Predicate clefting and long head movement in Finnish

Pauli Brattico, 2020

Abstract. Head movement constitutes a controversial topic in linguistic theory. Finnish long head movement exhibits an unusual combination of predicate clefting with A-bar movement instead of V-copying. An analysis is developed on the basis of Roberts (1993, 2010) and Chomsky (2008) that relies on a minimal top-down search. Exceptional properties of Finnish head movement are explained as arising from its lexicon which furnishes the language with an extensive catalogue of C-features participating in predicate formation. The analysis was formalized and tested by computational tools.

Keywords: head movement; long head movement; LHM; Finnish

1 Introduction

In Finnish, a canonical SVO language, non-finite verbs can appear in a noncanonical position before the subject and the finite verb (1).[1]

(1) Myy-dä-kö$_1$ Pekka aiko-i _$_1$ koko omaisuute-nsa?
sell-A/INF-Q Pekka.NOM plan-PAST.3SG all possessions-PX/3SG
'Was it selling that Pekka was going to do with his possessions?'

I call this phenomenon "long head movement" (LHM) to follow a tradition in the literature in which the term refers to movement of an infinitival or participle over the finite verb. My purpose in this article is to document the properties of LHM in Finnish and deduce the facts from a formal analysis. The theoretical interest of this endeavor lies in its relevance to the theory of head movement.

The article is organized in the following way. Section 2 documents the properties of Finnish LHM and the empirical generalizations that define it. It is divided into several subsections. Section 2.1 establishes the grammatical properties I regard as uncontroversial in the light of previous literature on Finnish clause structure, while the next looks at Finnish LHM against the background of previous research on long head movement in other languages

(Section 2.2). An important topic discussed in this section is a possible remnant VP-preposing analysis of the Finnish facts. Several arguments are presented against it. Section 2.3 documents the empirical generalizations covering the Finnish phenomenon specifically. Section 3 presents the analysis. The analysis, building on Roberts (2010) and Holmberg (2015), claims that Finnish long head movement constitutes predicate clefting by A-bar head movement. Exceptional properties of Finnish are explained as arising from its lexicon which, perhaps due to the agglutinative character of its morphology, licenses several C-features to participate in predicate formation. Several recent hypotheses concerning the nature of head movement are discussed in the light of Finnish data. Finally, the hypothesis is formalized and tested by computational tools. Formalization and algorithmic testing are addressed in Section 4.

2 Properties of Finnish long head movement

2.1 Finnish head movement

Certain properties of Finnish long head movement can be taken as uncontroversial on the basis of existing literature. They are as follows. The phenomenon is based on a well-known grammatical template in Finnish in which the verb moves to C^0 if and only if it has an overt morphological or prosodic left peripheral feature (Brattico et al. 2013; Holmberg 2014; Huhmarniemi 2012; Huhmarniemi and Brattico 2013; Vilkuna 1989, 1995). Local head movement involves the same features and the same position. Thus, compare (1) with local variants in (2).

(2)

a. My-y-kö$_1$ Pekka _$_1$ koko omaisuute-nsa?
sell- T/FIN.3SG-Q Pekka.NOM all possessions-PX/3SG
'Does Pekka sell all of his possessions?'

b. On-ko Pekka _$_1$ myynyt koko omaisuute-nsa?
be.T/FIN.3SG-Q Pekka.NOM sold.PAST-PRTCPL all possessions-PX/3SG
'Has Pekka sold all his possessions?'

Since local and nonlocal movement exhibit the same left peripheral features, same position, and induce same effects on semantic interpretation, absence of evidence to the contrary we pursue the null hypothesis according to which (1) and (2a-b) are based on the same

grammatical mechanism. The contrary hypothesis requires compelling justification. I return to this matter briefly at the end of this section.

Finnish is considered an agglutinative language with rich derivational and inflectional morphology. For example, it exhibits fifteen distinct nominal case suffixes, productive and systematic phi-agreement in number and person both in finite and infinitival domains (e.g., agreeing prepositions, adverbials) and relatively free word order. This morphological richness is reflected in the number of suffixes associated with left peripheral positions. Both local and nonlocal head movement to C occur in connection with the yes/no question particle *-kO* (3a), three separate discourse particles *-pA* (3b), *-hAn* (3c) and *-s* (3d) plus their combinations (e.g., 3e-f); corrective or contrastive focus (3g); combinations of prosodic focus with everything else (3h); and possibly also imperatives (3i). I call them *C-features* in this article, with a further distinction established later in this article.

(3)

a. My-y-kö$_1$ Pekka _$_1$ omaisuute-nsa?
sell-T/FIN.3SG-Q Pekka possessions-PX/3SG
'Does Pekka sell his possessions?'

b. My-y-pä$_1$ Pekka(kin) _$_1$ omaisuute-nsa.
sell-T/FIN.3SG -PA Pekka(also) possessions-PX/3SG
'(Also) Pekka sells his possessions.'

c. My-y-hän$_1$ Pekka _$_1$ omaisuute-nsa.
sell-T/FIN.3SG-HAN Pekka possessions-PX/3SG
'Pekka sells his possessions, doesn't he?'

d. My-y-pä-s Pekka _$_1$ omaisuutesi.
see-T/FIN.3SG-PA-S Pekka possessions-PX/3SG
'Why don't you sell you possessions, Pekka?'

e. My-y-pä-hän$_1$ Pekka _$_1$ omaisuute-nsa.
sell-T/FIN.3SG-PA-HAN Pekka possessions-PX/3SG
'Yes, Pekka sells his possessions.'

f. My-y-kö-hän$_1$ Pekka _$_1$ omaisuute-nsa?
sell-T/FIN.3sg-Q-HAN Pekka possessions-PX/3SG
'Will Pekka sell his possessions?'

g. MYY$_1$ Pekka _$_1$ omaisuute-nsa!
sell.T/FIN.3SG.FOC Pekka possessions-PX/3SG

’Pekka does sell his possessions!’

h. MYY-PÄ (sinä) _1 omaisuute-si!
SELL.IMP-PA (you) possessions-PX/2SG
’Sell your possessions!’

i. Myy$_1$ (sinä) _$_1$ omaisuute-si!
sell.IMP (you) possessions-PX/2SG
’Sell your possessions!’

Verb initial constructions create similar discourse effects in many other languages, such as in Slavic (King 1995; Lambova 2004; Rivero 1994; Wilder and Cavar 1994), Balkan (Rivero 1994), Early Modern Romanian (Alboiu, Hill, and Sitaridou 2015) and Romance (Rivero 1993; Roberts 1994), so the empirical phenomenon itself should not be regarded as particularly surprising. The Finnish data reviewed above, putting the problem of locality aside, is compatible with the analysis by Alboiu et al. (2015) who argue that in Old Romanian T-to-Focus (here T-to-C) movement encodes discourse features.

Verb movement to C is not possible in Finnish unless some features triggers it. Moreover, when a feature is present, movement is obligatory. Except for prosodic focus, none of the features listed in (3) can occur *in situ*. Head movement and phrasal movement to CP are complementary (Huhmarniemi 2012), a property that is again not unusual (e.g., Chung and McCloskey 1987; McCloskey 1979; Pesetsky and Torrego 2001). Thus, in Finnish verb-initial clauses are used to express C-features, otherwise they are ungrammatical (Holmberg and Nikanne 2002; Vilkuna 1989).[2] Finnish is not a V2-language. It is also important to note that these examples do not exhibit “V-copying,” as all gapless variants, such as (4), are ungrammatical.

(4) *Myy-kö Pekka my-y(-kö) omaisuute-nsa?
sell.T.3SG-Q Pekka.NOM sell-T/FIN.3SG(-Q) possessions-PX/3SG

The element that moves is the same as the one that would occur in the canonical position (minus the occurrence of the C-feature). Finnish does not implement a type of VP-fronting observed in Hebrew (Landau 2006) or Spanish (Vincente 2007) in which the fronted verb takes a different morphological form as the one that occurs in the canonical position.

Finally, the Finnish high complementizer *että* ‘that’ used in some of the examples discussed in this article is located above the fronted verb. This is shown by (5). I will assume

that the verb moves to C^0 and the high complementizer is at $Force^0$ selecting C^0. The *that*-clauses occurring here are regular embedded finite clauses selected by the main verb.

(5)

a. Pekka kysyi *että* kuka my-y omaisuute-nsa?
   Pekka asked that who sell-T/FIN.3SG possessions-PX/3SG
   'Pekka asked who sells his possessions.'

b. Pekka kysyi *että* my-y-kö Pekka $_1$ omaisuute-nsa?
   Pekka asked that sell-T/FIN.3SG-Q Pekka possessions-PX/3SG
   'Pekka asked if Pekka does sell his possessions.'

c. Pekka asked $Force^0$ T^0+C^0 SPEC (T^0)

The claim that Finnish local head movement and long head movement exhibit otherwise similar properties was not yet supported by a detailed argument. To argue for it, consider again (6).

(6)

a. *Local head movement*
   Myy-kö$_1$ Pekka _ koko omaisuute-nsa?
   sell.FIN.3SG-Q Pekka.NOM all possessions-PX/3SG
   'Does Pekka sell all his possessions?'

b. *Nonlocal head movement*
   Myy-dä-kö$_1$ Pekka aiko-i $_1$ koko omaisuute-nsa?
   sell-A/INF-Q Pekka.NOM plan-PAST.3SG all possessions-PX/3SG
   'Was it selling that Pekka was going to do with his possessions?'

Both verbs, the finite verb in (6)a and the infinitival in (b), are suffixed with the same C-feature, the yes/no particle *-kO*. This pattern generalizes to *all* examples of local and nonlocal features and to *all* C-features (3), without exception. Thus, whenever one can form (6)a, (6)b is also possible and vice versa. Furthermore, the semantic interpretation associated with the C-feature is always same, here it creates a yes/no interrogative, and it furthermore functions to 'target' the content of the moved predicate in the sense that both interrogatives in (6)a-b are interpreted as making a specific question concerning selling, thus the specific content of the predicate that is moved.[3] The local and nonlocal constructions share also several syntactic

properties. They both involve movement of a head, after which no further phrases or heads can be fronted. Verb movement affects selection in the same way in both examples; both (a-b) have interrogative force. Both sentences can be combined with the high complementizer *että* 'that', and both elements occur above the preverbal subject. Thus, they are in the same syntactic position. Therefore, absent any strong evidence to the contrary we should take local and nonlocal verb fronting to be based on the same mechanism.

The following information could be useful in interpreting the Finnish data reported in this article. Finnish is a canonical SVO language with the partial null subject profile (Holmberg 2005) and nominative-accusative marking. Thus, in most examples discussed in this article the finite verb agrees in number and person with the nominative subject, the latter which occupies a preverbal subject position. When the argument is not nominative, the verb exhibits either default third person agreement or no agreement. There are no obligatory determiners (see Laury 1997). Word order is relatively free when compared with languages such as English or Italian. This property correlates with rich case marking. It correlates also with discourse interpretation: Finnish is often said to exhibit discourse-configurationality (see Hakulinen 1976; Holmberg and Nikanne 2002; Vilkuna 1989, 1995). Finnish exhibits full agreement also on infinitival heads, such as nouns, preposition, adverbs and non-finite verbs (Huhmarniemi and Brattico 2015; Toivonen 2000; Vainikka 1989). For Finnish syntax in general, see Holmberg et al. (1993) and Manninen (2003).

2.2 Crosslinguistic perspective

2.2.1 Diagnostic properties of LHM

In a seminal paper citing data from several languages, Lema and Rivero (1990) argue that long head movement (LHM) is (i) restricted to root, (ii) not possible in negated clauses, (iii) local (i.e. skips only one head) and (iv) licensed exclusively by temporal auxiliaries. These restrictions do not apply to Finnish (7-10).

(7) *Finnish LHM is not restricted to root contexts*

a. Myy-dä-kö$_1$ Pekka aiko-i _$_1$ koko omaisuute-nsa?
sell-A/INF-Q Pekka.NOM plan.T/FIN.3SG all possessions-PX/3SG
'Was Pekka going/planning to sell all his possessions?'

b. Sirkku kysyi että myy-dä-kö Pekka aiko-i _$_1$ koko omaisuute-nsa.
Sirkku asked that sell-A/INF-Q Pekka plan-T/FIN.3SG all possessions-PX/3SG
'Sirkku asked whether Pekka was going to sell all his possessions?'

(8) *Finnish LHM is not blocked by the presence of intervening negation*

a. Myy-dä-pä$_1$ Peka-n ei tarvitse _$_1$ ihan koko omaisuutta-an.
sell-A/INF-PA Pekka.GEN not.0 need quite all possession-PAR-PX/3SG
'Pekka does not need to sell all of his possessions.'

b. Päättä-ä$_1$ Peka-n ei tarvitse _$_1$ yhtään mistään.
decide-A/INF Pekka-GEN not.0 need any thing
'Pekka does not need to decide on any issue.'

c. Matkusta-a$_1$ Pekka e-i halu-a _$_1$.
travel-A/INF Pekka.NOM not.3SG want-A/INF
'Pekka does not want to travel.'

(9) *Finnish LHM is not sensitive to locality*

a. Myy-dä-kö$_1$ Pekka sanoi että hän aiko-o _$_1$ kaikki tavaransa?
sell-A/INF-Q Pekka.NOM said that he plan-T/FIN.3SG all possessions-PX/3SG

b. Myy-vän-kö$_1$ Pekka uskoi Merja-n _$_1$ tämä-n auto-n?
sell-VA/INF-Q Pekka believed Merja-GEN this-ACC car-ACC
'Did Pekka believe that Merja is going to sell this car?'

(10) *Finnish LHM is licensed by other elements besides temporal auxiliaries*

a. Myy-dä-kö Pekka aiko-o _ kaikki tavara-nsa? (finite verb + infinitival)
sell-A/INF-Q Pekka.NOM plan-T/FIN.3SG all possessions-PX/3SG
'Is Pekka going to sell all his possessions?'

b. Syö-dä$_1$ Peka-n täytyy _$_1$ kaikki lääkkeet. (modal verb + infinitival)
eat-A/INFPekka-GEN must.0 all medicine
'Pekka must eat all the medicine.'

c. Syö-dä-pä $_1$ Pekka ei halu-a _$_1$. (Neg + finite verb + infinitival)
eat-A/INF-PA Pekka.NOM not.3SG want-A/INF
'Pekka did not want to eat.'

d. Rakenta-nut-pa$_1$ Pekka oli _$_1$ pätkän aita-a. (Aux + past participle)
build-PRTCPL-PA Pekka.NOM had.T/FIN.3SG segment fence-PAR
'Pekka had built a segment of fence.'

Subsequent research has found that (i-iv) are problematic on independent grounds. Embick and Izvorski (1997) show that in Czech 'Aux + prtcpl$_1$ + prtcpl$_1$' clauses both participles can be fronted, violating (iii). In the same paper they argue that LHM applies in root and non-root environments in Serbo-Croatian and Bulgarian. Rivero (1991) notes that the negation condition (iii) does not apply in all Slavic languages.[4]

2.2.2 Remnant VP-preposing analysis

Lema and Rivero (1990) show that LHM contrasts with VP-preposing, which is licensed under different auxiliaries and violates (i-iv). Let us consider the hypothesis that (7-10) exhibit remnant VP-movement. One problem is that it is possible to extract a head that has been 'sandwiched' between two heads (11).

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(11) Vaati-nut-pa$_1$ Pekka [oli [_$_1$ [$_\alpha$myy-dä myös tämä-n auto-n.]]]
request-PRTCPL-PA Pekka.NOM be.T/FIN sell-A/INF also this-ACC car-ACC
'Pekka had requested to sell also this car.'

A remnant VP-Fronting analysis would require αP to move out of VP, but there is no independent evidence that it does and the existence of the required movement operation, moving infinitival phrases to the right, must also be justified. The second problem concerns auxiliary data, which replicates some of the findings of Lema and Rivero (1990). Pure auxiliary verbs, such as *on* 'is', prohibit VP-preposition (12a) but allow LHM (12b).

(12)

a. *[Myy-nyt tavara-nsa]$_1$ Pekka o-n _$_1$.
sell-PAST.PRTCPL belonings-PX/SG Pekka.NOM be-3SG

b. Myy-nyt$_1$ Pekka o-n _$_1$ tavara-nsa.
sell-PAST.PRTCPL Pekka.NOM be-3SG belonings-PX/SG
'Pekka has sold his belongings.'

If (12b) instantiates remnant VP-preposing, then the ungrammaticality of (12a) remains unaccounted for. The third problem concerns distribution of left peripheral particles. When a whole phrase is moved to the operator position, a left peripheral particle such as *-kO* (among other suffices expressing C-features, see (3)) can be suffixed to the right edge of the moved

phrase to yield a yes/no question (13a). Overt VP-preposing does not exhibit this behavior (13b).

(13)

a. [Peka-n tavara-t-ko]$_1$ Merja my-i _$_1$?
Pekka-GEN stuff-PL-Q Merja.NOM sold-PAST.3SG
'Did Merja sell Pekka's stuff?'

b. *?[My-i Peka-n tavara-t-ko]$_1$ Merja _$_1$?
sold-PAST.3SG Pekka-GEN stuff-PL-Q Merja.NOM

We cannot therefore unify long head movement, if it were VP-fronting, trivially with phrasal A-bar movement (13a). This eliminates one theoretical motivation for the VP-fronting hypothesis.

There is a semantic difference between instances of LHM and VP-preposing. If it is mentioned in the previous discourse that Pekka wants to borrow his car to Merja, then it is possible to say (14a) to issue a correction that targets the conceptual content expressed by the verb. The reason the fronted verb triggers corrective interpretation is because the C position is associated with corrective focus/topic in Finnish (Vilkuna 1989, 1995). VP-preposing, however, is not available and does *not* elicit the same reading (14b-c).[5]

(14)

a. MYY-DÄ$_1$ Pekka halu-si _$_1$ auto-n Merjalle, ei lainata.
SELL-A/INF Pekka.NOM want-PAST.3SG car-ACC to.Merja not loan
'Pekka wanted to SELL the car to Merja, not to loan in.'

b. *?[MYY-DÄauto-n] Pekka halu-si Merjalle, ei lainata.
SELL-A/INF car-ACC Pekka.NOM want-PAST.3SG to.Merja not loan

c. *[MYYDÄ AUTO-N] Pekka halu-si Merjalle, ei lainata
SELL.A/INF CAR-ACC Pekka.NOM want-PAST.3SG to.Merja not loan

What could be the semantic function of fronted VPs in clauses such as (15)?

(15) [Myy-dä auto-n]$_1$ Pekka halu-si _$_1$ Merjalle.
sell-A/INF car-ACC Pekka.NOM want-PAST.3SG to.Merja
'Pekka wanted to sell the car to Merja.'

The VP is neither contrastive/corrective nor in the information focus. The topic is Pekka, not the VP. One possibility is that VP-preposing does not involve checking of C-features at all. This is supported by the fact that it is possible to combine movement to Spec,CP and VP-preposing (16a-b).

(16)

a. [Pekka-ko]$_1$ [myy-dä auto-n]$_2$ halu-si _$_1$ _$_2$ Merjalle?
Pekka.NOM sell-A/INF car-ACC want-PAST.3SG Merja-to-Q
'Was it to Merja that Pekka wanted to sell the car?'

b. [Halu-si-ko]$_1$ [Merjalle myy-dä auto-n]$_2$ Pekka _$_1$ _$_2$?
want-PAST.3SG-Q to.Merja sell-A/INF car-ACC Pekka.NOM
'Did Pekka want to sell the car to Merja?'

In (16a), the grammatical subject moves to Spec,CP to check the interrogative (yes/no) feature, while the infinitival phrase 'to sell the car' is at the preverbal subject position Spec,TP. In (16b), the main verb checks the yes/no interrogative feature at C, while the infinitival phase 'to sell the car to Merja' is at the preverbal subject position. VP-preposing is, therefore, independent of movement to the C-domain. This is supported further by properties of internal *wh*-movement. Constituents of the fronted VP can undergo internal A-bar movement in Finnish. When the object is fronted inside the VP, a corrective interpretation emerges (17a). This is because operator movement must perform roll-up movement to the edge of the pied-piped phrase in order to check a feature that is inside the moved phrase (Huhmarniemi, 2012). But in such cases 'contrast/correction' targets the moved DP, not the verb (17a-b).

(17)

a. [auto-n$_1$ myy-dä _$_1$]$_2$ Pekka halu-si _$_2$, ei polkupyörää.
car-ACC sell-A/INF Pekka.NOM want-PAST/3SG not bicycle
'Pekka wanted to sell the CAR, not the bicycle.'

b. *?[auto-n$_1$ myy-dä _$_1$]$_2$ Pekka halu-si _$_2$, ei lainata.
car-ACC sell-A/INF Pekka.NOM want-PAST/3SG not borrow

These data suggest that we must separate VP-preposing without internal movement, call it "bare VP-fronting," from one that contains internal movement. The latter involves criterial checking of a C-feature inside the moved phrase, while the former does not. This supports further the hypothesis that bare VP-fronting does *not* check C-features. To make this argument watertight we must consider one additional possibility, a "ping-pong movement" analysis (18).

(18) [__$_{1,3}$ myy-dä _$_1$]$_2$ Pekka halu-si _$_2$ auto-n$_3$
sell-A/INF Pekka.NOM want-PAST/3SG car-ACC
'Pekka wanted to sell the CAR, not the bicycle.'

According to the ping-pong analysis, the direct object undergoes internal movement to the edge of the VP, which is fronted, after which the direct object escapes to the right leaving the verb to the fronted position. Ping-pong movement is not generally available in Finnish, however. Examples (19) shows several hypothetical ping-pong constructions, in which a phrase moves to the right out of fronted adverbial (19a), nominal (19b) and adjectival (19c) phrases. They are all ungrammatical.

(19)

a. *[$_{AdvP}$__$_{1,3}$ Myy-mällä _$_1$]$_2$ Pekka rikastu-i __$_2$ auto-n$_3$
selling-MA Pekka.NOM got.rich-PAST.3SG car-ACC
Intended: 'By selling the car Pekka got rich.'

b. *[$_{DP}$__$_{1,3}$ Myynti-ä _$_1$]$_2$ Pekka harkitsi __$_2$ auto-n$_3$.
selling-par Pekka.nom considered car-acc
Intended: 'Pekka considered the selling of the car.'

c. *[$_{AP}$__$_{1,3}$ myyvän kauppiaan __$_1$]$_2$ Pekka tapasi __$_2$ auto-a$_4$
selling.A salesman Pekka met car-par
Intended: 'Pekka met a salesman who was selling the car.'

A further difference between VP-fronting and long head movement concerns situations in which the moved infinitival has its own thematic subject. VP-fronting is possible, long head movement is not (20). In examples (20a-b) the infinitival phrase contains a genitive thematic subject *Merja-n* 'Merja-gen' that by syntactic tests resides inside the infinitival 'Merja to sell

her possessions'.[6] The canonical structure underlining (20a-c) is illustrated in (20d), in pseudo-English for simplicity.

(20)

a. *?Myy-dä-kö Pekka käsk-i Merja-n _1 omaisuutensa?
sell-A/INF-Q Pekka.NOM order-PAST.3SG Merja-GEN possessions

b. ?[Myy-dä(-kö) omaisuute-nsa] Pekka käsk-i Merja-n _1?
sell-A/INF(-Q) possessions-PX/3SG Pekka.NOM order-PAST.3SG Merja-GEN
'Did Pekka ask Merja to sell her possessions?'

c. [Omaisuute-nsa-ko$_1$ myy-dä _1]$_2$ Pekka käsk-i Merja-n _2?
possessions-PX/3SG-Q sell-A/INF Pekka.NOM order-PAST.3SG Merja-GEN
'Did Pekka ask Merja to sell his POSSESSIONS?'

d. Pekka ordered [Merja.gen [to.sell her.possessions]]

Finally, local and nonlocal head movement are characterized by the same C-features, same position, and same discourse interpretation. The hypothesis that Finnish LHM were an instance of remnant VP-preposing would require a remnant VP-movement analysis also for local head movement or instead force us into a position in which what looks to be the same operation (local or nonlocal head movement) dissolves into two different processes. Both options are unconvincing.

2.3 Conditions on Finnish LHM

2.3.1 Introduction

This section provides empirical generalizations that define Finnish long head movement. Their relevance to the theory of head movement will be addressed in Section 3.

2.3.2 Restriction on long-distance movement of finite elements

While infinitival verbs can be extracted from embedded clauses, finite elements cannot (21).

(21)

a. Myy-dä-kö$_1$ Pekka sanoi että hän haluaa _1 koko omaisuutensa?
sell-A/INF-Q Pekka claimed that he wants all possessions
'Did Pekka said that he wishes to sell all his possessions?'

b. *Haluaa-ko$_1$ Pekka sanoi että hän _1 myy-dä koko omaisuutensa

want-3SG-Q Pekka said that he sell-A/INF all possessions

c. *Ei-kö$_1$ Pekka sanoi että hän _$_1$ halua myy-dä koko omaisuuttaan?
not-Q Pekka said that he wants sell-A/INF all possessions

d. *On-ko$_1$ Pekka sanoi että hän _$_1$ halun-nut myy-dä koko omaisuutensa?
is-Q Pekka said that he want-PRTCPL sell-A/INF all possessions.

Local T-to-C movement of a finite element is possible (22), so this restriction is limited to situations in which the finite element is moved from a finite clause.

(22)

a. Halua-a-ko$_1$ Pekka _$_1$ myy-dä koko omaisuutensa?
want-3SG-Q Pekka.NOM sell-A/INF all possessions
'Does Pekka want to sell all his possessions?'

b. E-i-kö$_1$ Pekka _$_1$ halu-a myy-dä koko omaisuuttaan?
not-3SG-Q Pekka want-A/INF sell-A/INF all possessions
'Does Pekka not want to sell all his possessions?'

c. O-n-ko$_1$ Pekka _$_1$ myy-nyt koko omaisuutensa?
has-3SG-Q Pekka.NOM sell-PRTCPL all possessions
'Has Pekka sold all his possessions?'

2.3.3 Island conditions

LHM is not possible from adverbials (23a), left branches (23b), relative clauses (23c) or conjuncts (23d). In addition, movement out of an interrogative embedded clause is ungrammatical or marginal (24). In this LHM resembles A-bar movement, which obeys similar or the same conditions (Huhmarniemi 2012). Holmberg (2015) was to my knowledge the first to propose that Finnish head movement involves A-bar movement, an idea I develop here as well.

(23)

a. *Myy-mällä-kö$_1$ Pekka rikastui [_$_1$ koko omaisuutensa]?
sell-MALLA-Q Pekka got.rich all possessions

b. *Myy-dä-kö$_1$ Pekka teki [sopimuksen _$_1$ koko omaisuutensa]?
sell-A/INF-Q Pekka made agreement all possessions

c. *Myy-dä-kö$_1$ tämä on [paikka jossa voi _$_1$ koko omaisuutensa] `?

	sell-A/INF-Q	this	is	place	where	can.3SG	all	possessions
d.	*Osta-a-kö$_1$	Pekka	halusi	[_$_1$	ja	korjata	vanhan	auton?]
	buy-A/INF-Q	Pekka	wanted		and	fix-A/INFold	car	

(24)	?*Myy-dä-kö$_1$	Pekka	kysyi	että	voi-ko	hän _$_1$	koko	omaisuutensa?
	sell-A/INF-Q	Pekka	asked	that	can-Q	he	all	possessions

2.3.4 No restrictions on the lexical category of the moved element

I have yet to find a finite or an infinitival form that cannot be fronted. All three finite elements in Finnish (negation, auxiliary and the finite verb) move locally to C (22). A-infinitivals (25a), VA-infinitivals (25b), the participle (25c) and the MA-infinitival (25d) move nonlocally.[7]

(25)

a.	Myydä-kö$_1$	Pekka	halusi	_$_1$	kaikki	tavaransa?		(A-infinitival)
	sell-A/INF-Q	Pekka	wanted		all	possessions		
	’Did Pekka wanted to sell all his possessions?’							
b.	Myy-vän-kö	Pekka	uskoi	Merja-n	_$_1$	kaikki	tavaransa?	(VA-infinitival)
	sell-VA/INF-Q	Pekka	believed	Merja-GEN		all	possessions	
	’Did Pekka believe that he was going to sell all his possessions?’							
c.	Myy-nyt-pä$_1$	Pekka	ei	_$_1$	kaikki	tavaroitaan!		(Participle)
	sell-PRTCPL-PA	Pekka	not		all	possessions		
	‘But Pekka did not sell all his possessions!’							
d.	Myy-mässä-pä	Pekka	oli	_$_1$	vanhaa	autoaan.		(MA-infinitival)
	sell-MA-PA	Pekka	had		old	car		
	‘Pekka was selling his old car.’							

The deciding factor, therefore, seems to be the presence of an overt C-feature.

2.3.5 LHM is possible only in connection with C-features

LHM is not possible inside infinitivals or phrases that are not headed by an (overt) C-feature. Examples (26-29) show a few putative configurations, all ungrammatical. The A-infinitival in (28) corresponds best with the English to-infinitival, while the VA-infinitival in (29) is more

propositional, is selected by verbs such as ‘believe’ and ‘think’, and is best translated to English by means of finite complement clause.

(26) *No head dislocation inside adverbials*

a. Pekka yllätti minut [aikomalla myy-dä omaisuute-nsa.]
Pekka surprised me.ACC by.planning sell-A/INF possessions-PX/3SG
‘Pekka surprised me by planning to sell all his possessions.’

b. *Pekka yllätti minut [myy-dä$_1$ aikomalla _$_1$ omaisuute-nsa.]
Pekka surprised me.ACC sell-A/INF by.planning possessions-PX/3SG

(27) *No head dislocation inside noun phrases*

a. Pekka teki [sopimuksen myy-dä omaisuute-nsa]
Pekka make.PAST.3SG agreement.ACC sell-A/INF possessions-PX/3SG
‘Pekka made an agreement to sell his possessions.’

b. *Pekka teki [myy-dä$_1$ sopimuksen _$_1$ omaisuute-nsa]
Pekka make.PAST.3SG sell-A/INF agreement.ACC possessions-PX/3SG

(28) *No head dislocation inside A-infinitival complements*

a. Peka-n täytyy [yrittä-ä myy-dä omaisuute-nsa.]
Pekka-GEN must.0 try-A/INF sell-A/INF possessions-PX/3SG
‘Pekka must try to sell his possessions.’

b. *Peka-n täytyy [myy-dä$_1$ yrittä-ä _$_1$ omaisuute-nsa.]
Pekka-GEN must.0 sell-A/INF try-A/INF possessions-PX/3SG

(29) *No head dislocation inside VA-infinitival complements*

a. Pekka uskoo Merja-n [halua-van yrittä-ä myy-dä omaisuute-nsa.]
Pekka believes Merja-GEN want-VA/INF try-A/INF sell-A/INF possessions-PX/3SG
‘Pekka believes that Merja wants to try to sell her possessions.’

b. *Pekka uskoo Merja-n [yrittä-ä$_1$ halua-van _$_1$ myy-dä omaisuute-nsa.]
Pekka believes Merja-GEN try-A/INF want-VA/INF sell-A/INF possessions-PX/3SG

c. *Pekka uskoo Merja-n myy-dä$_1$ halua-van yrittä-ä _$_1$ omaisuute-nsa.
Pekka believes Merja-GEN sell-A/INF want-VA/INF try-A/INF possessions-PX/3SG

2.3.6 Verum focus interpretation and two auxiliaries

Local movement of a bare auxiliary or negation to the C-position creates a verum (polarity) focus interpretation (30).

(30)

a. E-i$_1$ Pekka _$_1$ myy-nyt omaisuutta-an.
not-3SG Pekka.NOM sell-PAST.PRTCPL possessions-PX/3SG
'Pekka did NOT sell some possessions.'

b. Ol-i$_1$ Pekka _$_1$ myy-nyt omaisuutta-an.
had-PAST.3SG Pekka.NOM sell.PAST.PRTCPL possessions-PX/3SG
'Pekka DID sell some possessions.'

In (30b) there is no implication that the speaker denies the conceptual content of any predicate; instead, the denial targets the whole proposition. When the sentence contains two or more auxiliaries, it is not possible to create these interpretations by moving a nonlocal auxiliary. Only the local auxiliary can move.

(31)

a. Pekka e-i ol-lut myy-nyt omaisuutta-an.
Pekka.NOM not-3SG had-PAST.PRTCPL sell-PAST.PRTCPL possessions-PX/3SG
'Pekka had not sold some possessions.'

b. *Ol-lut$_1$ Pekka e-i _$_1$ myy-nyt omaisuutta-an.
had-PAST.PRTCPL Pekka.NOM not-3SG sell-PAST-PRTCPL possessions-PX/3SG

c. E-i Pekka _$_1$ ol-lut myy-nyt omaisuutta-an.
not-3sg Pekka.NOM had.PAST-PRTCPL sold.PRTCPL possessions-PX/3SG
'Pekka had NOT sold his possessions.'

d. Myy-nyt$_1$ Pekka e-i ol-lut _$_1$ omaisuutta-an.
sold.PAST-PRTCPL Pekka not-3SG had-PAST.PRTCPL possessions-PX/3SG
'Pekka had not SOLD some of his possessions (he loaned them instead).'

Verum focus head movement therefore satisfies HMC (Travis 1984). These data, whatever their ultimate explanation, show that LHM also contrasts with HMC in Finnish. This contrast can perhaps be rationalized in the following way. When a predicate with an overt C-feature(s) moves to C to create, say, corrective interpretation, that correction targets the content of the

predicate. It is the content of that predicate that is contrasted or corrected. An auxiliary verb, however, does not have independent lexical-conceptual content. Therefore, it is possible that the nonlocal effects documented in this article are connected to the presence of the C-feature on a predicate whose content is targeted for the special C-related interpretation. When the 'C + predicate' complex is missing, LHM is not possible.

2.3.7 Movement of an infinitival containing a subject

If the infinitival contains its own thematic subject, long head movement is either ungrammatical (32) or marginal (33).

(32)

a.	*Myy-vän-kö	Pekka	halusi	Merja-n	_1	omaisuutensa?
	sell-VA/INF-Q	Pekka	wanted	Merja-GEN		possessions
b.	*?Myy-dä-kö	Pekka	käski	Merja-n	_1	omaisuutensa?
	sell-A/INF-Q	Pekka	ordered	Merja-GEN		possessions

(33) ??Ihail-la-ko Pekka käski poik-i-en _1 Merja-a?
admire-A/INF-Q Pekka asked boy-PL-GEN Merja-PAR
'Did Pekka ask the boys to admire Merja?'

VP-fronting is possible:

(34)

a.	?[Myy-vän-kö	omaisuutensa]$_1$	Pekka	halusi	Merja-n	_1	?
	sell-VA/INF-Q	possessions	Pekka	wanted	Merja-GEN		
b.	[Myy-dä-kö	omaisuutensa]$_1$	Pekka	käski	Merja-n	_1	?
	sell-A/INF-Q	possessions	Pekka	ordered	Merja-GEN		

This restriction applies to situations in which the subject is syntactically part of the infinitival clause. If the thematic subject is part of the main clause, as in (35), long head movement is possible.

(35) Myy-mässä-kö$_1$ Pekka näki Merja-n [_1 vanhaa autoa?]
sell-MASSA-Q Pekka saw.PAST.3SG Merja-ACC old car

2.3.8 Predicate clefting

Finnish long head movement shares certain properties with predicate clefting in Hebrew (Landau 2006) and Spanish (Vincente 2007). Predicate clefting in Hebrew is illustrated by (36).

(36) **La'azor**, eyn li safek se-Gil hivtiax se-hu **ya'azor** le-Rina
to-help there-isn't to-me doubt that-Gil promised that-he help to-Rina
'As for helping, I have no doubt that Gil promised he would help Rina.'
(Landau 2006:42–43)

Both Finnish LHM and predicate clefting involve A-bar dependencies (nonlocal movement, island effects) and induce discourse effects, focus and topic interpretation in the case of predicate clefting but many more in the case of Finnish C-features (e.g., (3)). There are at least two major differences. Finnish long head movement leaves a gap, whereas Hebrew and Spanish predicate clefting does not. Another difference is that Finnish movement is always associated with overt C-features, whereas predicate clefts are bare infinitivals.

3 An analysis

3.1 Theoretical framework

I analyse Finnish long head movement within a broad minimalist EST/Y-architecture which derives phonology-meaning pairs ⟨PF, LF⟩ from a set of lexical items by narrow syntactic (NS) operations Merge and Agree, followed by a transfer to PF and LF (Chomsky 2000, 2001, 2008; Chomsky, Gallego, and Ott 2019). PF and LF diverge at *spellout structure* (SS for short) into the *phonological branch* and the *semantic branch*. Syntactic structure is generated by application of Merge to syntactic objects α, β, yielding $\gamma = [\alpha, \beta]$. Movement is re-merge $\gamma = [\alpha\ [_{\gamma} \ldots (\alpha) \ldots]]$. The operation is referred as *phrasal movement* if α is a phrase; *head movement* if α is non-phrasal. It is useful to divide head movement into two separate phenomena, following Harizanov and Gribanova (2018) and Rizzi and Roberts (1989). The first concerns the head in a noncanonical position. This is illustrated by (37).

(37) Myy-dä-kö$_1$ Pekka aiko-i _$_1$ koko omaisuute-nsa?
sell-A/INF-Q Pekka.NOM plan-PAST.3SG all possessions-PX/3SG
'Was Pekka going to sell all his possessions?'

I call this phenomenon *noncanonical head ordering*. Finnish long head movement instantiates noncanonical head ordering in a particularly clear way. Any proposal in which the phenomenon is deemed illusory in the sense that no actual head dislocation has taken place (see, for example, Embick and Izvorski 1997) can be ruled as inadequate for this language. On the other hand, the fronted head is a complex unit constituting of the verbal root *myy-* 'sell', productive A-infinitival suffix *-(t)A* (corresponding loosely with the English preposition 'to'), and the yes/no clitic *-kO*. How these morphemic units have been assembled inside one phonological word constitutes an independent issue (Harizanov and Gribanova 2018). I call this the *problem of morphological decomposition*. Whether this phenomenon is syntactic cannot be determined trivially from any data reported here.

Given this background, I would like to consider three approaches to head movement. The first models noncanonical head ordering and morphological decomposition as one syntactic operation that collects morpheme pieces from the syntactic structure in an iterative "roll-up" operation and bundles them into complex heads. The resulting complex heads are interpreted as phonological words inside the phonological branch. This approach goes back to Baker (1988), Koopman (1984) and Travis (1984), with a recent analysis that is particularly relevant to the data in this article provided by Roberts (2010), discussed further below. It follows that syntax must be furnished with a remerge operation [[α, β] [$_{\gamma P}$. . . (α) . . .]] that has several unusual properties. Matushansky (2006) proposed a variation, in which non-standard features of roll-up head movement were eliminated at the expense of increasing computational power in the phonological branch. Under Matushansky's analysis head movement is cyclic remerge [α_i [$_{\gamma P}$ γ^0 . . . (α_i) . . .]] while α is coalesced with an adjacent head γ inside the phonological branch by an operation called m-merger. A radical alternative is that both noncanonical ordering and morphological decomposition are a matter of the phonological branch (see Chomsky 2001; Platzack 2013; Schoorlemmer and Temmerman 2012). Harizanov and Gribanova (2018), developing an earlier proposal by Rizzi and Roberts (1989), argue that morphological decomposition takes place inside the phonological branch while noncanonical head ordering takes place in narrow syntax. I will explore Finnish long head movement from the point of view of these theoretical alternatives.

3.2 Head movement reconstruction

3.2.1 Noncanonical ordering in the phonological branch?

Let us consider whether noncanonical head ordering could take place inside the phonological branch (Chomsky 2001; Platzack 2013; Schoorlemmer and Temmerman 2012). The assumption would be that fronted heads are at their canonical positions at spellout and are dislocated in the phonological branch. The evidence, I think, shows that this is very unlikely. Finnish noncanonical head ordering is regulated by structural constraints such as islands, presence/absence of arguments, embedding, C-features and the number of auxiliary verbs, among other syntactic properties. This supports the first half of Harizanov and Gribanova (2018), who argue that noncanonical head ordering is syntactic.

3.2.2 Morphological decomposition in the phonological branch?

Let us examine whether the phonological branch could map heads, if they are first arranged into local configurations in syntax, into morphologically complex phonological words. Matushansky (2006), following Toyoshima (2000, 2001), claims that heads are bundled into phonological words by a postsyntactic m-merger operation bleeding syntactic spec-head configurations. Harizanov (2019) and Harizanov and Gribanova (2018), building on an earlier proposal by Rizzi and Roberts (1989), assume that the phonological branch performs amalgamation that combines two structurally adjacent heads (either by means of lowering or raising) into a single word. Holmberg (2015) assumes that Finnish LHM involves movement of a complex head to the Spec,CP (Spec,FocP) position, a position at which it could be targeted by m-merger, although Holmberg leaves the details unspecified.

The hypothesis that the C-morpheme in Finnish is attached to its head host in the phonological branch from two adjacent heads runs into problems with phrasal movement. The exact same C-features occur in connection with virtually any word inside a phrase pied-piped to Spec,CP (see Huhmarniemi 2012, Holmberg 2014). Consider (38a-e) and the checking configuration (39).

(38)

a. [Peka-n omaisuuden-**ko**] C(Q) Merja aiko-i myydä $_1$?
Pekka-GEN possessions-Q Merja.NOM plan-PAST.3SG sell-A/INF
'Was it Pekka's possessions that Merja planned to sell?'

b. [Peka-n-**ko** omaisuuden] C(Q) Merja aiko-i myydä $_1$?

Pekka-GEN-Q possessions Merja.NOM plan-PAST.3SG sell-A/INF
'Was it Pekka's possessions that Merja planned to sell?

c. [Peka-n isä-n-**kö** omaisuuden] C(Q) Merja aiko-i myy-dä _1?
Pekka-GEN father-GEN-Q possessions Merja plan sell-A/INF
'Was it Pekka's FATHER's possessions that Merja planned to sell?'

d. [Peka-n nuoremman-**ko** veljen] C(Q) Merja tapasi _1?
Pekka-GEN younger-Q brother Merja met?
'Was it Pekka's YOUNGER brother that Merja met?'

e. Aiko-i-**ko** Merja _1 myy-dä Peka-n omaisuuden?
plan-PAST.3SG-Q Merja sell-A/INF Pekka-GEN possessions
'WAS Merja planning to sell Pekka's possessions?'

The checking configuration for the data above is (39), in which a head inside the pied-piped phrase XP is checked by a corresponding C-feature, here the yes/no feature -kO together with the familiarity particle -hAn. These features must be part of C, since many of them change how the clause is selected.

(39) [$_{XP}$ …H(ko-han…) …] C(Q…)…
…H^0-*kO-han* (-*kO-han*)

The checked features do not need to occur at any specific position inside XP, such as at its head. The configuration is quite analogous to English *wh*-pied-piping such as [*towards which city*] *does Seine run,* in which we observe the same kind of embedding of the checked feature. Let us then consider the adjacent head analysis. According to the adjacent head analysis, H^0 (the host stem) and Q (C-feature) correspond to separate but adjacent heads, say H^0 and Q^0. The problem is that the occurrence of the C-features and their combinations are not tied with any special lexical category, requiring selection rules such as QP → Q + DP, QP → Q + NP, QP → Q + AP, QP → Q + Num, QP → Q + QP, DP → D + QP, NP → N + QP, and so on, with Q denoting the putative *-kO* head. Moreover, we must write these rules for all C-features (e.g., (3)), and further find some way to stipulate that when one of these putative heads occur in connection with some head, then they all, if one head contains several C-features, must occur in connection with the same head. Further rules are required to correlate phrase-internal C-elements with features of the sentence-initial C responsible for clause typing and selection. Because the C-feature may occur inside the pied-piped phrase, local specifier selection would

be too strong condition. These complications can all be avoided if we assume that the system instantiates criterial checking: *one* element inside a pied-piped phrase, no matter what its lexical category, hosts all C-features; these features are related to clause-typing and other C-features, not to phrase-internal heads; almost any head can carry them as long as they are carried by one head. Thus, the simplest way to capture (38) is (39).

Let us assume, therefore, that C-features are handled by criterial checking. This still leaves the analysis of word-internal morphemes A/INF, v and V and the question of whether their amalgamation could be created in phonology. Example (40) shows the syntactic spellout configuration if we follow this hypothesis and assume that adjacent heads are amalgamated in phonology. Specifically, we are now assuming that the T-v-V complex moves to C^0 and the Q-morpheme is handled in syntax, but the package marked with |------| is bundled in phonology.

(40) Myy-kö$_1$ Pekka [T [v [V auto-n Merjalle]]].
sell-Q Pekka |----------| car-ACC to.Merja

This analysis presupposes that prior to phonological amalgamation some operation evacuates phrasal elements that might have occurred between the amalgamated heads. Consider, for example, a Finnish noncanonical OVS sentence (41)(discussed at length by Holmberg & Nikanne, 2002, whose analysis I follow here).

(41) Tämän auton myi Pekka Merjalle.
this car-acc sold.3sg Pekka.nom to.Merja
'As for this car, it was sold by Pekka to Merja.'

The postverbal subject remains at Spec,vP while the direct object is topicalized. The configuration 'T-DP-v-V' now prevents amalgamation between T and v unless it is assumed that some extra operator evacuates the subject into another location prior to the operation *or* that amalgamation is possible over a distance. The latter solution overgeneralizes unless restricted in some fashion, whereas the former solution requires that we posit some type of evacuation movement for any element that would otherwise remain between the amalgamated heads. While it is possible to pursue either option in theory, this analysis does not lead automatically to any *simpler* theory since both solutions require additional syntactic mechanisms.[8]

In conclusion, giving up the standard theory does not lead automatically into a more elegant alternative. It is possible (but irrelevant for present purposes) that the phonological branch does process some elements, such as clitics or incorporated nouns (see Chomsky et al. 2019; Harizanov 2014). It is also possible that local morphological decomposition is provided in the phonological branch in some cases, although in the case of Finnish LHM the theoretical and empirical justification is weak. This leads me to believe that when it comes to the phenomena analysed in this article the safest bet is to assume the standard theory.

3.2.3 Roberts (1993, 2010) and Holmberg (2015)

I will now assume, on the basis of the discussion in the two previous sections, that head movement is a narrow syntactic operation creating and operating with syntactically complex heads. Finnish data supports, furthermore, the hypothesis that we must make room for some form of "A-bar head movement." This position, which I will follow here, is argued for by Roberts (2010) on the basis of predicate clefting data from other languages, all exhibiting an A-bar signature, and it was first suggested by Holmberg (2015) for Finnish, but without detailed analysis. I will provide a detailed analysis in the remaining portion of this article. The discussion is divided into two blocks. The first presents the key analytical principle and shows how it is supported by the facts, and the second presents the full formalization. This division is motivated by the fact that the formalization was implemented as an algorithm and involves, therefore, several technical assumptions that are necessary for the calculations but are not essential for the main hypothesis and could be done in a number of ways. I have tries to keep essential and inessential formalizations apart when addressing the issue.

3.3 Condition on head reconstruction

My analysis builds on the Roberts-Holmberg hypothesis which states that narrow syntax contains a head movement component that performs A-bar movement. I approach the problem from a somewhat unorthodox angle by first defining a notion of head chain that links complex heads with reconstructed gap(s), and then relate this approach to the more traditional bottom-up systems at the end of the article. Chains as such are directionless and can be modelled from either perspective.

Suppose the phonological branch provides syntax with a complex word $(H_1(H_2, \ldots))^0$ containing morphemes H_1, H_2, …. in some form that preserves the order of the internal morphemes observed inside the complex phonological word in the (ultimately sensory) input. Suppose, in addition, that the highest head H_1^0 is merged to the structure on the basis of its

position in the input, while the residuum $(H_2\ldots)^0$ reconstructs. These assumptions are illustrated in (42).

(42) Myy-dä-kö Pekka haluaa $\__1$ koko omaisuutensa?
sell-A/inf-Q Pekka wants all possessions
$Q(\_\_)^0 \rightarrow$ reconstruct $\rightarrow$ $A/inf(V)^0$

The highest morpheme Q is merged into the position indicated by the surface string, while the rest is reconstructed. With these assumptions in place, the data can be derived by rule (43).

(43) *Head reconstruction (inverse head chain algorithm)*

Head $(H_1, \ldots)^0$ is reconstructed from $(H_0\ (H_1,\ldots))^0$ into position X, $\{_{XP}X, \alpha P\}$, such that

A. the reconstructed head $(H_1, \ldots)^0$ satisfies selection at position X;

B. X is the first position satisfying (A) reached by a top-down search starting from the position of the complex head and entering αP in $\{_{\alpha P}XP\ \alpha P\}$ and $\{_{\beta P}\ \beta^0\ \alpha P\})$, β^0 not being a barrier.

Let us take notice of few things about (43) before looking at the data. The principle involves no movement triggers, such as uninterpretable probe-features. The input configuration for (43) is a structure at which all syntactic objects are already at their final spellout positions (e.g. 42). Head reconstruction can therefore be triggered by the trivial fact that the object is a complex head, assuming that no head can remain inside a complex head at the LF-interface. The analytic problem is, instead, to find the gaps, condition A in (43). Similarly, there are no probe-goal relations that define chains; instead, condition B (43) prevents search from going into left branches and left/right adjuncts and captures a notion of minimal top-down search that constitutes the core of what I will use to replace the standard locality metric. The search referred to in the rule (43B) will be implemented quite literally as a search algorithm, as elucidated in Section 4.

Condition B in (43) requires that search follows labelling until either there is nothing left to search or the head constitutes a barrier, with the notion of barrier left open. Barriers terminate search at certain heads. This notion is required to model the island effects.

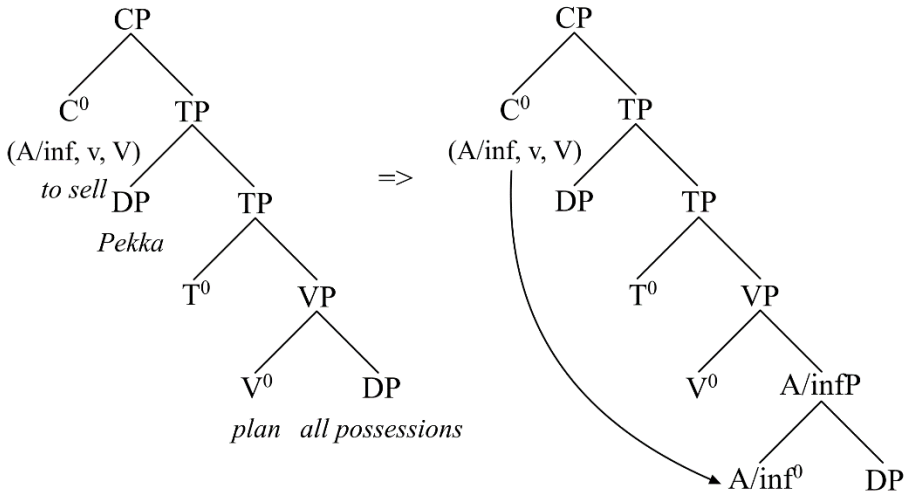
In every example cited in this article the fronted head must be reconstructed into a gap in which it could be selected by a higher head. This gives us the correct notion of a head gap in the present dataset. Consider the three possible reconstruction positions in (44a-c).

(44)

a.	Myy-dä-kö$_1$	Pekka	aiko-i	_$_1$	koko	omaisuute-nsa?
	sell-A/INF-Q	Pekka.NOM	plan-PAST.3SG		all	possessions-PX/3SG
	‘Was Pekka going to sell all his possessions?’					
b.	*Myy-dä-kö$_1$	Pekka	_$_1$	aiko-i	koko	omaisuute-nsa?
	sell-A/INF-Q	Pekka.NOM		plan-PAST.3SG	all	possessions-PX/3SG
c.	*Myy-dä-kö$_1$	Pekka	aiko-i	koko	omaisuute-nsa	_$_1$
	sell-A/INF-Q	Pekka.NOM	plan-PAST.3SG	all	possessions-PX/3SG	

The first head requiring reconstruction is *myy-dä-* (A/INF(v, V))^0. The correct gap position is one in which it can be selected by the finite verb *aikoa* ‘plans’, satisfying Condition (43A). In (44b) the head is selected wrongly by the finite/interrogative C, so this position is ruled out. Example (44c) is ruled out by Condition B of (43): the first position is closer to the starting point. Once the first gap is correctly targeted, (v, V)^0 can be extracted from (A/INF(v, V))^0 and V from (v, V)^0 by the same operation. The first step is illustrated in (45).

(45) [1]



Condition B requires search to follow selection. This prevents reconstruction into left branch phrases (subjects and left adjuncts) and right adjuncts (if they are allowed in the analysis), as shown in Section 2.3.3 and (46). It correctly rules out (46a-b) and allows (46c).

(46)

a. *Myy-dä-kö$_1$ [Peka-n sopimus _$_1$ omaisuus] oli väärennös.
sell-A/INF-Q Pekka-GEN agreement.NOM possession was fake
Intended, with ‘to sell’ moving: ‘Was Pekka’s agreement <u>to sell</u> the possessions a fake?’

b. *Myy-dä-kö$_1$ [Peka-n aikoessa _$_1$ omaisuut-ta] tapahtui virhe.
sell-A/INF-Q Pekka-GEN plan.ESSA possession-PAR happened error
‘Inteded: Did an error occurred while Pekka was selling the possessions?’

c. Myy-dä-kö$_1$ [Pekka [aiko-i _$_1$ kaiken omaisuute-nsa]]?
sell-A/INF-Q Pekka.NOM plan-PAST.3G all possessions-PX/3SG

This implements a version of the “minimal search” posited in Chomsky (2008, p. 146), but interprets it as a top-down reconstruction process. I classify subjects into the same category by requiring that search follows selection/labelling (assuming, therefore, that a subject is XP in {$_{\alpha P}$ XP αP}).

Consider the restriction on reconstructing finite verbs into embedded clauses, shown in (47) and discussed in Section 2.3.1.

(47)

a. Myy-dä-kö$_1$ Pekka sanoi että hän haluaa _$_1$ koko omaisuutensa?
sell-A/INF-Q Pekka claimed that he wants all possessions
‘Did Pekka said that he wishes to sell all his possessions?’

b. *Halua-a-ko$_1$ Pekka sanoi että hän _$_1$ myy-dä koko omaisuutensa
want-3SG-Q Pekka said that he sell-A/INF all possessions

c. *Ei-kö$_1$ Pekka sanoi että hän _$_1$ halua myy-dä koko omaisuuttaan?
not-Q Pekka said that he wants sell-A/INF all possessions

d. *On-ko$_1$ Pekka sanoi että hän _$_1$ halunnut myy-dä koko omaisuutensa?
is-Q Pekka said that he want.PRTCPL sell-A/INF all possessions.

Examples (47b-d) have the property that the first position at which the finite verb could be selected by a higher head is in the main clause (48).

(48)

a. *Haluaa-ko$_1$ Pekka _$_1$ sanoi että hän myy-dä koko omaisuutensa

want-3SG-Q Pekka said that he sell-A/INF all possessions

b. *Ei-kö$_1$ Pekka _$_1$ sanoi että hän halua myydä koko omaisuuttaan?
not-Q Pekka said that he wants sell-A/INF all possessions

c. *On-ko$_1$ Pekka _$_1$ sanoi että hän halunnut myydä koko omaisuutensa?
is-Q Pekka said that he want.PRTCPL sell-A/INF all possessions.

The finite verb is selected by C, a position satisfying (43A). If the head can only be fitted into the first position in which it *can* be selected, the correct, lower position is never targeted. The same phenomenon can be seen in examples in which an infinitival verb could be reconstructed either to the main clause or into an embedded clause. The lower site is not accessible (49) if a higher site exists.

(49)

a. *?Myydä-kö Pekka pyysi _$_a$ että Merjan täytyy _$_b$ koko omaisuutensa?
sell-A/INF-Q Pekka asked that Merja must all possessions
(Higher site available because *pyysi* + *myydä* 'to ask to sell' is possbile.)

b. Myy-dä-kö Pekka sanoi X että Merjan täytyy _$_b$ koko omaisuutensa?
sell-a/inf-q Pekka said that Merja must.0 all possessions
(Higher site unavailable because *sanoi* + *myydä* 'to say to sell' is not possible.)

Similar examples can be created by using double participles (50a) and A-infinitivals (50b), which I find equally marginal or ungrammatical.[9]

(50)

a. ??Myy-nyt-kö$_1$ Pekka ei/oli ol-lut _$_1$ omaisuuttaan?
sell-PRTCPL-Q Pekka not/was be-PAST.PRTCPL possessions
'Pekka had not SOLD his possessions?'
(Higher site available because *oli* + *myynyt* 'had sold' is possible.)

b. *?Lähte-ä-kö$_1$ Peka-n täytyy halu-ta _$_1$ mukaan.
leave-A/INF-Q Pekka-GEN must.0 want-A/INF with.us
'Pekka must want to LEAVE with us?'
(Higher site available because *täytyy* + *lähteä* 'must leave' is possible.)

Let us consider the ban on head movement inside infinitivals, as shown in (51).

(51)

a. Peka-n täytyy [yrittä-ä myy-dä omaisuute-nsa.]
Pekka-GEN must.0 try-A/INF sell-A/INF possessions-PX/3SG
'Pekka must try to sell his possessions.'

b. *Peka-n täytyy [myy-dä$_1$ yrittä-ä _$_1$ omaisuute-nsa.]
Pekka-GEN must.0 sell-A/INF try-A/INF possessions-PX/3SG

Conditions (43A) and (43B) are satisfied in (51b), but the clause is still ungrammatical. This follows from the analysis because reconstruction always begins from the second morpheme and leaves the first (highest) morpheme into the position it was encountered in the input string. For example, a head with an internal structure C#T#v will leave C into the left peripheral position at which the complex word was encountered in the input and reconstructs T#v (see 42). Applying the analysis produces (52), which crashes and is correctly judged ungrammatical.

(52) *Peka-n täytyy [A/INF myy- A/INF yrittä- omaisuute-nsa].
Pekka-GEN must.0 to sell to try possessions-PX/3SG
'*Pekka must: to sell: to try his possession.'

If, on the other hand, the moved infinitival is equipped with a discourse feature such as *-kO*, that feature will generate C(*wh*) in situ and violate a requirement of the finite modal verb 'must' which cannot select an interrogative CPs.

3.4 Long head movement and genitive subjects

Movement of an infinitival verb over its own thematic subject when the subject is part of the infinitival clause is impossible (53)(Section 2.3.8). The gap here represents the "correct" canonical position of the fronted verb.

(53) *Myy-vän-kö$_1$ Pekka uskoi Merja-n _$_1$ omaisuutensa?
sell-vA/INF-Q Pekka believed Merja-GEN possessions-PX/3SG

Genitive DPs differ from nominative, accusative and partitive DPs in that the former, unlike the latter, cannot occur in noncanonical postverbal positions (Brattico 2016).[10] Consider

again (53). The chain creation algorithm (43) reconstructs the infinitival verb into X in (54), which leaves both DP arguments into postverbal positions. The genitive DP cannot reconstruct into Spec,vP.

(54)	C(Q)	Pekka	uskoi	X	v	V	[$_{DP}$	Merja-n	omaisuute-nsa]
	C(Q)	Pekka	believed	vA/INF	v	V		Merja-GEN	possessions-PX/3SG

Thus, the genitive data is captured if we assume an independently motivated principle of Finnish which bans rightward movement of genitive arguments.

3.5 Head movement constraint

The head movement constraint (HMC) is not explicitly stated in the analysis. Finnish Neg-to-Force movement is, however, constrained by HMC (or by some locality restriction resembling HMC). Example (55a) shows that the negation climbs and adjoins to complementizer *että* 'that', but the operation is not possible if an interrogative intervenes (55b-c).

(55)

a.	Pekka	sanoi	ett-ei$_1$	hän	_$_1$	myy	kaikkia	tavaroitaan.		
	Pekka	said	that-not	he		sell	all	possessions		
	'Pekka said that he will not sell all of his possession.'									
b.	Pekka	kysyi	että	miksi	hän	ei	voi	myydä	kaikkia	tavaroitaan.
	Pekka	asked	that	why	he	not	can	sell	all	possessions
	'Pekka asked why he could not sell all of his possessions.'									
c.	*Pekka	kysyi	ett-ei$_1$	miksi	hän	_$_1$	voi	myydä	kaikkia	tavaroitaan.
	Pekka	asked	that-not	why	he		can	sell	all	belonings

HMC is also attested in cases of verum focus and polarity focus constructions in Finnish (Section 2.3.7). There is a possible generalization behind these observations. The high complementizer in (55) is higher than C, thus it does not express C-features (Section 2.1). Moreover, I have yet to find an instance of nonlocal head movement in connection with any head besides those expressing overt C-features. Assuming Finnish verum focus or polarity focus do not target the conceptual content of the moved predicate, the facts are compatible with the hypothesis that only C-features are involved with LHM. In addition, both HMS-compliant head movement and the core instances of A-movement target the closest head or

the closest phrasal position, respectively, suggesting that a general locality property holds. Furthermore, the reason we do not see LHM in a language such as English could be because English verbs do not carry C-features (only phrases do). The same reasoning applies to the more formal V2-phenomenon characteristic of many Germanic languages, which is not involved in checking interrogative, relative or discourse features. To separate formal T-to-C movement from discourse features targeting the conceptual content of the moved predicate, I will use symbol C*-feature for the latter. Provided these background assumptions, notice that (42A-B) are true of local head movement as well: the head is reconstructed into a position selected by the higher head and search follows labelling and targets the first position. The difference between HMC and LHM is that the former cannot skip heads. I will capture the difference in the formal analysis by assuming that every head constitutes a barrier for head movement with the exception of movement triggered by C*-features. Thus, the notion of "barrier" in (43B) will be relativized with respect to the features involved in reconstruction.

3.6 Arguments and heads

One additional complication is presented by examples of the type (56).

(56) [Myy-kö$_1$ [Pekka _$_1$ omaisuute-nsa?]]
sell.3SG-Q Pekka.NOM possessions-PX/3SG
(C(T(v,V)))^0

The chain creation algorithm yields (57).

(57) [Myy-kö$_1$ [_$_1$ [Pekka omaisuutensa?]]]
sell.3SG-Q Pekka.NOM possessions-PX/3SG
C(__)^0 T(v,V)

The problem is that T will have no subject and the EPP, which must be checked in Finnish (Holmberg and Nikanne 2002; Vainikka 1989), remains unchecked. We can solve this issue by assuming that a finite head requiring a mandatory specifier (EPP) must be reconstructed into a position in which it satisfies (43A) *and* its EPP requirement. T now lowers into the correct position below the subject that will check its EPP (58).

(58) C^0(Q) [Pekka] T^0(v,V)

This condition, which was added to the notion of "selection" in (43A), derives (57) and many examples of its kind in the dataset. The problem, though, is that now the chain creation algorithm can end up finding no acceptable position. This occurs for example if the grammatical subject occurs further to the right (such input sentences are grammatical in Finnish). To solve this issue, I assume a last resort principle which reconstructs the head locally (e.g., C(T) → [C [T…]]) if no position is found by (43).

Informally, then, the principle seems to suffice the derive the whole dataset. Moreover, the principle is simple at least in relation to the complex data it captures. On the other hand, scientific hypotheses must ultimately be justified by a chain of deductive steps linking hypotheses to observations. In linguistics, too, we would like to "construct a formalized general theory of linguistic structure" because by "pushing a precise but inadequate formulation to an unacceptable conclusion, we can often expose the exact source of this inadequacy and, consequently, gain a deeper understanding of the linguistic data. More positively, a formalized theory may automatically provide solutions for many problems other than those for which it was explicitly designed" (Chomsky 1957:5). This issue was addressed in the next Section.

4 Formalization and testing

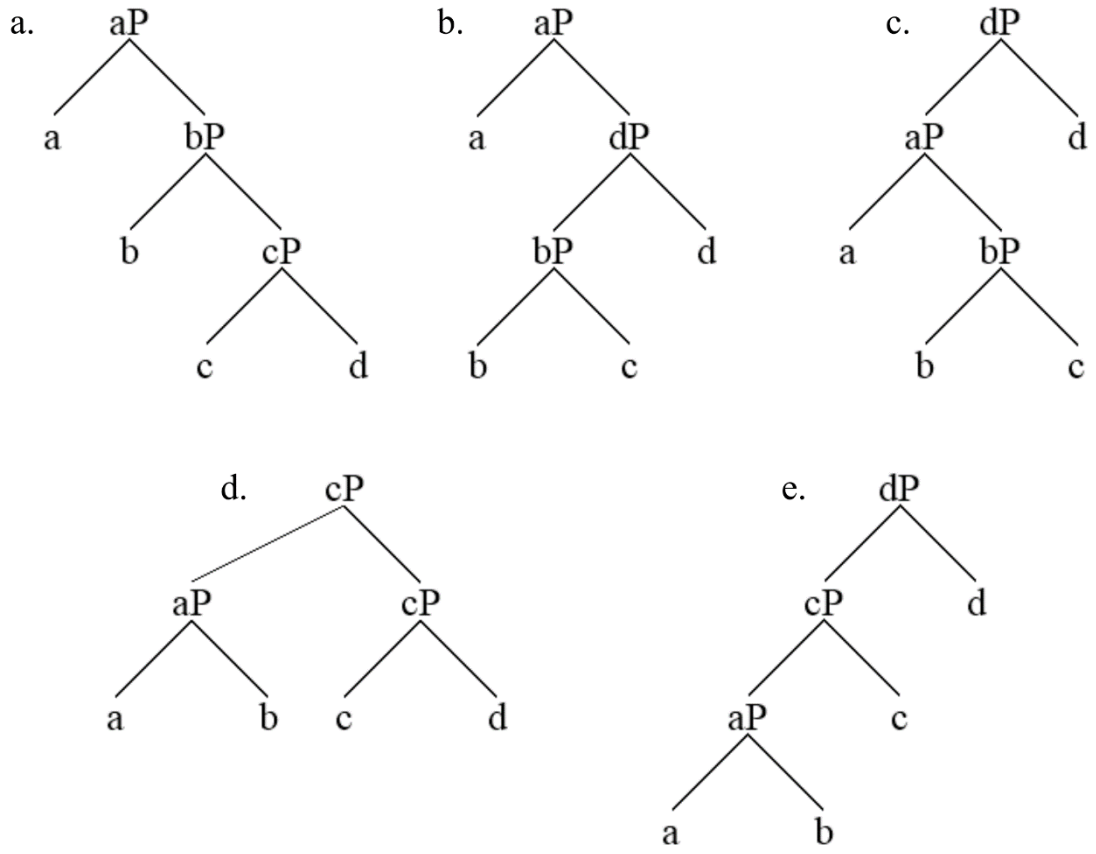
This section describes the formalization and testing. Complete formalization exists in the form of a Python source code and the technical documentation is available in the public domain.[11]

There are at least two ways to use deductive calculation in justifying a linguistic hypothesis. One method is to write an algorithm that, by using the axioms and principles of the proposed theory, enumerates expressions and/or structural analyses and then verifies that the output set is correct. This would correspond to a literal generative grammar. The second method, adopted here, is to formalize the theory as an algorithm that decides from any input sentence whether it is grammatical or not and, if the former, provides it with a set of structural analyses and semantic interpretation(s). The second method is easier to use than the first as it allows one to test individual input sentences in isolation without generating anything else, but the tradeoff is that it requires a parser.

The parser used in this study (written as a separate component of the algorithm) maps linear strings of phonological words into a set of binary bare phrase structure objects called

spellout structures which preserve the linear order of the input string under a left-to-right depth-first linearization algorithm. To illustrate, an input string $a * b * c * d$ containing ad hoc lexical items *a*, *b*, *c* and *d* is mapped into structures (59a-e) by the parser.

(59)

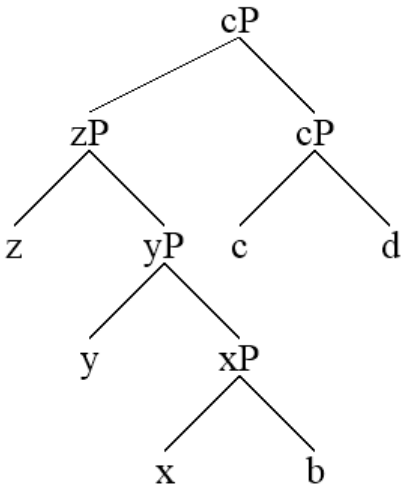


Structures (59) are asymmetric and binary branching bare phrase structure objects with the labels determined by a recursive top-down labelling algorithm.[12] The output of the labelling algorithm is explicit in all output produced by the algorithm, as it is in (59). If the input word is complex, it is first decomposed by using *surface vocabulary* mapping phonological material from the input into morphological decompositions and lexical items (e.g., *admires* → T#v#V). These appear in narrow syntax/spellout structure as *complex heads* assumed in the analysis (43). Complex heads are marked in the output of the algorithm by $H(X, Y, \ldots))^0$, with X, Y, ... being contained inside H^0 in that order.

All elements will appear at their surface positions at any given spellout structure (e.g., 59). For example, an interrogative pronoun will occur to the left edge of spellout structure in a language that exhibits *wh*-movement, as this is the position at which it is encountered in the input. The algorithm will *reconstruct* elements occurring at such noncanonical positions to

canonical positions by creating *top-down chains.* This operation is called *transfer (to LF).* The head reconstruction by rule (43) posited in this article takes place during transfer. It takes a spellout structure and extracts individual lexical items out of complex heads by using an algorithmic version of (43). To illustrate, we provide *a* with an ad hoc decomposition *x#y#z* in the surface vocabulary and use solution (59d) as a seed, which then produces (60).

(60)



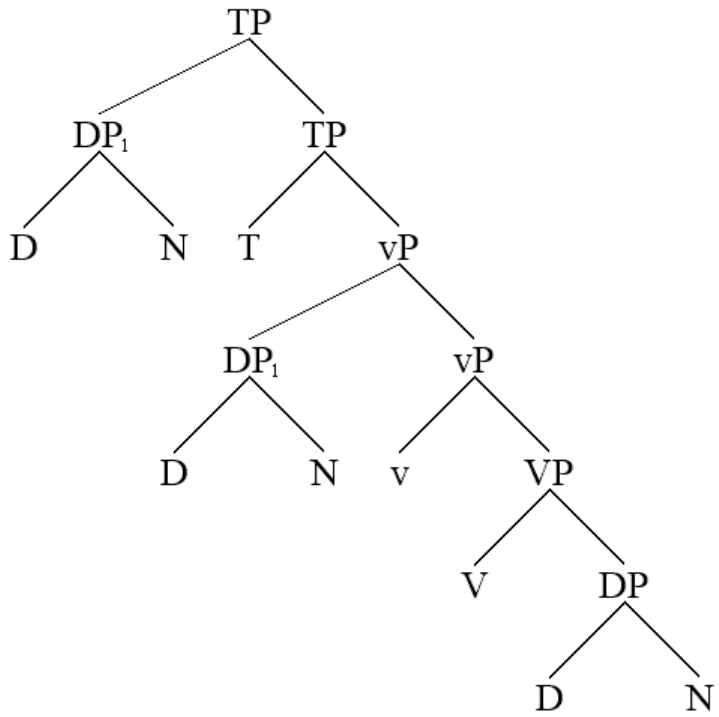
Since these ad hoc lexical items do not have any features, let alone selection features, reconstruction adopts the last resort option (Section 3.6). The result would have been the same however if we provided in the lexicon that *z* selects *y* and *y* selects *x*. Notice that *b* is "pushed downwards" as the new heads populate the structure. This follows automatically from (43). Derivation (60) can be thought of as an inverse version of the standard "roll-up" head movement.

Once all transfer operations are done, an LF-legibility check filters out uninterpretable solutions. For example, **John admires* does not pass LF-legibility because the mandatory lexical selection feature of the verb is not satisfied in any candidate solution arriving from the spellout structure to LF via transfer. A structure that passes LF-legibility is *accepted*; a structure that does not is *rejected*. Accepted solutions constitute the final set of analyses provided by the algorithm; if the set is empty, the input is judged ungrammatical.

Let us consider a more realistic example, the derivation of *John ∗ admires ∗ Mary*, with the lexical items supplied with realistic decompositions and selection features (e.g., *admires* ~ admire#v#T#3sg). The algorithm produces (61) as output (the algorithm provides its output

both in textual and graphical format, thus these phrase structure trees constitute raw data produced by the algorithm).

(61)



The ultimate primitive lexical items (e.g., D, N, T, v, V) are sets of features, with the most important features being the lexical category (shown above) and selection features targeting the lexical categories of complements and specifiers as provide by the labelling algorithm. Both *John* and *Mary* are decomposed into D#N by the surface vocabulary and extracted into trivial chains [D N] by (43), with D selecting N as its complement. The finite verb *admires* is decomposed into T-v-V, with T, v and V being primitive items, selecting and being selected in the manner illustrated in (43). The grammatical subject is reconstructed from SpecTP into SpecvP by phrasal reconstruction (chain (DP_1, DP_1)). Phrasal reconstruction is discussed in Brattico & Chesi (2020). The spellout structure, from which (61) is created by the application of (43) and phrasal reconstruction, is $[_{TP}\ D(N)^0\ [T(v, V)^0\ D(N)^0]]$. It is of course transparently related to the original input sentence from which it was parsed, as shown explicitly by (62).

(62) *John* * *admires* * *Mary*
D(N) ^{0} T(v, V)^0 D(N)^0

Principle (43) left several issues concerning its technical step-by-step implementation open. The operation was implemented by performing a top-down search from the highest node (TP in the above example) following labelling (43B) that detects complex heads either to the left (e.g., T(v, V)) or to the right (last D(N)) and, upon finding one, creates a head chain by locating the closest suitable gap. If a gap is not found, the last resort rule is applied. Once the chain has been created, the algorithm returns to the position of the original complex head and continues the search, trying to find other complex heads until no further structure exists.[13] This ensures that all complex heads are eventually reconstructed.

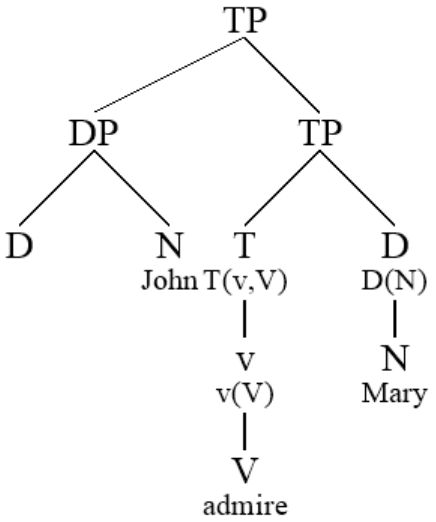
Let us consider the internal structure of the complex heads themselves. The standard assumption at least since Chomsky (1995) has been to detach the notion of 'head' from phrase structure geometry. Any algorithm (ultimately a computational operation in the human language faculty) that applies a syntactic rule to the spellout structure must determine, from any given complex constituent [α β] that it processes in some manner, whether it is a head or a phrase. I adopted (63) for this purpose in this study.

(63) *Definition for phrasal constituent*

Constituent α is a *phrasal constituent* if and only if it has two daughter constituents; otherwise it is *primitive*.

A primitive lexical item (terminal constituent) is not phrasal in virtue of having zero daughter constituents. Thus, *a, b, c* and *d* in the example (59) are treated as primitive constituents, while *a*P, *b*P, *c*P and *d*P are phrasal constituents, having two constituents each. Complex heads are non-phrasal constituents that are not terminal, thus they must have exactly one daughter (=the constituent it contains). The rule applies iteratively.[14] These daughters are visible in the image output of the algorithm, as shown in (64) which represent the spellout structure for the input sentence *John admires Mary*.

(64)



For the purposes of the analytical principle (43) any other system could do as long as it satisfies two conditions: (i) it must create complex syntactic heads and (ii) preserve the linear order of the morphemes as they were in the input. If (i-ii) are satisfied, rule (43) works correctly. Thus, (62) is not essential when evaluating (43), but it is necessary in the sense that some concrete formalization must always be adopted.

Provided that the surface vocabulary contains lexical entries corresponding to the words in the input, it is possible to test the operation of the algorithm with any input, both grammatical and ungrammatical, and in any language.[15] In this way we can test any imaginable linguistic hypothesis or analysis. However, testing each hypothesis by running the algorithm with each input in isolation is laborious and does not provide a good overview of the operation and success rate of the model as a whole. All input sentences were therefore collected into a test corpus file and a main script was created that applied the algorithm automatically to all sentences in that file. An advantage of this method is that it is possible to examine the consequences of any change in the hypothesis over an unlimited number of test sentences and/or languages by running just one main script. The study reported in this article was done in this way, therefore its raw data consists of the input and output files associated with one such run together with the final source code that was used in that particular session.

I tested the proposed analytical principle against input sentences containing both local and nonlocal head movement, and both grammatical and ungrammatical variations. I contrasted Finnish with English, the latter which does not exhibit long head movement. Furthermore, I used several types of finite elements (finite verbs, Finnish finite negation,

auxiliaries, modals) and several kinds of verbs, each having distinct lexical feature profiles. On the other hand, I only had one principle (43) to test. This created a test corpus of 293 input sentences that contains virtually every example discussed in the main article (or equivalent) plus several others that were used for control purposes and to check that the model does not overgeneralize. The test corpus was divided into two blocks, one which contains control constructions *without* long head movement, verifying that the grammatical mechanisms were working correctly, and another *with* long head movement. The latter block contained local C-to-T head movement and its variants (e.g., Neg-to-C, Modal-to-C), under both canonical (SVO) and noncanonical (OVS) words orders and both grammatical and ungrammatical variants; basic LHM phenomena (e.g. V-over-T movement), both grammatical and ungrammatical; long-distance LHM, with V moving over two elements; head movement out of embedded *that*-clauses; VP-fronting constructions and head movement islands. In addition, I tested constructions in which the heads were in the wrong order and in which the C-features were suffixed to wrong heads to check possible overgeneration issues. The full test corpus using in this study can be found from the public domain.

The main script sends each input sentence to the parser algorithm, which returns a set of solutions together with information concerning the semantic interpretation. The output is stored into two machine-generated raw data files. The first lists each input sentence together with the phrase structure solutions returned by the algorithm (if any), quantitative information concerning the computations (i.e. number of garden paths and other computational operations, such as Merge/Move/Agree) and properties of the semantic interpretation. The second file, written by the parser, reports a detailed step-by-step list of the derivational steps consumed during the processing of each sentence and the justifications for all of its decisions, including justification for rejection. Finally, the algorithm delivers the output also in image format (e.g., the images used in this section), which are simplified versions of the those found from the text files. Once the main script has been executed, the researcher has to verify the correctness of the output.[16] The present study therefore reports an algorithm whose output was successfully verified in this way for all sentences in the test corpus. The methodological framework is illustrated in Figure 1.

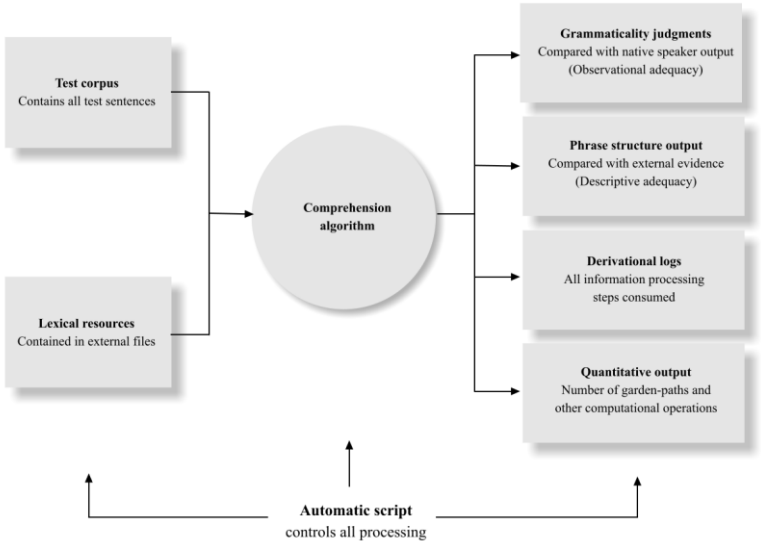
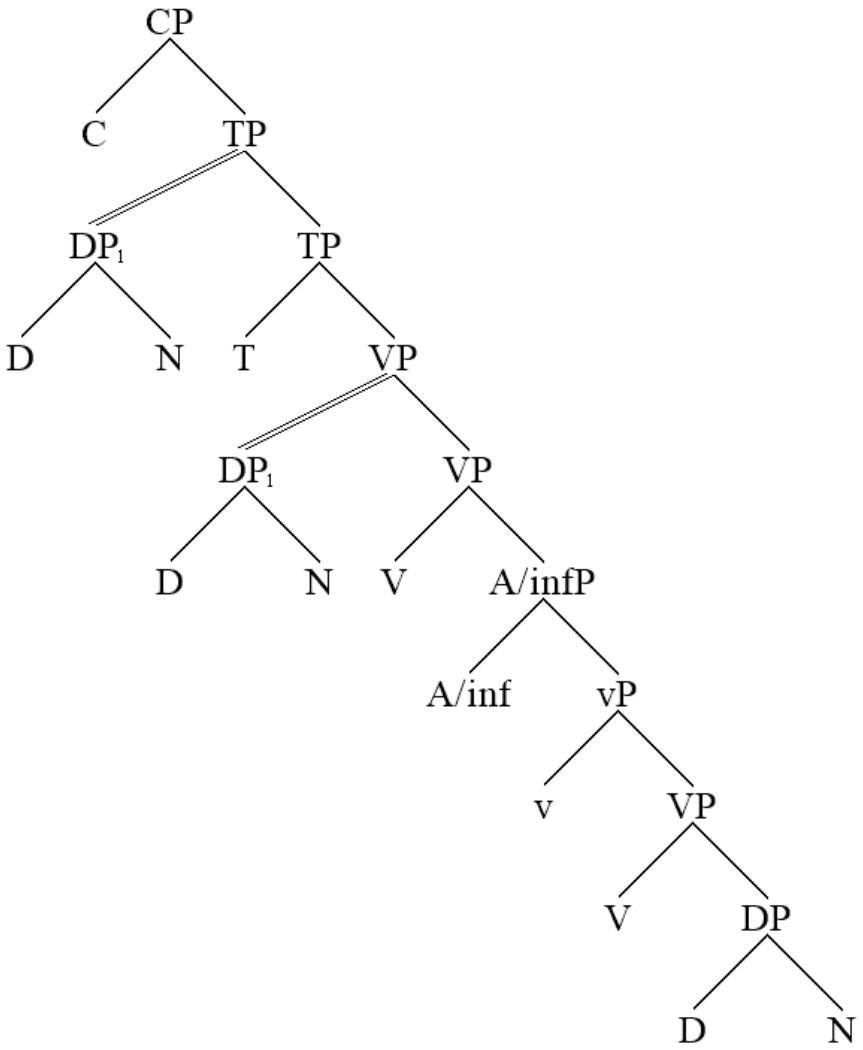


Figure 1. The general methodological framework assumed in this study. See the main text for explanation.

Phrase structure (65) illustrates the output of the algorithm in the case of a complex long head movement construction in Finnish, where C/op stands for any C*-feature and is provided in the surface vocabulary (i.e. contrastive focus, yes/no question, familiarity particle, see (3)). (66) is the raw image data generated by the algorithm.

(65) Myy-dä$_1$-kö Pekka haluaa _$_1$ omaisuutensa.
sell-A/inf-C/op Pekka.nom wants his.possessions
'Pekka wants to SELL his possessions.'

(66)



The heads (and phrases) have been reconstructed correctly. Specifically, the internal part of the complex head C(A/inf, v, V) is correctly reconstructed below the main verb V. The same structure can be found in textual format from the results file, which provides additional information, for example that the sentence was derived without any garden path solutions and that Pekka is the agent of both wanting and selling, and that 'possessions' represents the patient of selling. We can examine the internal operation of head reconstruction also from the derivational log file. There it is reported that the spellout structure corresponding to this output was [C/fin(A/inf,v,V) [[D *Pekka*] [T/fin(V) D(N)]]](line 93528 in the log file), corresponding closely to the input string from which it was directly constructed by the parser. Head reconstruction was applied during transfer (lines 93531-93539) and yielded [C/fin [[D *Pekka*] [T/fin [V [A/inf [v [V D(N)]]]]]]], in which the fronted complex verb *myy-dä*-C/op 'admire-v-A/inf-C/op' has been extracted correctly, while the grammatical subject remains at

SpecTP. Subject chain (DP_1, DP_1) is created after head reconstruction (lines 93547-93555 in the derivational log file). The algorithm provides this information for all input sentences in the test corpus when the main script is executed.

English sentences exhibiting LHM are rejected. Neither the surface vocabulary nor morphological decomposition can interpret verbal heads with C*-features. Thus, only HMC-compliant head reconstruction is available, which means that the algorithm cannot find a position for any head that needs reconstructed over several heads. The last resort strategy is adopted, which leads into rejection at the LF-interface due to selection violations caused by wrongly positioned heads. On the other hand, Finnish sentences in which the C*-feature occurs in any other position expect at the left periphery are rejected due to the generation of a corresponding C-head into a wrong position. Recall that the highest morpheme inside any complex head, in this case the one carrying the C*-feature, is merged on the basis of its position *in the input* and are not moved.[17] Reconstruction into left branches (e.g., subjects) and into right branches (right adverbials) is impossible due to the fact that minimal search follows labelling.

No PIC or equivalent was required in order to account for the present dataset, even though locality restrictions were correctly captured. It does not follow that the condition is irrelevant. There could be other data that requires it. Integrating PIC or an equivalent principle with the top-down derivation is, however, nontrivial and merits a comment. Top-down reconstruction extends the structure towards the bottom, therefore phase heads such as C and v cannot render the lower part of the derivation inaccessible. The upper part could be sealed if both heads and phrases are first reconstructed into the phase edges and then from there, successive-cyclically, into lower positions. This would constitute a ‘mirror image’ of the standard bottom-up derivation. Yet it leads into nontrivial issues if we assume that the phase heads define cyclic nodes also for spellout. This assumption cannot be carried trivially to the spellout component in the comprehension algorithm, since the parser does not know in advance what the intended structure is and does not therefore know which segments of words in the input it can treat as finalized CPs or vPs. For example, if the previous words were *the * new * car * Mary * wants* and the next word is *was*, the parser should treat the result as a DP + T structure (as in *the new car Mary wants was on sale*), but if the next word is *to*, a different continuation is more likely (*the new car Mary wants to buy…*). Thus, at what point can the parser seal one particular interpretation and send it off to LF without looking at the next word? I do not have an answer, and the question is clearly nontrivial. Derivation of the present dataset was, however, possible without assuming that CPs and vPs are phases.

The parser approach allows one to test any grammatical theory and to do so very efficiently. It computes regular input sentences at the speed of ~100ms on a standard laptop computer without optimization or parallel processing. It is therefore both possible and feasible to test linguistic hypothesis rigorously over very large sets of test sentences. Indeed, once an algorithm of this type exists, anything less rigorous feels unjustifiable and thus unsatisfactory. Yet the results are similar and, in many cases, identical to structures generated by the standard generative bottom-up derivations. Does the choice between top-down parsing approach and bottom-up generation matter? Perhaps the least interesting approach is to regard the comprehension algorithm as an alternative but also a practical and rigorous way for defining the set of grammatical sentences while observing descriptive and explanatory adequacy. As such, it constitutes an auxiliary research tool. A more interesting approach is to aim for a unified, and thus more constrained theory of the human language faculty that accounts for both production and comprehension. Both concerns motivated the study reported in this article.

5 Conclusion

Several left peripheral C*-features are involved in predicate formation in Finnish. The data examined in this paper suggest that such predicates exhibit A-bar head movement. This supports Roberts (1993) and Holmberg (2015), who argue that A-bar movement extends to head movement. An analysis along those lines was proposed that further adopts the notion of minimal search from Chomsky (2008): head chains involving C*-features are constrained by minimal top-down locality search defined by selection/labelling. The data suggests that both noncanonical head ordering and morphological decomposition are syntactic. Thus, all head chains are formed in syntax. Local head movement differs from long head movement in that that latter involves C*-features. It was argued that the ultimate explanation for systematic long head movement effects in Finnish is lexical: perhaps due to its agglutinative nature its lexicon is supplied with a variety of C*-features that can be used in predicate formation.

References

Alboiu, Gabriela, Virginia Hill, and Ioanna Sitaridou. 2015. “Discourse-Driven V-to-C in Early Modern Romanian.” *Natural Language & Linguistic Theory* 33:1057–88.

Anttila, Arto and Jong-Bok Kim. 2017. “Locality and Variation in Finnish Structural Case.” *Natural Language & Linguistic Theory* 35:581–634.

Baker, Mark. 1988. *Incorporation. A Theory of Grammatical Function Changing*. Chicago: University of Chicago Press.

Harizanov, Boris. 2019. “Head Movement to Specifier Positions.” *Glossa: A Journal of General Linguistics* 4(1):1–36.

Brattico, Pauli. 2016. “Is Finnish Topic Prominent?” *Acta Linguistica Hungarica* 63:299–330.

Brattico, Pauli, Saara Huhmarniemi, Jukka Purma, and Anne Vainikka. 2013. “The Structure of Finnish CP and Feature Inheritance.” *Finno-Ugric Languages and Linguistics* 2(2):66–109.

Cardinaletti, Anna and Michael Starke. 1999. “The Typology of Structural Deficiency: On the Three Grammatical Classes.” Pp. 145–233 in *Clitics in the Languages of Europe*, edited by H. C. van Riemsdijk. Berlin: Mouton de Gruyter.

Chomsky, Noam. 1957. *Syntactic Structures*. The Hague: Mouton.

Chomsky, Noam. 2000. “Minimalist Inquiries: The Framework.” Pp. 89–156 in *Step by Step: Essays on Minimalist Syntax in Honor of Howard Lasnik*, edited by R. Martin, D. Michaels, and J. Uriagereka. Cambridge, MA.: MIT Press.

Chomsky, Noam. 2001. “Derivation by Phase.” Pp. 1–37 in *Ken Hale: A Life in Language*, edited by M. Kenstowicz. Cambridge, MA.: MIT Press.

Chomsky, Noam. 2008. “On Phases.” Pp. 133–66 in *Foundational Issues in Linguistic Theory: Essays in Honor of Jean-Roger Vergnaud*, edited by C. Otero, R. Freidin, and M.-L. Zubizarreta. Cambridge, MA.: MIT Press.

Chomsky, Noam, Ángel J. Gallego, and Dennis Ott. 2019. “Generative Grammar and the Faculty of Language: Insights, Questions, and Challenges.” *Catalan Journal of Linguistics* Special Is:229–61.

Chung, Sandra and James McCloskey. 1987. “Government, Barriers, and Small Clauses in Modern Irish.” *Linguistic Inquiry* 18:173–237.

Embick, David and Roumyana Izvorski. 1997. “Participle-Auxiliary Word Orders in Slavic.” Pp. 210–39 in *Proceedings of Formal Approaches to Slavic Linguistics 4: The Cornell Meeting*, edited by W. Browne, E. Dornisch, N. Kondrashova, and D. Zec. Ann Arbor: Michigan Slavic.

Hakulinen, Auli. 1976. *Reports on Text Linguistics: Suomen Kielen Generatiivista Lauseoppia 2*. Vol. 7.

Hakulinen, Auli and Fred Karlsson. 1979. *Nykysuomen Lauseoppia*. Finnish Literature Society.

Harizanov, Boris. 2014. “Clitic Doubling at the Syntax-Morphophonology Interface: A-Movement and Morphological Merger in Bulgarian.” *Natural Language and Linguistic Theory* 4(32):1033–88.

Harizanov, Boris and Vera Gribanova. 2018. “Whither Head Movement?” *Natural Language & Linguistic Theory* 37(2):461–522.

Holmberg, Anders. 2000. “Scandinavian Stylistic Fronting: How Any Category Can Become an Expletive.” *Linguistic Inquiry* 31(3):445–83.

Holmberg, Anders. 2005. “Is There a Little pro? Evidence from Finnish.” *Linguistic Inquiry* 36(4):533–64.

Holmberg, Anders. 2014. “The Syntax of the Finnish Question Particle.” Pp. 266–89 in *Functional Structure from Top to Toe*, edited by P. Svenonius. Oxford University Press.

Holmberg, Anders. 2015. *The Syntax of Yes and No*. Oxford: Oxford University Press.

Holmberg, Anders and Urpo Nikanne. 2002. “Expletives, Subjects and Topics in Finnish.” Pp. 71–106 in *Subjects, Expletives, and the EPP*, edited by P. Svenonius. Oxford: Oxford University Press.

Holmberg, Anders, Urpo Nikanne, Irmeli Oraviita, Hannu Reime, and Trond Trosterud. 1993. “The Structure of INFL and the Finite Clause in Finnish.” Pp. 177–206 in *Case and other functional categories in Finnish syntax*, edited by A. Holmberg and U. Nikanne. Mouton de Gruyter.

Huhmarniemi, Saara. 2012. *Finnish A´-Movement: Edges and Islands*. Ph.D. dissertation, University of Helsinki.

Huhmarniemi, Saara and Pauli Brattico. 2013. “On Primary and Secondary Movement.” *Acta Linguistica Hungarica* 60(2):173–216.

Huhmarniemi, Saara and Pauli Brattico. 2015. “The Finnish Possessive Suffix.” *Finno-Ugric Languages and Linguistics* 4(1–2):2–41.

King, Tracy Holloway. 1995. *Configuring Topic and Focus in Russian*. Stanford: CSLI Publications.

Kiparsky, Paul. 1998. “Partitive Case and Aspect.” Pp. 265–307 in *The Projection of Arguments: Lexical and Compositional Factors*, edited by M. Butt and W. Geuder. CSLI Publications.

Koopman, Hilda. 1984. *The Syntax of Verbs: From Verb Movement Rules in the Kru Languages to Universal Grammar*. Foris.

Koskinen, Päivi. 1998. *Features and Categories: Non-Finite Constructions in Finnish*. Dissertation, University of Toronto.

Lambova, Mariana. 2004. “On Triggers of Movement and Effects at the Interfaces.” Pp. 231–58 in *Studies in generative grammar, 75: Triggers*, edited by A. Breibarth and H. C. van Reimsdijk. Berlin: de Gruyter.

Landau, Idan. 2006. “Chain Resolution in Hebrew (V)P-Fronting.” *Syntax* 9(1):32–66.

Laury, Ritva. 1997. *Demonstratives in Interaction: The Emergence of a Definite Article in Finnish*. Amsterdam: John Benjamins.

Lema, José and María-Luisa Rivero. 1990. “Long Head Movement: ECP vs. HMC.” *Proceedings of NELS* 20:333–47.

Manninen, Satu. 2003. *Small Phrase Layers: A Study of Finnish Manner Adverbials*. Amsterdam/Philadelphia: John Benjamins.

Matushansky, Ora. 2006. “Head Movement in Linguistic Theory.” *Linguistic Inquiry* 37:69–109.

McCloskey, James. 1979. *Transformational Syntax and Model Theoretic Semantics: A Case Study in Modern Irish*. Dordrecht: Reidel.

Nelson, Diane C. 1998. *Grammatical Case Assignment in Finnish*. London: Routledge.

Pesetsky, David and Esther Torrego. 2001. “T-to-C Movement: Causes and Consequences.” Pp. 355–426 in *Ken Hale: A Life in Language*, edited by M. Kenstowicz. MIT Press.

Platzack, Christer. 2013. “Head Movement as a Phonological Operation.” Pp. 21–43 in *Diagnosing syntax*, edited by L.-S. Lisa Cheng and N. Corver. Oxford: Oxford University Press.

Rivero, María-Luisa. 1991. “Long Head Movement and Negation: Serbo-Croatian vs. Slovak and Czech.” *The Linguistic Review* 8:319–51.

Rivero, María-Luisa. 1993. “Long Head Movement vs. V2, and Null Subjects in Old Romance.” *Lingua* 89:217–45.

Rivero, María-Luisa. 1994. “Clause Structure and V-Movement in the Languages of the Balkans.” *Natural Language & Linguistic Theory* 12:63–120.

Rizzi, Luigi. 2006. “On the Form of Chains: Criterial Positions and ECP Effects.” Pp. 97–133 in *Wh-movement: Moving on*, edited by L. L.-S. Cheng and N. Corver. Cambridge, MA.: MIT Press.

Rizzi, Luigi and Ian Roberts. 1989. “Complex Inversion in French.” *Probus* 1:1–30.

Roberts, Ian. 1993. *Verbs and Diachronic Syntax. A Comparative History of English and French*. Amsterdam: Kluwer Academic Press.

Roberts, Ian. 1994. “Two Types of Head Movement in Romance.” Pp. 207–42 in *Verb movement*, edited by D. Lightfoot and N. Hornstein. Cambridge: Cambridge University

Press.

Roberts, Ian. 2010. *Agreement and Head Movement: Clitics, Incorporation, and Defective Goals*. Cambridge, MA.: MIT Press.

Schoorlemmer, Erik and Tanja Temmerman. 2012. “Head Movement as a PF-Phenomenon: Evidence from Identity under Ellipsis.” Pp. 232–40 in *West Coast Conference on Formal Linguistics (WCCFL) 29*.

Schoorlemmer, Erik and Tanja Temmerman. 2012. “Head Movement as a PF-Phenomenon: Evidence from Identity under Ellipsis.” Pp. 232–40 in *West Coast Conference on Formal Linguistics (WCCFL) 29*.

Toivonen, Ida. 2000. “The Morphosyntax of Finnish Possessives.” *Natural Language and Linguistic Theory* 18(3):579–609.

Toyoshima, Takashi. 2000. “Heading for Their Own Places.” Pp. 93–108 in *Proceedings of the 9th Student Conference in Linguistics (SCIL 9)*, edited by L. Veselinova, S. Robinson, and L. Antieau. Cambridge, MA.

Toyoshima, Takashi. 2001. “Head-to-Spec Movement.” Pp. 115–36 in *The minimalist parameter: Selected papers from the Open Linguistics Forum, Ottawa, 12–23 March 1997*. Amsterdam: John Benjamins.

Travis, Lisa. 1984. “Parameters and Effects of Word Order Variation.” Ph.D dissertation, MIT.

Vainikka, Anne. 1989. “Deriving Syntactic Representations in Finnish.” University of Massachusetts Amherst.

Vainikka, Anne. 1993. “The Three Structural Cases in Finnish.” Pp. 129–59 in *Case and other functional categories in Finnish syntax*, edited by A. Holmberg and U. Nikanne. Mouton de Gruyter.

Vainikka, Anne. 2003. “Postverbal Case Realization in Finnish.” Pp. 235–66 in *Generative approaches to Finnic and Saami linguistics*, edited by D. Nelson and S. Manninen. CSLI Publications.

Vainikka, Anne. 2011. “Genitive Case in Finnish Reconsidered.” *Biolinguistical Fennica Working Papers* 2:1–32.

Vainikka, Anne and Pauli Brattico. 2014. “The Finnish Accusative: Long Distance Case by Agreement.” *Linguistics* 52(1):73–124.

Vilkuna, Maria. 1989. *Free Word Order in Finnish: Its Syntax and Discourse Functions*. Helsinki: Finnish Literature Society.

Vilkuna, Maria. 1995. “Discourse Configurationality in Finnish.” Pp. 244–68 in *Discourse*

Configurational Languages, edited by K. É. Kiss. Oxford: Oxford University Press.

Vincente, L. 2007. “The Syntax of Heads and Phrases: A Study of Verb (Phrase) Fronting.” Leiden.

Wilder, Chris and Damir Cavar. 1994. “Word Order Variation, Verb Movement, and Economy Principles.” *Studia Linguistica* 48:46–86.

[1] Abbreviations: 0 = no agreement or default agreement; A/INF = A-infinitival (corresponding loosely to English to-infinitival); ESSA = ESSA-adverbial, roughly 'while doing something'; FOC = corrective/contrastive focus; GEN = genitive Case; HAN = a second position discourse clitic; IMP = imperative verb; NOM = nominative case; MA, MALLA, MATTA, MASSA, = MA-adverbials and infinitivals; PA = the second position discourse clitic *-pA*; PAR = partitive Case; PRTCPL = participle verb; PX = possessive suffix and/or infinitival agreement marker; Q = yes/no question particle *-kO*; T = tense (finite, nonfinite, past/present); T/FIN = finite tense; VA/INF = *VA*-infinitival.

[2] An exceptional group of verb-initial clauses that do not involve V-movement to C^0 are grammatical in Finnish, but the phenomenon is irrelevant here.

[3] There is one difference worth mentioning already here: (6)a seems to have an additional verum focus interpretation that the example (b) lacks, one in which the question concerns the truth value of the whole proposition.

[4] These data together with the Finnish facts cited above suggest that we should treat the term "Finnish long head movement" as a descriptive notion until a rigorous analysis can be developed; it does not necessarily describe the same phenomenon denoted by this term in other languages.

[5] I find (13b) hard to judge and difficult to interpret. The point here, however, is that it differs in its status from (a), which is not difficult to judge and has a clear semantic function.

[6] This claim is based on the following considerations. First, as argued by Vainikka (1989, 1993, 2003, 2011), the genitive constitutes a structural subject-specifier case in Finnish. It occurs systematically in the specifier positions of various functional heads, such as e.g. prepositions, adjectives, nouns and infinitivals. In these positions, it often triggers infinitival agreement in person and number with the local head, and this is sometimes also the case with the infinitivals (although not with the A-infinitival used in the main text). Second, this construction contrasts with infinitival constructions in which the second argument is part of the main clause, is assigned the direct object case, and satisfies other direct object tests in Finnish (e.g., *Pekka näki heidät nukkumassa* 'Pekka saw them.acc sleeping'). The genitive argument does not satisfy these object tests.

[7] For Finnish infinitivals, see Vainikka (1989) and Koskinen (1998).

[8] There are further problems if we look at the details of these analysis. For example, the Transparency Condition proposed in (Matushansky 2006:78) requiring heads to be

inaccessible once the next head begins to project, restricting head movement to "paradigmatic" HMC environments, constitutes a problem that needs to be addressed before we can make use of her analysis.

[9] I find example (50a) marginal but difficult to interpret. It is possible that the verbal components of complex tense constructions do not have same labels despite the surface forms; they create mutually dependent tense nodes. This is supported by the fact that the construction is not recursive (**Pekka ei ollut halunnut myynyt*…, 'Pekka not is.PRTCPL want.PRTCPL sell.PRTCLP…').

[10] For Finnish genitive case, see (Vainikka 1989, 1993, 2003, 2011).

[11] www.github.com/pajubrat/parser-grammar/Documentation.

[12] Labelling is performed by function α.head() returning the head/label for any constituent α by searching for a suitable head in top-down order. It can be expressed in pseudo-code as follows: 'Return α if α is primitive; if not applicable, suppose α = [A B] and return A if A primitive, but if not, return B if B is primitive; if not, apply the rule recursively to B if B not an right adjunct; if it is, apply the rule recursively to A'.

[13] The algorithm is in the module head_movement.py and can be expressed as follows: 'Given a phrase structure P, perform minimal search S_1, as defined by (43B), from its highest node and reconstruct any complex head H(X...) encountered by preforming minimal search S_2 from the location of the complex head, trying to merge [X α] until a solution is found that satisfies (43A); if we reach a bottom node N without finding anything, try [N X] and, if this still does not work, assume [H [X...]] as last resort; then continue S_1 until there is no more structure to search.' If applied to the highest node only, the algorithm would leave all left branches and right adjuncts without processing; therefore, they constitute cyclic phases that are reconstructed independently (self citation).

[14] The definition leaves room for 'word-internal phrasal constituents', which could in theory be applied to pronominal clitics, but the algorithm presented here does not have any derivational path for producing 'word-internal phrases'.

[15] Thus, a lexical element may contain a feature designating the language into which it belongs; these features are then used to determine the input language. The input language has an effect on some of the features that appear in functional items. For example, Finnish prepositions, unlike their English counterparts, exhibit productive phi-agreement. Instead of assuming that the lexicon contains two distinct prepositions $P_{English}$ and $P_{Finnish}$, the component

containing the redundancy rules (e.g., P requires a DP complement) can be conditioned by the input language.

[16] The algorithm provides an output file that contains only the original test sentences with associated grammatical judgments as generated by the model. This file can be compared automatically with a gold standard provided by a native speaker (in this case, the author), speeding up the evaluation process considerably. Thus, before examining the analytic solutions generated by the algorithm in any detail the researcher can see with one glance that the model is observationally adequate.

[17] This could provide a motivation for movement. Only the moved element allows the language comprehension system, and the algorithm constructed here, to infer the presence and location of the C-head and its feature content. Similarly, if the moved element is a phrase, then the presence of the pied-piped phrase together with the criterial feature can determine the position of the C-head and its feature content. We could perhaps assume that a C*-feature that lacks phonological content and is therefore checked against an element at its edge (head or specifier) that carries an overt version of the same element to result in an ‘noncanonical spellout option’. Although lack of phonological content does not correlate perfectly with movement, the idea that movement has to do with phonological deficiency is perhaps interesting enough to merit serious consideration.