Culicover, T. Wasow, & A. Akmajian (Eds.),
809 *Formal Syntax* (pp. 71–132). Academic Press.
- 810 Chomsky, N. 1980. On binding. *Linguistic Inquiry*, 11, 1–46.
- 811 Chomsky, N. 1981. *Lectures in Government and Binding*. Dordrecht: Foris.
- 812 Chomsky, N. 1982. Some Concepts and Consequences of the Theory of Government and
813 Binding, Cambridge, MA: MIT Press.
- 814 Chomsky, N. 1995. *The Minimalist Program*. Cambridge, MA.: MIT Press.
- 815 Chomsky, N., & Lasnik, H. 1977. Filters and Control. *Linguistic Inquiry* 8, 425–504.
- 816 Clements, G. N. 1975. The logophoric pronoun in Ewe: its role in discourse. *Journal of West*
817 *African Languages* 10, 141–177.
- 818 Clifton, C., Kennison, S. M., & Albrecht, J. E. 1997. Reading the words him and her:
819 Implications for parsing principles based on frequency and on structure. *Journal of Memory*
820 *and Language* 36, 276–292.
- 821 Culicover, P., & Jackendoff, R. 1995. “Something else” for the binding theory. *Linguistic*
822 *Inquiry* 26(2), 249–275.
- 823 Cunnings, I., & Felser, C. 2013. The role of working memory in the processing of reflexives.
824 *Language and Cognitive Processes* 28(1–2), 188–219.
825 <http://dx.doi.org/10.1080/01690965.2010.548391>

- 826 Cunnings, I., & Sturt, P. 2014. Coargumenthood and the processing of reflexives. *Journal of*
827 *Memory and Language* 75, 117–139. <http://dx.doi.org/10.1016/j.jml.2014.05.006>
- 828 Déchaine, R.-M., & Wiltschko, M. 2012. The Heterogeneity of Reflexives. Manuscript,
829 retrieved from <https://ling.auf.net/lingbuzz/001665>.
- 830 Déchaine, R.-M., & Wiltschko, M. 2017. A Formal Typology of Reflexives. *Studia Linguistica*
831 71(1–2), 60–106.
- 832 Dechaine, R., & Wiltschko, M. 2002. Decomposing pronouns. *Linguistic Inquiry* 33(3), 409–
833 422.
- 834 Dillon, B., Mishler, A., Sloggett, S., & Phillips, C. 2013. Contrasting intrusion profiles for
835 agreement and anaphora: Experimental and modeling evidence. *Journal of Memory and*
836 *Language* 69(2), 85–103.
- 837 Evans, G. 1980. Pronouns. *Linguistic Inquiry* 11(2), 337–362.
- 838 Fedele, E., & Kaiser, E. 2014. Looking Back and Looking Forward: Anaphora and Cataphora
839 in Italian. *University of Pennsylvania Working Papers in Linguistics* 20(1). Retrieved from
840 <https://repository.upenn.edu/pwpl/vol20/iss1/10>
- 841 Fiengo, R., & May, R. 1994. *Indices and identity*. Cambridge, MA.: MIT Press.
- 842 Fischer, S. 2015. Theories of binding. In T. Kiss & A. Alexiadou (Eds.), *Syntax - Theory and*
843 *Analysis. An international handbook* (pp. 1357–1399). Berlin: de Gruyter.
- 844 Garrod, S., & Sanford, A. J. 1994. Resolving sentences in a discourse context: How discourse
845 representation affects language understanding. In M. A. Gernsbacher (Ed.), *Handbook of*
846 *psycholinguistics* (pp. 675–698). San Diego, CA: Academic Press.
- 847 Givón, T. 1983. Topic continuity in discourse: An introduction. In T. Givón (Ed.), *Topic*
848 *Continuity in Discourse: A Quantitative Cross-Language Study* (pp. 5–41). Berlin: John
849 Benjamins.
- 850 Grosz, B. J., Joshi, A. K., & Weinstein, S. 1995. Centering: a Framework for Modelling the
851 Local Coherence of Discourse. *Computational Linguistics* 21(2), 203–226.

- 852 Hankamer, J., & Sag, I. 1976. Deep and Surface Anaphora. *Linguistic Inquiry* 7.3, 391–426.
- 853 Heim, I. 1982. *The Semantics of Definite and Indefinite Noun Phrases*. University of
854 Massachusetts at Amherst.
- 855 Helke, M. 1971. *The Grammar of English Reflexives*. MIT.
- 856 Hellan, L. 1988. *Anaphora in Norwegian and the Theory of Grammar*. Dordrecht: Foris.
- 857 Hicks, G. 2008. Why the Binding Theory Doesn't Apply at LF. *Syntax* 11(3), 255–280.
- 858 Holmberg, A. 2005. Is There a Little pro? Evidence from Finnish. *Linguistic Inquiry* 36(4),
859 533–564.
- 860 Holmberg, A., & Nikanne, U. 2002. Expletives, subjects and topics in Finnish. In P. Svenonius
861 (Ed.), *Subjects, Expletives, and the EPP* (pp. 71–106). Oxford: Oxford University Press.
- 862 Holmberg, A., & Sheehan, M. 2010. Control into finite clauses in partial null-subject
863 languages. In T. Biberauer, A. Holmberg, Ian Roberts, & M. Sheehan (Eds.), *Parametric*
864 *Variation: Null Subjects in Minimalist Theory* (pp. 125–152). Cambridge: Cambridge
865 University Press.
- 866 Hornstein, N. 2001. *Move! A Minimalist Theory of Construal*. Malden, USA: Blackwell.
- 867 Huang, Y. 2000a. *Anaphora: A Cross-Linguistic Study*. Oxford: Oxford University Press.
- 868 Huang, Y. 2000b. Discourse anaphora: Four theoretical models. *Journal of Pragmatics* 32(2),
869 151–176.
- 870 Huhmarniemi, S. 2019. The movement to SpecFinP in Finnish. *Acta Linguistica Academica*
871 66(1), 85–113. <http://dx.doi.org/10.1556/2062.2019.66.1.4>
- 872 Huhmarniemi, S., & Brattico, P. 2015. The Finnish possessive suffix. *Finno-Ugric Languages*
873 *and Linguistics* 4(1–2), 2–41.
- 874 Huhmarniemi, S., & Vainikka, A. 2010. Multiple wh-questions and syntactic islands in Finnish.
875 In *Proceedings of Congressus XI Internationalis Fenno-Ugristarum (FUII) Pars VI* (pp. 227–
876 233). Reguly Társaság.

- 877 Kaiser, E. 2003. Encoding (Non)Locality in Anaphoric Relations. In D. Nelson & S. Manninen
 878 (Eds.), *Generative Approaches to Finnic and Saami Linguistics* (pp. 269–294). CSLI
 879 Publications.
- 880 Kaiser, E. 2011. Focusing on pronouns: Consequences of subjecthood, pronominalisation, and
 881 contrastive focus. *Language and Cognitive Processes* 26(10), 1625–1666.
 882 <http://dx.doi.org/10.1080/01690965.2010.523082>
- 883 Kamp, H. 1981. A Theory of Truth and Semantic Representation. In J. A. G. Groenendijk, T.
 884 Janssen, & M. Stokhof (Eds.), *Formal Methods in the Study of Language*. Mathematical Centre.
- 885 Kanerva, J. 1987. Morphological integrity and syntax: The evidence from Finnish possessive
 886 suffixes. *Language* 63(3), 498–501.
- 887 Kayne, R. S. 1984. *Connectedness and Binary Branching*. Dordrecht: Foris.
- 888 Kazanina, N., Lau, E. F., Lieberman, M., Yoshida, M., & Phillips, C. 2007. The effect of
 889 syntactic constraints on the processing of backwards anaphora. *Journal of Memory and*
 890 *Language* 56(3), 384–409. <http://dx.doi.org/10.1016/j.jml.2006.09.003>
- 891 Koornneef, A., & Reuland, E. 2016. On the Shallow Processing (Dis)Advantage: Grammar
 892 and Economy. *Frontiers in Psychology* 7. <http://dx.doi.org/10.3389/fpsyg.2016.00082>
- 893 Koskinen, P. 1998. Features and categories: Non-finite constructions in Finnish. University of
 894 Toronto.
- 895 Lebeaux, D. 2009. *Where Does Binding Theory Apply?* Cambridge, MA: MIT Press.
- 896 Lees, R. B., & Klima, E. S. 1963. Rules for English Pronominalization. *Language* 39, 17–28.
- 897 Longobardi, G. 1994. Reference and proper names: A theory of N-Movement in Syntax and
 898 Logical Form. *Linguistic Inquiry* 25, 609–665.
- 899 Malt, B. C. 1985. The role of discourse structure in understanding anaphora. *Journal of*
 900 *Memory and Language* 24(3), 271–289.
- 901 Manzini, R., & Wexler, K. 1987. Parameters, Binding Theory and Learnability. *Linguistic*
 902 *Inquiry* 18.3, 413–444.

- 903 Marr, D. 1982. *Vision: A Computational Investigation into the Human Representation and*
 904 *Processing of Visual Information*. Cambridge, MA.: MIT Press.
- 905 Murphy, G. L. 1985a. Processes of understanding anaphora. *Journal of Memory and Language*
 906 24(3), 290–303.
- 907 Murphy, G. L. 1985b. Psychological explanations of deep and surface anaphora. *Journal of*
 908 *Pragmatics* 9(6), 785–81
- 909 Nicol, J., & Swinney, D. 1989. The role of structure in coreference assignment during sentence
 910 comprehension. *Journal of Psycholinguistic Research* 18(1), 5–19.
- 911 Nicol, J., & Swinney, D. A. 2003. The Psycholinguistics of Anaphora. In Adrew Barss (Ed.),
 912 *Anaphora: A Reference Guide* (pp. 72–104). Malden, MA.: Blackwell Publishing.
- 913 Parker, D. 2019. Cue Combinatorics in Memory Retrieval for Anaphora. *Cognitive Science*
 914 43(3), e12715. <http://dx.doi.org/10.1111/cogs.12715>
- 915 Parker, D., & Phillips, C. 2017. Reflexive attraction in comprehension is selective. *Journal of*
 916 *Memory and Language* 94, 272–290. <http://dx.doi.org/10.1016/j.jml.2017.01.002>
- 917 Pollard, C., & Sag, I. 1992. Anaphors in English and the Scope of Binding Theory. *Linguistic*
 918 *Inquiry* 23(2), 261–303.
- 919 Postal, P. 1971. *Cross-over Phenomena*. New York: Holt, Rinehart and Winston.
- 920 Raposo, E. 1986. Some asymmetries in the binding theory in romance. *Linguistic Review* 5(1),
 921 75–110.
- 922 Reinhart, T. 1983. Anaphora and Semantic Interpretation. Croom Helm.
- 923 Reinhart, T., & Reuland, E. 1993. Reflexivity. *Linguistic Inquiry* 24(4), 657–720.
- 924 Reuland, E. 2001. Primitives of Binding. *Linguistic Inquiry* 32, 439–492.
- 925 Reuland, E. 2006. Agreeing to bind. In *Organizing Grammar* (pp. 505–513). Berlin: de Gruyter
 926 Mouton.

- 927 Rooryck, J., & Wyngaerd, G. Vanden. 2011. *Dissolving Binding Theory*. Oxford: Oxford
928 University Press.
- 929 Safir, K. 2004. *The Syntax of Anaphora*. Oxford: Oxford University Press.
- 930 Schlenker, P. 2005. Non-Redundancy: Towards a Semantic Reinterpretation of Binding
931 Theory. *Natural Language Semantics* 2005 13(1), 1–92. [http://dx.doi.org/10.1007/s11050-](http://dx.doi.org/10.1007/s11050-004-2440-1)
932 004-2440-1
- 933 Sells, P. 1987. Aspects of Logophoricity. *Linguistic Inquiry* 18.3, 445–479.
- 934 Sperber, D., & Wilson, D. 1995. *Relevance: Communication and Cognition*. New York:
935 Blackwell.
- 936 Sturt, P. 2003. The time-course of the application of binding constraints in reference resolution.
937 *Journal of Memory and Language*. Academic Press Inc.
- 938 Thráinsson, H. 1990. A Semantic Reflexive and the Typology of NPs. In J. Maling & A. Zaenen
939 (Eds.), *Modern Icelandic Syntax* (pp. 289–307). New York: Academic Press.
- 940 Thráinsson, H. 1991. Long Distance Reflexives and the Typology of NPs. In Jan Koster & E.
941 Reuland (Eds.), *Long-Distance Anaphora* (pp. 49–75). Cambridge: Cambridge University
942 Press.
- 943 Toivonen, I. 2000. The Morphosyntax of Finnish Possessives. *Natural Language and*
944 *Linguistic Theory* 18(3), 579–609.
- 945 Trosterud, T. 1990. Binding relations in two Finnmark Finnish dialects: A Comparative
946 Syntactic Study. Dissertation, University of Trondheim.
- 947 Trosterud, T. 1993. Anaphors and Binding Domains in Finnish. In A. Holmberg & U. Nikanne
948 (Eds.), *Case and other functional categories in Finnish syntax* (pp. 225–243). Mouton de
949 Gruyter.
- 950 Vainikka, A. 1989. *Deriving Syntactic Representations in Finnish*. University of Massachusetts
951 Amherst.
- 952 Vainikka, A., & Levy, Y. 1999. Empty subjects in Finnish and Hebrew. *Natural Language &*
953 *Linguistic Theory* 17(3), 613–671.

- 954 van Steenbergen, M. 1987. *Binding Relations in Finnish*. Univ. of Groningen.
- 955 van Steenbergen, M. (1989). Finnish: Configurational or Not? In L. Marácz & P. Muysken
956 (Eds.), *Configurationality: The Typology of Asymmetries* (pp. 143-157.). Foris Publications.
- 957 van Steenbergen, M. (1991). Long-distance binding in Finnish. In J Koster & E. J. Reuland
958 (Eds.), *Long-distance anaphors* (pp. 231–244). Cambridge University Press.
- 959 Vilkuna, M. (1989). Free word order in Finnish: Its syntax and discourse functions. Helsinki:
960 Finnish Literature Society.
- 961 Vilkuna, M. (1995). Discourse Configurationality in Finnish. In K. É. Kiss (Ed.), *Discourse*
962 *Configurational Languages* (pp. 244–268). Oxford: Oxford University Press.

* File for review purposes: <https://we.tl/t-FMyVI8NP5W>

† Files for review purposes, grammaticality judgments calculated by the model (<https://we.tl/t-TjVzFKuwSu>); results file which contains syntactic analyses and semantic interpretations (<https://we.tl/t-mKadNoXy3x>); derivational log file which contains whole derivations for each input sentence (<https://we.tl/t-D7qjmZyN1Y>). The original test corpus is also available (<https://we.tl/t-FMyVI8NP5W>).

‡ File for review purposes: <https://we.tl/t-FMyVI8NP5W>

§ File for review purposes: <https://we.tl/t-mKadNoXy3x>.

** All phrase structure images can be downloaded from <https://we.tl/t-74yZXJNtZI>.