ISBN

979-8690460686

Syntax & Semantics At Santa Cruz

Edited by
Andrew A. Hedding and
Morwenna Hoeks

VOLUME IV

SYNTAX & SEMANTICS

at

SANTA CRUZ

Volume IV

Edited by

Andrew A. Hedding
&
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2020

Distributed by: Linguistics Research Center
Department of Linguistics
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064
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Cover photo by Margaret Kroll

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Introduction

We are very pleased to release volume 4 of Syntax Semantics at Santa Cruz (SASC), a set of papers which represent some of the current work being done in the linguistics department of the University of California, Santa Cruz. Previously published in 1992, 1993, and 2001, we hope that the 4th SASC will continue the tradition of excellence established in those previous volumes, as well as set an example for future SASCs to come.

These six papers truly encapsulate some of the most exciting work being done at Santa Cruz today and they reflect some of the broader intellectual strands that run deep through our department. They demonstrate a commitment to field methods (Brodkin, Hedding, Roberts, Sichel & Toosarvandani) as well as experimental methods (Ben-Meir). They investigate questions of formal semantics (Brasoveanu & Dotlačil) as well as formal syntax (Sichel & Toosarvandani). They challenge previously held beliefs (Ben-Meir, Brodkin) and they offer new ways of thinking about older questions (Brasoveanu & Dotlačil, Hedding, Roberts). This set of papers provides a snapshot of the diverse, careful, and compelling work that is currently being done at Santa Cruz.

We are very grateful to everyone who contributed to this volume despite the challenging times we find ourselves in. Due to the coronavirus pandemic, contributors were forced to work remotely with consultants and collaborators, and wrote their papers in difficult and unusual circumstances. However, despite these difficulties, the final papers are incredibly rich, engaging, and thought-provoking.

We would also like to express our gratitude to Maziar Toosarvandani in particular, for his help and support throughout the editing process, as well as for initiating the revitalization of this series.

Andrew A. Hedding & Morwenna Hoeks
November, 2020

Free Inversion in Modern Hebrew*

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Abstract Modern Hebrew has default SV(O) word order but allows subject-verb inversion in the form of Free Inversion (FI), where the verb appears sentence-initially. Previous studies claim that FI is restricted to existential uses, with the post-verbal subject remaining lower in the clause (Borer 2010; Shlonsky 1997). However, the availability of pre-verbal existential interpretation and post-verbal definite subjects suggests that FI is better understood as a word order expression of a thetic judgment (Melnick 2006; Kuroda 1972, 2005; Ladusaw 1994). Under this analysis, FI results from movement of the verb to a functional head F above T. Evidence from the interpretive effects of word order in Italian and English are found to be consistent with this view, alongside novel experimental evidence investigating the acceptability of sub-extraction from subjects in Hebrew.

1 Introduction

A central question in theories of the syntax-interpretive interface has been that of how the syntactic position of subjects relates to the availability of particular interpretations (Diesing 1992; Longobardi 2000; Borer 2010). Free Inversion (FI) in Modern Hebrew offers an important perspective on this question, providing evidence for a correspondence between subject position and judgment type (Bianchi and Chesi 2014; Kuroda 1972, 2005; Ladusaw 1994). Judgment type here does not refer to a formalized semantic notion, but rather to systematic correspondences between sentential properties, verb height, and the interpretation of subjects in different positions. Through a comparison of Hebrew, Italian, and English we can observe that the mapping from syntactic position to judgment type is stable cross-linguistically, despite surface differences between the languages.

Hebrew has default SV(O) word order but allows the verb to appear in sentence-initial position under the licensing conditions of FI. Some examples appear in (1). The subjects in (1) are non-presupposed indefinites, and the verbs are unaccusative and presentational. Previous studies assume that these are requirements of FI and restrict FI to existential uses, analyzing post-verbal subjects as internal to the domain of existential closure (Borer 2010; Diesing 1992; Shlonsky 1997).

* I would like to thank Ivy Sichel, Jim McCloskey, Matt Wagers, Pranav Anand, Nick Van Handel, Jed Pizarro-Guevara, Kelsey Sasaki, Margaret Kroll, Hitomi Hirayama, and Maho Morimoto for helpful feedback and discussion.

This also entails that post-verbal definite subjects should be banned in FI.

(1) a. partza srefa
erupted.3.M.SG fire.M.SG
"A fire erupted."

b. hofia pitom ashan
appeared.3.M.SG suddenly smoke.M.SG
"Smoke suddenly appeared."

c. higiu kama tayarim
arrived.3.M.PL a.few tourist.M.PL
"A few tourists arrived."

However, Melnick (2006) argues against this, demonstrating that the relevant generalizations do not implicate definiteness or verbal argument structure directly. Instead, Melnick analyzes FI as a word order expression of a thetic judgment, defined as a simple logical act that involves an expression of a state, event, or situation. This contrasts with a categorical judgment, which can be defined as a complex logical act involving the presentation of an entity and the attribution of some property to it (Kuroda 1972; Ladusaw 1994). The definition of judgment type has been somewhat controversial in terms of formal semantics, which will not be addressed here. Instead judgment type should be understood as representative of the cut in sentence types captured by Melnick, referring to the intuition at the heart of these notions. Thetic judgments can be coarsely construed as sentences that describe events, and categorical judgments as sentences that describe properties.

Since FI is only available to thetic judgments, definite subjects that appear in FI must be "weakly familiar" in the sense of Roberts (2003), or unique but not discourse familiar. Relevant examples of FI, given by Melnick, appear in (2).

(2) a. partza ha-srefa ha-noraa beyoter
erupted DEF-fire DEF-terrible most
"The worst fire erupted."

b. tilfenu ha-xaverim shel Idan
called DEF-friends of Idan
"Idan's friends called."

I extend Melnick's proposal by arguing that judgment type corresponds to syntactic structure, deriving FI by verb movement past a lower subject position. This lower position is associated with stage-level predicates, the possibility of subextraction from a subject, and the assignment of thetic judgment type (Bianchi and Chesi 2014). A higher subject position corresponds to categorical judgment type, is typically associated with individual-level predicates, and bans subextraction. I utilize evidence from English, Hebrew, and Italian alongside novel experimental results on sub-extraction from subjects in Hebrew to advance this analysis. Experimental study provides a useful tool here since the data rely on subtle distinctions that are difficult to achieve using introspection.

In section 2, I discuss the landscape of word order and interpretation across English, Hebrew, and Italian. In section 3, I provide an analysis of Hebrew FI. Following this, I explore the connection between FI and thetic judgment type in section 4. In section 5, I present the results of an experiment on the acceptability of sub-extraction from subjects in Hebrew, and show that it is consistent with the analysis of FI presented in section 3.

2 Word order and interpretation

The connection between position and interpretation is based on cross-linguistic generalizations and thus makes specific predictions for languages that allow FI, such as Hebrew. These proposals originate with Diesing (1992), who identifies a contrast between generic and existential interpretation that corresponds to pre-verbal and post-verbal position, as well as predicate type. Diesing observes that pre-verbal position and individual-level predicate (ILP) type correspond to generic interpretation, while post-verbal position and stage-level predicate type (SLP) correspond to existential interpretation. These interpretive effects relate to the characterization of SLPs as representative of transitory and accidental properties, but ILPs as representative of permanent and essential properties. For English, the examples in (3) demonstrate the difference between ILPs and SLPs.

(3) a. *Stage-level predicate*
Firemen are available.
b. *Individual-level predicate*
Firemen are intelligent.

Bare nominal subjects of ILPs can only be interpreted as generic, while bare nominal subjects of SLPs can be interpreted as either generic or existential. Generic interpretation evokes a general property of fireman (3a and 3b), while existential interpretation requires that some fireman exist with the relevant property (3a only). These readings are supported by the possibility of positioning subjects of SLPs, but not ILPs, post-verbally. This contrast is shown in (4).

(4) a. *Stage-level predicate*
There are firemen available.
b. *Individual-level predicate*
*There are firemen intelligent.

The existential readings in (4) are forced by post-verbal position and "there" insertion. Diesing accounts for the interpretive contrasts between ILPs and SLPs and between pre-verbal and post-verbal position by introducing the *Mapping Hypothesis*, defined in (5).

(5) *Mapping Hypothesis*: Material from VP is mapped into the nuclear scope. Material from the IP (TP) is mapped into a restrictive clause.

For our purposes, this hypothesis requires that the VP, or post-verbal domain, is that of existential closure. Elements in the VP are caught within the scope of the existential operator, and an existential interpretation of the clause is forced. Indefinites, such as bare nominals, have a variable that will be bound by the existential operator VP-internally, and by the generic operator VP-externally. This triggers the generic interpretation of indefinites VP-externally, and the existential interpretation of indefinites VP-internally.

The Mapping Hypothesis therefore restricts the semantic and morphosyntactic properties of post-verbal subjects. Definite subjects, and presupposed or specific indefinite subjects, cannot appear post-verbally because they are incompatible with the presence of the existential operator. Additionally, since the existential operator can only bind material within the VP, pre-verbal subjects can only be interpreted as existential if they reconstruct into the VP, becoming VP-internal at LF. Reconstruction is therefore possible with SLPs, which are compatible with existential interpretation, but not with ILPs. For Diesing, this means that subjects of ILPs are merged high, in Spec-TP, leaving them no position to reconstruct into. I will return to this point in section 3, where I instead attribute the restriction on ILPs to the movement of the subject to a higher position than Spec-TP, from which reconstruction is not possible.

Hebrew is similar to English in that generic interpretation is only possible pre-verbally, while existential interpretation is possible both pre-verbally and post-verbally, with an SLP. The difference between Hebrew and English lies in whether an expletive is required with verb-subject (VS) order. Hebrew allows for FI, while English requires an expletive. The Hebrew possibilities appear in (6).

(6) *SV order, generic and existential interpretation both available (a)*
VS order, only existential interpretation available (b)

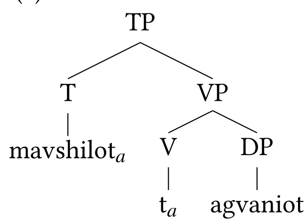
a. agvaniot mavshilot
tomato.F.PL ripen.3.F.PL
"Tomatoes ripen." Generic
"There are tomatoes ripening." Existential

b. mavshilot agvaniot
ripen.3.F.PL tomato.F.PL
"There are tomatoes ripening." Existential

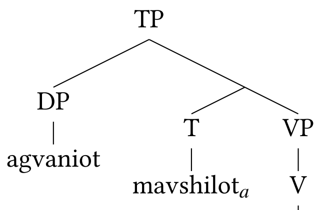
Note that there is no additional focus marking licensing existential interpretation in (6a), indicating that (6a) and (6b) are relatively equivalent in terms of interpretation. In contrast to (6), previous accounts of Hebrew assume that only generic interpretation is possible pre-verbally, and that only existential interpretation is possible post-verbally, regardless of predicate type (Borer 2005a,b). This state of affairs is instead represented by Italian. Longobardi (2000) discusses these interpretive restrictions and argues that they support a version of the *Mapping Hypothesis*, where generic or referential material maps to the functional layers of the clause, and existential material to the predicative nucleus.[1]

If Hebrew were like Italian, the absence of FI in English could be explained by the presence of strict EPP on T. English has a strict EPP on T, which accounts for the presence of the expletive "there" in Spec-TP when the subject does not raise to this position. In Hebrew and Italian, which allow FI, the EPP on T would either be optional, or satisfied by a null element such as an operator, pronoun, or expletive. Such proposals have been considered for FI, since languages that allow FI tend to also allow pro-drop, which may involve a null element in Spec-TP. Furthermore, the differences in pre-verbal interpretation between a language like English, which lacks FI, and languages like Hebrew and Italian, which exhibit FI, would stem from the availability of reconstruction in English, but not in Hebrew or Italian. The resulting syntactic structures of a sentence with and without FI under this type of analysis are given in (7) and (8).

(7) mavshilot agvaniot
ripen.3.f.pl tomato.f.pl
"There are tomatoes ripening."



(8) agvaniot mavshilot
tomato.f.pl ripen.3.f.pl
"Tomatoes ripen."



In (7), we see that only the VP-internal position would be available to the post-verbal subject, which must be existential, while in (8), only the VP-external position would be available to the pre-verbal subject, which must be generic. However, if existential interpretation is also possible pre-verbally in Hebrew, as I argue, reconstruction must also be possible, and the availability of reconstruc-

1 Longobardi notes that post-verbal generic subjects are possible in Italian. These must be preceded by a prosodic break, indicating that some further syntactic movement of the verb above the subject is probably needed. Post-verbal generics are not possible in Hebrew, even with an intonational break.

tion can no longer be connected to a strict EPP on T. Given the possibility of reconstruction and the absence of expletive insertion in VS order, it is possible that post-verbal subjects in Hebrew actually occupy Spec-TP, from which they reconstruct into the VP, or the domain of existential closure. This is the analysis I present in section 3.

Further support for an analysis of Hebrew FI where the subject appears in a position outside the VP can be drawn from the possibility of post-verbal definites. If post-verbal subjects were in a position that required the existential binding of its contents, we would expect definites, which lack a variable to bind, to be ungrammatical. Perhaps surprisingly, both definites and strong quantifiers seem to be grammatical in Hebrew FI. According to consultations with native speakers, the sentences in (9) are acceptable.

(9) a. nafal etz/ha-etz/kol etz
fell.3.M.SG tree.M.SG/DEF-tree/every tree
"A/The/Every tree fell"
b. naflu kol ha-etzim
fell.3.M.PL all DEF-trees.M.PL
"All of the trees fell."

Additionally, some instances of FI are actually more acceptable with a definite subject. This occurs with verbs that have a terminative quality. Compare (a) to (b) in examples (10) and (11).

(10) a. nifseku ha-gshamim
stopped.3.M.PL DEF-rain.M.PL
"The rains stopped.'
b. *nifseku gshamim
stopped.3.M.PL rain.M.PL
Intended: "Some rains stopped."

(11) a. nigmeru ha-sukariyot
finished.3.F.PL DEF-candy.F.PL
"The candies were finished."
b. *nigmeru sukariyot
finished.3.F.PL candy.F.PL
Intended: "Some candies were finished."

Borer (2010) briefly addresses these cases, arguing that the subject is postposed, having escaped the domain of existential closure. However, there is little independent evidence in favor of postposing. Fortunately, this will not be an issue for the analysis I present in section 3, in which post-verbal subjects appear in Spec-TP, rather than in-situ. Additionally, if FI is analyzed as representative of a thetic judgment, the grammaticality of (10) and (11) is expected based on the weak familiarity of the subject (Melnick 2006; Roberts 2003).

Weak familiarity may also explain the grammaticality of post-verbal definite subjects in possesive dative constructions, which are widely acknowledged as an exception to the restriction on definite subjects in FI. A possesive dative construction involves a dative argument that is interpreted as the personal possessor of the subject, demonstrated in (12).

(12) naflu li ha-maftexot
fell.3.F.PL to.me DEF-keys.F.PL
"My keys fell."

The verb in (12) agrees with the subject *ha-maftexot*, while the dative argument *li* indicates the possessor. These cases instantiate an exception to previously asserted restrictions on post-verbal definite subjects in FI, but are expected to be grammatical under an analysis of FI as representative of a thetic judgment.

The possibilities of pre-verbal existential interpretation and post-verbal definite subjects in Hebrew are crucial to analyzing the mapping between syntactic structure and interpretation. Given these possibilities, a three-way contrast is maintained between English, Hebrew, and Italian. In Italian, pre-verbal bare nominal subjects must be generic, but in English and Hebrew they can be either generic or existential. In all three languages existential interpretation may occur post-verbally, but generic interpretation is *only* possible pre-verbally. Additionally, Hebrew and Italian allow Free Inversion, while English only allows post-verbal subjects that are accompanied by an expletive "there". In section 3 below, I show that these differences can be attributed to a difference in the height of verb movement.

3 An analysis of Free Inversion in Hebrew

To account for FI in Modern Hebrew, I adopt a version of Bianchi and Chesi's (2014) analysis of Italian. Bianchi and Chesi observe a cross-linguistic difference between English and Italian in terms of the availability of sub-extraction. In English, where subjects almost always appear in a derived position due to the EPP on T, there appears to be no consistent syntactic constraint that can explain the acceptability, or occasional lack thereof, of sub-extraction. This contrasts with experimental results they present for Italian, where they found that sub-extraction is only possible out of post-verbal subjects of SLPs. Based on the Italian data, sub-extraction can be analyzed as possible only from subjects that can reconstruct into their thematic position. As discussed in section 2, this is also the configuration that results in the existential interpretation of bare nominals.

To account for the differences in sub-extraction between Italian and English, Bianchi and Chesi propose a difference in the height of pre-verbal subjects and verb movement. They implement a derived subject position in addition to Spec-

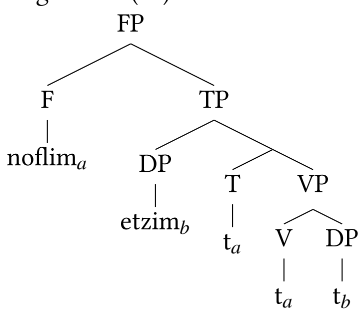
TP, the specifier of a head SubjP, whose contents must be interpreted as the subject of a categorical judgment. This position is analyzed as being an island for sub-extraction, and subjects that appear in this position cannot undergo reconstruction. They conclude that pre-verbal subjects in Italian must generally appear in this specifier since pre-verbal bare nominals must be assigned generic interpretation, which is only possible in categorical judgments. Post-verbal subjects in Italian must appear in Spec-TP or lower, since sub-extraction is possible from these subjects. Subjects which appear in Spec-TP are interpreted as subjects of thetic judgements, which corresponds to their ability to reconstruct, as well as to the existential interpretation of bare nominals in this position.

This analysis also explains why sub-extraction in English appears to be so messy. In English, the ambiguity between generic and existential interpretation of bare nominals pre-verbally corresponds to an ambiguity in the assignment of thetic or categorical judgment type to sentences with pre-verbal subjects. Pre-verbal subjects can appear in either Spec-TP or Spec-SubjP, and allow or ban sub-extraction accordingly.

An expansion of Bianchi and Chesi's analysis to Hebrew captures the interpretive properties of bare nominals by position across Hebrew, English, and Italian, as well as the properties of FI relevant to all three languages. The analysis here differs from Bianchi and Chesi's in the nature of the functional head whose specifier corresponds to categorical judgment type. I choose to remain agnostic about what exactly this functional head is, referring to it as F, although I assume it probably relates to some sense of topicality.

With this functional head in place, the differences between English, Hebrew, and Italian can be boiled down to a difference in verb height requirements. This refers to how high the verb is *obliged* to raise, and how high the verb is *allowed* to raise. In both Hebrew and Italian FI, I assume that the verb has raised to F, past the subject in Spec-TP, creating a configuration where the subject is post-verbal. This is the position where the subject is understood to be part of a thetic judgment, and where a bare nominal is assigned the relevant existential interpretation. A tree demonstrating a sentence in Hebrew FI is given in (13).

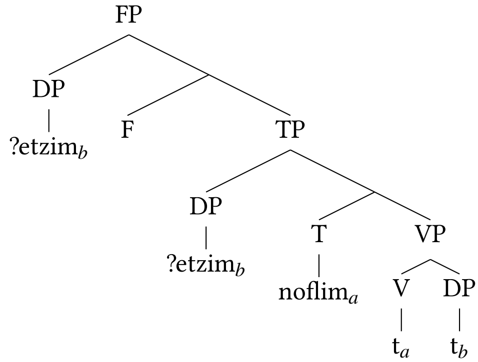
(13) noflim etzim
fall.3.M.PL tree.M.PL
"There are trees falling."



Movement of the verb to the head F is optional in Hebrew. In Italian the verb must raise to F, while in English it cannot. Since Spec-TP is only available to subjects of thetic judgments and bare nominals with existential interpretation, we expect existential interpretation of bare nominals and thetic judgment type in Hebrew to be possible both pre-verbally and post-verbally. The post-verbal subject in FI does not need to appear in a position within the domain of existential closure, but instead in a position from which reconstruction can occur into this domain. This is also the case for pre-verbal subjects of thetic judgments.

In English, the verb is not allowed to raise past T. This allows pre-verbal subjects to remain ambiguous in terms of their participation in either a thetic or categorical judgment, and accordingly their appearance in either Spec-FP or Spec-TP. A tree of a sentence with a pre-verbal subject in Hebrew that demonstrates the ambiguity of pre-verbal position for Hebrew and English is given in (14). Note that I assume that even if there is nothing overt in F, it is still projected.

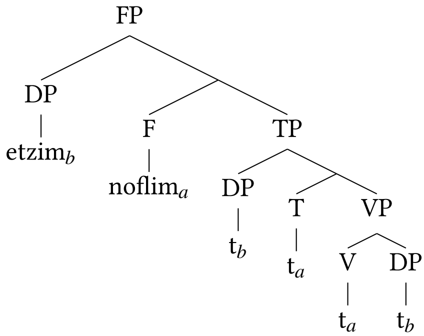
(14) etzim noflim
tree.M.PL fall.3.M.PL
"There are trees falling" or "Trees fall"



In a sentence with a pre-verbal bare nominal subject, the subject must appear in Spec-TP if the subject receives existential interpretation, and in Spec-FP if it receives generic interpretation. Out of context, the position and interpretation are both ambiguous. This is parallel to the subject's position depending on judgment type. The presence of a subject in Spec-TP indicates that the sentence is assigned a thetic judgment, and the presence of a subject in Spec-FP indicates that the sentence is assigned a categorical judgment. Bianchi and Chesi identify predicate type, or the SLP or ILP nature of a predicate, as a factor that can affect whether a subject appears in Spec-FP or Spec-TP as well. ILPs requires categorical judgment type, which forces the subject to appear in Spec-FP. On the other hand, SLPs can involve either thetic or categorical judgment type, allowing their subjects to appear in either subject position. Note that the judgment type associated with a predicate is directly parallel to the interpretive properties of bare nominals associated with predicates. Bare nominal subjects of ILPs must be generic, but bare nominal subjects of SLPs may be either generic or existential.

Recall that in Italian, where movement of the verb to F is obligatory, pre-verbal subjects can only be interpreted as part of a categorical judgment and can only receive generic interpretation. A tree for pre-verbal subjects in Italian resembles a tree for subjects with generic interpretation in Hebrew, given in (15). I assume that subjects assigned generic interpretation originate low, and raise to Spec-TP before raising to Spec-FP in order to undergo agreement with the verb and receive structural nominative case. Subjects are required to raise to Spec-FP potentially via some kind of probe and goal agreement relationship alongside an EPP, where the DP drawn to Spec-FP possesses whatever feature is needed by a probe in F. As mentioned above, this feature is probably related to topicality in some way. This is only one possibility – there are others, but these matters are left for future work.

(15) etzim noflim
tree.M.PL fall.3.M.PL
"Trees fall"

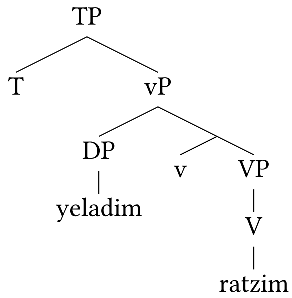


The question may arise of whether anything occupies Spec-FP when the subject remains in Spec-TP. This might be where an event argument or a null *pro* could occur. I leave this matter for future work as well, since the answer to this question probably depends on the nature of the functional head F. It is also unclear whether the verb is required to raise to F in Hebrew when the subject is in Spec-FP, leaving another interesting avenue for further investigation.

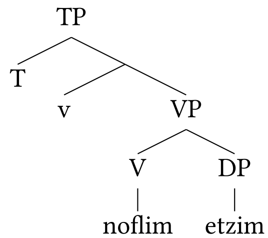
The analysis above shows that the properties of FI in Hebrew result from the landing site of the verb, rather than the position of the subject. In Hebrew, English, and Italian, a subject in the specifier of T will always be interpreted as part of a thetic judgment, and a subject in the specifier of F will always be interpreted as part of a categorical judgment, but verb movement is not equally flexible across all three languages. Unlike previous analyses of FI, my proposal allows for the existential interpretation of bare nominals to arise in both pre-verbal and post-verbal position in Hebrew. Previous analyses require that existential interpretation only arise post-verbally.

These cross-linguistic differences could also reasonably be explained if thetic judgment type were assigned within the vP, instead of within the TP. Optional V to T movement in Hebrew and obligatory V to T movement in Italian could allow for the necessary interpretive consequences and sub-extraction restrictions. However, it is preferable to to assume that subjects in FI have moved out of the vP, at least some of the time. If thetic judgment type were assigned within the vP, we would expect bare nominal subjects of unaccusative verbs, merged as complements of V, to never receive existential interpretation pre-verbally. This is not the case. Consider the trees in (16) and (17).

(16) yeladim ratzim
child.M.PL run.3.M.PL
"Children are running"



(17) noflim etzim
fall.3.M.PL tree.M.PL
"There are trees falling"



In (16), the subject in Spec-vP precedes the verb, and is interpreted as existential. In (17), there is no pre-verbal position available to the subject where it could be interpreted as existential. If the subject were to raise to Spec-TP, it would be assigned generic interpretation. Designating the specifier of vP as a landing site for the subject would solve this problem, but in that case we would need to establish independently that this is a possible movement. We would also need independent evidence that the verb does not always raise to T in Hebrew, and instead only raises to the v head, even though it displays the properties of tense and subject agreement typically associated with raising to T. The analysis above involving the addition of a functional head F to account for FI is therefore at present present preferred.

Let us now turn to a more detailed discussion of judgment type in section 4, and the connection between FI and thetic judgment type in Hebrew.

4 Thetic judgment type and Free Inversion

Analyzing FI as the manifestation of a thetic judgment provides an explanation for the previously unexplained grammaticality of certain definite subjects in FI, as well as the tendency of FI to appear in presentational type sentences. Judgment type can be influenced by a multitude of factors that affect which specifier position the subject should appear in. Predicate type has been discussed as one of these factors in section 3, explaining why a correlation might be observed between FI and SLPs. Since SLPs are representative of more transitory properties, their compatibility with thetic judgment type, which is typical of events, is expected.

Furthermore, Melnick (2006) explains that thetic judgments often involve presentational sentences, neutral descriptions, news sentences, and event reports. This highlights the properties typically attributed to FI as correlated with thetic judgment type, such as unaccusative verbs and indefinite subjects. For example, a report of an event is more likely to involve an indefinite subject, because reports involve elements new to a discourse, and indefinite subjects characteristically introduce new discourse referents. Crucially however, this does not impose a requirement on the definiteness of FI subjects per se. The position of the subject in FI is associated with thetic judgment type rather than existential closure, allowing for the existential interpretation of bare nominals in these contexts via reconstruction, but not preventing the appearance of definites. Definite subjects compatible with thetic judgment type may appear in FI, in Spec-TP.

Melnick shows that definite subjects compatible with thetic judgment type are non-topical and non-discourse familiar, while those compatible with categorical judgment type are topical and discourse familiar. Definite subjects appearing in FI must be those which are identifiable to the hearer, but have not been mentioned in the discourse. A clear example involves the definite description "the sun", which is obviously identifiable, but does not need to be discourse familiar. This delineation of definites closely resembles that of Roberts (2003) in terms of familiarity and uniqueness. Melnick's notion of identifiability corresponds closely to Roberts' notion of "weak familiarity", contrasted with "strong familiarity". A weakly familiar definite is unique and entailed by context, but has not yet been introduced into the discourse. On the other hand, a strongly familiar definite has been mentioned in the discourse, and is subject to the familiarity effects typically associated with definites.

In sum, if a subject is familiar in the discourse, it is more likely to be the subject of a categorical judgment. If the subject is weakly familiar, it is more likely to be compatible with a thetic judgment. Identifiability of the subject, or uniqueness, does not lead to the assignment of categorical judgment type on its own. A definiteness effect in FI should then only be observed when categorical judgment type is assigned, which occurs when the subject is strongly familiar. This distinction accounts for the seemingly aberrant grammaticality of definite subjects in FI with possessive datives, shown by Melnick's example in (18).

(18) a. ne'exal le-ruti ha-kiwi
was.eaten.3.M.SG to-Ruti DEF-kiwi.M.SG
"Ruti's kiwi was eaten."

b. #ne'exal ha-kiwi
was.eaten.3.M.SG DEF-kiwi.M.SG

"The kiwi was eaten."

In (18b), the definite description *ha-kiwi* is not unique, and therefore must be interpreted as strongly familiar. When given an attribute of uniqueness as in (18a), or that of "belonging to Ruti", it no longer needs to be interpreted as strongly familiar. The subject *ha-kiwi* may therefore felicitously appear post-verbally in (18a). Beyond possessive datives, Melnick identifies that FI is also grammatical with a definite subject when the subject is modified by a restrictive relative clause, a superlative (as in 2a), and when it is situationally evoked (as in 10 and 11). These are all instances where the subject is weakly familiar. The analysis of FI as a thetic judgment therefore provides an explanation for the possibility of definite subjects in FI.

Analyzing FI as an expression of a thetic judgment also explains why the addition of a locative improves the acceptability of FI, as discussed by Borer (2010). A locative can affect the aspect of a clause (Diesing 1992; Jäger 2001), making it more event-like, and therefore more like a thetic judgment. An example is provided in (19).

(19) avad ganan ba-xatzer
worked.3.M.SG gardener.M.SG in.DEF-yard
"A gardener worked in the yard."

The locative *ba-xatzer* favors the assignment of thetic judgment type. The improvement that comes with locatives makes a very broad prediction, which is that any added semantic content compatible with thetic judgment type will improve the acceptability of FI by increasing the likelihood of such an interpretation.

The analysis of FI as the manifestation of a thetic judgment is promising, and a syntactic analysis of FI in the context of Bianchi and Chesi's work allows for an account of pre-verbal existential interpretation in Hebrew and the acceptability of definite subjects in FI. However, adopting this view leaves many open questions regarding the assignment of judgment type. Since judgment type relies on both the functional and lexical content of a clause, it is likely a nuanced, compositional effect. As further support of this analysis, I present the results of an experiment on sub-extraction from subjects in Hebrew in section 5 that are consistent with Bianchi and Chesi's experimental results from Italian.

5 Experiment: Sub-extraction from subjects in Hebrew

Bianchi and Chesi's analysis is consistent with the results they obtain from an acceptability judgment task on sub-extraction in Italian using magnitude estimation. They manipulated the position of the subject {SV, VS} and predicate type {ILP, SLP} in sentences where sub-extraction has taken place from a non-presuppositional subject. An item from their study is given in (20), which uses the SLP *be timely* and the ILP *be unconstitutional.*

(20) **Context**: A discussion between two experts on constitutional law.

a. Di quale articolo ritieni che...
of which section think that

(i) [una revisione _] sarebbe ormai opportuna?
a revision would.be by.now timely

(ii) sarebbe ormai opportuna [una revisione _]?
would.be by.now timely a revision
"Of which section do you think a revision would be timely by now?" SLP:(i)SV,(ii)VS

b. Di quale articolo ritieni che...
of which section think that

(i) [una revisione _] sarebbe incostituzionale?
a revision would.be unconstitutional

(ii) sarebbe incostituzionale [una revisione _]?
would.be unconstitutional a revision
"Of which section do you think a revision would be unconstitutional?" ILP:(i)SV,(ii)VS

Bianchi and Chesi's results did not show a significant difference in extractability ratings by predicate type, but did show a significant effect of subject position and a significant interaction between subject position and predicate type. Although sub-extraction was not rated very highly in general, sub-extraction from ILPs and pre-verbal subjects of SLPs was rated significantly worse than sub-extraction from post-verbal subjects of SLPs. This means that sub-extraction is only at all acceptable in Italian when the predicate is an SLP, and the subject is post-verbal. As explained in section 3, this is the only position from which Italian subjects may reconstruct. Since Hebrew allows reconstruction from pre-verbal and post-verbal position as long as the predicate is an SLP, we expect extraction to be more acceptable from SLPs in Hebrew in general, regardless of subject position.

The current study was designed to test Bianchi and Chesi's predictions for sub-extraction from pre-verbal and post-verbal subjects in Hebrew. Again, since Hebrew allows existential interpretation pre-verbally, but Italian does not, we expect Hebrew speakers to assign better ratings to sub-extraction out of all subjects of SLPs. Since the restriction on sub-extraction is understood by Bianchi and Chesi as a restriction on sub-extraction from subjects of categorical judgments, sub-extraction from subjects of ILPs should be as bad in Hebrew as was demonstrated for Italian.

5.1 Participants

Participants included 70 native speakers of Modern Hebrew, recruited via a facebook group administered by Tel-Aviv University for paid experiments. Participants were paid 25 shekels (roughly seven dollars) for completing the experiment. Two people were excluded due to reporting a different language than Hebrew as their first language. An additional person was excluded due to exhibiting unreasonably short reaction times in rating the sentences.

5.2 Procedure and stimuli

Using a 2 x 2 design, this experiment crosses the factors predicate type {ILP, SLP} and word order {SV, VS}. Since the stimuli in this experiment acted as fillers for another, items were presented as text message exchanges preceded by a sentence of background information.[2] For the present study the background is completely irrelevant. The text message presentation allows participants in a dialogue to have a clear idea of which sentence they should attribute to themselves, and which to the other discourse member, as well as to present a target sentence in context (Kroll and Wagers 2017).

A sample trial is shown in figure 1, along with a translation of a sample item in the SV condition. Both possible target sentences (SLP, ILP) are underlined.

Figure 1 Sample trial

(21) **Background**: Dror's friend is looking for a movie to watch.

You have the following conversation:

Blue: I heard that people have started hiding bad movie reviews
Grey1: Yea so maybe you remember
Grey2: <u>About which movie is just one review hidden?</u> SLP
or
Grey2: <u>About which movie is just one review damaging?</u> ILP

2 Thank you to Margaret Kroll for providing the idea and javascript code for this presentation style.

Participants were asked to judge the grammaticality of each target sentence on a 7-point Likert scale, with 1 being the worst and 7 the best. The target sentence was always the last sentence in the discourse. The participants were also instructed to imagine that they were sending the blue messages as a 30 year old native Hebrew speaker. The experiment consisted of 16 items, distributed across lists via Latin Square, as well as 32 fillers balanced for the distribution of ratings and target sentence form. The experiment was administered using *Ibex Farm* (Drummond 2016). Note that because the target sentences were all in the form of a question, filler targets were also balanced between questions and declaratives. Each participant saw a total of 48 trials.

The ILP or SLP status of each predicate was determined by the experimenter's intuition that they described either temporary or permanent states. As identified by Jäger (2001), aspectual and temporal properties of the clause can allow a shift in predicate type, so the items were given in present tense. This helped to force an individual-level reading of less temporary predicates, which in the past tense can adopt an SLP interpretation, without affecting the more temporary predicates, which were interpretable as stage-level.

Since sub-extraction from subjects is generally somewhat difficult in Hebrew, the subject of each sentence was a non-presuppositional indefinite. This reading was enforced via the "just one" modification, making sub-extraction possible (Sichel 2018). Additionally, sub-extraction of nominal complements headed by the preposition *shel* "of", is almost never good. For this reason, extracted constituents were generally complements headed by the prepositions *al* "about" and *me-* "from", balanced across items. Out of the 16 items, 2 used the preposition *shel*, as a baseline for especially bad sub-extraction. Predicates were also chosen carefully to avoid interpretations of the nominal complement as an adjunct modifier of VP.

5.3 Results and discussion

Results were analyzed using a cumulative link model in *R* (R Core Team 2018), using the package *Ordinal* (Christensen 2018). Participants' ratings were used as the dependent measure, and the factors PREDICATE TYPE and WORD ORDER were entered into the model as fixed effects. The factors were sum-coded with SLP and VS mapped onto the positive coefficients. Random effects by subject and by item were included with random slopes and intercepts for both factors, along with their interactions. A visualization of the mean ratings, including standard error bars, is given in figure 2.

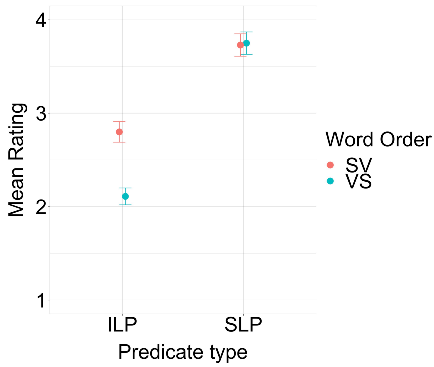


Figure 2 Sub-extraction ratings

There was a significant main effect of PREDICATE TYPE ($p < .001$), which suggests that sub-extraction from SLPs is overall better in Hebrew than from ILPs. There was also a significant effect of WORD ORDER ($p = .01072$) that was driven entirely by ILPs, since the mean ratings of sub-extraction from pre-verbal and post-verbal SLPs are almost exactly the same. This suggests that word order only matters for sub-extraction when the subject is an ILP, where sub-extraction from post-verbal position is actually worse than sub-extraction from pre-verbal position. Finally, there was also a significant interaction between VERB TYPE and WORD ORDER ($p = .00206$), suggesting that the difference in sub-extraction between SLPs and ILPs is affected by word order. The mean ratings for each condition are summarized in table 1. Although not reported here in detail, the two items including the preposition *shel* were not rated substantially lower than other items.

	ILP		**SLP**	
	SV	**VS**	**SV**	**VS**
Mean Rating	2.80	2.11	3.73	3.75
SE	0.10	0.09	0.12	0.12

Table 1 Means and standard errors

These results are *exactly* what we would predict under Bianchi and Chesi's proposal. We see that sub-extraction in general is not that good, as expected. On top of the difficulty of sub-extraction in Hebrew, sub-extraction creates more complex sentences that involve A-bar dependencies, which speakers may judge as less acceptable. Additionally, sub-extraction from subjects of SLPs is significantly better than from subjects of ILPs, and word order *has no effect* on sub-extraction from the subject of an SLP. This is expected, since the subject of an SLP can be interpreted as part of a thetic judgment, and would be located in the sub-extraction-friendly position associated with thetic judgments, Spec-TP. Since sub-extraction is also possible pre-verbally, this result is consistent with an analysis of Hebrew that relies on bare nominals receiving pre-verbal existential interpretation. If Hebrew were like Italian, and only allowed the existential interpretation of bare nominals post-verbally, we would expect sub-extraction from pre-verbal subjects of SLPs to be rated lower, as in Bianchi and Chesi's study.

The results above also show that extraction from the subject of an ILP is significantly better from pre-verbal position. This is probably simply related to the impossibility of VS order with ILPs in general, possibly adding to the sense of ungrammaticality associated with sub-extraction from any ILP.

This does not directly confirm either Bianchi and Chesi's theory of syntax and interpretation, nor Melnick's proposal that FI is a thetic judgment. However, it is very promising that the Hebrew sub-extraction results pattern as predicted by Bianchi and Chesi's analysis. It is also promising for Melnick's proposal that Bianchi and Chesi define the driving force behind this sub-extraction behavior as a distinction between thetic and categorical judgment types, mediated by corresponding subject positions.

6 Conclusion

Analyzing FI as the exponent of a thetic judgment with the relevant corresponding syntactic structure accounts for the possibility of post-verbal definite subjects and pre-verbal existential interpretation of bare nominal subjects in Modern Hebrew. The syntax of FI proposed in section 3 utilizes an additional functional head as a landing site for the verb, while the specifier of this head maps to categorical judgment type. The specifier of T, which is occupied by subjects in FI, maps to thetic judgment type. This captures the interpretive properties of bare nominals in Hebrew, English, and Italian via different restrictions on how high the verb may raise in each language. The differing availability of verb movement also accounts for the possibility of FI in Hebrew and Italian to the exclusion of English. Experimental data from Hebrew presented in section 5 are consistent with this proposal, since they show that sub-extraction from subjects in Hebrew is equally possible from pre-verbal and post-verbal position with an SLP. This is unlike Italian, where sub-extraction from subjects is only possible from post-verbal position. In both languages sub-extraction from an ILP is significantly worse than sub-extraction from an SLP, consistent with the proposal that subjects of ILPs occupy a syntactic position that is an island for extraction, and maps to categorical judgment type.

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Incremental Interpretation and Dynamic Semantics

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Abstract We motivate and define a strictly incremental semantics for Dynamic Predicate Logic (Groenendijk and Stokhof 1991). In particular, we extend the incremental semantics for dynamic propositional logic introduced in Vermeulen (1994) to first-order predicate logic (borrowing central notions from Visser 2002). We call the resulting logical system Incremental Dynamic Predicate Logic (IDPL), and we show how this system can be used to derive correct truth conditions for apparently non-incremental structures like donkey conditionals *in a strictly incremental fashion*: the correct meanings for donkey conditionals are derived by means of a strictly left-to-right compositional procedure. This is accomplished without having to type-shift the meanings of the individual words (as in Steedman 2001, for example), and with dynamic conjunction/sequencing as the only compositional operation.

1 Introduction and basic proposal

The goal of this paper is to motivate and define an incremental semantics for Dynamic Predicate Logic (DPL; Groenendijk and Stokhof 1991), i.e., to extend the incremental semantics for Dynamic Propositional Logic (DPropL) introduced in Vermeulen (1994) to first-order predicate logic. We call the resulting logical system Incremental Dynamic Predicate Logic (IDPL) and we show how this system can be used to derive correct truth conditions for apparently non-incremental structures like donkey conditionals in a strictly incremental fashion, i.e., strictly left-to-right and word by word.

We start by introducing an incremental semantics for propositional logic, following Vermeulen (1994: 244-246). We want our incremental semantics for DPropL to respect three principles:

(1) a. **Incrementality**: we can interpret texts as we hear them.
b. **Pure compositionality**: we do not assume that a full syntactic analysis precedes interpretation (hence 'pure' semantic composition); this is in contrast to standard (neo)Montagovian semantics, or the incremental DRS construction algorithm in Kamp and Reyle (1993).

c. **Break-in**: every segment of a text should be interpretable, even if what comes after, or came before, is unknown; wherever we 'break in' a text, interpretation should be possible.

Together, (1a) and (1c) entail **associativity**: text meanings have to form an algebra with an associative operation ('merger'/conjunction) by which the meanings can be glued together. This straightforwardly captures texts that are actually conjoined (we use ';' for conjunction in a dynamic system):

(2) a. Bob inherited a donkey (p), and Jane bought it from him (q), and she sold it to Bill (r).

b. $[\![(p;q);r]\!] = [\![p;(q;r)]\!]$

The problem is that conditionals do not have an associative semantics. The text in (3) below is intuitively interpreted as in (3a), not as in (3b): if p is false, the text is false, not true. But an incremental and fully associative semantics forces the bracketing in (3c), which is equivalent to the incorrect interpretation in (3b):

(3) The driver was not working that night (p) and if the butler was working that night (q), the butler committed the murder (r).
$\rightsquigarrow$ (let's translate it as) $p;\mathbf{if};q;\mathbf{then};r;\mathbf{end}$

a. Intended interpretation: $p;(\mathbf{if};q;\mathbf{then};r;\mathbf{end})$ i.e., $p \wedge (q \rightarrow r)$

b. By associativity: $(p;\mathbf{if};q);\mathbf{then};r;\mathbf{end}$ i.e., $(p \wedge q) \rightarrow r$

c. $((((p;\mathbf{if});q);\mathbf{then});r);\mathbf{end}$

How can we provide an associative semantics for conditionals that derives the right truth conditions? Specifically, how can we provide a semantics for DPropL relative to which the formula in (3c) receives the same truth conditions as the formula in (3a)? More concisely: how can we provide a semantics for DPropL that makes the formulas in (3a), (3b) and (3c) equivalent?

The formulas in (3) already hint at the basic solution: (*i*) everything is conjoined/merged with an associative operation ; (conjunction), which ensures associativity, and (*ii*) the right truth conditions are derived by using three special formulas **if**, **then** and **end**, which denote specific dynamic updates of appropriately-defined semantic evaluation contexts.

But how should we define evaluation contexts in such a way that we can interpret conditionals in a strictly incremental fashion, and still derive the correct truth conditions? The basic solution pursued in Vermeulen (1994) is *memory*: semantic evaluation contexts will keep track of the denotations of the previous formulas, i.e., they will be *update histories*. The special formulas **if**, **then** and **end** manipulate these update histories in specific ways so that the correct truth conditions for conditionals are derived in a purely associative manner.

Informally, we will interpret (3) as follows.

> "We store the information that p in our memory before we interpret q. This information [i.e., q] is again stored before we interpret r. Now we can construct from the information that we have stored the information that **if** q **then** r. Finally this information can be added to the information that p. [W]e do not need brackets to tell us how [...] to store the information: the special elements **if**, **then** and **end** will tell us exactly what has to be done." (Vermeulen 1994: 248)

2 Dynamic Propositional Logic (DPropL) with sequences

To formalize this idea of storing updates in memory (i.e., in semantic evaluation contexts) and assembling them in specific ways by means of the special formulas **if**, **then** and **end**, we define a Dynamic Propositional Logic (DPropL) system. We start by defining the syntax of DPropL:

(4) **DPropL syntax.** Given a set of atomic propositional variables (atomic texts) A, we define the set T_A of texts (well-formed propositional formulas) based on A as the smallest set such that (s.t.):

a. $A \subseteq T_A$, $\bot \in T_A$, $\mathbf{if} \in T_A$, $\mathbf{then} \in T_A$, $\mathbf{end} \in T_A$;

b. Conjunction (text concatenation): if $\varphi \in T_A$ and $\psi \in T_A$, then $\varphi; \psi \in T_A$.

The choice of basic expressions in DPropL (4a) is driven by our main goal for this logic: provide an associative semantics for conditionals. First, *falsum* $\bot$ is the formula that is always false, i.e., $[\![\bot]\!] = \mathbb{F}$. We overload the symbol $\bot$ and use it both for the syntactic object and for its semantic value. Second, we introduce the basic expressions **if**, **then** and **end** that enable us to 'annotate' where a conditional begins, where it ends, and how it is split between an antecedent and a consequent. These 'annotations', when suitably interpreted, enable semantic composition to proceed fully incrementally in a left-to-right, strictly word-by-word fashion, and yet derive the intuitively correct truth conditions for conditional.

Returning to the example in (3) above, we want our logic to derive the equivalence below between the strictly incremental expression on the left, and the expression with intuitively correct truth conditions on the right:

(5) $((((p;\mathbf{if});q);\mathbf{then});r);\mathbf{end} \quad \Leftrightarrow \quad p;(\mathbf{if};q;\mathbf{then};r;\mathbf{end})$

Importantly, conditionals are a very simple, propositional-level example of texts with non-associative meanings. If we find a way to interpret them fully incrementally, i.e., in a fully associative semantics, the solution could be generalized to all other non-associative semantic operators, e.g., quantifiers or adverbs of quantification. In the case of quantifiers, for example, the restrictor has to be semantically combined with nuclear scope first and the surrounding text only later, in much the same way that a conditional antecedent has to be semantically combined with the consequent first and the surrounding text only later.

Similarly, we hope to be able to generalize our solution to other structures, e.g., conditionals with sentence final *if*-clauses (6). As Milward and Cooper (1994) observe, incremental left-to-right interpretation and the need to derive the correct truth conditions place opposite requirements on how the interpretation of sentences like (6) should proceed: incremental interpretation requires the consequent r to be interpreted before the antecedent q, while truth-conditionally, the antecedent q needs to be interpreted first.

(6) The butler committed the murder (r) if the butler was working that night (q). $\rightsquigarrow$ $\textbf{then}; r; \textbf{if}; q; \textbf{end}$, i.e., $r \leftarrow q$, or $q \rightarrow r$

In sum, we need the basic expressions **if**, **then** and **end** in DPropL to interpret conditionals, and we need conjunction ; for general text concatenation. In addition to these, we only need *falsum* $\bot$ (a 0-ary propositional operator) to have an 'expressively complete' propositional logic in which we can define negation $\neg$, *verum* $\top$ and disjunction $\vee$ as shown in (7) below.

(7) **DPropL abbreviations**:

a. $\neg\varphi := \textbf{if}; \varphi; \textbf{then}; \bot; \textbf{end}$ basically, $\neg\varphi := \varphi \rightarrow \bot$
b. $\top := \neg\bot$, i.e., $\top := \textbf{if}; \bot; \textbf{then}; \bot; \textbf{end}$ basically, $\top := \bot \rightarrow \bot$
c. $\varphi \vee \psi := \neg(\neg\varphi;\ \neg\psi)$ basically, De Morgan's laws

Just as in the case of *falsum* $\bot$, we will henceforth overload the *verum* symbol $\top$ and use it both for the syntactic object and its semantic value.

With the syntax of DPropL in place, we can turn to its semantics. As discussed, the semantics of DPropL needs to be associative. That is, the semantic value of text conjunction ; has to be an associative operation over the semantic values of the concatenated texts (8a). Symbolizing the semantic value of conjunction $[\![\,;\,]\!]$ as the operation $\bullet$, we can reformulate associativity as the constraint in (8b):

(8) a. $[\![(\varphi;\psi);\chi]\!] \quad = \quad [\![\varphi;(\psi;\chi)]\!]$
b. $([\![\varphi]\!] \bullet [\![\psi]\!]) \bullet [\![\chi]\!] \quad = \quad [\![\varphi]\!] \bullet ([\![\psi]\!] \bullet [\![\chi]\!])$

In particular, the conditional formula $\textbf{if}; \varphi; \textbf{then}; \psi; \textbf{end}$ will receive an associative semantics in terms of the $\bullet$ operation, but we will still be able to derive the intuitively-correct truth conditions for this formula. As we already indicated, the main ingredient of the solution is to define semantic evaluation contexts as structures with *memory* that keep track of the (recent) history of updates.

> "[W]e will allow ourselves to have more than one slot where information can be stored. We will not only have a slot for our current state of information, but we will also have slots for some specific information

states that we used to be in. So we remember our information *history*." (Vermeulen 1994: 247-248)

2.1 Models for DPropL are extended monoids

The interpretation function for DPropL is defined relative to a model $\mathfrak{M}$ and a semantic evaluation context $\mathfrak{c}$, symbolized as $[\![\cdot]\!]^{\mathfrak{M},\mathfrak{c}}$. We require models $\mathfrak{M}$ to be *extended monoids* in the sense of Visser (2002). Vermeulen (1994) required them to be Heyting algebras, but the extended monoids of Visser (2002) are both (*i*) more general, which will be useful when we move on to Dynamic Predicate Logic, and (*ii*) more directly related to the relational formula denotations standardly used in dynamic semantics.

These monoids are defined over a set $\mathbf{I} = \{i, j, k, \ldots\}$ of propositional denotations; intuitively, these are the kind of semantic values that are appropriate for atomic texts (atomic propositions). In the spirit of dynamic semantics, we will call $i, j, k \ldots$ information states, but we need to remember that they do *not* encode variable assignments, whether partial assignments as in Discourse Representation Theory (DRT; Kamp 1981, Kamp and Reyle 1993)/File Change Semantics (FCS; Heim 1982), or total assignments as in Dynamic Predicate Logic (DPL; Groenendijk and Stokhof 1991). Info states $i, j, k, \ldots$ are meant to encode denotations of full Discourse Representation Structures (DRSs) or DPL formula denotations, i.e., binary relations over partial/total variable assignments. The reader should probably consult the first sections of Brasoveanu (2013) for an introduction to dynamic semantics if this distinction between assignments and binary relations over assignments is not completely clear, or if the reader is not familiar with the way DPL assigns binary relations over assignments as formula denotations.

The set of info states $\mathbf{I}$ together with the binary operation $\bullet$ (which is the denotation of text conjunction/concatenation ;) are required to form a monoid:

(9) A monoid is a triple $\langle \mathbf{I}, \bullet, \mathbf{id} \rangle$ ($\mathbf{I}$ is a set, $\bullet$ is a binary operation over $\mathbf{I}$ and $\mathbf{id} \in \mathbf{I}$ is a designated element of $\mathbf{I}$) satisfying the following three axioms:
Ax1 Closure: for all $i, j \in \mathbf{I}$, we have that $i \bullet j \in \mathbf{I}$.
Ax2 Associativity: for all $i, j, k \in \mathbf{I}$, we have that $(i \bullet j) \bullet k = i \bullet (j \bullet k)$.
Ax3 Identity element: there is an element $\mathbf{id} \in \mathbf{I}$ s.t. for all $i \in \mathbf{I}$, we have that $\mathbf{id} \bullet i = i \bullet \mathbf{id} = i$.

An example that we will use later in the paper is the monoid formed by the set of all binary relations over a set S, with relation composition $\circ$ as the binary operation and the identity relation on S as the identity element:

(10) Given a set S (of variable assignments, for example), the tuple $\langle \mathbf{R}, \circ, R_{\mathbf{id}} \rangle$ is a monoid, where:

a. $\mathbf{R} = \{R : R \subseteq S \times S\} = \wp(S \times S)$,
($S \times S := \{\langle x, y\rangle : x \in S \wedge y \in S\}$ and $\wp$ is the powerset operation)
b. $R \circ R' = \{\langle x, y\rangle : \exists z(xRz \wedge zR'y)\}$
(in prefix notation: $R \circ R' = \{\langle x, y\rangle : \exists z(R(x, z) \wedge R'(z, y))\}$)
c. $R_{\mathbf{id}} = \{\langle x, x\rangle : x \in S\}$

We extend monoids (defined in (9)) with a so-called zero element $\perp$, which we will use as the denotation for *falsum*, and a binary operation $\twoheadrightarrow$, which we will use as the denotation for implication (basically, the truth conditions of conditionals).

To define $\perp$ and $\twoheadrightarrow$, we first define a partial order $\leqslant$ that can be associated with any monoid because it is induced by the operation $\bullet$ over the elements of $\mathbf{I}$:

(11) Partial order $\leqslant$ (definition): for any $i, j \in \mathbf{I}$, we let $i \leqslant j$ iff $i \bullet j = i$.

Intuitively, this partial order $\leqslant$ encodes the notion of *entailment*, since its definition has the same structure as the following basic theorem of propositional logic: $p \vDash q$ iff $p \wedge q \Dashv\vDash p$ ($\vDash$ symbolizes entailment, and $\Dashv\vDash$ equivalence).

As an example, consider the binary-relation monoid in (10). We define the partial order $R \leqslant R'$ as: $R \leqslant R'$ iff $R \circ R' = R$. But what kind of structure do the binary relations R and R' need to have for the 'entailment' $R \leqslant R'$ to obtain? The notion of entailment in DPL (Groenendijk and Stokhof 1991: 67, Definition 20), symbolized as $\vDash_{\text{DPL}}$ in (12) below, gives us a hint:

(12) DPL entailment $\vDash_{\text{DPL}}$ (definition, preliminary version):
$\varphi \vDash_{\text{DPL}} \psi$ iff $\mathbf{Ran}(\llbracket\varphi\rrbracket) \subseteq \mathbf{Dom}(\llbracket\psi\rrbracket)$
a. $\mathbf{Dom}(R) := \{x \in S : \exists y \in S(xRy)\}$
b. $\mathbf{Ran}(R) := \{y \in S : \exists x \in S(xRy)\}$

Let R be the denotation of φ (i.e., $R := \llbracket\varphi\rrbracket$) and R' be the denotation of ψ (i.e., $R' := \llbracket\psi\rrbracket$). The condition in (12) that the range of R be a subset of the domain of R' is a necessary, but not a sufficient condition for $R \leqslant R'$. That is, in general, $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(R')$ does not guarantee that the result of composing $R \circ R'$ is once again R, which is required by the definition of $\leqslant$ in (11). For this to happen, we need the additional assumption that $R' \subseteq R_{\mathbf{id}}$, that is, R' *test* (in the sense of dynamic semantics).

But this is in fact a harmless assumption. To see this, let's follow Visser (2002) and define $\mathbf{diag}(R)$ (the diagonal of the binary relation R) as shown in (13a). The **diag** operator takes any relation R and makes it into a test with the same domain as R. An immediate consequence of this definition is that for any R, $\mathbf{diag}(R) \subseteq R_{\mathbf{id}}$. We can now redefine DPL entailment as shown in (13), which is equivalent to the definition in (12). With this final definition of DPL entailment $\vDash_{\text{DPL}}$ in hand, it is easy to prove the equivalence in (14) between DPL entailment and the partial order $\leqslant$ for the binary-relation monoid.[1]

(13) DPL entailment $\vDash_{\text{DPL}}$ (definition, final version):
$\varphi \vDash_{\text{DPL}} \psi$ iff $\mathbf{Ran}([\![\varphi]\!]) \subseteq \mathbf{Dom}(\mathbf{diag}([\![\psi]\!]))$
a. $\mathbf{diag}(R) = \{\langle x,x\rangle : x \in \mathbf{Dom}(R)\}$

(14) Theorem: $\varphi \vDash_{\text{DPL}} \psi$ iff $[\![\varphi]\!] \leqslant \mathbf{diag}([\![\psi]\!])$

Defining the 'entailment' partial order $\leqslant$ is the first step towards extending our monoids with a notion of *falsum* and a binary operation that corresponds to implication. We first define and require the existence of a zero element $\bot$, which is the least element in the partial order $\leqslant$ (both on the left and on the right of the $\bullet$ operation):

(15) There exists $\bot \in \mathbf{I}$ s.t. for any $i \in \mathbf{I}$, $\bot \bullet i = i \bullet \bot = \bot$.[2]

Not all monoids can be extended in this way, but the binary-relation monoid has a natural $\bot$ element $R_\bot$, which is the empty relation:

(16) $R_\bot = \varnothing \qquad (= \{\langle x,x\rangle : x \in S \wedge x \neq x\})$

The reader can easily verify that, for any $R \in \mathbf{R}$, it's true that $R \circ R_\bot = R_\bot \circ R = R_\bot$.

We also define and require the existence of a binary operation $\twoheadrightarrow$, which will provide the basic denotation for implication. Intuitively, we will say that the implication $j \twoheadrightarrow k$ is entailed / 'is true' in a context i iff i conjoined with the antecedent j entail / 'guarantee the truth of' the consequent k:

(17) There exists a binary operation $\twoheadrightarrow$ from $\mathbf{I} \times \mathbf{I}$ to $\mathbf{I}$ s.t. for any $i, j, k \in \mathbf{I}$, $i \leqslant (j \twoheadrightarrow k)$ iff $(i \bullet j) \leqslant k$.

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1 **Proof of Theorem (14)**. Let R be $[\![\varphi]\!]$ and R' be $[\![\psi]\!]$. From definition (13), we have that $\varphi \vDash_{\text{DPL}} \psi$ iff $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(\mathbf{diag}(R'))$. From definition (11), we have that $R \leqslant \mathbf{diag}(R')$ iff $R \circ \mathbf{diag}(R') = R$. Thus, to prove (14), we need to show that $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(\mathbf{diag}(R'))$ iff $R \circ \mathbf{diag}(R') = R$.

We first prove the LR direction: if $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(\mathbf{diag}(R'))$, or equivalently $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(R')$, then $R \circ \mathbf{diag}(R') = R$. Consider an arbitrary pair $\langle x,y\rangle$: $\langle x,y\rangle \in R \circ \mathbf{diag}(R')$ iff (by (10b)) there is a z s.t. xRz and $z\mathbf{diag}(R')y$ iff (by (13a)) xRy and $y \in \mathbf{Dom}(R')$ iff (since we already assume that $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(R')$) xRy iff $\langle x,y\rangle \in R$. Thus, under the assumption that $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(\mathbf{diag}(R'))$, we have that $\langle x,y\rangle \in R \circ \mathbf{diag}(R')$ iff $\langle x,y\rangle \in R$ for any pair $\langle x,y\rangle$, which means that $R \circ \mathbf{diag}(R') = R$.

We now prove the RL direction: if $R \circ \mathbf{diag}(R') = R$, then $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(\mathbf{diag}(R'))$, or equivalently $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(R')$. $R \circ \mathbf{diag}(R') = R$ means that, for any pair $\langle x,y\rangle$, $\langle x,y\rangle \in R \circ \mathbf{diag}(R')$ iff $\langle x,y\rangle \in R$. But $\langle x,y\rangle \in R \circ \mathbf{diag}(R')$ iff (by (10b)) there is a z s.t. xRz and $z\mathbf{diag}(R')y$ iff (by (13a)) xRy and $y \in \mathbf{Dom}(R')$ iff $\langle x,y\rangle \in R$ and $y \in \mathbf{Dom}(R')$. Thus, $R \circ \mathbf{diag}(R') = R$ means that, for any pair $\langle x,y\rangle$, the conjunction '$\langle x,y\rangle \in R$ and $y \in \mathbf{Dom}(R')$' is equivalent to the first conjunct '$\langle x,y\rangle \in R$', which means that the first conjunct $\langle x,y\rangle \in R$ implies the second conjunct $y \in \mathbf{Dom}(R')$ for any pair $\langle x,y\rangle$, which is tantamount to saying $\mathbf{Ran}(R) \subseteq \mathbf{Dom}(R')$. ■

2 Note that $\bot$ is unique. We can prove this by *reductio ad absurdum*. Assume that there exists a $\bot' \in \mathbf{I}$, $\bot' \neq \bot$, satisfying the same 'least element' condition. By the definition of $\bot$, we have $\bot \bullet \bot' = \bot' \bullet \bot = \bot$. By the definition of $\bot'$, we have $\bot' \bullet \bot = \bot \bullet \bot' = \bot'$. Hence $\bot' = \bot$, which is a contradiction. ■

For the binary-relation monoid example, the binary operation $R \twoheadrightarrow R'$ (for any $R, R' \in \mathbf{R}$) can be defined in the same way that dynamic implication is defined in DRT/FCS/DPL. Recall that dynamic implication is externally static, which means that the update $R \twoheadrightarrow R'$ is a test, i.e., a subset of $R_{\mathbf{id}}$. At the same time, dynamic implication is internally dynamic, which means that $\twoheadrightarrow$ relates R and R' in a way that involves linking the range of R and the domain of R' (similar but not identical to the way conjunction, i.e., relation composition $\circ$, relates two updates).

(18) $R \twoheadrightarrow R' = \{\langle x,x\rangle : x \in S \wedge \{y \in S : xRy\} \subseteq \{y \in S : \exists z(yR'z)\}\}$

In words, $R \twoheadrightarrow R'$ is that subset of $R_{\mathbf{id}}$ which retains only the elements $x \in S$ whose image under the first relation R is included in the domain of the second relation R'. That is, any element y that is R-accessible from x is a good starting point for the second accessibility relation R'.

We can re-express the formula in (18) more concisely and more readably as shown in (19) below. We do this by using two abbreviations: (*i*) $\mathbf{Dom}(R')$, which we already defined, and (*ii*) xR, which stands for the image of an element x under the relation R, defined in (19a).

(19) $R \twoheadrightarrow R' = \{\langle x,x\rangle : x \in S \wedge xR \subseteq \mathbf{Dom}(R')\}$
  a. $xR := \{y \in S : xRy\}$

We can show that the definition of $\twoheadrightarrow$ in (19) satisfies the condition in (17) above.[3]

The resulting class of extended monoids $\langle \mathbf{I}, \bullet, \mathbf{id}, \perp, \twoheadrightarrow\rangle$, i.e., monoids $\langle \mathbf{I}, \bullet, \mathbf{id}\rangle$ extended with $\perp$ and $\twoheadrightarrow$, will provide the right kind of models for DPropL.

3 To show this, we need an extra assumption, namely that $R' \subseteq R_{\mathbf{id}}$. Just as in the case of the 'entailment' partial order $\leqslant$ above, this is harmless, which we can see by leveraging the **diag** operator once again. It is easily seen that $R \twoheadrightarrow R' = R \twoheadrightarrow \mathbf{diag}(R')$, since $\mathbf{Dom}(R') = \mathbf{Dom}(\mathbf{diag}(R'))$. This means that R' and $\mathbf{diag}(R')$ are interchangeable in the consequent of an implication, so we can use the relation $\mathbf{diag}(R')$, which is by definition a subset of $R_{\mathbf{id}}$, without loss of generality.

With the extra assumption that $R' \subseteq R_{\mathbf{id}}$, we can show that the definition of $R \twoheadrightarrow R'$ in (19) satisfies the condition in (17):

(i) $R'' \leqslant R \twoheadrightarrow R'$ iff $R'' \circ R \leqslant R'$ (assuming $R' \subseteq R_{\mathbf{id}}$):

a.	$R'' \leqslant R \twoheadrightarrow R'$ iff	[by (11)]
b.	$R'' \circ (R \twoheadrightarrow R') = R''$ iff	[since $(R \twoheadrightarrow R') \subseteq R_{\mathbf{id}}$]
c.	$\mathbf{Ran}(R'') \subseteq \mathbf{Dom}(R \twoheadrightarrow R')$ iff	[by (19)]
d.	$\forall x \in \mathbf{Ran}(R'')(xR \subseteq \mathbf{Dom}(R'))$ iff	[by (10b)]
e.	$\forall x \in \mathbf{Dom}(R'')(x(R'' \circ R) \subseteq \mathbf{Dom}(R'))$ iff	[by (12a), (12b), (19a)]
f.	$\mathbf{Ran}(R'' \circ R) \subseteq \mathbf{Dom}(R')$ iff	[since $R' \subseteq R_{\mathbf{id}}$]
g.	$(R'' \circ R) \circ R' = R'' \circ R$ iff	[by (11)]
h.	$R'' \circ R \leqslant R'$	

2.2 Dynamic Predicate Logic (DPL) models as extended monoids

To make this even more concrete, we will anticipate our discussion of Incremental DPL here by showing how the space of Dynamic Predicate Logic (DPL; Groenendijk and Stokhof 1991) formula denotations together with the right kind operations forms an extended monoid. This will be a variation on the general binary-relation extended monoid we just discussed.

Recall that in DPL, the denotation of a formula φ, symbolized $[\![\varphi]\!]$, is a binary relation over variable assignments. The set of variable assignments $\mathscr{G}$ is the set of all functions g from the set of variables $\mathscr{V}$ to the domain of individuals $\mathbf{D}$, i.e., $\mathscr{G} = \mathbf{D}^{\mathscr{V}}$ for short.

The domain of the relation denoted by $[\![\varphi]\!]$, symbolized as $\mathbf{Dom}([\![\varphi]\!])$, is the set of all assignments g that can be input assignments for φ. That is, $\mathbf{Dom}([\![\varphi]\!])$ is the set of all assignments g relative to which φ is true.

Similarly, the range of the relation $[\![\varphi]\!]$, symbolized as $\mathbf{Ran}([\![\varphi]\!])$, is the set of all assignments h that are output assignments after some input assignment or other is updated with φ. That is, $\mathbf{Ran}([\![\varphi]\!])$ is the set of all assignments that are the result of the update contributed by φ; subsequent formulas are interpreted relative to these assignments.

Finally, we also define the image $g[\![\varphi]\!]$ of an assignment g under the binary relation $[\![\varphi]\!]$, which is the set of all assignments that we can get when we update g with $[\![\varphi]\!]$.

If we let $\mathscr{R}$ be the binary relation over assignments denoted by φ in DPL, i.e., $\mathscr{R} := [\![\varphi]\!]$, we can easily see that these three abbreviations, listed below, are just specific versions of the abbreviations we already introduced above when we discussed the general binary-relation monoid.

(20) a. $\mathbf{Dom}(\mathscr{R}) := \{g : \exists h(g\mathscr{R}h)\}$
b. $\mathbf{Ran}(\mathscr{R}) := \{h : \exists g(g\mathscr{R}h)\}$
c. $g\mathscr{R} := \{h : g\mathscr{R}h\}$

Thus, (*i*) the DPL denotations of formulas over a set of variable assignments $\mathscr{G}$, together with (*ii*) the denotation of dynamic conjunction ;, and (*iii*) the identity relation **id** over variable assignments, which is a test (in fact, the maximal test), form a monoid. The reason for this is that the DPL semantic values for formulas are binary relations over variable assignments, i.e., subsets of the Cartesian product $\mathscr{G} \times \mathscr{G}$, and the DPL denotation of dynamic conjunction is relation composition $\mathscr{R} \bullet \mathscr{R}'$, defined as shown below.

(21) a. $\mathscr{R} \bullet \mathscr{R}' = \{\langle g,h\rangle : \exists k(g\mathscr{R}k \wedge k\mathscr{R}'h)\}$
b. $\mathbf{id} = \{\langle g,g\rangle : g \in \mathscr{G}\} = \{\langle g,h\rangle \in \mathscr{G} \times \mathscr{G} : g = h\}$

Just as we did when we discussed the more general binary-relation monoid in the previous section, we use the more intuitive infix notation $g\mathscr{R}h$ to indicate that the binary relation $\mathscr{R}$ relates g and h. The relation $\mathscr{R} \bullet \mathscr{R}'$ that is the result of composing $\mathscr{R}$ and $\mathscr{R}'$ relates two assignments g and h iff there exists some intermediate assignment k s.t. $\mathscr{R}$ takes us from g to k and $\mathscr{R}'$ takes us from k to h.

It is straightforward to check that $\langle \wp(\mathscr{G} \times \mathscr{G}), \bullet, \mathbf{id} \rangle$ is a monoid.[4]

To complete our extended monoid construction, we only need to define $\bot$ and $\twoheadrightarrow$ relative to the DPL monoid. Following Visser (2002), we let $\bot$ be the empty binary relation and define $\twoheadrightarrow$ as the dynamic implication of DRT/FCS/DPL.

(22) a. $\bot = \emptyset \subseteq \mathscr{G} \times \mathscr{G}$[5]

b. $\mathscr{R} \twoheadrightarrow \mathscr{R}' = \{\langle g, g \rangle : \text{for all } h \text{ s.t. } g\mathscr{R}h, \text{ there is an } i \text{ s.t. } h\mathscr{R}'i\}$
$= \{\langle g, g \rangle : g\mathscr{R} \subseteq \mathbf{Dom}(\mathscr{R}')\}$[6]

As Visser (2002: 112) notes, if negation $\neg\varphi$ is defined as in (7a) above, we correctly derive the meaning of DRT/FCS/DPL dynamic negation:[7]

(23) $[\![\neg\varphi]\!] := \overline{[\![\varphi]\!]}$, where:

a. $\overline{\mathscr{R}} := \mathscr{R} \twoheadrightarrow \bot$

Finally, if we define the *verum* (always-true) formula $\top$ as in (7b) above, i.e., $\top := \overline{\bot} (= \bot \twoheadrightarrow \bot)$, we see that $\top$ is the maximal test, i.e., $\top = \mathbf{id}$.[8] We return to DPL after we complete our discussion of the incremental semantics for DPropL.

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4 **Ax1**: for any binary relations $\mathscr{R}, \mathscr{R}' \subseteq \mathscr{G} \times \mathscr{G}$, their composition $\mathscr{R} \bullet \mathscr{R}'$ is also a subset of $\mathscr{G} \times \mathscr{G}$.
Ax2: $\langle g, g' \rangle \in (\mathscr{R} \bullet \mathscr{R}') \bullet \mathscr{R}''$ iff $\exists h' (\, \exists h (\, g\mathscr{R}h \wedge h\mathscr{R}'h' \,) \wedge h'\mathscr{R}''g' \,)$ iff $\exists h, h' (\, g\mathscr{R}h \wedge h\mathscr{R}'h' \wedge h'\mathscr{R}''g' \,)$ iff $\exists h (\, g\mathscr{R}h \wedge \exists h' (\, h\mathscr{R}'h' \wedge h'\mathscr{R}''g' \,) \,)$ iff $\langle g, g' \rangle \in \mathscr{R} \bullet (\mathscr{R}' \bullet \mathscr{R}'')$.
Ax3: since the identity element **id** is the diagonal $\{\langle g, h \rangle \in \mathscr{G} \times \mathscr{G} : g = h\}$, we have that for any binary relation $\mathscr{R} \subseteq \mathscr{G} \times \mathscr{G}$, $\langle g, g' \rangle \in \mathbf{id} \bullet \mathscr{R}$ iff $\exists h (g \mathbf{id} h \wedge h\mathscr{R}g')$ iff $\exists h (g = h \wedge h\mathscr{R}g')$ iff $\langle g, g' \rangle \in \mathscr{R}$ iff $\exists h (g\mathscr{R}h \wedge h = g')$ iff $\exists h (g\mathscr{R}h \wedge h \mathbf{id} g')$ iff $\langle g, g' \rangle \in \mathscr{R} \bullet \mathbf{id}$.

5 We can check that for any $\mathscr{R} \subseteq \mathscr{G} \times \mathscr{G}$, we have that $\bot \bullet \mathscr{R} = \mathscr{R} \bullet \bot = \bot$. By the definition of $\bullet$, a pair of assignments $\langle g, h \rangle$ belongs to the relation $\bot \bullet \mathscr{R}$ iff $\exists k (g \bot k \wedge k\mathscr{R}h)$. Since $\bot$ is the empty set, it does not contain any pair of assignments, so there is no k s.t. $g \bot k$. Therefore, $\bot \bullet \mathscr{R}$ is the empty relation $\bot$. The same reasoning also establishes that $\mathscr{R} \bullet \bot$ is the empty relation $\bot$.

6 We can check that this definition of dynamic implication satisfies the constraint $\mathscr{R}'' \bullet \mathscr{R} \leqslant \mathscr{R}'$ iff $\mathscr{R}'' \leqslant \mathscr{R} \twoheadrightarrow \mathscr{R}'$ – with the additional, and harmless, assumption that the binary relation $\mathscr{R}'$ is a test, i.e., $\mathscr{R}' \subseteq \mathbf{id}$. The reasoning is the same as in the more general proof for (19) above.

7 $\mathscr{R} \twoheadrightarrow \bot = \{\langle g, g \rangle : g\mathscr{R} \subseteq \mathbf{Dom}(\bot)\} = \{\langle g, g \rangle : g\mathscr{R} \subseteq \emptyset\} = \{\langle g, g \rangle : g\mathscr{R} = \emptyset\} = \{\langle g, g \rangle : g \notin \mathbf{Dom}(\mathscr{R})\} = \{\langle g, g \rangle : g \in (\mathscr{G} \backslash \mathbf{Dom}(\mathscr{R}))\}$.

In addition, anaphoric closure !, a.k.a. double negation, also receives the expected interpretation: its denotation is the **diag** operator introduced above. Recall that the operator ! is called anaphoric closure because, for any formula φ, $!\varphi$ is a test, i.e., $[\![!\varphi]\!] := [\![\neg\neg\varphi]\!] = \mathbf{diag}([\![\varphi]\!]) \subseteq \mathbf{id}$. It is easy to show that, in general, $\overline{\overline{\mathscr{R}}} = \mathbf{diag}(\mathscr{R})$: $\overline{\overline{\mathscr{R}}} = \{\langle g, g \rangle : g \in (\mathscr{G} \backslash \mathbf{Dom}(\neg\mathscr{R}))\} = \{\langle g, g \rangle : g \in (\mathscr{G} \backslash (\mathscr{G} \backslash \mathbf{Dom}(\mathscr{R})))\} = \{\langle g, g \rangle : g \in \mathbf{Dom}(\mathscr{R})\} = \mathbf{diag}(\mathscr{R})$. In fact, we have the following interesting three-way identity: $\mathbf{diag}(\mathscr{R}) = \overline{\overline{\mathscr{R}}} = \mathbf{id} \twoheadrightarrow \mathscr{R}$.

Because a doubly negated relation $\overline{\overline{\mathscr{R}}}$ is identical to the diagonal of that relation $\mathbf{diag}(\mathscr{R})$, it follows (just as in DPL) that the double negation of a relation is not in general identical to the original relation $\mathscr{R}$, although their domains are the same.

8 $\top := \overline{\bot} = \bot \twoheadrightarrow \bot = \{\langle g, g \rangle : g\bot \subseteq \mathbf{Dom}(\bot)\} = \{\langle g, g \rangle : \emptyset \subseteq \emptyset\} = \{\langle g, g \rangle : g \in \mathscr{G}\} = \mathbf{id}$.

2.3 Sequence semantics for DPropL

We already introduced the kind of models $\mathfrak{M}$ we need for the recursive definition of the DPropL interpretation function $[\![\cdot]\!]^{\mathfrak{M},\mathfrak{c}}$. They are extended monoids, i.e., monoids whose binary 'merge' operator $\bullet$ provides the interpretation for conjunction, extended with (*i*) a $\perp$ element that provides the interpretation for *falsum*, and (*ii*) a binary operator $\twoheadrightarrow$ that provides the interpretation for implication.

In this subsection, we first introduce semantic evaluation contexts $\mathfrak{c}$. We then define the DPropL interpretation function $[\![\cdot]\!]^{\mathfrak{M},\mathfrak{c}}$ and show how the resulting semantics for DPropL derives the intuitively correct truth conditions for our initial example in (3) in a fully incremental, left-to-right fashion.

Given a set of info states $\mathbf{I}$, which are the elements of a DPropL extended monoid $\langle \mathbf{I}, \bullet, \mathbf{id}, \perp, \twoheadrightarrow \rangle$, we define an info history / sequence σ as a finite non-empty sequence of info states. The set of all info histories $\mathbf{H_I}$ is defined as:

(24) $\mathbf{H_I} := \bigcup_{n \in \mathbb{N}*} \mathbf{I}^n$, where
  a. $\mathbb{N}*$ is the set of natural numbers without 0
  b. $\mathbf{I}^n$ is the set of all sequences σ of length n whose components are info states from the set $\mathbf{I}$

(25) Equivalently, $\mathbf{H_I} := \{\langle \sigma_1, \ldots, \sigma_n \rangle : n \geqslant 1 \wedge \sigma_1, \ldots, \sigma_n \in \mathbf{I}\}$.

As indicated in (25), we will often 'unpack' an info history σ with n components ($n \geqslant 1$) as the sequence $\langle \sigma_1, \ldots, \sigma_n \rangle$, where σ_1 is the first info state in the history (e.g., info state $i \in \mathbf{I}$), σ_2 is the second info state in the history (e.g., info state $j \in \mathbf{I}$), σ_3 is the third info state in the history (e.g., info state $k \in \mathbf{I}$), and so on and so forth, all the way to σ_n, which is the last info state in the history.

A semantic evaluation context $\mathfrak{c}$ is an info sequence/history $\sigma \in \mathbf{H_I}$. That is:

(26) The interpretation function for DPropL has the form $[\![\cdot]\!]^{\mathfrak{M},\sigma}$, where $\mathfrak{M}$ is an extended monoid and σ is an info history over the set $\mathbf{I}$.

Using info histories as semantic evaluation contexts formally encodes the basic proposal we put forth above (following Vermeulen 1994): a fully incremental dynamic semantics requires a notion of memory/update history. Info sequences encode this idea in a direct way.

Now that we fully defined the parameters of the interpretation function $[\![\cdot]\!]$ (i.e., models $\mathfrak{M}$ and semantic evaluation contexts $\mathfrak{c}$), we can turn to its recursive definition. The exact form of the definition is determined by the way we conceptualize denotations of DPropL formulas.

At a general level, the denotation of a DPropL formula φ will have the same general form as the semantic value of a formula in DPL: a binary relation over semantic evaluation contexts $\mathfrak{c}$, i.e., a binary relation over the set of info histories

$\mathbf{H_I}$. However, it turns out that we do not need the non-deterministic aspect of binary relations, and instead we can restrict ourselves to (deterministic) partial functions. That is, we can restrict ourselves to binary relations satisfying the extra condition that any element in their domain (i.e., any element for which they are defined) is mapped to exactly one element in their range.

The reason for this is simple. In DPL, we need non-deterministic binary relations over evaluation contexts as formula denotations because DPL evaluation contexts are variable assignments, so existential quantification has to be modeled as the non-deterministic introduction of a witness, i.e., the non-deterministic update of the input context (the same as in classical, static predicate logic).

In DPropL, and as we will soon see, in Incremental DPL, evaluation contexts are sequences of info states. What matters here is not that they are sequences, but that the info states $i, j, k, \ldots$ inside the sequences are 'fully-fledged' binary relations over variable assignments, and not merely variable assignments. The non-determinism needed to properly interpret existential quantification is therefore encapsulated inside info states and, as such, there is no need to be non-deterministic at the higher level of info-state sequences. Formula denotations, which update info sequences, can therefore be simpler, i.e., deterministic. In sum:

(27) The denotation of any DPropL formula φ is a partial function over info histories, i.e., $[\![\varphi]\!] : \mathbf{H_I} \to \mathbf{H_I}$.
That is, for an info sequence $\sigma \in \mathbf{H_I}$, if $\sigma \in \mathbf{Dom}([\![\varphi]\!])$, we have that: $[\![\varphi]\!](\sigma) = \sigma'$, for some $\sigma' \in \mathbf{H_I}$.

Following Vermeulen (1994), we will use the postfix notation $\sigma[\![\varphi]\!]$ instead of the usual $[\![\varphi]\!](\sigma)$, as it is more suitable for our purposes:

(28) In postfix notation: $\sigma[\![\varphi]\!] = \sigma'$ says that, to interpret a formula φ relative to an input info history σ, we update the info history σ with the semantic value $[\![\varphi]\!]$, and the deterministic result is a new info history σ'.

The intuition motivating the postfix notation generalizes to sequences of updates, i.e., to partial function composition, which is simply relation composition $\bullet$ restricted to partial functions:

(29) We say that $\sigma([\![\varphi]\!] \bullet [\![\psi]\!]) = \sigma'$, or even more simply $\sigma[\![\varphi]\!][\![\psi]\!] = \sigma'$, iff σ' is the result of (deterministically) updating the info history σ with $[\![\varphi]\!]$ first, and then with $[\![\psi]\!]$. That is, $\sigma[\![\varphi]\!][\![\psi]\!] = (\sigma[\![\varphi]\!])[\![\psi]\!] = \sigma'$.

We see here that the postfix notation for partial functions is more intuitive, and more in-line with the infix notation we use for binary relations.

The last issue we need to address before providing the recursive definition of the DPropL interpretation function $[\![\cdot]\!]^{\mathfrak{M},\mathfrak{c}}$ concerns the denotations of atomic formulas. For each atomic text / propositional variable $p \in A$, we assume that an info state $i_p \in \mathbf{I}$ exists that encodes the information that p. These atomic formulas $p \in A$ are unanalyzable in DPropL, and therefore their corresponding denotations i_p seem a bit mysterious. When we turn to predicate logic, however, we will see that they are tests contributed by lexical relations like $\textsc{sleep}(x)$ or $\textsc{like}(x,y)$. The corresponding info states $i_{\textsc{sleep}(x)}$ and $i_{\textsc{like}(x,y)}$ will just be the regular DPL semantic values of the atomic formulas $\textsc{sleep}(x)$ and $\textsc{like}(x,y)$, i.e., $i_{\textsc{sleep}(x)} = \{\langle g,g\rangle : g(x) \in [\![\textsc{sleep}]\!]\}$ and $i_{\textsc{like}(x,y)} = \{\langle g,g\rangle : \langle g(x),g(y)\rangle \in [\![\textsc{like}]\!]\}$.

We are now ready to define a fully incremental semantics for DPropL. The recursive definition of the interpretation function $[\![\cdot]\!]^{\mathfrak{M},\sigma}$ – or, in postfix notation, $\sigma[\![\cdot]\!]^{\mathfrak{M}}$ – is provided below. The model $\mathfrak{M}$ superscript is left implicit throughout.

(30) **DPropL semantics** (Vermeulen 1994)

a. Atomic formulas:

$$\sigma[\![\bot]\!] = \langle \sigma_1, \ldots, \sigma_{n-1}, \sigma_n \bullet \bot\rangle$$
$$\sigma[\![p]\!] = \langle \sigma_1, \ldots, \sigma_{n-1}, \sigma_n \bullet i_p\rangle$$
$$\sigma[\![\mathbf{if}]\!] = \langle \sigma_1, \ldots, \sigma_{n-1}, \sigma_n, \top\rangle$$
$$\sigma[\![\mathbf{then}]\!] = \langle \sigma_1, \ldots, \sigma_{n-1}, \sigma_n, \top\rangle$$
$$\sigma[\![\mathbf{end}]\!] = \langle \sigma_1, \ldots, \sigma_{n-2} \bullet (\sigma_{n-1} \twoheadrightarrow \sigma_n)\rangle$$

b. Conjunction: $\sigma[\![\varphi;\psi]\!] = \sigma([\![\varphi]\!] \bullet [\![\psi]\!]) = (\sigma[\![\varphi]\!])[\![\psi]\!] = \sigma[\![\varphi]\!][\![\psi]\!]$

c. Truth. A formula φ is true in model $\mathfrak{M}$ relative to an input info state $i \in \mathbf{I}$ iff $\langle i\rangle[\![\varphi]\!] = \langle i\rangle$. A formula φ is true in model $\mathfrak{M}$ *simpliciter* iff it is true relative to the input info state $\top$, i.e., iff $\langle\top\rangle[\![\varphi]\!] = \langle\top\rangle$.

For example, an atomic formula p is true in a model $\mathfrak{M}$ *simpliciter* iff $\langle\top\rangle[\![p]\!] = \langle\top\rangle$. But $\langle\top\rangle[\![p]\!] = \langle\top \bullet i_p\rangle = \langle i_p\rangle$, so p is true iff the info state i_p is in fact $\top$.

The definition in (30) gives us the intuitively-correct truth conditions for the formula in (3a) above. We can derive the correct truth conditions for the text in (3) while preserving a fully incremental left-to-right interpretation procedure because of the way the interpretations of **if**, **then** and **end** work together. In particular, **if** and **then** do not make any truth-conditional contribution: they simply open two new slots in the info history relative to which the conditional is interpreted. Then, the denotations contributed by the antecedent and the consequent of the conditional are stored in these two slots. The two denotations are merged in the appropriate way, i.e., by means of the implication operator $\twoheadrightarrow$, only when we reach **end**. In detail:

(31)
$$\langle\top\rangle[\![p;\mathbf{if};q;\mathbf{then};r;\mathbf{end}]\!] = \langle\top \bullet i_p\rangle[\![\mathbf{if};q;\mathbf{then};r;\mathbf{end}]\!]$$
$$= \langle i_p\rangle[\![\mathbf{if};q;\mathbf{then};r;\mathbf{end}]\!] = \langle i_p,\top\rangle[\![q;\mathbf{then};r;\mathbf{end}]\!]$$
$$= \langle i_p,\top \bullet i_q\rangle[\![\mathbf{then};r;\mathbf{end}]\!] = \langle i_p,i_q\rangle[\![\mathbf{then};r;\mathbf{end}]\!] = \langle i_p,i_q,\top\rangle[\![r;\mathbf{end}]\!]$$
$$= \langle i_p,i_q,\top \bullet i_r\rangle[\![\mathbf{end}]\!] = \langle i_p,i_q,i_r\rangle[\![\mathbf{end}]\!] = \langle i_p \bullet (i_q \twoheadrightarrow i_r)\rangle$$

Depending on what the monoid elements i_p, i_q, and i_r happen to be, the element

$i_p \bullet (i_q \twoheadrightarrow i_r)$ could be $\top$, in which case our sentence will be true relative to our model $\mathfrak{M}$ – or not, in which case our sentence will be false.

To summarize, the info-history-based semantics for DPropL is fully incremental and associative because the semantic values / updates contributed by formulas are partial functions, and conjunction / concatenation is interpreted as function composition, which is by definition associative. Furthermore, this semantics is able to incrementally derive the correct truth conditions for non-associative operators like conditionals because its evaluation contexts have memory, i.e., are able to store update histories.

But the semantics in (30) is not completely satisfactory because the meanings of *if* and *then* are identical. This incorrectly predicts that *then* could introduce the antecedent of a conditional, while *if* could introduce the consequent, i.e., that **if**; p; **then**; q; **end** is equivalent to **then**; p; **if**; q; **end**. Conditionals with a sentence-final antecedent exist, e.g., *I will buy you a toy if you behave*,[9] but that does not make them equivalent to conditionals in which the antecedent and the consequent are exchanged, e.g., *If I buy you a toy, you will behave.*

3 Incremental semantics for DPropL with trees

The sequence semantics for DPropL is incremental and associative, but it sacrifices the difference in truth-conditional / update status between the antecedent and the consequent of conditionals. Intuitively, we want *if* to mark the 'beginning' of the conditional and *then* to mark the 'elaboration'. In the sequence semantics for DPropL in (30) above, *if* and *then* both mark that a new info state slot should be opened at the end of the current info history.

One way to make finer-grained distinctions between info states in a history is to add more structure to our notion of history. This is what Vermeulen (1994) basically proposes. We should think of a conditional not as an element of the current info history, but as a kind of embedded / subordinate history. In Vermeulen's terms, we should think of info histories not simply as sequences, but as trees.

To improve readability, we will modify many aspects of the original formulation in Vermeulen (1994): notational conventions, various definitional details, tree representations etc. We will not indicate these differences in the text, but the reader can consult Vermeulen (1994: 250-253) for the original formulation.

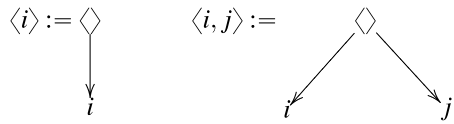
3.1 From sequences to trees

Switching from sequences to trees is simply adding more structure to sequences. We can think of sequences as trees with only one level of embedding or, alternatively, we can think of trees as recursively-specified sequences, i.e., as sequences

9 Although adding *then* at the beginning of the matrix clause is infelicitous in these cases.

that can contain other sequences.

To see this, consider two simple sequences of info states $\langle i \rangle$ and $\langle i, j \rangle$. We can think of these sequences as trees with one level of embedding: the mother node consists of the angular brackets $\langle\rangle$, and the info states inside the angular brackets are the daughter nodes, specified from left to right, as shown below.

(32) 

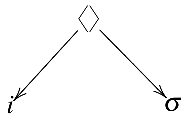
In general, we might need info trees, i.e., recursive info-state sequences, of arbitrary complexity. But for the limited purposes of this paper, we simply need trees with unary, binary and ternary branching nodes of a particular structure:

(33) The set of info histories $\mathbf{H_I}$ is the smallest set s.t.:

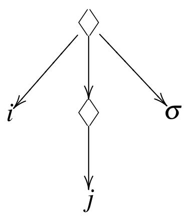
a. for any info state $i \in \mathbf{I}$, $\langle i \rangle \in \mathbf{H_I}$; in tree format:

 $\in \mathbf{H_I}$;

b. if $i \in \mathbf{I}$ and $\sigma \in \mathbf{H_I}$, then $\langle i, \sigma \rangle \in \mathbf{H_I}$, i.e.,

 $\in \mathbf{H_I}$;

c. if $i, j \in \mathbf{I}$ and $\sigma \in \mathbf{H_I}$, then $\langle i, \langle j \rangle, \sigma \rangle \in \mathbf{H_I}$, i.e.,

 $\in \mathbf{H_I}$;

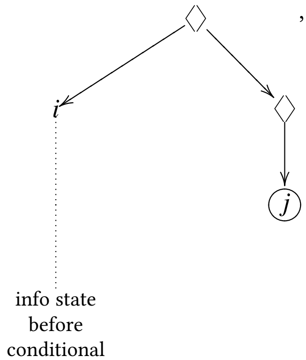
3.2 Ways of updating tree-based info histories

There are three basic types of trees that are relevant for our incremental semantics: (*i*) trees that are updated with a matrix clause or with a conjunction (either the first or the second conjunct), (*ii*) trees that are updated with the antecedent of a conditional, and (*iii*) trees that are updated with the consequent of a conditional. Typical examples of such trees are provided below; the info state that is targeted by the update is enclosed in a circle.

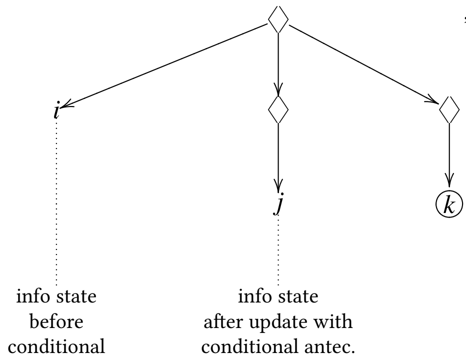
(34) Types of updates:

a. Main clause or conjunct: 

, i.e., in sequence format: $\langle \textcircled{i} \rangle$;

b. Conditional antecedent: 

, i.e., $\langle i, \langle \textcircled{j} \rangle \rangle$;

c. Conditional consequent: 

,

i.e., $\langle i, \langle j \rangle, \langle \textcircled{k} \rangle \rangle$.

Different updates target different positions in the current tree-based info history, which enables us to distinguish between updates with a conditional antecedent contributed by *if*, and updates with a conditional consequent contributed by *then*. The tree-based definition of the DPropL interpretation function incorporates these ideas. To make it more readable, we first introduce some notational conventions:

(35) An info history σ whose final subtree is ρ, i.e., s.t. $\mathbf{ftree}(\sigma) = \rho$, is symbolized as $\sigma\{\rho\}$.

(36) The final subtree of an info history σ is recursively defined as follows:

a. $\mathbf{ftree}(\langle i\rangle) = \langle i\rangle$, for any $i \in \mathbf{I}$

b. $\mathbf{ftree}(\langle i,\tau\rangle) = \begin{cases} \langle i,\tau\rangle & \text{if } \tau = \langle j\rangle, \text{ for some } j \in \mathbf{I} \\ \mathbf{ftree}(\tau) & \text{otherwise} \end{cases}$

c. $\mathbf{ftree}(\langle i,\langle j\rangle,\tau\rangle) = \begin{cases} \langle i,\langle j\rangle,\tau\rangle & \text{if } \tau = \langle k\rangle, \text{ for some } k \in \mathbf{I} \\ \mathbf{ftree}(\tau) & \text{otherwise} \end{cases}$

(37) If we have an info history of the form:

$\sigma\{\rho\}$, i.e., ρ is the final subtree of σ,

and we replace ρ with an arbitrary tree ρ', the resulting info history is represented as:

$\sigma\{\{\rho'\}\}$, i.e., we use double curly braces around the tree ρ'.

Given the definition of info histories in (33) and of the **ftree** function in (36), the final subtree of any info history σ can have only one of the following three forms: (*i*) $\langle i\rangle$ ('matrix' level only), (*ii*) $\langle i,\langle j\rangle\rangle$ ('matrix' and conditional antecedent), or (*iii*) $\langle i,\langle j\rangle,\langle k\rangle\rangle$ ('matrix', conditional antecedent, and conditional consequent).

3.3 Semantics for DPropL with tree-based info histories

We can now provide the final version of the definition of the DPropL interpretation function $[\![\cdot]\!]^{\mathfrak{M}}$, which we build on when we turn to predicate logic. Once again, the model superscript is omitted throughout.

(38) **DPropL tree-based semantics – final version** (Vermeulen 1994)

a. Atomic formulas:

$$[\![\bot]\!] = \begin{bmatrix} \sigma\{\langle i\rangle\} & \mapsto & \sigma\{\{\langle i\bullet\bot\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\bullet\bot\rangle\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\rangle,\langle k\bullet\bot\rangle\rangle\}\} \end{bmatrix}$$

$$[\![p]\!] = \begin{bmatrix} \sigma\{\langle i\rangle\} & \mapsto & \sigma\{\{\langle i\bullet i_p\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\bullet i_p\rangle\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\rangle,\langle k\bullet i_p\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{if}]\!] = \begin{bmatrix} \sigma\{\langle i\rangle\} & \mapsto & \sigma\{\{\langle i,\langle\top\rangle\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j,\langle\top\rangle\rangle\rangle\}\} \\ \sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\rangle,\langle k,\langle\top\rangle\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{then}]\!] = \begin{bmatrix} \sigma\{\langle i,\langle j\rangle\rangle\} & \mapsto & \sigma\{\{\langle i,\langle j\rangle,\langle\top\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{end}]\!] = \begin{bmatrix} \sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\} & \mapsto & \sigma\{\{\langle i\bullet(j\twoheadrightarrow k)\rangle\}\} \end{bmatrix}$$

b. Conjunction: $[\![\varphi;\psi]\!] = \begin{bmatrix} \sigma & \mapsto & (\sigma[\![\varphi]\!])[\![\psi]\!] \end{bmatrix}$

c. Truth. A formula φ is true in model $\mathfrak{M}$ relative to an input info state $i \in \mathbf{I}$ iff $\langle i\rangle[\![\varphi]\!] = \langle i\rangle$. A formula φ is true in model $\mathfrak{M}$ *simpliciter* iff it is true relative to the input info state $\top$, i.e., iff $\langle\top\rangle[\![\varphi]\!] = \langle\top\rangle$.

We can unpack the function denoted by $[\![\bot]\!]$ in (38a) as follows. The first line shows how we can update with *falsum* at the 'matrix' level: $\sigma\{\langle i\rangle\}[\![\bot]\!] = \sigma\{\!\{\langle i \bullet \bot\rangle\}\!\}$. The second line shows how the update proceeds when *falsum* is the meaning of the conditional antecedent: $\sigma\{\langle i,\langle j\rangle\rangle\}[\![\bot]\!] = \sigma\{\!\{\langle i,\langle j \bullet \bot\rangle\rangle\}\!\}$. Finally, the third line shows how the update proceeds when *falsum* is the meaning of the conditional consequent: $\sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\}[\![\bot]\!] = \sigma\{\!\{\langle i,\langle j\rangle,\langle k \bullet \bot\rangle\rangle\}\!\}$.

The function denoted by $[\![p]\!]$ can be similarly unpacked. When p is a matrix-level proposition, the update is $\sigma\{\langle i\rangle\}[\![p]\!] = \sigma\{\!\{\langle i \bullet i_p\rangle\}\!\}$. When p is a conditional antecedent, the update is: $\sigma\{\langle i,\langle j\rangle\rangle\}[\![p]\!] = \sigma\{\!\{\langle i,\langle j \bullet i_p\rangle\rangle\}\!\}$. Finally, when p is a conditional consequent, the update is $\sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\}[\![p]\!] = \sigma\{\!\{\langle i,\langle j\rangle,\langle k \bullet i_p\rangle\rangle\}\!\}$.

Turning to **if**, the first line shows how we can start a conditional at the 'matrix' level: $\sigma\{\langle i\rangle\}[\![\mathbf{if}]\!] = \sigma\{\!\{\langle i,\langle\top\rangle\rangle\}\!\}$. The second line shows how we start a conditional inside another conditional antecedent: $\sigma\{\langle i,\langle j\rangle\rangle\}[\![\mathbf{if}]\!] = \sigma\{\!\{\langle i,\langle j,\langle\top\rangle\rangle\rangle\}\!\}$. The final line shows how we can start a conditional inside another conditional consequent: $\sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\}[\![\mathbf{if}]\!] = \sigma\{\!\{\langle i,\langle j\rangle,\langle k,\langle\top\rangle\rangle\rangle\}\!\}$.

The meanings for **then** and **end** are more restrictive, as expected. If we have a conditional antecedent, we can start a conditional consequent with **then**: $\sigma\{\langle i,\langle j\rangle\rangle\}[\![\mathbf{then}]\!] = \sigma\{\!\{\langle i,\langle j\rangle,\langle\top\rangle\rangle\}\!\}$. Otherwise, **then** is undefined. Similarly, if we have both a conditional antecedent and a conditional consequent, we can form a conditional with **end** and merge it with the 'matrix' info state:
$\sigma\{\langle i,\langle j\rangle,\langle k\rangle\rangle\}[\![\mathbf{end}]\!] = \sigma\{\!\{\langle i \bullet (j \twoheadrightarrow k)\rangle\}\!\}$. Otherwise, **end** is undefined.

Finally, the meaning of conjunction in (38b) and the definition of truth in (38c) are the same as the sequence-based ones in (30) above. The only difference is that we present the meaning of conjunction in a different format, but it is clear that it's the same when we unpack it: $\sigma[\![\varphi;\psi]\!] = (\sigma[\![\varphi]\!])[\![\psi]\!] = \sigma[\![\varphi]\!][\![\psi]\!]$.

Just like the sequence-based definition, the tree-based definition in (38) gives us the right result for the formula in (3a) above. But it also preserves the difference in truth-conditional / update status between the antecedent and the consequent of a conditional: the $[\![\mathbf{then}]\!]$ update is a partial function defined only for info histories in which the update contributed by a conditional antecedent is already present. The compositional derivation of the meaning of (3a) in a tree-based DPropL semantics is provided below for completeness:

(39)
$$\begin{aligned}&\langle\top\rangle[\![p;\mathbf{if};q;\mathbf{then};r;\mathbf{end}]\!] = \langle\top \bullet i_p\rangle[\![\mathbf{if};q;\mathbf{then};r;\mathbf{end}]\!]\\ &= \langle i_p,\langle\top\rangle\rangle[\![q;\mathbf{then};r;\mathbf{end}]\!] = \langle i_p,\langle\top \bullet i_q\rangle\rangle[\![\mathbf{then};r;\mathbf{end}]\!]\\ &= \langle i_p,\langle i_q\rangle,\langle\top\rangle\rangle[\![r;\mathbf{end}]\!] = \langle i_p,\langle i_q\rangle,\langle\top \bullet i_r\rangle\rangle[\![\mathbf{end}]\!] = \langle i_p \bullet (i_q \twoheadrightarrow i_r)\rangle\end{aligned}$$

4 Incremental DPL (IDPL): Tree-based semantics for DPL

It is probably clear by now that the 'memory'-based solution proposed by Vermeulen (1994) for DPropL can be extended to DPL. To prepare the ground for the formalization, we provide the standard DPL semantics in (40) below. This semantics and the syntax it implicitly assumes are not identical to the original ones in Groenendijk and Stokhof (1991), but they are equivalent; see Brasoveanu (2013) for a gentler introduction and more arguments in favor of this format.

(40) **DPL semantics (equivalent to Groenendijk and Stokhof 1991)**

a. Atomic formulas:
$[\![\bot]\!]^{\text{DPL}} = \{\langle g,g\rangle : g \neq g\} = \emptyset$.
If π is an n-place predicate and $x_1,\ldots,x_n$ are variables, then
$[\![\pi(x_1,\ldots,x_n)]\!]^{\text{DPL}} = \{\langle g,g\rangle : \langle g(x_1),\ldots,g(x_n)\rangle \in [\![\pi]\!]^{\text{DPL}}\}$.
If x and y are terms, then $[\![x = y]\!]^{\text{DPL}} = \{\langle g,g\rangle : g(x) = g(y)\}$.

b. Formulas (sentential connectives):
$[\![\varphi;\ \psi]\!]^{\text{DPL}} = [\![\varphi]\!]^{\text{DPL}} \bullet [\![\psi]\!]^{\text{DPL}}$
$[\![\varphi \rightarrow \psi]\!]^{\text{DPL}} = [\![\varphi]\!]^{\text{DPL}} \twoheadrightarrow [\![\psi]\!]^{\text{DPL}} = \{\langle g,g\rangle : g[\![\varphi]\!]^{\text{DPL}} \subseteq \textbf{Dom}([\![\psi]\!]^{\text{DPL}})\}$

c. Formulas (random assignment): $[\![[\upsilon]]\!]^{\text{DPL}} = \{\langle g,h\rangle : g[\upsilon]h\}$,
where $g[\upsilon]h$ requires g and h to differ at most with respect to the value of υ, i.e., for all $\upsilon' \neq \upsilon$, $g(\upsilon') = h(\upsilon')$.

d. Abbreviations:
$$[\![\sim \varphi]\!]^{\text{DPL}} := [\![\varphi \rightarrow \bot]\!]^{\text{DPL}} = \{\langle g,g\rangle : g \notin \textbf{Dom}([\![\varphi]\!])\}$$
$$[\![\exists\upsilon\varphi]\!]^{\text{DPL}} := [\![[\upsilon];\ \varphi]\!]^{\text{DPL}} = [\![[\upsilon]]\!]^{\text{DPL}} \bullet [\![\varphi]\!]^{\text{DPL}} = \{\langle g,g\rangle : g[\![[\upsilon]]\!]^{\text{DPL}} \cap \textbf{Dom}([\![\varphi]\!]^{\text{DPL}}) \neq \emptyset\}$$
$$[\![\forall\upsilon\varphi]\!]^{\text{DPL}} := [\![[\upsilon] \rightarrow \varphi]\!]^{\text{DPL}} = [\![[\upsilon]]\!]^{\text{DPL}} \twoheadrightarrow [\![\varphi]\!]^{\text{DPL}} = \{\langle g,g\rangle : g[\![[\upsilon]]\!]^{\text{DPL}} \subseteq \textbf{Dom}([\![\varphi]\!]^{\text{DPL}})\}$$

e. Truth: A formula φ is true in model $\mathfrak{M}$ relative to an input assignment g iff $g \in \textbf{Dom}([\![\varphi]\!]^{\text{DPL}})$, i.e., there exists an h s.t. $\langle g,h\rangle \in [\![\varphi]\!]^{\text{DPL}}$.

This format for DPL syntax and semantics makes it clear that the semantics of the existential quantifier $\exists x(\varphi)$ in (40d), i.e., $[x];\varphi$, is automatically associative because it simply involves dynamically conjoining two formulas. Furthermore, the non-associative semantics for the universal quantifier $\forall x(\varphi)$ is reformulated in terms of implication $[\upsilon] \rightarrow \varphi$, which makes it clear how to generalize Vermeulen's DPropL solution to universal quantification – we simply need to rewrite it using the Vermeulen (1994) syntax: **if**$;[x];$**then**$;\varphi;$**end**.

The definition of DPL semantics in (40) above gives us the template for a tree-based semantics for DPL, which generalizes the DPropL tree-based semantics in (38) to predicate logic. We dub the resulting system Incremental DPL (IDPL). Subsection 2.2 already introduced the extended monoids we use as IDPL models. Here's how we relate atomic formulas and elements of those extended monoids:

(41) **Atomic info states.** We associate an info state, i.e., a binary relation over assignments, with every atomic formula. These info states are just the standard DPL denotations of the corresponding formulas:

a. $\mathscr{R}_{\pi(x_1,\ldots,x_n)} = \{\langle g,g\rangle : \langle g(x_1),\ldots,g(x_n)\rangle \in [\![\pi]\!]\}$
b. $\mathscr{R}_{x=y} = \{\langle g,g\rangle : g(x) = g(y)\}$

c. $\mathscr{R}_{[\upsilon]} = \{\langle g,h\rangle : g[\upsilon]h\}$
d. Given a set of n atomic formulas $\varphi_1,\ldots,\varphi_n$, we abbreviate the merge of the corresponding info states $\mathscr{R}_{\varphi_1} \bullet \cdots \bullet \mathscr{R}_{\varphi_n}$ as $\mathscr{R}_{\varphi_1;\ldots;\varphi_n}$.

With this correspondence in place, we are ready to provide a strictly incremental, tree-based dynamic semantics for predicate logic:

(42) **Incremental DPL (IDPL) tree-based semantics**

a. Atomic formulas:

$$[\![\bot]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R}\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R}\bullet\bot\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\bullet\bot\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\bullet\bot\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\pi(x_1,\ldots,x_n)]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R}\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R}\bullet\mathscr{R}_{\pi(x_1,\ldots,x_n)}\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\bullet\mathscr{R}_{\pi(x_1,\ldots,x_n)}\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\bullet\mathscr{R}_{\pi(x_1,\ldots,x_n)}\rangle\rangle\}\} \end{bmatrix}$$

$$[\![x=y]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R}\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R}\bullet\mathscr{R}_{x=y}\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\bullet\mathscr{R}_{x=y}\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\bullet\mathscr{R}_{x=y}\rangle\rangle\}\} \end{bmatrix}$$

$$[\![[\upsilon]]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R}\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R}\bullet\mathscr{R}_{[\upsilon]}\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\bullet\mathscr{R}_{[\upsilon]}\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\bullet\mathscr{R}_{[\upsilon]}\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{if}]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R}\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\top\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}',\langle\top\rangle\rangle\rangle\}\} \\ \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}'',\langle\top\rangle\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{then}]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\top\rangle\rangle\}\} \end{bmatrix}$$

$$[\![\mathbf{end}]\!] = \begin{bmatrix} \sigma\{\langle\mathscr{R},\langle\mathscr{R}'\rangle,\langle\mathscr{R}''\rangle\rangle\} & \mapsto & \sigma\{\{\langle\mathscr{R}\bullet(\mathscr{R}'\twoheadrightarrow\mathscr{R}'')\rangle\}\} \end{bmatrix}$$

b. Formulas (conjunction): $[\![\varphi;\psi]\!] = \begin{bmatrix} \sigma & \mapsto & (\sigma[\![\varphi]\!])[\![\psi]\!] \end{bmatrix}$

c. Abbreviations:
$[\![\varphi \to \psi]\!] := [\![\mathbf{if};\varphi;\mathbf{then};\psi;\mathbf{end}]\!]$
$[\![\sim\varphi]\!] := [\![\varphi \to \bot]\!]$
$[\![\exists\upsilon\varphi]\!] := [\![[\upsilon];\ \varphi]\!]$
$[\![\forall\upsilon\varphi]\!] := [\![[\upsilon] \to \varphi]\!]$

d. Truth. A formula φ is true in model $\mathfrak{M}$ relative to an input info state $\mathscr{R} \subseteq \mathscr{G} \times \mathscr{G}$ iff there exists an output info state $\mathscr{R}' \subseteq \mathscr{G} \times \mathscr{G}$ that is non-empty (i.e., $\mathscr{R}' \neq \bot$) s.t. $\langle\mathscr{R}\rangle[\![\varphi]\!] = \langle\mathscr{R}'\rangle$.

The definition of IDPL semantics in (42) follows the DPropL tree-based semantics in (38) very closely, so there is no need to discuss the formal details any further. It is, however, worthwhile to show in detail that IDPL preserves the DPL equivalences that enable it to account for donkey anaphora. In particular, existentials have unlimited scope over conjuncts to the right, and they can freely scope out of conditional antecedents:

(43) $(\exists\upsilon\varphi);\ \psi \Leftrightarrow ([\upsilon];\ \varphi);\ \psi \Leftrightarrow [\upsilon];\ (\varphi;\ \psi) \Leftrightarrow \exists\upsilon(\varphi;\ \psi)$

(44) $(\exists \upsilon \varphi) \rightarrow \psi \Leftrightarrow ([\upsilon];\ \varphi) \rightarrow \psi \Leftrightarrow \textbf{if}; [\upsilon]; \varphi; \textbf{then}; \psi; \textbf{end}$
$\Leftrightarrow \textbf{if}; [\upsilon]; \textbf{then}; \textbf{if}; \varphi; \textbf{then}; \psi; \textbf{end}; \textbf{end} \Leftrightarrow [\upsilon] \rightarrow (\varphi \rightarrow \psi) \Leftrightarrow \forall \upsilon (\varphi \rightarrow \psi)$

A typical donkey conditional is provided in (45). Its IDPL translation, which is identical to its DPL translation, is provided in (45a). However, this translation is simply a high-level abbreviation of the IDPL formula in (45b).

(45) If a^x farmer owns a^y donkey, he$_x$ beats it$_y$.
 a. $\exists x(\textsc{farmer}(x); \exists y(\textsc{donkey}(y); \textsc{own}(x,y))) \rightarrow \textsc{beat}(x,y)$
 b. $\textbf{if}; [x]; \textsc{farmer}(x); [y]; \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end}$

The formula in (45b) can be interpreted in a strictly incremental, left-to-right fashion. Importantly, we derive the truth-conditionally correct interpretation requiring all pairs $\langle \alpha, \beta \rangle$ s.t. $\alpha \in \llbracket \textsc{farmer} \rrbracket$, $\beta \in \llbracket \textsc{donkey} \rrbracket$ and $\langle \alpha, \beta \rangle \in \llbracket \textsc{own} \rrbracket$ to also be s.t. $\langle \alpha, \beta \rangle \in \llbracket \textsc{beat} \rrbracket$.[10]

Thus, IDPL successfully provides a strictly incremental dynamic semantics for predicate logic, formulated in an accessible and extendable fashion. While this is not a trivial achievement, it is far from clear that all incremental aspects of natural language interpretation should be captured at the semantic level, i.e., in a competence-level theory, rather than in the processor, i.e., in a performance-level theory (as discussed in Brasoveanu and Dotlačil 2015: Sect. 4, for example).

IDPL instantiates the semantic end of the spectrum, while the processing models proposed in Brasoveanu and Dotlačil (2020), for example, instantiate the other end of the spectrum. It is not clear to us where exactly on this spectrum we should locate a systematic theory of incremental interpretation, although currently, we are biased towards the processing end of the spectrum. We hope that the IDPL system introduced in this paper is useful as an anchoring point for future research into this foundational, hence thorny, issue.

10 $\langle \top \rangle \llbracket \textbf{if}; [x]; \textsc{farmer}(x); [y]; \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \top \rangle \rangle \llbracket [x]; \textsc{farmer}(x); [y]; \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \top \bullet \mathscr{R}_{[x]} \rangle \rangle \llbracket \textsc{farmer}(x); [y]; \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x]} \bullet \mathscr{R}_{\textsc{farmer}(x)} \rangle \rangle \llbracket [y]; \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x]} \bullet \mathscr{R}_{\textsc{farmer}(x)} \bullet \mathscr{R}_{[y]} \rangle \rangle \llbracket \textsc{donkey}(y); \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x]} \bullet \mathscr{R}_{\textsc{farmer}(x)} \bullet \mathscr{R}_{[y]} \bullet \mathscr{R}_{\textsc{donkey}(y)} \rangle \rangle \llbracket \textsc{own}(x,y); \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x]} \bullet \mathscr{R}_{\textsc{farmer}(x)} \bullet \mathscr{R}_{[y]} \bullet \mathscr{R}_{\textsc{donkey}(y)} \bullet \mathscr{R}_{\textsc{own}(x,y)} \rangle \rangle \llbracket \textbf{then}; \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x];\textsc{farmer}(x);[y];\textsc{donkey}(y);\textsc{own}(x,y)} \rangle, \langle \top \rangle \rangle \llbracket \textsc{beat}(x,y); \textbf{end} \rrbracket =$
$\langle \top, \langle \mathscr{R}_{[x];\textsc{farmer}(x);[y];\textsc{donkey}(y);\textsc{own}(x,y)} \rangle, \langle \top \bullet \mathscr{R}_{\textsc{beat}(x,y)} \rangle \rangle \llbracket \textbf{end} \rrbracket =$
$\langle \top \bullet (\mathscr{R}_{[x];\textsc{farmer}(x);[y];\textsc{donkey}(y);\textsc{own}(x,y)} \twoheadrightarrow \mathscr{R}_{\textsc{beat}(x,y)}) \rangle =$
$\langle \mathscr{R}_{[x];\textsc{farmer}(x);[y];\textsc{donkey}(y);\textsc{own}(x,y)} \twoheadrightarrow \mathscr{R}_{\textsc{beat}(x,y)} \rangle =$
$\langle \{ \langle g, g \rangle : g\mathscr{R}_{[x];\textsc{farmer}(x);[y];\textsc{donkey}(y);\textsc{own}(x,y)} \subseteq \textbf{Dom}(\mathscr{R}_{\textsc{beat}(x,y)}) \} \rangle =$
$\langle \{ \langle g, g \rangle :$ all pairs $\langle \alpha, \beta \rangle$ s.t. $\alpha \in \llbracket \textsc{farmer} \rrbracket, \beta \in \llbracket \textsc{donkey} \rrbracket, \langle \alpha, \beta \rangle \in \llbracket \textsc{own} \rrbracket$
are s.t. $\langle \alpha, \beta \rangle \in \llbracket \textsc{beat} \rrbracket \} \rangle$.

5 Conclusion

IDPL provides a strictly incremental semantics for Dynamic Predicate Logic, building on the incremental semantics for dynamic propositional logic introduced in Vermeulen (1994) and borrowing central notions from Visser (2002). IDPL enables us to derive correct truth conditions for apparently non-incremental structures like donkey conditionals in a *strictly* incremental fashion: the correct meanings for donkey conditionals are derived by means of a strictly left-to-right compositional procedure. This is accomplished without having to type-shift the meanings of the individual words (as in Steedman 2001, for example), and with dynamic conjunction/sequencing as the only compositional operation.

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Pseudoclefts and Parameters in the Pacific*

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Abstract Many languages of the Austronesian family show a restriction in content questions: nominal WH-words cannot undergo direct WH-movement. Recent works propose a typological generalization which links this restriction to a separate pattern common in the family: nominals cannot move to the left periphery in any language which derives its basic word order through VP-fronting (Oda 2005; Travis 2006b). Facts from Mandar (South Sulawesi, Indonesia) suggest that this link cannot be absolute: this language shows a verb-initial word order and the classic signs of VP-fronting, but appears to permit direct WH- and focus-movement of nominal categories. These patterns are expected on a Minimalist approach to variation where UG does not directly encode typological generalizations between putative cross-linguistic parameters.

1 Introduction

What is the significance of typological generalization in linguistic theory? This question involves two separate lines of inquiry. On the empirical level, it must be known whether generalizations hold cross-linguistically. On the theoretical level, it must be asked where such generalizations should be housed in the grammar, and which grammatical primitives should be employed to derive them.

The various iterations of generative theory have provided different answers to the theoretical questions above. The Principles and Parameters framework (P&P; Chomsky 1981) espoused a model of Universal Grammar (UG) rich enough to directly encode typological generalizations through primitive parameters. On this approach, UG contained lists of interconnected principles arranged in implicational hierarchies to derive cross-linguistic generalizations (Baker 2001); variation arose through parameter-setting in areas left underspecified by UG. Thus Chomsky writes, "what we 'know innately' are the principles of the various subsystems of s^0 and the manner of their interaction, and the parameters associated

* I am very grateful to Nabila Haruna and Jupri Talib for sharing their languages with me over the past three years. Special thanks to Sandy Chung for advice and feedback on this paper, to Dan Kaufman, Maziar Toosarvandani, Ileana Paul, and Eric Potsdam for comments along the way, Jed Pizarro-Guevara for his assistance with Cebuano, Vishal Arvindam, Jorge Hankamer, Andrew Hedding, Jed Pizarro-Guevara, and Erik Zyman for valuable discussion, and to Andrew Hedding and Morwenna Hoeks for putting this series of papers together. All errors are my own.

with these principles. What we learn are the values of these parameters" (Chomsky 1986: 150-151).

The Minimalist Program (MP; Chomsky 1995, 2001) takes a different position. On this view, UG reflects a minimal, evolutionarily plausible 'optimal solution' to language design (Chomsky et al. 2019); variation arises only as a uniform syntax undergoes externalization (Berwick and Chomsky 2016). The resultant grammatical architecture cannot encode typological generalizations directly in the syntax: if variation arises outside this domain, the relationships between points of variation must do so as well. And if this domain falls beyond the purview of UG, then these relationships are left without a clear home: some may be localized to indivdual heads and rehoused in the lexicon, but it is not clear that all can be handled this way. As a result, MP offers the expectation that the typological generalizations taken to exist robustly in the P&P era should be theoretically non-primitive and empirically non-absolute.

This paper illustrates that the logic above yields correct predictions in the realm of one former absolute: the link between VP-fronting and the lack of argument WH-movement. This connection appears robust in the Austronesian family, where many Western Malayo-Polynesian (WMP), Formosan, and Polynesian languages show two properties. The first involves the derivation of V1 word order: many of these languages show evidence for a step of VP-fronting in the basic clause (Pearson 1998; Cole and Hermon 2008). The second involves a restriction on constituent questions: in these languages, interrogative argument WH-phrases occur clause-initially but do not undergo direct WH-movement. Instead, they form the higher predicates of pseudoclefts (Kader 1976; Dahl 1986). The correlation between these properties is shown in (1).

(1) *Typological Generalization across Austronesian*
Languages which derive their basic word order via VP-fronting lack direct WH-movement of WH-arguments into the left periphery.

This generalization has been formalized in several ways. Oda (2002, 2005) proposes that any language which establishes its basic word order via VP-fronting systematically lacks movement of nominal categories into the C-domain (2). Travis (2006a,b) argues for a stronger position: Malagasy (and other WMP languages) systematically disallow phrasal movement of nominal categories (3).

(2) *Oda's Generalization* *(Oda 2002, 2005)*
a. If a language derives verb-initial order via VP-fronting, then it lacks WH-movement of arguments into the left periphery.
b. *Summary*: VP-FRONTING → NO WH-MOVEMENT.

(3) *Travis's Typology* (*Travis 2006a,b*)

a. Languages fall into two types with regard to movement operations:
   (i) TYPE A: head-movement of V; phrasal movement of DP
   (ii) TYPE B: phrasal movement of VP; head-movement of D
b. Malagasy and other WMP languages are of TYPE B.

These formal generalizations cannot be expressed in the syntax on the Minimalist view of UG. The component parts of the generalization above cannot be linked: they cannot reduce to the properties of an individual head in the lexicon and MP has no straightforward means to encode either into UG. If this approach is on the right track, then the generalizations above should not be absolute: there could exist WMP languages that go against this pattern.

Mandar, a language of the South Sulawesi subgroup (Central Indonesia), serves as such a case. This language shows both VP-fronting and direct WH-movement in constituent questions: nominal WH-words move directly from their thematic positions into the left-periphery. The examples below illustrate. [1]

(4) *Wh1 Questions* *Mandar*

a. **Innai** mam-eang diong?
   who AV-fish there
   'Who's fishing down there?'

b. [$_{CP}$ **Innai** mameang t_{innai}]?

The present paper argues that consituent WH-questions like (4) involve direct WH-movement. Key evidence comes from three domains: agreement paradigms, biclausality tests, and pied-piping patterns. The argumentation extends to parallel constructions which involve clause-initial argument foci (F1). Throughout this paper, I use the term WH1/F1 to refer explicitly to constructions like (4a).

The Mandar evidence above fits neatly into the MP view above. While particular patterns may tend to co-occur, 'parametric links' cannot be encoded directly into UG and thus should not reflect cross-linguistic absolutes. The presence of direct WH-movement in Mandar suggests that the same holds for the link between VP-fronting and the lack of argument WH-movement in Austronesian.

The remainder of this paper is organized as follows. Section 2 below lays out a sketch of Mandar clause structure and argues for an operation of VP-fronting behind the basic V1 order. Section 3 lays out several empirical properties of WH1/F1 structures and argues that they arise through direct displacement. Section 4 concludes that an absolute parametric link between the two properties under discussion cannot be maintained.

1 Abbreviations include: 1/2/3: first, second, third person, ABS: absolutive, AV: agent voice, DAT: dative, EMPH: emphatic, EX: exclusive, EXPL: expletive, FUT: future, GEN: genitive, IMP: imperative, IPFV: imperfective, LNK: linker, NEG: negative, OBL: oblique, PASS: passive, PFV: perfective, PRT: particle, PV: patient voice, Q: question particle, RED: reduplication, REL: relativizer, SUBJ: subjunctive

2 Clause Structure and VP-Fronting in South Sulawesi

2.1 South Sulawesi: Background and Methodology

Mandar is a member of the South Sulawesi Subgroup, a primary branch of wmp spoken in central Indonesia. This subgroup contains roughly thirty languages in four subfamilies: the Seko, Makassar, Bugis, and Northern groups (Grimes and Grimes 1987). Mandar, spoken in West Sulawesi, is a primary branch of the last.

This paper presents data from three sources: (*i*) texts published by the Indonesian language ministry, (*ii*) spontaneous speech, and (*iii*) sentences judged in elicitation. Two speakers have been consulted for this study; both have worked with me in person since 2018 and over Zoom since the spring of 2020. The present discussion focuses on the 'standard' dialects of Balanipa and Polewali.

2.2 Word Order and VP-Constituency

Transitive clauses show a verb-initial order in Mandar. The agent and patient show flexible order and the verb precedes arguments and *v*p-level adjuncts (5).

(5) *Mandar permits both VAO and VOA Orders.* *Mandar*

a. Map-pamula=i **bunga i=Murni**.
av-plant=3 flower name
'Murni is planting flowers.' (Pelenkahu et al. 1983: 195)

b. Pura=i na-ala **baine-na diqo bau**.
already=3 3.pv-take wife-3 that fish
'His wife had already taken that fish.' (Pelenkahu et al. 1983: 155)

The predicate which precedes the surface subject is phrasal. Three facts suggest this view. First, non-verbal predicates occupy a clause-initial position as well. When phrasal, these constituents precede the subject in full (6).

(6) *Nonverbal Predicates can be Phrasal.* *Mandar*

a. **Diong**=dua=i **di=litaq** diqe tommuane=e.
there=still=3 obl=floor this man=def
'This man was still on the floor.' (Pelenkahu et al. 1983: 154)

b. **Posasi**=i **annaq paqgalung** to dini di=kappung=e.
Fisherman=3 and famer prs here obl=village=def
'The people who live here are fishermen and farmers.'

Second, coordination tests suggest that the verb and object form a constituent. The v-o string can coordinate with v-o sequences (7a) and bare verbs (7b). Similar patterns suggest that a vp constituent across wmp (Keenan 1978).

(7) *Mandar Permits VP-Coordination* *Mandar*

a. [Mam-baca=i buku] annaq [maq-jama PR] i=Kacoq.
AV-read=3 book CONJ AV-work HW NAME
'Kacoq reads books and does his homework.'

b. [Mang-uma=i] annaq [maq-baluq soklat] i=Kacoq.
AV-garden=3 CONJ AV-sell chocolate NAME
'Kacoq keeps a garden and sells chocolate.'

Third, Mandar permits 'pseudo-incorporation' structures where the verb forms an accentual unit with following phrasal material. Second-position clitics follow the phrasal constituent (8).[2] Similar patterns occur in Polynesian (Massam 2001).

(8) *The Narrow VP can form a prosodic constituent.* *Mandar*

a. Maq-itai **baine=malólo=o** dini di=Mandar a?
AV-look.for wife=pretty=2 here OBL=Mandar PRT
'So you're looking for a pretty wife here in Mandar country, huh?'

b. Miq-keqdeq **di=lémbang**=i ia digenaq.
AV-stand OBL=river=3 he earlier
'He was standing in the river earlier.'

Distributional restrictions suggest that the accentual unit is an intact VP. The postverbal position hosts only those elements which remain inside the VP: NP objects and locative PPs. It cannot contain elements which originate above the VP (external arguments: 9a) or raise out of it (DP objects: 9b).

(9) *No Pseudo-incorporation for Constituents outside the VP.* *Mandar*

a. *Maq-ande **to dini**=i bau.
AV-eat REL here=3 fish
INT: 'The people here eat fish.'

b. *Maq-itai **yau**=**do**=**qo**?
AV-look.for me=Q=2
INT: 'Are you looking for me?'

2.3 Predicate Fronting

These patterns show that the Mandar VP forms a surface constituent. This conclusion raises a separate question: does the linearization of the VP before the subject arise through predicate fronting? On a certain view, the predicate-initial order cannot arise in any other way (Kayne 1994). From a theoretical perspective, this position is problematic for a range of reasons (Clemens and Coon 2018). Nevertheless, the classical diagnostics brought to bear on this puzzle in WMP yield positive results in Mandar.

2 The subfamily literature calls this 'incorporation': (Campbell 1989; Valkama 1995; Friberg 1991; Basri 1999; Jukes 2006); the construction involves focus in Mandar (Brodkin 2020).

The first argument for predicate fronting in Mandar stems from freezing effects. Like other WMP languages, Mandar bans objects which remain within the VP from undergoing movement later in the derivation. This pattern is typically demonstrated in WMP through the interaction of object shift with extraction (Chung 2006). Mandar verbs show a binary morphological alternation linked to object specificity: they take inflecting prefixes (PATIENT VOICE; PV) if objects are specific and an invariant prefix *maN-* (AGENT VOICE; AV) if not (10). Following (Rackowski 2002), I take the former series of prefixes to encode the presence of object shift.

(10) *Prefix Selection Marks Object Shift.* *Mandar*

a. **Maq**-itai=i dalleq-na.
AV-look.for=3 fortune-3
'He's looking for his fortune.'
(Muthalib and Sangi 1991: B4)

b. **Na-**itai=i i=Nabila.
3.PV-look.for=3 NAME
'He's looking for Nabila.

c. ***Maq**-itai=i i=Nabila.

Objects and other elements which remain within the VP cannot undergo movement later in the derivation. Mandar permits foci to surface in a position identical to that occupied by argument WH-words (11). Objects can move to this position when they independently shift out of the VP (when the verb bears PV morphology); when they do not (when the verb bears AV morphology), they cannot.

(11) *Nonshifted Objects cannot Front* *Mandar*

a. **I=Nabila na**-itai.
NAME 3.PV-look for
'He's looking for NABILA.'

b. ***Dalleq-na maq**-itai=i.
fortune-3 AV-look.for=3
INT: 'He's after his FORTUNE.'

This pattern suggests that the VP becomes an island for extraction at a certain point in the derivation. This restriction resembles a freezing effect (Wexler and Culicover 1980): the VP becomes an island because it moves.

The second argument for predicate fronting comes from adverb linearization. Mandar requires certain adverbial elements to appear in second-position (12). Controlled for prosody, the elements which cluster in this position surface in a mirrored order: higher-scoping adverbs occur to the right of lower ones.[3]

3 The same pattern arises among 2P elements in Tagalog (Jed Pizarro-Guevara; p.c.).

(12) *Adverbs show Mirrored Order* *Mandar*

a. Loppa=**sanna**=**dua**=**bandi**?
hot=really=still=honestly
'Is it honestly still really hot?'

b. Dio=**poleq**=**kapang**=**todiq**.
there=again=maybe=sadly
'Sadly maybe there again.'

Similar patterns have been argued to arise via roll-up predicate fronting across Austronesian. Within WMP, Malagasy requires non-clitic adverbs to surface in mirrored order postverbally (Rackowski 1998); in Formosan, Seediq shows the same requirement (Holmer 2006). The standard analysis derives this pattern via iterative COMP-to-SPEC movement (Rackowski and Travis 2000): adverbs head projections base-merged in an LCA-compliant Cinquean hierarchy and trigger fronting of their complements into specifier positions.

These diagnostics establish that Mandar follows other Austronesian languages on the classic tests for predicate fronting. If convincing, they suggest Mandar derives its basic word order through phrasal movement of a predicative constituent. The minimal analysis posits one step of VP-fronting to derive the patterns in (5)-(9); further movements may be required for the adverb facts in (12).

Setting the latter subject aside, I assume that the Mandar VP undergoes minimally one step of predicate fronting. This operation targets a low position: the verb follows both negation (6a) and aspectual adverbs (6b), which stand below T in the Cinquean hierarchy (Cinque 1999). For concreteness, I assume that the VP moves to the edge of *voice*P (Collins 2017).

(13) *Verbs follow Negation; Middle-field adverbials* *Mandar*

a. **Andap**=pa=i **mala** u-pau.
NEG=IPFV=3 can 1.PV-say
'I can't say it yet.' (Friberg and Jerniati 2000: B17)

b. Maq-ua=m=i baine-na "**Pura**=i=tuqu u-paressuq!"
AV-say=PFV=3 wife-3 already=3=EMPH 1.PV-cook
'His wife said "I already cooked it!"' (Pelenkahu et al. 1983: A15)

The resultant view of clause structure divorces the verb's position from both its morphological complexity and a formal EPP localized to T. I assume that the verb undergoes no head-movement in the narrow syntax and takes on prefixes only through post-syntactic amalgamation (Harizanov and Gribanova 2019). Moreover, the linear ordering facts suggest that predicate-fronting does not target the specifier of TP; as a result, I see no reason to connect the process to an EPP requirement localized to this position (*pace* Massam 2001).

3 Mandar Wh-Questions and Pseudoclefts

3.1 The Pseudocleft Analysis

The model of clause structure developed above places Mandar in line with the Austronesian languages which adhere to (1). Like its relatives across the family, Mandar shows a v1 order which arises via predicate-fronting. The typological generalizations in (2)-(3), then, yield the prediction below: Mandar wh1-questions like (14a) should have the underlying pseudocleft structure in (14b).

(14) *The Pseudocleft Analysis of Mandar Wh-Questions* *Mandar*

a. **Apa** na-peang?
what 3.pv-fish.for
'What is he fishing for?'

b. *Ø* **Apa** [**Ø** *na-peang*]
cop pivot free relative
What's what he's fishing for?'

On this view, the wh1 structure in (14a) would bear the structure of a specificational pseudocleft. The pivot, the wh-word, would merge in object position of a copular clause. The counterweight, or remainder, would be treated as a free relative merged in subject position (Akmajian 1970; Van Luven 2018), despite the lack of relativizing morphology. The surface word order of wh-remainder would arise through the process of predicate-fronting described above.

From a surface perspective, this analysis seems unlikely. Pseudoclefts show both an overt copula and relativizing morphology in English, but the wh-question in (14a) shows neither. In Austronesian, moreover, relativizing morphology is generally required. Cebuano (Central Philippines), for instance, recruits the morpheme which heads free relatives (here *ang*) for these constructions (15).

(15) *Wh-Pseudoclefts Require Relativizers* *Cebuano*

a. Dautan **ang** amo=ng gi-na-buhat.
bad d 1.ex=lnk pv-ipfv-do
'What we were doing was bad.'

b. **Unsa** *(**ang**) amo=ng gi-na-buhat?
what d 1.ex=lnk pv-ipfv-do
'What were we doing?' Jed Pizarro-Guevara; p.c.

Nevertheless, clause-initial arguments show certain properties which suggest an analysis like (14b). Mandar has a subjunctive enclitic *=a* which occurs adjacent to predicates (16a) and cannot appear after nominals in argument positions (16b). However, this element can surface on clause-initial wh1 and f1 elements (17).[4]

4 Many second-position particles show the same distribution in Mandar, but the complexities behind their linearization undermine the diagnostic value of their surface positions. To my knowledge, the subjunctive *a* is the only enclitic which does not move to second position in the language.

(16) *Subjunctive -a: follows Predicates, not Arguments* *Mandar*

a. Baraq siccoq-**a**=i dosa-na.
hopeful bit-SUBJ=3 sin-3.GEN
'Hopefully his sin is little.'

b. *Pole=pa=i i=Mulle-**a**.
come=IPFV=3 PRS=N-SUBJ
INT: 'Mulle might come later.'

(Sikki 1987: C99)

(17) *Subjunctive -a: occurs with clause-initial wh-words, foci* *Mandar*

a. Innai-**a**=mo di=aya=e?
who-SUBJ=PFV OBL=top=DEF
'Who might be up there?'

b. Bekkeq-**a**=mo na-gereq.
goat=SUBJ=PFV 3.PV-kill
'He might kill a goat.'

This pattern places Mandar WH1/F1 structures in line with constructions argued to be covert pseudoclefts elsewhere in Austronesian. Both Standard Fijian and certain dialects of Malagasy form WH1-questions without overt relativizing morphology, but both languages permit 'predicate-only' particles to follow the WH-word in these constructions (Potsdam 2009; Potsdam and Polisky 2015). As a result, WH1-questions in these languages have been argued to conform to the structure in (14b): they involve biclausal, pseudoclefted structures and pose no threat to the generalization in (1). As such, the covert pseudocleft analysis serves as the null hypothesis on WH1-questions in Mandar. This analysis appears sensible for comparative reasons and can be empirically justified through a particle placement pattern which recurs across the family. From a theoretical perspective, moreover, this approach eliminates a potential counterexample to (2) and allows for the preservation of a deep link between VP-fronting and WH-pseudoclefts.

Given these advantages, the pseudocleft analysis in (14b) cannot be discarded lightly. A convincing refutation of this approach requires minimally two things: (*i*) detailed counterarguments from independent properties of equation, predication, embedding, and extraction structures and (*ii*) a convincing alternative explanation for the particle placement pattern in (17). A successful proposal of this sort should also (*iii*) contextualize the Mandar argumentation within the broader context of WH1/F1 structures in South Sulawesi and WMP at large.

The present paper aims for a modest goal: to demonstrate that there are more compelling reasons to consider a monoclausal WH-displacement analysis of WH1 questions in Mandar. Key evidence comes from four predictions of the pseudocleft analysis which are systematically not borne out.

(18) *The Mandar Pseudocleft Analaysis: Predictions*

a. The counterweight should behave like a headless relative clause.
b. The WH-word should behave as the predicate of a copular clause.
c. The WH-question should show other signs of being biclausal.

d. The WH-question should show other properties of pseudoclefts.

The patterns below suggest that Mandar WH1 questions lack the canonical biclausal structure of WH-pseudoclefts across WMP. This conclusion places these structures at odds with the typological generalization in (1): Mandar appears to be a language with both VP-fronting and direct WH-movement.

3.2 Headless Relative Clauses

The first argument for direct WH-movement comes from the distribution of null relativizers. On the pseudocleft approach, the post-WH constituent is a headless relative clause in subject position. This stance yields the prediction in (19).

(19) *First Prediction of the Pseudocleft Analysis*
The COUNTERWEIGHT resembles a headless relative in subject position.

This prediction is not borne out. Mandar forms headless relatives with two relativizers: the inanimate *anu* and animate *to*. These morphemes must be overt when headless relatives surface in subject (20a) or object (20b) position.

(20) *Headless Relatives Require Overt Relativizers in Argument Positions*

a. Mararas=i *(**anu**) na-bawa.
spicy=3 REL 3.PV-bring
'What he brought is spicy.'

b. U-oloqi=i *(**to**) maq-ellong.
1.PV-like=3 REL AV-sing
'I like who is singing.

The pseudocleft analysis treats the post-WH material as a free relative subject of a copular clause. As a result, it predicts that this constituent should contain an overt relativizer. However, WH1 questions cannot contain these morphemes: it is impossible to insert either *anu* or *to* in the constituent which follows an argument WH-word (21a). The same restriction holds over F1 constructions (21b).

(21) *Wh1 Questions ban Overt Relativizers* *Mandar*

a. Apa (***anu**) mane bemme?
what REL just fall
'What just fell?'

b. Hape-u=di (***anu**) bemme.
phone-1=just REL fall
'Just my phone fell.'

3.3 Copular Syntax

The second argument for WH-movement comes from the agreement paradigm. On the pseudocleft approach, WH1-questions involve copular structure: the WH-word forms the predicate of a copular clause. This leads to the prediction in (22).

(22) *Second Prediction of the Pseudocleft Analysis*
WH1 elements should resemble the predicates of copular clauses.

WH-words show the expected behavior as predicates of equational copular clauses. These constructions show unremarkable syntax in Mandar: the predicate occurs in its typical position and hosts canonical agreement with the subject (23a). When a WH-word serves as the predicate, it shows the same behavior (23b).

(23) *Wh-Words host agreement in Predicative Copular Clauses* *Mandar*

a. Ceh, **asu**=**i** kandiq-qu.
PRT dog=3 little.sibling-1
'Ugh, my brother's a jerk.'

b. Apa=**o** iqo?
what=2 you
'What are you?' (Halloween)

Copular clauses which link two specific nominals show a different pattern. These constructions permit two orders linked with distinct agreement paradigms in Mandar: the predicate can occur initially and host regular agreement (24a) or the subject can occur initially and take an expletive agreement clitic *mi* (24b).

(24) *Two Agreement Frames* *Mandar*

a. Guru-nna=**i** i=Majiq.
teacher-3=3 NAME
Majid is the teacher.

b. i=Majiq=**mi** guru-nna.
PRS=N=EXPL teacher-3
It's Majid that's the teacher.

Clausal subjects trigger regular agreement under normal circumstances. Full CPs must be indexed with agreement when they serve as the subjects of clauses like (25a). Headless relatives show the same behavior: they trigger canonical third-person agreement even on nominal predicates (25b).

(25) *Free Relatives and CPs trigger Agreement* *Mandar*

a. Pura=**i** na-pipissangang **muaq** na=na-ropoq=i boyang-na,
Already=3 3.PV-announce if FUT=3.PV-sell.off=3 house-3
'He announced that he'd sell his house.' (Sikki 1987: C219)

b. Tommuane=**i** **to** maq-itai=o digenaq.
man=3 REL AV-look.for=2 earlier
'The one who was looking for you earlier was a man.'

On the pseudocleft analysis, Mandar WH1 questions involve a structure like (25b): the WH-word is predicated against a headless relative. Specifically, the pseudocleft analysis assumes a null-headed headless relative. Mandar does permit this type of constituent in one context: beneath the existential verb *diang* (26a). Crucially, these null-headed headless relatives can trigger expletive agreement (25b).

(26) *Null-headed HRCs co-occur with Expletive Agreement* *Mandar*

a. Diang **u-paressuq** dio di=pacceko, tapi sumaya=o: mararas=i!
EXIST 1.PV-cook there OBL=kitchen but careful=2 spicy=3
'There's something I cooked in the kitchen, but be careful- it's spicy!'

b. Diang=**mi** manarang mak-kalindaqdaq indini di=kappung=e.
EXIST=EXPL skilled AV-LOCAL.POEM here OBL=village=DEF
'There's someone skilled at reciting *kalindaqdaq* here in the village.'

The pseudocleft analysis thus arrives at a strong prediction. Mandar permits two forms of agreement in copular clauses: canonical agreement (23a) and expletive agreement in an inverse configuration (24b). Regular CP subjects trigger regular agreement (25a); null-headed headless relatives exist and can trigger expletive agreement (26b); nominal predicates can host agreement (25a) and WH-words do in equative copular clauses (23b). As a result, clause-initial WH-words and foci should be able to host some type of agreement if WH1/F1 structures bear any type of copular structure. However, these constructions ban all agreement (27).

(27) *Wh1 Questions ban all Agreement* *Mandar*

a. Apa(*=**i**/*=**mi**) di-pogauq?
what=3/EXPL PASS-do
'What are you doing?'
(Friberg and Jerniati 2000: 37)

b. Iqo(*=**i**/*=**mi**) u-salili.
you=3/EXPL 1.PV-miss
'I miss YOU.'
(Muthalib and Sangi 1991: A162)

This pattern poses a challenge to any analysis which ascribes copular structure to the clauses in (27). The complete ban on agreement suggests that clause-initial WH-words and foci do not behave as predicates in any meaningful sense. Instead, these elements must be arguments which have undergone movement.

3.4 Biclausality

A third set of arguments for direct WH-movement come from diagnostics for monoclausality. On the pseudocleft approach, the post-WH constituent contains a CP boundary and the overt material which follows occupies an embedded clause. This view leads to the prediction in (28).

(28) *Third Prediction of the Pseudocleft Analysis*
The post-WH constituent should resemble an embedded clause.

The distribution of imperative morphology provides a first argument against this claim. Mandar has a direct imperative marked by a null verbal prefix which replaces normal ergative agreement (29a). This morphology occurs only in matrix clauses: it cannot occur beneath the prohibitive *da* 'don't!,' which embeds a small clause, or within an embedded CP (29b)-(30).

(29) *Imperative Morphology* *Mandar*

a. Ø-Baca=m=i iting=o!
IMP-read=PFV=3 that=DEF
'Read that!'

b. Da *Ø/mu-baca=i!
DON'T! IMP/2.PV-read=3
'Don't read it!'

(30) *Imperative Morphology: Matrix Clauses Only* *Mandar*

U-posara=mo annaq *Ø/mu-baca=i, tapi ndang=o min-dalinga!
1.PV-beg=PFV C IMP/2.PV-read=3 but NEG=2 AV-listen

'I begged that you read it, but you didn't listen!'

Clause-initial focus constructions like (31a) allow the predicate following the focus to bear imperative morphology (31b). This pattern suggests that the resultant structures are monoclausal: the main verb cannot occupy an embedded clause.

(31) *F1 Constructions allow Imperative Morphology* *Mandar*

a. Iting boyang na-papia.
that house 3-make
'He built THAT HOUSE.'

b. Boyang=doloq Ø-papia!
house=first IMPER-build
'Build a HOUSE first!'
(Sikki 1987: C488)

The same diagnostic cannot be run in interrogative clauses. Nevertheless, clause-initial WH-words and foci show identical syntactic behavior and plausibly occupy the same position.[5] As a result, this conclusion over F1 structures extends naturally to their WH1 equivalents: the latter must be monoclausal as well.

Clitic climbing patterns provide further evidence that WH1/F1 structures are monoclausal. Mandar has second-position clitics which follow the first prosodic word in an intonational unit linked to the clause (32a). These clitics cannot raise to the C domain: they cannot climb to C (32b) or escape free relatives (33).[6]

5 In Mandar, foci and wh-words both (*i*) host predicate-only particles, (*ii*) cannot host agreement with the following constituent (*iii*) or trigger agreement in it, and (*iv*) obey identical extraction constraints.

6 Similar restrictions recur over clitic systems in South Sulawesi and the Philippines (Kaufman 2008, 2018).

(32) *2P Clitic Placement Patterns* *Mandar*

a. Indang=**bappa**=**tia** urang.
NEG=hopefully=just rain
'Hopefully it won't rain.'
(Friberg and Jerniati 2000: 262)

b. **Apaq** sibuq=**bega**=**i** i=Ali.
because busy=too=3 NAME
'Because Ali is too busy.'
(Friberg and Jerniati 2000: 68)

(33) *Clitics cannot climb out of Free Relatives* *Mandar*

a. Indandiang **to** maq-ita=**aq**.
NEG.EXIST REL AV-see=1
'There's nobody who saw me.'

b. Muaq **to** tuna=**mo**=**todiq**,
as.for REL suffer=PFV=poor
'As for whoever suffers,'
(Muthalib and Sangi 1991: A98)

Philippine languages show a common restriction over second-position elements: they cannot climb to clause-initial WH-words and foci. The Cebuano data below illustrate: the clitics *niya* '3.GEN' and *nako* '1.GEN' originate within the post-WH constituent but cannot climb to follow the initial WH1/F1 elements. Given that philippine 2P clitics cannot climb across CP boundaries, this pattern suggests that these constructions are biclausal (Aldridge 2002; Billings and Kaufman 2004).

(34) *Wh1/F1 Structures ban Clitic Climbing* *Cebuano*

a. **Unsa** ang gi-na-buhat=**niya**
what D PV-IPFV-do=3.GEN
'What is he doing?'

b. *Unsa=**niya** ang gi-na-buhat?

c. **Si**=**Indang** ang gusto=**nako**
NAME D like=1.GEN
'Indang's the one I like.'

d. *Si=Indang=**nako** ang gusto.

Unlike Cebuano, Mandar permits clitic climbing to the clause-initial WH-word. All dialects permit aspectual clitics like *boi* 'again' to follow clause-initial WH-words while modifying the matrix predicate (35a). The northern dialects, moreover, permit subject agreement to do the same (35b).

(35) *Wh1/F1 can host clitics linked to the main predicate* *Mandar*

a. Innai=**boi** maq-ellong?
who=AGAIN AV-sing
'Who's singing again?'
All Mandar Dialects

b. **Apa=o** na-bengan?
what=2 3.PV-give
'What did he give you?'
Tapalang Mandar

This clitic climbing pattern suggests that Mandar WH1 structures are monoclausal. Second-position elements generally cannot climb high into the C domain and cannot cross overt clausal boundaries. In the Philippine languages which form WH1 questions via pseudocleft, this restriction yields a ban on clitic-climbing to clause-initial WH-words. In Mandar, however, no such ban arises.

The two patterns reviewed here suggest that WH1/F1 structures are monoclausal in Mandar. This conclusion goes directly against the pseudocleft analysis of Mandar WH-questions laid out above.

3.5 Pied-Piping: Against Pseudoclefts

Pied-piping facts offer a final argument for direct WH-movement. Mandar has a class of path prepositions which encode the direction of motion along which an action occurs (36). These elements head phrases which follow the verb and precede their complements, which often surface with the oblique marker *di=*.

(36) *Path Prepositions* *Mandar*

a. Tileller=i **naung** di=bao letteq-na.
droop=3 down OBL=top foot-3
'[His beard] droops down to his feet.' (Sikki 1987: C147)

b. Meq-ita=aq **daiq** di=bulang- kara-karambo=pa=i!
AV-look=1 up OBL-moon RED-far=IPFV=3
'I look up at the moon -how far it is!' (Muthalib and Sangi 1991: A5)

These elements are prepositions. Unlike motion verbs, they surface without voice morphology. Like other functional elements, they cannot reduplicate (37). Like prepositions, they introduce arguments: psych predicates require that goals surface with the path *lao* 'toward' (38a), and this context forces suppletive forms of pronominal objects (38b).

(37) *Path Prepositions, Functional Categories cannot Reduplicate* *Mandar*

a. Lambiq (***lao**)-lao aheraq.
reach RED-to afterlife
'Until (we) reach death.'
(Muthalib and Sangi 1991: D20)

b. (i) *Iti-iting (RED-that); D
(ii) *Mua-muaq (RED-if); C
(iii) Bala-balao: RED-rat; N
(iv) Loa-loa: RED-say; V

(38) *Paths Introduce Objects; trigger Suppletion* *Mandar*

a. Wah, mongeq=sannal=i *(**lao**) di=kottaq-na.
PRT sick=really=3 to OBL=girlfriend-3
'Man, he really loves his girlfriend.'

b. Pallaq=tongang=o **mai** / (***lao** di=yau)!
heartless=truly=2 to.me (to OBL=me)
'You're so uncaring toward me!'

The pseudocleft analysis makes the prediction in (40) about path questions. Pseudoclefts generally resist pied-piping of prepositions cross-linguistically: the pivot cannot pied-pipe prepositions in English (Heggie 1988) or Cebuano (39).

(39) *No Pied-Piping in Pseudoclefts* *Cebuano*

*Para sa imo ang gi-buhat nako ang adobo.
for DAT you REL PV-make 1.GEN ABS adobo
LIT: 'For you is who I made the adobo.'

(40) *Fourth Prediction of the Pseudocleft Analysis*
Paths should be unable to pied-pipe in complement questions.

WH1 questions do not conform entirely to this prediction. Mandar permits two patterns when the complement of a path is questioned: the path either strands in-situ (41a) or surfaces in a derived position above the verb (41b).[7]

(41) *Path Questions permit Pied-Piping* *Mandar*

a. **Inna** mu-ola **tama**?
where 2.PV-go into
'Where did you go in?'

b. **Apa tama** mu-peqitai?
what into 2.PV-look
'What are you looking into?'

I argue that the latter pattern involves pied-piping of the path under movement of its complement. Two patterns suggest this conclusion. First, paths cannot follow their complements (42a) or occur preverbally (42b) without extraction.

(42) *No Independent Path Inversion, Fronting* *Mandar*

a. *Di-bawa=i di=buttu **daiq**.
PASS-bring=3 OBL=hill up
INT: 'We took her up the hill.'

b. ***Lao**=i mongeq di=kindoq.
to=3 sick OBL=mom
INT: 'He loves mom.'

Second, paths surface only in the preverbal position only when it is their complements which extract. As such, the path associated with a goal cannot surface preverbally when the theme surfaces clause-initially (43).

7 Path questions require the complement of the path to surface without the oblique marker *di=*. I assume this constraint has a non-syntactic origin: paths can generally take bare nominal complements without extraction (e.g. *lao* 'to' in (37a)), and the proclitic *di=* cannot be stranded. In addition, there is no context, to my knowledge, where the strings *di=inna* 'in where' and *di=apa* 'on what' occur.

(43) *Path Prepositions front only when Complements move* *Mandar*

a. ***Apa naung** mu-toloq t_{naung} di=kaca?
what down.to 2.PV-pour OBL=glass
INT: 'What did you pour into the glass?'

The displaced path occupies a position through which its complement has moved. The stranded paths strictly follow both temporal and aspectual adverbs which occur immediately before the verb (44).[8] This pattern suggests that they occupy a position at the left edge of the verbal domain. A'-extraction requires that moved nominals pass through such a position on standard assumptions about cyclicity (Chomsky 1986). As a result, I assume that displaced paths are spelled out in SPEC,*voice*P.[9]

(44) *Path Prepositions Strand Low* *Mandar*

a. Apa **tulu daiq** na-peqitai?
what always up.to 3.PV-look.at
'What is he always looking up at?'

b. Apa **biasa naung** na-toloqi?
what usually down.to 3.PV-pour.in
'What does he usually pour it into?'

This pattern poses a final challenge to the pseudocleft analysis above. Mandar allows paths to be spelled out in intermediate positions when their associates surface clause-initially. This construction involves partial pied-piping plus spell-out of the path at the lower phase edge.[10] Pseudoclefts, however, show a cross-linguistic tendency to resist this operation: English and Austronesian languages like Cebuano completely ban the pied-piping configurations in (39). As a result, this pattern offers further evidence for the key conclusion advanced here: Mandar WH1/F1 structures are not pseudoclefts.

8 The examples in (44) illustrates the only possible order of path and middle-field element in the pied-piping construction. Path elements can surface above aspectual and temporal adverbs when used as independent motion verbs; in these constructions, the path reading is unavailable.

9 Mandar does not allow the path to surface overtly before the clause-initial WH-word. This pattern follows from a broader prosodic constraint active elsewhere in the language: interrogative WH-words must stand at the left edge of an intonational unit corresponding to the clause whenever possible. See Brodkin (2020) for further discussion.

10 This pattern may involve either subextraction of the WH-word from the PATHP or PATHP movement plus scattered deletion. The first account does not violate constraints on movement operations of insufficient length (e.g. COMP-TO-SPEC Antilocality; Abels 2003): only the prepositions high in the extended projection of P can strand (e.g. PATH, but not AXIAL.PART; Svenonius 2004).

4 Conclusion

This paper has put forward two claims about clause structure in Mandar. First, this language derives its basic v1 order through an operation of vp-fronting. The vp forms a surface constituent for the purposes of coordination and 'pseudo-incorporation' and shows freezing effects which suggest that it has moved. The linear ordering of the verb with middle-field adverbs suggests that vp-fronting targets a projection within the lower phase, *pace* previous analyses which link predicate-fronting in Austronesian to a parameterized epp feature on t.

Second, Mandar permits argument wh-words and foci to undergo direct movement to the left periphery. Despite surface appearances, this conclusion is not trivial. While Mandar shows no overt copula or relativizer in wh1/f1 structures, it allows wh-words and foci to host 'predicate-only particles'- a pattern taken as key evidence for a biclausal analysis of wh1-questions elsewhere in Austronesian. Nevertheless, four patterns suggest that wh1/f1 structures are not pseudoclefts in this language. First, wh1/f1 structures ban overt relativizers, while null relativizers cannot occur in the configuration which the pseudocleft analysis assumes in these contexts. Second, wh1/f1 structures do not show the agreement pattern which obtains in typical copular clauses- and show an idiosyncratic ban on expletive agreement clitics which suggests that they may not be predicates themselves. Third, wh1/f1 structures permit imperative morphology on the non-initial verb and clitic climbing from the predicate: both patterns which suggest a monoclausal analysis of these constructions. Fourth, wh1/f1 structures permit the pied-piping of path prepositions despite the ban on pied-piping in pseudocleft structures cross-linguistically. Together, these patterns suggest that Mandar may break from the Austronesian prototype in (1): this language may form wh1/f1 structures through direct displacement of wh-words.

These two points place Mandar in a typological cell which does not exist on parametric accounts of the vp-fronting-pseudocleft link. Since the 1990s, the view has been entertained that predicate fronting arises due to a parameterization of epp features on t. On this view, particular assumptions about the c-t relationship lead to theoretical positions like (2)-(3) which formalize the generalization in (1) into a principle of ug. While this approach finds success across much of Austronesia, the Mandar facts show that it is too strong: this language derives its word order by vp-fronting but nevertheless may permit direct movement of wh-words into the left periphery.

This conclusion fits neatly into the model of variation espoused by mp at large. On this view, correlations like (1) cannot be directly encoded into ug; within a family, patterns of this sort are more likely to reflect historical accident than deep structural truth. The facts above suggest that the vp-fronting-pseudocleft link exists along these lines: while many languages have vp-fronting and lack wh-movement, the Mandar data show that the two options can coexist.

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Can Selection Explain Stranding?
Revisiting a Structural Asymmetry*

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Abstract In this squib, I show that San Martín Peras Mixtec demonstrates the same extraction asymmetry that is found in several Mayan languages: subextraction of interrogative possessors is possible from transitive objects and unaccusative subjects, but not possible from transitive or unergative subjects. I revisit the account of this asymmetry provided in Aissen (1996), adapting and applying it to the analysis of pied-piping and extraction in Coon (2009). I hypothesize that the difference in subextraction acceptability lies in the different selectional requirements of *v* and V: while V can take either a QP, a DP or a $DP_{[uQ]}$ as its complement, *v* can only select a QP or a DP as its specifier.

1 Introduction

In this squib, I provide novel data to show that San Martín Peras Mixtec (henceforth, SMPM) displays an extraction asymmetry: interrogative possessors can subextract from within the subject of an unaccusative subject or the direct object of an transitive verb, but not from within a transitive subject or unergative subject. In this respect, SMPM resembles two other Mesoamerican languages—Tsotsil and Ch'ol (Mayan)—both of which have the same pattern of restrictions, as described in Aissen (1996) and Coon (2009), respectively.

An example of the contrast is given in (1). While an interrogative possessor contained within the subject of an unaccusative predicate can strand its possessum *in situ* (1a), an interrogative possessor contained within the subject of an unergative predicate cannot (1b).

(1) a. Yó nìtsivi [kárro ñà'ǎ __]
who broke.down car thing
'Whose car broke down?'

* I am very grateful to Natalia Gracida Cruz and Roselia Durán Cruz for providing the judgments reported in this paper. In addition, I thank Eraclio Gracida Cruz, Juan Gracida Ortiz, Irma López Basurto, and one additional consultant for teaching me about wh-movement and possession in SMPM more generally. Finally, I also thank Judith Aissen, Ben Eischens, Jason Ostrove, and Maziar Toosarvandani for helpful discussion and feedback. This work was partially funded by the Jacob's Research Foundation and The Humanities Institute of the University of Santa Cruz.

b. *Yó shínun [amigo ñà'ǎ __]
who runs friend thing
Intended: Whose friend is running?

In this paper, I revisit the account of this asymmetry provided in Aissen (1996), assuming the analysis of subextraction from possessive DPs presented in Coon (2009).

Aissen (1996) argues that the same asymmetry in Tsotsil stems from whether the trace is able to be properly governed in each position (Empty Category Principle). She argues that traces within the complement of V can be governed, while traces in the specifier of VP cannot, leading to the impossibility of subextraction from transitive or unergative subjects. This reasoning is very much in line with the prevailing theoretical assumptions of the time—subject-object asymmetries were used as part of the original motivation for the ECP (Chomsky 1981), and the ECP was also used in a similar way to account for argument-adjunct extraction asymmetries (e.g. Huang 1982; Rizzi 1990). However, given more recent Minimalist movement away from notions such as Government (Chomsky 1995, 2000), it is worthwhile to reconsider how we can account for and understand the asymmetry displayed in Mesoamerican languages, as well as other structural asymmetries that were previously accounted for using the ECP.

Coon (2009), for her part, briefly notes that the same extraction asymmetry holds for Ch'ol, but the analysis in her brief squib does not attempt to account for it. Instead, Coon's main purpose is to account for the difference between subextraction and pied-piping by showing that the two are distinguished by the position of a Question Particle (which heads a QP) relative to the possessum. In cases where the Q particle takes the entire possessive phrase as its sister, phrasal movement of the QP to the specifier of CP will cause the entire possessive DP to front. In cases where the Q particle takes the possessor as its sister, only the possessor will front when the QP is moved, stranding the possessum *in situ*.

This squib, then, has two main goals. First, I provide the data to show that SMPM displays the same extraction asymmetry as Tsotsil and Ch'ol (§2), suggesting that it may be an areal feature of Mesoamerica, or perhaps an even more general cross-linguistic phenomenon. Second, I apply Aissen's core insight about the asymmetry (§3)—that it reflects a difference in selection—to Coon's analysis of extraction and pied-piping (§4), formulating a hypothesis that provides a first step towards accounting for this restriction in Minimalist terms (§5). Beyond these narrow goals, this squib is also a small step towards a larger goal of reconsidering how formal tools, and the phenomena that they were adopted to explain, can be reunderstood given changing theoretical assumptions, by reducing them to their core essential properties (see e.g. Rizzi 2016).

2 The Facts

SMPM is an Otomanguean language spoken in Oaxaca, Mexico, and by sizable diaspora populations in various parts of California. Default word order in out-of-the-blue contexts is VSO, but deviations from this order are common when forming questions, as well as when certain constituents are topicalized or in focus. Relevant for our purposes here is the fact that SMPM has obligatory wh-movement to a preverbal position (Ostrove 2018; Hedding 2020), like other varieties of Mixtec (e.g. Caponigro et al. 2013; Macaulay 1996; Eberhardt 1999).

2.1 Possession in SMPM

I am aware of three basic ways of expressing possession in SMPM, with each structure corresponding to a different type of possessum. The first is used for inalienable possession, such as of family members and body parts. Here the possessor immediately follows the possessum (2a). The second is used for alienable possession, such as of human-made objects (2b). Here the possessum and the possessor are separated by the word *ñà'ǎ*, which literally means *thing*.[1] The third type of possession structure is used for the possession of things within the "animal" noun class, which includes animals, as well as spherical objects, such as some fruit (2c). In this case, the possessum and its possessor are separated by the word *sana*, which as far as I know has no other meaning.

(2) a. sè'e Maria
child M.
'Maria's child'

b. karro ñà'ǎ Eraclio
car thing E.
'Eraclio's car'

c. tsìnà sana Juan
dog POSS.AML J.
'Juan's dog'

In most cases, it is ungrammatical to insert *ñà'ǎ* in cases of inalienable possession (such as with kinship terms) and ungrammatical to remove it from alienable possession structures. However, I am aware of a few words that optionally take *ñà'ǎ* when they are possessed, perhaps reflecting cases where possession

1 Most prepositional meanings in Mesoamerican languages are derived from words that are also used for body parts (Campbell et al. 1986). It seems reasonable to assume that *thing* is used in possession structures in a similar way: a nominal that provides a preposition-like meaning. I remain agnostic here on whether this is truly a preposition that is historically derived from a noun, whether it is a noun that creates a preposition-type meaning when it forms a compound with another noun, or whether it has some other structure.

can variably be construed as alienable or inalienable.

(3) a. amigo (ñà'ǎ) Margarita
friend thing M.
'Margarita's friend'

b. utu (ñà'ǎ) Juan
corn.field thing J.
'Juan's cornfield'

2.2 Pied-piping with Inversion

Like many other Mesoamerican languages, SMPM displays pied-piping with inversion (PPWI). That is, despite the fact that possessors follow their possessa in non-interrogative contexts (4a), a fronted interrogative possessor will proceed its pied-piped possessum (4b). Though I do not discuss it here, inversion also occurs when a wh-word pied-pipes a preposition.

(4) a. Kìshâ [sè'e Juan] Ahuejutla
arrived child J. A.
'Juan's child arrived in Ahuejutla.'

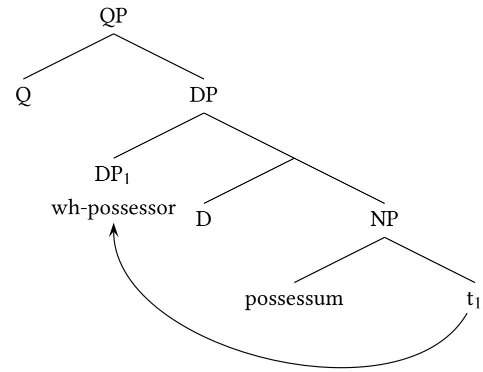
b. [Yó sè'e __] kìshâ __ Ahuejutla
who child arrived A.
'Whose child arrived in Ahuejutla?'

PPWI is an areal feature of Mesoamerican languages. It also occurs in other Mixtec languages (Caponigro et al. 2013; Eberhardt 1999), as well as Zapotec languages (Broadwell 2001; Black 1994), and Mayan languages (Aissen 1996; Coon 2009; Broadwell 2005; Polian and Aissen 2020).

For the purposes of this paper, I assume, following Aissen (1996) and Coon (2009) that inversion occurs when the interrogative possessor moves to the specifier of a possessive DP.[2] In addition, following Cable (2010) and Coon (2009), I assume that the target for wh-movement to the specifier of CP is a QP which contains a wh-word. When this QP dominates the entire possessive DP, then the possessum moves along with the interrogative possessor, creating the illusion of pied-piping.

2 While Aissen (1996) and Coon (2009) assume that the possessor originates as a rightward specifier of NP, Coon (2010) argues that the base order of possessum-possessor is derived via movement of the possessum to a DP-internal functional head. Here I remain agnostic on whether possessa remain in their base position or are moved, as it will have no bearing on the question under discussion.

(5) Possessor Inversion



My assumption about the derivation of PPWI is not entirely innocent, however, as there are some empirical uncertainties that remain about how inversion is derived in SMPM. There is some evidence that multiple derivations can result in inversion. As (5) predicts, in many cases the interrogative possessor simply appears at the beginning of the fronted constituent.

(6) PPWI with Unaccusative Subject

a. [Yó sè'e __] nàkaba __
who child fell
'Whose child fell?'

b. [Yó ndána ñà'ǎ __] nìta'avi __
who window thing broke
'Whose window broke?'

c. [Yó tsìnà sana __] nìshi'i __
who dog POSS.AML died
'Whose dog died?'

However, there are two other possibilities that should be noted. First, in most cases a fronted possessive DP can be optionally doubled by a clitic which agrees in noun class with the possessum. In some instances, this seems to improve the acceptability of the sentence.

(7) Yó ndána ñà'ǎ yá nìta'avi
who window thing it.NEUT broke
'Whose window broke?' (cf. 6b)

This is consistent with a general tendency in SMPM for fronted constituents to be doubled by pronouns in certain contexts. This may be a way of indicating contrast or signaling D-linking (Hedding 2020), or perhaps it reflects a distinct derivation. I expect that more naturally occurring examples or more carefully constructed contexts will help clarify the cases in which speakers prefer doubling.

Second, alienable and "animal" possession can also undergo what we might call "complete inversion," where the order of elements within the fronted constituent are completely reversed, in addition to cases where only the interrogative possessor occurs in a non-canonical position.

(8) Yó sana tsìnà nìshi'i
who POSS.AML dog died
'Whose dog died?' (cf. 6c)

As this squib primarily focuses on the possibility of possessum stranding, I leave investigation of these various possibilities to future work.

2.3 Stranding

In addition to pied-piping possessa along with fronted wh-words, SMPM also allows for the possibility of possessum stranding in certain contexts. First, stranding of a possessum that is part of an unaccusative subject is possible (9), in addition to pied-piping with inversion (6). Here I use % to indicate judgments that seem to be subject to inter-speaker variation. Of the two speakers consulted for this squib, one found stranding in cases of inalienable possession to be somewhat degraded (though perhaps not completely ungrammatical). The other speaker found them completely acceptable. A similar observation is made by Coon (2009) (pg. 168, fn. 5), who notes that some speakers of Ch'ol seem to disprefer stranding inalienably possessed nouns. This suggests the possibility of a structural or semantic difference between alienable and inalienable possession that influences the grammaticality of extraction, at least for some speakers.

(9) Extraction Possible from Unaccusative Subject

a. %Yó nàkaba [sè'e __]
who fell child
'Whose child fell?'

b. Yó nìta'avi [ndána ñà'ǎ __]
who broke window thing
'Whose window broke?'

c. Yó (nà) nìshi'i [tsìnà sana __]
who 3SG.N died dog POSS.AML
'Whose dog died?'

Stranding a possessum within a transitive object is also possible (10), with the same caveat about inalienably possessed nouns. PPWI is also possible (11).

(10) Extraction Possible from Transcitive Object

a. %Yó shînon [táta __]
who saw.2SG father
'Whose father did you see?'

b. Yó shìshon [ndayajyí vá'a ñà'ǎ __]
who ate.2SG broth good thing
'Whose mole[3] did you eat?'

c. Yó sà-kǔshi Maria [tsìnà sana __]
who CAUS-eat M. dog POSS.AML
'Whose dog did Maria feed?'

(11) PPWI with Transitive Object

a. [Yó táta __] shînon __
who father saw.2SG
'Whose father did you see?'

b. [Yó ndayajyí vá'a ñà'ǎ __] shìshon __
who broth good thing ate.2SG
'Whose mole did you eat?'

c. [Yó tsìnà sana __] sà-kǔshi Maria __
who dog POSS.AML CAUS-eat M.
'Whose dog did Maria feed?'

In contrast, possessum stranding is ungrammatical within an unergative subject (12). Instead, only pied-piping with inversion is possible (13).

(12) No Extraction from Unergative Subject

a. *Yó ka'an [sè'e __]
who speaks child
Intended: Whose child is speaking?

b. *Yó shínun [amigo ñà'ǎ __]
who runs friend thing
Intended: Whose friend is running?

c. *Yó ndâyi [tsìnà sana __]
who barks dog POSS.AML
Intended: Whose dog is barking?

3 Mole is a catch-all term for several different sauces common in Oaxaca, which are typically made using a combination of chiles, nuts, and spices.

(13) PPWI with Unergative Subject

a. [Yó sè'e __] ka'an __
who child speaks
'Whose child is speaking?'

b. [Yó amigo ñà'ǎ __] shínun __
who friend thing runs
'Whose friend is running?'

c. [Yó tsìnà sana __] ndâyi __
who dog POSS.AML barks
'Whose dog is barking?'

Finally, possessor extraction is also not possible from a transitive subject (14), once again leaving pied-piping with inversion as the only option (15).

(14) No extraction from Transitive Subject

a. *Yó tsyâ [sè'e __] shìtǎ
who makes child tortillas
Intended: Whose child is making tortillas?

b. *Yó kàni [kárro ñà'ǎ __] itǔn
who hit car thing tree
Intended: Whose car hit the tree?

c. *Yó shàshi [tsìnà sana __] kôñù
who ate dog POSS.AML meat
Intended: Whose dog ate the meat?

(15) PPWI with Transitive Subject

a. [Yó sè'e __] tsyâ __ shìtǎ
who child makes tortillas
'Whose child is making tortillas?'

b. [Yó kárro ñà'ǎ __] kàni __ itǔn
who car thing hit tree
'Whose car hit the tree?'

c. [Yó tsìnà sana __] shàshi __ kôñù
who dog POSS.AML ate meat
'Whose dog ate the meat?'

These observations partially overlap with those previously reported for SMPM. While Ostrove (2018) also reports that subextraction is impossible from transitive subjects or unergative subjects, he argues that possessum stranding within unaccusative subjects and transitive objects is only possible when the possessor undergoes A-movement, such as quantifier raising, but not Ā-movement, such as wh-movement (pg. 153-157). Perhaps importantly however, many of the ungrammatical examples of possessum stranding that he reports involve inalienable possession, while many of his grammatical examples of stranding under A-movement involve alienable possession. As previously mentioned, stranding inalienably possessed nouns is degraded, at least for some speakers. Thus, it is possible that the difference in grammaticality that Ostrove reports actually highlights a sensitivity to this difference for some speakers. While future exploration of the generalization presented in Ostrove (2018) is certainly warranted, in this paper I will assume instead that the generalization in (16) holds for SMPM, as it seems to for Tsotsil and Ch'ol.

(16) **Subextraction Generalization:**
Possessors can subextract from the complement of V, but not from the specifier of *v*P.

3 Aissen and the ECP

Aissen (1996) accounts for this generalization in Tsotsil by appealing to the Empty Category Principle (Chomsky 1981). That is, she assumes that every trace has to be either lexically governed or antecedent governed. Under the definitions she assumes (pg. 459), traces are antecedent governed if they are bound within a local domain, and traces are lexically governed if they are c-commanded by a head that is [+V] (i.e. V or I) within a local domain. She assumes that domains are delineated by *barriers*, which are any maximal projection that is not sister to a [+V] head. Specifically, a trace must be governed by something that it is *subjacent* to—that is, for any barrier between the trace and its governor, the maximal projection immediately dominating the barrier must also dominate the governor.

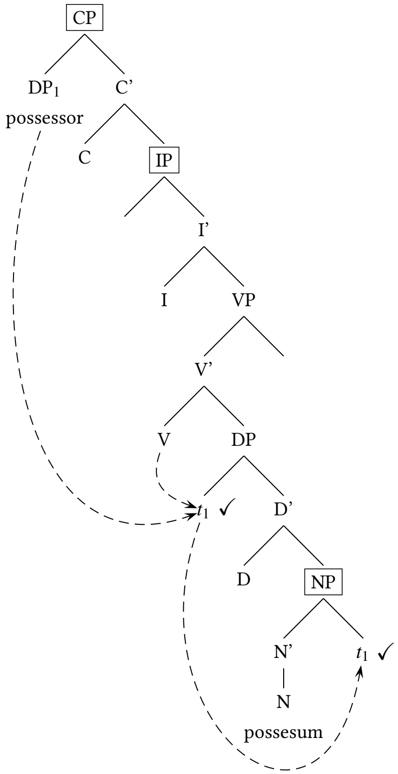
Because they originate as the complement of V, a possessive DP that is an unaccusative subject or transitive object is not a barrier. This contrasts with unergative subjects, which are *not* sister to V or I, and thus *are* barriers. This additional barrier means that a trace within an unergative or transitive subject can not be governed, and thus extraction from within an unergative or transitive subject will be ill-formed. This is exemplified by the trees in (17) and (18) on the following page. I indicate barriers with boxes, government with dotted lines, and ungoverned traces with a circle.[4]

Important for our purposes will be to consider the underlying intuition of Aissen's account, rather than focusing on her specific implementation. Crucially, her account derives the difference based on *selection.* Selection determines barriers, and barriers can block government. Thus, her insight might be restated as follows: possessum stranding is possible from constituents that are selected by the verb, but not from other constituents. In this way, her account closely mir-

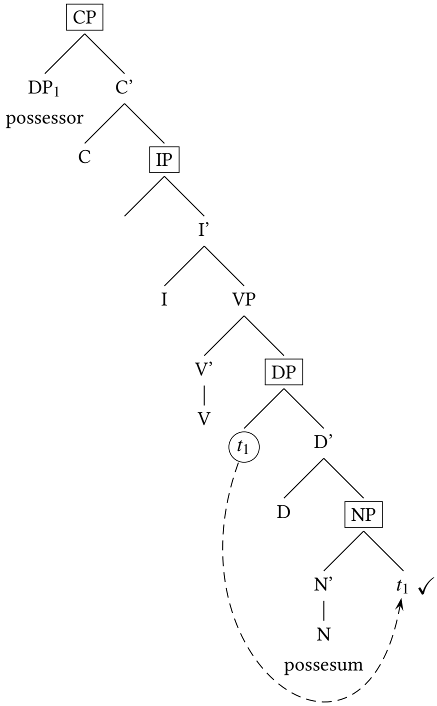
4 Note that Aissen (1996) assumes that in Tsotsil lexical heads have a rightward specifier and functional heads have a leftward specifier (see the Specifier Ordering Principle, pg. 451).

rors the Condition on Extraction Domain (CED) (Huang 1982), which states that a phrase can only be subextracted out of a domain that is properly governed. Because Huang (1982) assumes that a lexical category will properly govern its object, the CED will rule out extraction from subjects or adjuncts.

(17) Unaccusative



(18) Unergative

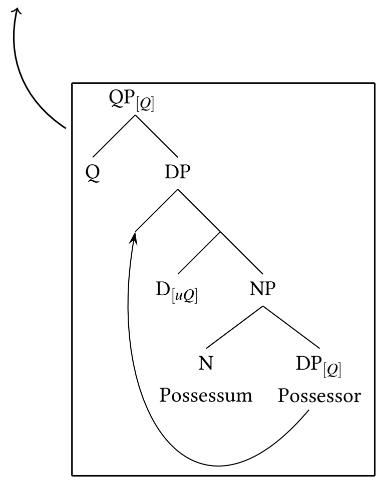


4 Extraction vs. Pied-Piping according to Coon

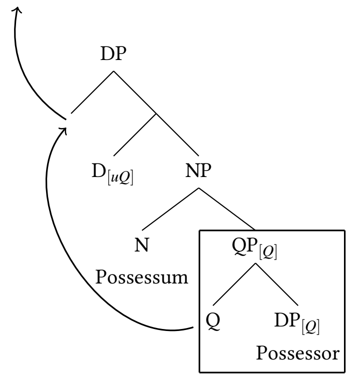
Coon (2009) uses data from the Mayan language Ch'ol to argue against a feature percolation account of pied-piping (e.g. Grimshaw 2005), and in favor of a Q-particle analysis (Cable 2010). Under this analysis, "wh-movement" is triggered by an agreement relationship between a CP with an uninterpretable Q feature, and a QP that bears an interpretable Q feature. QP is headed by a Q-particle which is sometimes null, and which contains a wh-word in its c-command domain. In her paper, Coon shows that a Q-particle analysis of pied-piping in Ch'ol can straightforwardly account for multiple-possessor structures, while an analysis assuming feature percolation requires additional, unmotivated stipulations. I refer the interested reader to her paper for the details of her reasoning.

Important for our purposes is Coon's account of the difference between pied-piping and possessor extraction. For her, the difference is based on the position of the Q-particle relative to the possessive DP. If Q is sister to the possessive DP, then phrasal movement of QP to the specifier of CP will move both the possessor and the possessum (pied-piping) (19). If, however, Q is sister to the possessor, then phrasal movement of QP will strand the possessum *in situ* (20).[5] In order to account for pied-piping with inversion, as well as the possibility of a QP extracting from within a DP, Coon argues that DPs in Ch'ol can bear an uninterpretable Q feature. This uninterpretable feature will attract either the interrogative possessor (triggering inversion in 19) or the QP itself (moving it to an escape hatch from which it can move to spec-CP in 20).

(19) Pied-Piping with Inversion



(20) Possesor Extraction



While she notes that possessum stranding is only possible within unaccusative subjects and transitive objects in Ch'ol (pg. 166), her analysis does not explicitly account for this asymmetry. Because she does not indicate any restrictions on the distribution of $DP_{[uQ]}$, we have no reason to expect that the DP in (20) could not be the specifier of *v*P, triggering extraction from a transitive subject or unergative subject.

5 Coon also shows that a QP can be merged in between two possessors in Ch'ol, which accounts for the possibility of one possessor fronting and another possessor being stranded in a multiple-possessor structure. I leave exploration of this possibility in SMPM to future work.

5 A Selectional Hypothesis

If we combine the respective insights of Aissen (1996) and Coon (2009), an analysis begins to emerge. According to Coon, the difference between cases of pied-piping and possessor extraction reflects a difference in where a Q-particle is merged relative to the possessive DP. If Q is sister to the entire DP, then the possessum will move along with the QP when it fronts to spec-CP. If, however, Q is sister to the possessor, then QP will front without the possessum, stranding it *in situ*. Moreover, the insight of Aissen's analysis is that the possibility of subextraction depends on whether the possessive DP is directly selected by the verb or not. If the possessive DP is sister to the verb, then subextraction is possible. If, however, the possessive DP is not sister to the verb, then subextraction is blocked.

If we want to maintain Aissen's intuition while adopting the analysis of Coon, then we are lead to the following hypothesis:

(21) **A Selectional Hypothesis**
  a. V can select DP, QP or $DP_{[uQ]}$ as its complement.
  b. *v* can select DP or QP, but not $DP_{[uQ]}$ as its specifier.

Suppose that V can select either a QP or a $DP_{[uQ]}$ as its complement (in addition to DPs with no Q feature). If it selects a QP, then its entire complement will front as a unit, triggering pied-piping. If, however, it selects a $DP_{[uQ]}$, then if there is QP sister to the possessum it will subextract via spec-DP. Now suppose that *v* *cannot* merge a $DP_{[uQ]}$ as its specifier. Then, subextraction of the possessor will not be possible from transitive or unergative subjects. Even if a QP were merged inside the possessive DP as the sister of the possessum, it would not be attracted to the specifier of DP (due to the lack of an uninterpretable feature on D), and, by hypothesis, it would then not be able to move to the specifier of CP, due to the fact that it will not move to an escape-hatch and thus will be inaccessible to a probe on C (Gavruseva 2000). If we assume that an uninterpretable Q feature on C must be valued in order for the derivation to converge, then if a QP does not value this feature we expect the derivation to crash. If, however, QP is directly merged as the specifier of *v*P, then the entire possessive DP subject will front.

Given the scope of this squib, (21) will remain as a hypothesis to be explored in future work. While it is perhaps not controversial to claim that V and *v* have different selectional requirements, ideally we would find a principled reason for this difference. In the case of (21), the difference is especially striking because it is not simply that V and *v* select phrases of different categories. Rather, they select phrases of the same category, but one restricts phrases bearing a certain uninterpretable feature. It should go without saying that much more work must be done to investigate the viability of selectional restrictions as a way to account for this and other subject extraction restrictions.

6 Conclusion

This squib has had two modest goals. The first was to demonstrate that SMPM displays the same extraction restriction as two other Mesoamerican languages: while possessum stranding is possible from the complement of V, it is not possible from the specifier of *v*P. The second was to offer a hypothesis on the nature of that restriction, by applying the insight of Aissen (1996) to the analysis of Coon (2009). According to this hypothesis, the difference lies in the selectional requirements of *v* and V. Beyond SMPM, this hypothesis, or a variant of it, could prove useful in thinking about how to account for structural asymmetries that were previously explained by the ECP.

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The root of it all: Affectedness across lexical categories *

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Abstract The inability of some event-denoting nominals to form the 'nominal passive', whereby the internal argument of the verb corresponding to that nominal surfaces in front of the nominal as a possessor (*the city's destruction* but **algebra's knowledge*), has been proposed to derive from the structural deficiencies of such nominals: they violate the Affectedness Constraint (Anderson 1977, 1984), which limits passivization to nominals with sufficiently complex event structure. In this paper, I propose that the Affectedness Constraint can be unified with a superficially different syntactic restriction: partitive case assignment in Estonian. In Estonian, the assignment of partitive case on objects of certain verbs tracks almost precisely with the inability of cognate nominals of those verbs to passivize. This cross-domain commonality suggests that the Affectedness Constraint is sensitive to properties of roots, and not verbal structure as previously proposed.

1 Introduction

It is well-known that the internal arguments of some nominals derived from transitive result verbs, such as *construction* and *examination*, can surface in front of those nominals as preposed possessors in the 'nominal passive' form (Chomsky 1970; Anderson 1977; Doron and Rappaport Hovav 1991: *et seq.*).

(1) a. The aliens constructed the ziggurats.
    b. The ziggurats' construction was mysterious.

(2) a. The doctor examined the patient.
    b. The patient's examination was lengthy.

(3) a. The megalomaniac imprisoned the dissenter.
    b. The dissenter's imprisonment was unjust.

* Many thanks are in order for Mark Norris, Ivy Sichel, Anissa Zaitsu, Erik Zyman, and audiences at UCSC and the LSA for feedback on early stages of this work, as well as Marju Kaps and Uku Visnapuu for discussion and judgments. All errors are my own.
I use the following abbreviations in interlinear glosses: ACC = accusative, ADE = adessive, ALL = allative, COM = comitative, GEN = genitive, NEG = negative, NOM = nominative, PART = partitive, TRNSL = translative.

This pattern contrasts with transitive stative verbs like *know* and their corresponding nominals like *knowledge*. A direct object of a stative verb cannot appear as a preposed possessor before a nominal which is cognate with that verb.[1]

(4) a. Flora knows algebra.
b. *Algebra's knowledge is well-established.

(5) a. The oboist hates the arid climate.
b. *The arid climate's hatred is extreme.

Anderson (1977) observed that the (in)ability of some nominals to passivize correlates with semantic properties of the events described by those nominals. Namely, an internal argument must be 'Affected' by the event in order to permit preposing, in the sense of Doron and Rappaport Hovav (1991) and Sichel (2010):[2]

(6) **Affectedness**
An argument y of a $V(x, y)$ is Affected iff there is a subeventuality e of the eventuality e' denoted by V such that y, but not x, is an argument in e.

(7) **Affectedness Constraint**
Only Affected arguments of event nominals may prepose.

In other words, 'Affected' objects are those which participate in events with at least two subparts, one of which involves the object but not the subject. The AC also correctly predicts that stative nominals disallow preposing, because stative eventualities are homogeneous: every proper subinterval of a state is also an instance of a state of the same kind (Dowty 1979: *et seq.*), so there is necessarily no subevent of a state that involves the object as an argument to the exclusion of the subject.

The Affectedness Constraint is often taken to indicate that unpassivizable nominals are deficient in some way that is reflected morphosyntactically, be it their argument structure (Grimshaw 1990: a.o.) or event structure (Doron and Rappaport Hovav 1991; Sichel 2010: a.o.). What is most striking, however, is that a notion quite similar to Affectedness has been argued to play a prominent role in the verbal domain: object case assignment in Finnic. In languages like Finnish, the choice of object case correlates quite closely with 'boundedness' of events, which closely mirrors the subevent condition of the AC.

In this paper, I propose that Affectedness is not limited to nominals: it also plays a role in the verbal domain, specifically with respect to object case assignment. I demonstrate that in Estonian, in which stative nominals are unpassivizable like English, the notion of Affectedness can also be leveraged to explain the

1 There are of course other ways in which stative and eventive nominals differ, but they are not germane here.

2 While these authors couch Affectedness in terms of *events*, I use the more inclusive description *eventuality*, since Affectedness is also highly relevant for states.

distribution of direct objects of verbs which get assigned partitive case, including statives. In so doing, I argue that this cross-domain sensitivity of eventuality-denoting words to Affectedness strongly suggests that what matters for the Affectedness Constraint is the lexical semantics of the nominal root, as opposed to its syntactic argument structure or event structure, in the spirit of Smirnova (2015) and Smirnova and Jackendoff (2017).

The paper proceeds as follows. In §2 I provide necessary background about case assignment in Estonian, and demonstrate that stative verbs and nominals all behave uniformly with respect to case assignment and passivization respectively, even across disparate semantic classes. In §3 I propose that only Affected objects receive partitive case, and demonstrate that this characterization is preferable to other potential accounts of partitive case assignment. In §4 I discuss where the sensitivity of some eventualities to come from, and conclude that it must be localized within lexical semantic properties of eventuality-denoting roots. §5 concludes and points to future directions for cross-categorial work on statives.

2 Properties of Estonian states

2.1 No nominal passive

In Estonian, nominals derived with the suffix *-us* exhibit English-like behavior with respect to argument realization. Like English, Estonian word order is canonically SVO, and direct objects are allowed to prepose event nominals in the genitive case; stative nominals disallow this preposing.

(8) a. Keskerakond valitses Eestit.
Centre.Party governed Estonia
'The Centre Party governed Estonia.' EVENTIVE
b. Eesti valitsus on stabiilne.
Estonia.GEN government is stable
'Estonia's government is stable.'

(9) a. Liis armastab matemaatikat.
Liis loves mathematics
'Liis loves mathematics.' STATIVE
b. *Matemaatika armastus on oluline.
mathematics.GEN love(N) is important
Intended: 'Love of mathematics is important.' [3]

As we will see, the pattern in (9) is robustly attested for stative verbs and stative *-us* nominals of many different kinds.

3 In this example, and many of the examples that follow, it is licit to phrase the subject here as a noun-noun compound in which the first noun is genitive i.e., *matemaatikaarmastus*. While this is superficially similar to the possessor construction, it is prosodically distinct, and also not fully productive, as the first noun in the compound cannot be a proper name or a pronoun.

2.2 States take obligatorily partitive objects

Many Finnic languages, including Finnish, Estonian, Votic, Veps, and Livonian, are well-known for direct object case marking correlating roughly with aspectual properties of the predicate, though a fully predictive description of what those properties are has been famously elusive (Kiparsky 1998, 2001; Tamm 2008; Csirmaz 2012; Lees 2015). Direct objects in Finnic are morphologically marked either with accusative or partitive case. Very roughly speaking, accusative objects mark events that are telic, bounded, or perfective. By contrast, partitive objects mark events that are atelic, unbounded, or imperfective. We will revisit this characterization in §3.

In Estonian, as in the other languages, a large number of verbs (called 'partitive verbs') take only partitive objects, and not accusative ones.[4] Notably, the class of partitive verbs is claimed to include all stative verbs (Erelt et al. 1995; Craioveanu 2014), exemplified by *kartma* 'fear' in (10):

(10) Ma kardan ämblikke/*ämblikkud.
I fear spiders.PART/spiders.ACC
'I'm afraid of spiders.'

2.3 Defining states

Stative verbs, true to their name, are verbs which denote states. States are eventualities which are durative, but do not involve change (Vendler 1967). Another way of saying this is that states are internally homogeneous; every proper subpart of a state is itself a state of the same kind (Dowty 1979; Kearns 1991). From this fact it follows that states do not have natural temporal boundaries: if we cannot tell one subpart of a state from another, then we certainly cannot identify a *transition* from one part of that state to another either.

I demonstrate that the Affectedness Constraint for nominal passives and obligatory partitive case assignment hold robustly for stative verbs of different argument configurations. There are numerous grammatical diagnostics for stativity, largely capitalizing on their homogeneity: they cannot be complements of verbs like *force*, they cannot occur as imperatives, and they cannot be modified by deliberative adverbs such as *carefully* (Lakoff 1966; Dowty 1979). The statives discussed in this section all pass these tests with flying colors, though the application of these tests is omitted for space.

Because we are only interested in what happens to the direct objects of

4 Unlike Finnish, Estonian lacks a dedicated morphological accusative case. Rather, non-partitive objects are morphologically genitive when singular and nominative when plural. There is debate in the literature about whether Estonian also lacks a syntactic accusative case, but for our purposes what matters is the contrast between partitive and non-partitive case. I follow Norris (2018) in treating these as morphological realization of syntactic accusative case and gloss them as ACC accordingly.

states, I will not discuss statives which do not take a direct object. In this section, we will see that the generalizations of interest hold robustly for stative verbs of varying argument configurations.

2.4 Subclasses of states

2.4.1 Subject-experiencer verbs

Subject-experiencer verbs can be grouped into two categories. The first consists of psych verbs which have nominative experiencers, such as *armastama* 'love' and *vihkama* 'hate', which we have seen assign partitive case to their objects and reject nominal passivization, as in (9).

Estonian also has experiencer verbs in which the experiencer is expressed preverbally and carries non-nominative case, thus it is less clearly a 'subject'. For allative-marked experiencer verbs like *meeldima* 'like' and *meenuma* 'recall, remember', the post-verbal argument generally takes nominative case. In corresponding nominalizations, this nominative object can surface as a preposed possessor.

(11) a. Mulle meenub minu lapsepõlv.
1SG.ALL recalls my childhood.NOM
'I remember my childhood.'
b. lapsepõlve meenutus
childhood.GEN rememberance
'childhood remembrance/memory of childhood'[5]

A small number of verbs, such as *valutama*, also have what appear to be preverbal subjects with adessive case, resembling possessor constructions (Erelt et al. 1995), though it is not clear that these subjects should be considered experiencers. Although the nominal counterpart of *valutama* is not an *-us* nominal, it does allow the postverbal nominal to prepose as well, though notably, is it not necessarily clear that this is a semantic argument of the nominal itself.

(12) a. Mul valutab hammas.
1SG.ADE hurts tooth.NOM
'My tooth hurts/I have a toothache.'
b. hamba valu
tooth.GEN pain
'tooth's pain'

In both (11) and (12), we have stative verbs with no partitive arguments, but which do permit the normally postverbal argument to function as a preposed possessor in the nominal domain.

5 See the song 'Lapsepõlve meenutus' by Anne Veski (1985).

2.4.2 Object-experiencer verbs

Object-experiencer statives are semantically similar to their subject-experiencer brethren, but assign experiencer roles to their objects, such as *tüütama* 'bother, annoy'. In some cases, these verbs are counterparts of subject-experiencer verbs, in that they describe the same situation but with a reversed mapping of thematic roles onto syntactic arguments (Pesetsky 1995; Landau 2010: a.o.). This is the case for the OE verb *hirmutama* 'frighten', which is the OE counterpart of the subject-experiencer verb *kartma* 'fear'. Notably, few of these verbs, if any, seem to alternate with an *-us* nominal, so it is difficult to assess the Affectedness Constraint for these nominals.

(13) a. Ämblikud hirmutavad Priitu/*Priidu.
spiders frighten Priit.PART/GEN
'Spiders frighten Priit.'

2.4.3 Measure verbs

Measure verbs are those whose complements describe the degree to which a particularly property holds of the subject. Verbs in this class include *kaaluma* 'weigh' and *ulatuma* 'span'. Because the complements of these verbs are typically numerical expressions, it is not straightforward to determine their case, since numerals always assign partitive case to whatever they modify. It is also difficult for this reason to know whether to attribute the badness of the corresponding nominal passive to a clash between possessive genitive case and numerical partitive case.

(14) a. Sild ulatub 10 miili üle vee.
bridge spans 10 mile.PART across water
'The bridge spans 10 miles across the water.'
b. *10 miili ulatus
10 mile.GEN span
Intended: '10 miles' span'

2.4.4 Modal verbs

Modal verbs are a small class, arguably similar to subject-experiencers, though I consider their nominalizations separately following Alexiadou (2011). Like vanilla subject-experiencers and measure verbs, verbs of modal state require partitive objects and their corresponding nominals cannot passivize.

(15) a. Lapsed vajavad armastust/*armastus.
children need love.PART/love.ACC
'Children need love.'

b. *armastuse vajadus
   love.GEN need
   Intended: 'The need for love'

2.4.5 Spatial-orientation verbs

Kratzer (2000) observed that verbs of spatial orientation often have both stative and eventive readings; one can force the stative reading with an non-agentive subject. For instance, *ümbritsema* 'surround' and *hõlmama* 'cover' have both eventive and stative readings. While both partitive and accusative case are possible on objects of these verbs, that is only the case if the subject is agentive; otherwise, only partitive objects are possible.

(16) a. Tara ümbritseb aeda/*aia.
   fence surrounds garden.PART/garden.ACC
   'The fence surrounds the garden.'
b. Armee ümbritseb aeda/aia.
   army surrounds garden.PART/garden.ACC
   'The army is surrounding the garden.'

This dichotomy is also reflected in the nominal passive. The passive forms of spatial orientation nominals are licit, but only in a context in which it is clear that the nominal is describing an event. For instance, the Estonian equivalent of a passive *by*-phrase, a PP headed by the postposition *poolt*, may only contain an agentive DP when paired with such a nominal passive:

(17) aia ümbritsus *tara/armee poolt
   garden.GEN surrounding fence/army by
   'The surrounding of the garden by the fence/army'

It has been claimed by Tamm (2004) that a subclass of these verbs, namely verbs of division like *poolitama* 'halve', are unique among stative verbs in that they *only* admit accusative objects. She does not provide specific aspectual tests to support the notion that such uses of these verbs are indeed stative, and I have not been able to replicate her judgments. Rather, I found that a partitive-marked object with *poolitab* was not only grammatical, but is indeed truly stative. For instance, *poolitama* with a partitive object cannot combine with an *in x time* adverbial, which can only modify telic predicates:

(18) Jõgi poolitas naabruskonda kaheks võrdseks osaks
   river divided neighborhood.PART two.TRNSL equal.TRNSL part.TRNSL
   (*viie aastaga).
   five year.COM
   'The river divided the neighborhood in two equal parts (*in five years)'
   (Adapted from Tamm 2004: 101)

Rather than being an accusative-assigning stative, I suggest that *poolitama* is of a kind with other spatial verbs: it has a life both as a stative and eventive predicate, and when genuinely stative, it behaves as other statives and assigns partitive case to the direct object.

2.5 Summary

Across several semantic subcategories, the behavior of stative verbs and their cognate nominals appears to track very closely. If a verb is interpreted statively, it must assign partitive case to its direct object (should it have one); if a nominal is interpreted statively, the equivalent argument to the partitive-marked object of the verb cannot surface as a prenominal possessor. For the handful of stative verbs whose postverbal arguments are non-partitive, such as non-nominative subject experiencers, passivization of the equivalent nominal is possible, suggesting that partitive case assignment in the verbal domain mutually entails inability to passivize in the nominal domain.

3 Affectedness and Partitive Case

3.1 Partitive case beyond states

In what we have seen so far, there is a clear link between stativity and partitivity. However, partitive objects in Estonian also surface in other linguistic contexts. Simplifying quite a bit, while accusative objects mark ‘bound’ or perfective events, partitive objects tend to correspond either to an imperfective interpretation of the event, or some indeterminate quantity of the object (19). Additionally, partitive case on objects is obligatory under sentential negation, regardless of the aktionsart of the verb (20):

(19) a. Arvo kooris kartul.
Arvo peeled potato.ACC
‘Arvo peeled the potato.’
b. Arvo kooris kartulit.
Arvo peeled potatoe.PART
‘Arvo was peeling the potato.’/‘Arvo peeled some of the potato.’

(20) Liis ei lugenud raamatut/*raamatu.
Liis NEG read.PAST.NEG book.PART/book.ACC
‘Liis didn’t read the book.’

We cannot appeal only to stativity itself in generalizing about the partitive case. However, what stativity, imperfectivity, and negation all have in common is the absence of a natural ‘endpoint’, or what is commonly referred to as ‘boundedness’ in literature on Finnic. I believe that the close kinship between partitive objects of verbs and unpassivizability of nominals reveals that the notion of Affectedness itself is the right cut to make:

(21) **Partitive Case Assignment Generalization (PCAG)**
Non-Affected direct objects get assigned partitive case.

In what follows, I will show that the PCAG can account for object partitivity in Estonian across all three syntactic-semantic environments: in complements of stative verbs, under negation, and in imperfective contexts. I also show that apparent counterexamples to the PCAG, verbs which assign partitive case to their objects are but have Affected objects, are in fact not counterexamples at all. I then compare the PCAG to other semantic generalizations about partitive case assignment, and conclude that the PCAG provides greater empirical coverage.

3.2 Negation

The PCAG correctly predicts that the objects of stative verbs are necessarily partitive. Given the assumption that negation 'stativizes' eventive verbs (i.e. turns them into homogenous eventualities), the PCAG also predicts objects under sentential negation to receive partitive case (Mittwoch 1977; Verkuyl 1993). For instance, if we examine a canonical negated event like (22):

(22) Ta ei söönud šokolaadi/*šokolaad.
3sg neg eat.past.neg chocolate.part/chocolate.acc
'She did not eat chocolate.'

The structure of the (non-)eventuality in (22), insofar as there is one, is completely homogeneous, perhaps vacuously so. More to the point, in a situation which is completely and accurately described by (22), the chocolate does not change at all. Simply put, there is no sense in which an object can be affected by an event which does not occur.

3.3 Imperfective events

The perhaps most well-known environment in which partitive objects show up in Estonian is in imperfective contexts (Craioveanu 2014 and references therein), exemplified in cases like (23).

(23) Arvo kooris kartulit.
Arvo peeled potato.part
'Arvo was peeling the potato.'

Roughly speaking, the imperfective is an aspectual category which makes 'explicit reference to the internal temporal constituency of a situation', in contrast with the perfective, which ‘presents the totality’ of an eventuality , in the words of Comrie (1976). There are as many theories of the imperfective as there are papers written about it, and its empirical profile exhibits a good deal of cross-linguistic variation (Arregui et al. 2014). What is relevant for our purposes here is whether sentences like (23) involve affectedness of the direct object.

Recall that the object of (23) is Affected if there is a subevent of the eventuality described by the sentence in which the potatoes are an argument and Arvo is not. The reasonable candidate for such a subevent would be the result state of the peeling event, in which the potatoes are peeled but Arvo is uninvolved, analogous to other accomplishments. In other words, does the situation described by (23) result in *culmination* of the peeling event?

Decisively, the answer is no. It is contradictory to follow an utterance of (23) with an assertion that the potato is indeed peeled. On the other hand, this follow-up is *not* contradictory after a minimally different version of (23) in which the direct object is accusative.

(24) a. Arvo kooris kartulit, #nii kartul on kooritud.
Arvo peeled potato.PART so potato is peeled
‘Arvo was peeling the potato, #so the potato is peeled.’
b. Arvo kooris kartul, nii kartul on kooritud.
Arvo peeled potato.NOM so potato is peeled
‘Arvo peeled the potato, so the potato is peeled.’

I take this to provide evidence that the imperfective event described by (23) does not include the result state of peeling. What is not immediately clear is whether it is (phonologically null) imperfective aspect which licenses partitive case on the object, or the semantics of partitive case within the VP compositionally deriving imperfectivity. While both possibilities are compatible with the PCAG, they do have very different consequences for the syntax and semantics of object case assignment; I leave this important question to further research.

3.4 Potential Counterexamples

So far, the PCAG seems to hold of states, negated objects, and imperfectives, though other environments for partitive objects have been claimed. Notably Erelt et al. (1995), in the Estonian grammar *Eesti Keele Grammatika*, claim that a significant number of partitive verbs–verbs whose objects must be partitive–are in fact eventive, though do not receive inherently imperfective interpretations.

Their list of non-stative partitive verbs can be broadly divided into two categories. The first category consists of Vendlerian activities like *kahjustama* ‘damage’ and *kaunistama* ‘decorate’. If these verbs do indeed only take partitive objects, this is a problem for the PCAG, because transitive activity verbs can reliably be coerced into accomplishments; however, as Tamm (2004) notes, one does not have to look far to find naturally-occurring examples of these verbs occurring with accusative objects. Moreover, the arguments corresponding to the direct objects of these verbs can surface as preposed possessors of cognate nominals.

(25) a. Rahe kahjustas autosid/autod.
hail damaged cars.PART/cars.ACC
'Hail damaged the cars.'
b. autode kahjustus
cars.GEN damage
'the cars' damage' (the damage the cars received)

(26) a. Sisekujundaja kaunistas tuba/toa.
interior.designer decorated room.PART/room.ACC
'The interior designer decorated the room.'
b. toa kaunistus
room.GEN decoration
'the room's decoration' (by the interior designer)

This suggests that this subclass of 'partitive verbs' are really not partitive verbs at all, but rather fairly ordinary activities: though they lexically describe atelic eventualities can receive telic (and thus bounded) interpretations given the right context. For instance, the verb (26a), when it occurs with an accusative object, is interpreted as an accomplishment consisting of two distinct subevents: an activity in which the room is being decorated, and a result state in which the room has been successfully turned from drab to fab. The latter state satisfies the AC, so it does not receive partitive case.

The second subclass of non-stative partitive verbs, and more challenging for the PCAG, are semelfactives: verbs which describe punctual or instantaneous events[6] with no internal structure, such as *noogutama* 'nod', *helistama* 'ring, call', *vangustama* 'shake (one's head)', and *liputama* 'wave, wag' (see discussion of semelfactivity in Comrie 1976).[7] A core property of semelfactive verbs is that they can be used in ways which combine with durative adverbials like *for x time*, in which case they typically receive an iterative interpretation. In effect, the semelfactive predicate describes a minimal non-durative event, which can be coerced into an activity if interpreted iteratively (Levin 1999).

If the PCAG were merely sensitive to predicate (a)telicity, as opposed to Affectedness, we would expect that non-iterative semelfactives would not take partitive case, assuming that instantaneous events are telic and therefore bounded. However, we see that objects of these semelfactive verbs are obligatorily partitive regardless of whether the event is interpreted iteratively (as with a *for x time*

6 That is to say, perceptually instantaneous.

7 Erelt et al. do not claim that *every* semelfactive is a partitive verb, though their list includes many semelfactives. A study of semelfactive verbs at the scale of the entire lexicon is needed to decisively determine whether all semelfactives only take partitive objects.

adverbial) or non-iteratively:

(27) a. Mees vangustas pead/*pea kaua aega.
man shook head.PART/ACC long time
'The man shook his head for a long time.'

b. Mees vangustas pead/*pea ainult üks kord.
man shook head.PART/head.ACC only one time
'The man shook his head only once.'

The partitivity of semelfactive verbs like *vangustama* demonstrate that atelicity is indeed not the right characterization of the environment in which partitive objects appear. However, although the event described by (27b) is punctual, and therefore telic, it does not involve an Affected object. A man can shake his head as many times as he wants, but that does not entail a change of state of his head. Though in practice the man might get a bit dizzy, his head remains fundamentally unchanged before and after being shaken. In the absence of this kind of change of state, there is no subevent one can identify which has the man's head as a semantic argument, but not the man himself.[8]

Summing up, an examination of Erelt et al.'s potential counterexamples does not reveal genuine threats to the PCAG. Of the verbs they claim are partitive, some are stative (and indeed genuine partitive verbs which obey the the PCAG), some are activities which admit accusative objects when interpreted as accomplishments, and some are semelfactives, which although they have a life as telic predicates, they crucially do not entail Affectedness of their direct objects, and thus are partitive verbs as the PCAG would have it.

3.5 Alternative generalizations

I have proposed that the (lack of) Affectedness of an object is the relevant notion which determines whether it gets partitive case. I examine here other prominent generalizations, and argue that they do not achieve the same empirical coverage as the PCAG.

3.5.1 Syntax is not enough

Syntactic proposals which explicitly analyze partitive case assignment Estonian (as opposed to Finnish) are relatively rare, though a notable attempt to unify the disparate environments for partitive case assignment in Finnish and Estonian is that of Craioveanu (2014). He proposes formal 'non-quantization' feature $[\beta]$ is responsible for partitive case. In his proposal, there is an unvalued $[u\beta]$ feature

8 This is not merely because the man inalienably possesses his head, as partitive objects are also obligatory in other semelfactive predicates such as *helistama kella* 'ring the bell'. Erelt does not claim that all semelfactives are partitive verbs, although the current analysis would predict that.

on the head of every KP (Case Phrase) which must probe for a $[i\beta]$. If $[\beta]$ on DP becomes valued, this results in partitive case assignment. Crucially, he proposes that $[i\beta]$ can be present on verbs, inner aspect, negation, or be DP-internal–covering the bases of contexts where partitive case appears.[9] Stative verbs, then, come packaged with $[\beta]$ in Estonian, though not necessarily so in Finnish.

Though a robust account of how partitive case is assigned in the syntax is no doubt necessary, we cannot have an adequate account of the Estonian partitive without appealing to semantics. Indeed, while it is commonly assumed that partitive is a structural case on direct objects (see e.g. Kiparsky 2001), partitive case assignment in Estonian and Finnish has an undeniable semantic flavor. Craioveanu acknowledges that his $[\beta]$ must have a potent semantics, and though he explores possible options, he stops short of outright committing to one.

3.5.2 Partitivity as Parthood

Krifka (1992) was the first to explicitly formalize a proposal about Finnish partitive case assignment in purely semantic terms. Essentially, he proposes that partitive case denotes a 'parthood' predicate modifier:

(28) $[\![\text{PART}]\!] = \lambda P \lambda x' \exists x[P(x) \wedge x' \sqsubseteq x]$ (Krifka 1992: 47)

PART applied to a one-place predicate denotes the set of entities which are subparts of the entities in the set denoted by that predicate. This formulation is explicitly analogized as a sort of nominal imperfectivity; the imperfective for Krifka denotes a similar parthood operator over events. Thus, our familiar potato-peeling example could have the denotation in (29b), modulo tense and assuming indefiniteness of the object for ease of composition:

(29) a. Arvo kooris kartulit.
Arvo peeled potato.PART
b. $\exists y[\exists x[\mathbf{potato}(x) \wedge y \sqsubseteq x] \wedge \mathbf{peel}(a)(y)]$

This is equivalent to saying that there is some potato of which Arvo peeled a part. But as Kiparsky (1998) points out and Krifka shows, in order for partitive objects to yield genuinely imperfective readings on Krifka's account, we need certain assumptions about the relation between events and partitive objects. Namely, there is a relation between event-parthood and object-parthood of the following sort: an event of peeling part of a potato is part of an event of peeling a potato, and vice versa. With these assumptions, (29) has a denotation which is indistinguishable from the Krifka imperfective (his PROG), which is identical to PART except ranges over events instead of individuals:

9 This also has the consequence of requiring a model of Agree which is both cyclic (Béjar and Rezac 2009) and bidirectional, since some elements which host $[\beta]$ are below K, and others above.

(30) $[\![\text{PROG}]\!] = \lambda P \lambda e' \exists e[P(e) \wedge e' \sqsubseteq e]$ (Krifka 1992: 47)

This is a reasonable proposal for incremental themes like *peel*, but as Kiparsky notes, the parthood analysis makes problematic predictions about complements of stative verbs, since there is not a straightforward sense in which a stative relation 'only' holds of subparts of the direct object of a stative verb. For example, it is not at all clear that *loving mathematics* can be true if one loves Fermat's Last Theorem and detests all other things mathematical. It would also be difficult to explain why partitive case should be required on objects of negated verbs, where ostensibly parthood is not a relevant consideration.

In all, Krifka's analysis captures the intuitive facts about imperfectivity with some verbs, but appears to derive intuitively incorrect meanings with stative verbs, and struggles to unify imperfectivity with other uses of the partitive case. On the other hand, the PCAG appears to capture more of the relevant data.

3.5.3 *Diversity, divisiveness, and cumulativity*

Kiparsky (1998), for his part, proposes that partitive objects are licensed only in 'unbounded' predicates, again in Finnish. A predicate P is unbounded iff it has the three following properties:

(31) a. $\forall x[P(x) \wedge \neg atom(x) \rightarrow \exists y[y \sqsubset x \wedge P(y)]]$ DIVISIVENESS

b. $\forall x[P(x) \wedge \neg sup(x,P) \rightarrow \exists y[x \sqsubset y \wedge P(y)]]$ CUMULATIVITY

c. $\neg(\forall x \forall y[P(x) \wedge P(y) \wedge x \neq y \rightarrow \neg x \sqsubset y \wedge \neg y \sqsubset x])$ NON-DIVERSITY

Divisiveness and cumulativity conspire to ensure that if an event of *peeling a potato* can be unbounded even if the entire potato, or the smallest possible subpart of the potato, was peeled. The condition on non-diversity simply ensures that if the direct object which does not have proper subparts (i.e., it is purely atomic) the event as a whole is bounded.

Kiparsky's analysis again fares well with incremental theme verbs, although it is less clear how well this generalization holds up for stative verbs. The non-diversity condition is tailor-made to treat predicates with definite direct objects as bounded. But as we have seen, proper names in Estonian, like other nominals, obligatorily receive partitive case as objects of stative verbs. A verb phrase like *love John*, for instance, would seemingly violate the non-diversity condition, unless we somehow say that loving John involves loving subparts of John.

Finally, the partitive under negation is also problematic (though not insurmountably) if we assume that the locus of partitive case assignment is strictly about the predicate (i.e., the VP), since partitive objects under negation are required regardless of the boundedness of the predicate.

In sum, semantic generalizations about partitive case assignment which operate only at the level of predicates or nominal parthood both struggle to capture the behavior of Estonian stative verbs, whereas the PCAG can not only unify partitive case assignment across objects in various contexts, but also relate commonalities between behavior in the verbal and nominal domains.

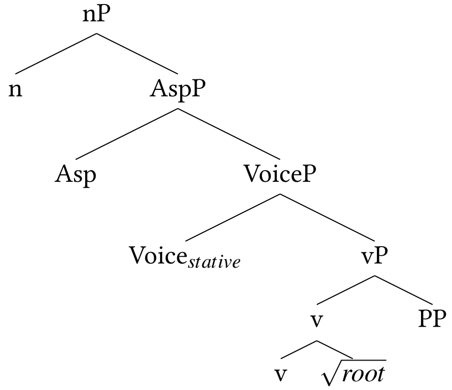
4 Whence the Affectedness Constraint?

It is generally believed that the Affectedness Constraint in the nominal domain is a reflex of deficient argument or event structure, it is no surprise at all that the nominal passive is impossible for statives (e.g. Grimshaw 1990; Doron and Rappaport Hovav 1991; Sichel 2010). For instance, it has been proposed that some or all statives lack Davidsonian eventuality arguments altogether (e.g. Kratzer 1995; Maienborn 2005). And if the AC for nominals can be unified with the PCAG for verbs, it stands to reason that the source of the AC must derive from some commonality between these two domains. This is not a straightforward question to answer, as it is debated whether or not eventive/stative nominals are derived from verbs or acategorial roots. If these nominals are verb-derived, then whatever shared component which is sensitive to Affectedness could live in the verbal projection. On the other hand, if both nominals and verbs are root-derived, then clearly the AC must be derivable from properties of roots. In this section, I suggest that the latter is more plausible.

4.1 The root of the AC

The question of what, exactly, is responsible for the AC is perhaps easiest to investigate stative nominals because of their presumed structural simplicity. Though explicit characterizations of the structure of stative nominals are relatively scant, a prominent exception is Alexiadou (2011). Building on Borer (2005), she proposes that statives in Greek in both the verbal and nominal domains contain some event structure, though not much: namely, they contain of an Asp(ect)P projection. Transitive statives include a $\text{Voice}_{stative}$ projection which introduces the external argument, and the second argument is introduced with a (possibly null) preposition. Corresponding nominals simply compose AspP with a nominalizing *n*. Her resulting structure for a transitive stative nominal (in Greek) is as follows:

(32)



The chief argument that AspP (and therefore verbal event structure) is present in stative nominals is the compatibility of such nominals with *for x time* adverbials (Borer 2005). While Alexiadou claims these constructions are good in Greek, in Estonian, such adverbials are judged to be fairly degraded with stative nominals:

(33) ??Marja armastus matemaatika vastu kaua aega
Marja.GEN love mathematics.GEN for long time
'Marja's love of mathematics for a long time'

Beyond these adverbials, there is little overt evidence in Alexiadou's analysis which supports the claim that stative nominals contain any verbal structure. For Estonian, there is a lack of compelling language-internal reasons to believe that *-us* nominals are verb-derived. As Iordachioaia et al. (2015) argue for psych verbs, I propose instead that stative nominals, and indeed perhaps event nominals, in Estonian are root-derived across the board.

One piece of evidence comes from the absence of unambiguous verbal morphology in stative nominals. Nominals which can be stative or eventive generally display no clear morphological alternation (see §2.4.5), and some nominals cognate with stative verbs have idiosyncratic interpretations which are not explicitly derivable from their verbal counterparts; indeed, a number of them do not clearly refer to eventualities at all (cf. Smirnova and Jackendoff 2017).

(34)

teadus	'science'	(cf. *teadma* 'know')
hoius	'bank deposit'	(cf. *hoidma* 'hold, keep')
katus	'roof'	(cf. *katma* 'cover')
tunnus	'feature'	(cf. *tundma* 'feel')

While we should not stake our claim that stative nominals don't contain verbal elements purely on the existence of lexical exceptions, more challenging for the view that stative (or indeed eventive) nominals must contain verbal content is that some eventuality-denoting *-us* nominals either lack a clear verbal counterpart to begin with, or alternate with a verb that contains explicit verbalizing morphology, such as the suffix *-stama*, which derives verbs from nouns or other verbs (Erelt et al. 1995), suggesting that these stative nominals are not verb-derived.

(35) *vargus* 'theft' (cf. *varas* 'thief', *varastama* 'steal')
kurbus 'sadness' (cf. *kurb* 'sad', *kurvastama* 'sadden')
ausus 'honesty' (cf. *aus* 'honest')
iharus 'lewdness' (cf. *ihar* 'lewd')

We also cannot simply chalk stativity up to the influence of *-us* itself, as the Estonian lexicon is replete with nominals derived from nouns and adjectives which do not refer to eventualities:

(36) *jumalus* 'deity' (cf. *jumal* 'god')
värvus 'color (mass)' (cf. *värv* 'color (count)')
sõrmus 'ring' (cf. *sõrm* 'finger')

A final nail in the coffin for the notion that stative nominals necessarily contain verbal structure is that stative *-us* nominals can be modified by adjectives but not adverbs, unlike gerundive *-ine* nominals, which do permit adverbial modification.

(37) a. valuline mälestus sõja
painful remembrance war.GEN
'painful remembrance of the war'

b. *mälestus valusalt sõja
remembrance painfully war.GEN
intended: 'painful remembrance of the war'

(38) mälestine valusalt sõja
remembering painfully war.GEN
'(the) remembering painfully of the war'

I take the total of these observations to indicate that stative *-us* nominals are simply derived by combining with roots directly, crudely schematized as follows:

(39) a. $\sqrt{\text{ARMAST}}$ + *-us* = *armastus* 'love (N)' (cf. *armastama* 'love (V)', **armast*)
b. $\sqrt{\text{EELIST}}$ + *-us* = *eelistus* 'preference' (cf. *eelistama* 'prefer, **eelist*)
c. $\sqrt{\text{US}}$ + *-us* = *usus* 'faith' (cf. *uskuma* 'believe', **us*)

I make no claim about the locus of this derivation, be it in the syntax proper or in the lexicon, if those are indeed distinct. However, the fact that stative nominals are robustly sensitive to AC, even if they contain no embedded verbal structure, leads to the conclusion that the locus of the Affectedness Constraint must be within the stative roots themselves.

5 Conclusion

Though stative verbs remain relatively understudied in work on argument and event structure, their aspectual homogeneity and restricted syntactic distribution render them a valuable testing ground for theories on the relationship between phrasal syntax and argument/event structures.

Statives in Estonian have a deficient syntactic profile compared to eventives in both verbal and nominal domains: stative verbs can only assign partitive case to direct objects, and stative nominals cannot passivize. Case assignment and the nominal passive have been argued, on independent grounds, to be restricted by similar constraints on event structure. In the absence of strong evidence for deriving stative nominals from their verbal counterparts (or vice versa), I suggested this leads us to conclude that the syntactic effects of Affectedness must come from the lexical semantics of roots, given that nominals which are sensitive to the AC don't seem to have verbal structure, although it is an open question what precise component of the lexical semantics gives rise to the AC.

It also remains to be seen how well the PCAG can be extended to other languages, notably Finnish. The comparison between the two could prove enlightening, because while the facts of partitive case in the two languages are very similar, they have crucial differences; for instance, some stative verbs in Finnish permit accusative objects (Craioveanu 2014). Future work will be needed to determine the extent to which these potential counterexamples pose a problem for the PCAG, and if they do, how this generalization will needed to be revised.

Finally, this proposal is in large part consonant with frameworks like Distributed Morphology (Halle and Marantz 1993: *et seq.*), in which words are composed of acategorial roots which combine with functional heads which turn the root into a lexical category, such as noun or verb. More generally, if this work is on the right track, it suggests that while functional elements may do a significant amount of heavy lifting in constraining linguistic structure, ultimately, lexical semantics is at the root of it all.

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Pronouns and attraction in Sierra Zapotec*

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Abstract Many languages have clitic or weak pronouns, which are displaced from their base argument position. What causes these pronouns to move, and what does pronoun movement have to tell us about displacement, more generally? We examine two classes of pronouns in Sierra Zapotec, which exhibit a distributional asymmetry: while clitic pronouns are perfectly grammatical without an accompanying independent pronoun, an independent pronoun often requires an accompanying clitic. We explore to what extent this asymmetry can be attributed to a theory in which pronoun movement is triggered by the properties of a functional head, as in an attraction theory of movement. This investigation provides a new perspective on the structural and derivational relationships between pronominal classes, as well as between classes of nominal arguments.

1 Why do pronouns move?

In many languages, pronouns regularly fail to surface in the same position as non-pronominal arguments (henceforth, *full DPs*). In one famous case, object shift in Scandinavian, a weak pronoun is obligatorily displaced, when certain conditions are met (1). In other languages, such as French, an independent pronoun must be doubled by a clitic, which itself is obligatorily displaced (2).

(1) *Object shift (Danish)*

a. Du husker **ham** sikkert ikke.
you remember **him** probably not
'You probably don't remember him.'

b. *Du husker sikkert ikke **ham**.
you remember probably not **him** (Mikkelsen 2011: 232–233)

(2) *Clitic doubling (French)*

a. Jean **me** connait **(moi)**.
Jean **me** knows **me**
'Jean knows me.'

* We are extremely grateful to Fe Silva Robles, Isidro Vázquez Jerónimo, Raul Díaz Robles, Rosario Reyes Vázquez, and two other speakers of Zapotec for their generosity in teaching us about their language. We also appreciate the questions and comments from audiences at UC Santa Cruz and UCLA.

b. *Jean connait **{me, moi}**.
Jean knows **me, me** (Kayne 2000: 163–164)

Why is this? What is the trigger for pronoun movement, and what can we learn about displacement, more generally, from it?

While pronoun movement is a widespread phenomenon, it has been studied most extensively in Romance and Germanic. Our focus here will be on pronoun movement in Sierra Zapotec, a group of Zapotec varieties from the southeastern Sierra Norte of Oaxaca, Mexico.[1] Clitic pronouns cannot occur in an argument's base position, only in a designated position immediately following the verb.

(3) *Sierra Zapotec*

Shtahs=**a'** **(nada')**.
sleep.CONT=**1SG** **1SG**
'I am sleeping.' (FA/RM, GZYZ051, 51:24)

Sierra Zapotec also has independent pronouns, which are not obligatorily displaced (though they are, under certain conditions, doubled by a clitic).

The behavior of these two classes of pronouns finds a parallel in other languages. In French, as in (2) above, the clitic must move, while an independent pronoun can stay in an argument's base position. In Scandinavian, the division is, at least superficially, into non-stressed pronouns, which must move, as in (1) above, and stressed pronouns which need not move, as in (4).

(4) *Danish*

...men du husker sikkert ikke **HAN**.
but you remember probably not **him**
'...but you probably don't remember HIM.' (Mikkelsen 2011: 233)

Based on facts like these, a substantial line of work has emerged that takes pronoun movement to be driven by what Chomsky (1993) calls "greed" (Roberts and Shlonsky 1996; Cardinaletti and Starke 1999; Holmberg 1999; Koopman 1999). The displacement patterns in Romance and Germanic lend themselves naturally to the view that it is the pronoun itself that bears the trigger for movement, since this makes it easy to state the fact that only pronouns, and often only a subset of pronouns, are targeted. The question, of course, then becomes why it is just these nominal elements that bear the relevant movement trigger.

1 The data presented here are based on the judgements of three Zapotec speakers who grew up in the towns of San Sebastián Guiloxi, Santiago Laxopa, and Santa María Yalina and now reside in California (Santa Cruz and Los Angeles). These varieties are all highly mutually intelligible, and are most closely related to the Zapotec spoken in San Bartolomé Zoogocho (Sonnenschein 2004), Hidalgo Yalálag (López and Newberg 2005; Avelino Becerra 2004), and San Baltazar Yatzachi el Bajo (Butler 1980).

There are reasons, however, to doubt that pronoun movement is driven entirely by considerations of greed. On a conceptual level, Sichel (2001, 2002) argues that this would make the displacement of pronouns entirely distinct from other kinds of movement, such as wh-movement, which are motivated by requirements of the position to which an element moves, as in a theory of attraction (Chomsky 1995, 2000). Based on a detailed examination of pronominal doubling in Celtic (Welsh and Breton) and Standard Arabic, Sichel also offers empirical reasons that pronoun movement is driven, at least in part, by attraction. In these languages, strong pronouns, which do not themselves move, are doubled by raised pronominal element. Such patterns point to the essential role for a functional head (the probe), which satisfies its needs by searching and moving an eligible pronoun (the goal) in its domain.

There are other empirical reasons for rejecting a greed-only based approach. Many languages constrain the combinations of clitic or weak pronouns that are possible, e.g. Person–Case Constraints (5) (Perlmutter 1971; Bonet 1991) and Gender–Case Constraints (6) (Foley and Toosarvandani, to appear).

(5) *Person–Case Constraint (Spanish)*

a. Pedro **me** **lo** envía.
Pedro **1sg** **3sg.m.acc** send.pres.3sg
'Pedro sends it to me.'

b. *Pedro **le** **me** envía.
Pedro **3sg.m.dat** **1sg** send.pres.3sg
Intended: 'Pedro sends me to him.'
(Ormazabal and Romero 2007: 316–317)

(6) *Gender–Case Constraint (Sierra Zapotec)*

a. Bdel=**ba'**=**b**.
hug.comp=**3.hu**=**3.an**
'S/he hugged it.' (RM, GZYZ012-s, 23)

b. *Bdin=**b**=**ba'**.
bite.comp=**3.an**=**3.hu**
Intended: 'It bit her/him.' (RM, GZYZ014, 33:30)

These asymmetrical hierarchy-sensitive constraints require multiple pronouns to interact with a single head (Anagnostopoulou 2003, 2005; Béjar and Rezac 2003; Nevins 2007, 2011, a.o). It is possible, of course, that distinct pronouns with distinct needs just happen to target the same position. But a more straightforward approach would attribute this convergence of needs to a single functional head, which attracts all the pronouns in its domain.

Our goal here is to bring pronoun movement deeper into the fold of the theory of attraction, as required by the considerations above. As in Sichel's analysis of Celtic and Semitic, we argue that the patterns of pronominal displacement and doubling in Sierra Zapotec are best understood in terms of attraction. As we will show, there is a distributional asymmetry between clitic and independent pronouns, which suggests a central role for a probe in their syntax. Whereas clitics are perfectly grammatical without an accompanying independent pronoun, an independent pronoun often requires an accompanying clitic. This asymmetry follows directly if pronoun movement is triggered by the properties of a functional head. While this is, in principle, compatible with the pronoun also having needs of its own, we will explore to what extent these can be eliminated altogether, or at least removed from the syntax by reducing them to phonological requirements.

2 Two types of pronouns in Sierra Zapotec

Sierra Zapotec has two series of pronouns: independent and clitic. The distinction between the series is not governed by case or grammatical function, as both appear in multiple syntactic environments: as subjects, direct objects, indirect objects, possessors, and prepositional complements. In this respect, these pronouns are similar to pronouns in French, Standard Arabic, and Celtic.

	Independent	**Clitic**
1sg.	*nada’ ∼ neda’*	*=a’*
2sg.	*lhe’*	*=o’ ∼ =u’*
3 el(der)	*le’*	*=e’*
3 hu(man)	*leba’*	*=ba’*
3 an(imal)	*leb*	*=(e)b ∼ =ba*
3 in(animate)	*lenh*	*=(e)nh*

Table 1 Pronouns in Sierra Zapotec

At the same time, the distribution of these pronouns is not free. In “neutral” contexts (broad focus or out of the blue) with subjects in the first or second person, only clitics can appear, as in (7a) and (8a). An independent pronoun is impossible, as in (7b–c) and (8b–c).

(7) (Bixtse’nh shlohk Maria? ‘Why is Maria upset?’)

a. We’ej=**a’** meskal tse=ba’.
drink.COMP=**1SG** mezcal of=3.HU
‘I drank her mezcal.’ (FA/RM, GZYZ054, 9:00)

b. *We’ej **nada’** meskal tse=ba’.
eat.COMP **1SG** mezcal of=3.HU (FA/RM, GZYZ054, 11:19)

c. #We'ej=a' **nada'** meskal tse=ba'.
drink.COMP=1SG **1SG** mezcal of=3.HU (FA/RM, GZYZ054, 10:10)

(8) (Bixtse'nh shlhoko'? 'Why are you upset?')

a. Dzonh=**o'** dzed nada'.
do.CONT=**2SG** bother 1SG
'You are bothering me.' (FA/RM, GZYZ048, 10:07)

b. *Dzonh **lhe'** dzed nada'.
do.CONT **2SG** bother 1SG (FA/RM, GZYZ054, 12:44)

c. #Dzonh=o' **lhe'** dzed nada'.
do.CONT=2SG **2SG** bother 1SG (FA/RM, GZYZ048, 10:21)

Independent pronouns surface in "non-neutral" environments: when the subject bears narrow focus in postverbal position, as the answer to a question (9a), when it undergoes focus movement (9b), or when it appears in a fragment answer (9c).

(9) (Nhu yega'an? 'Who is going to stay?')

a. Yega'an=o' **lhe'**.
stay.POT=2SG **2SG**
'You are going to stay.' (FA/RM, GZYZ051, 53:34)

b. Bitu yega'an=a', **lhe'**$_1$ yega'an=o' t_1.
NEG stay.POT=1SG **2SG** stay.POT=2SG
'I am not going to stay, you are.' (RM, GZYZ051, 57:13)

c. (Nhu yeyej? 'Who is going to go?')
Le'.
2SG
'You.' (FA/RM, GZYZ052, 1:02:58)

The third person pronouns show the same distribution: a clitic appears in neutral contexts (10a–c), while the independent form appears in non-neutral contexts (11a–c).

(10) (Bixtse'nh shlhoko'? 'Why are you upset?')

a. We'ej=**ba'** meskal tsi=a'.
drink.CONT=**3.HU** mezcal of=1SG
'S/he drank my mezcal.' (FA/RM, GZYZ054, 13:48)

b. #We'ej **leba'** meskal tsi=a'.
drink.CONT **3.HU** mezcal of=1SG (FA/RM, GZYZ054, 14:50)

c. *We'ej=ba' **leba'** meskal tsi=a'.
drink.CONT=3.HU **3.HU** mezcal of=1SG (FA/RM, GZYZ054, 15:47)

(11) a. (Nhu shtahs? 'Who is sleeping?')
Shtahs **leba'**.
sleep.CONT **3.HU**
'S/he is sleeping.' (FA/RM, GZYZ051, 55:02)

b. Bitu shtahs=a', **leba'**$_1$ shtahs t_1.
NEG sleep.CONT=1SG **3.HU** sleep.CONT
'I am not sleeping, s/he is.' (FA/RM, GZYZ048, 37:21)

c. (Nhu shtahs? 'Who is sleeping?')
Leba'.
3.HU
'Her/him.' (FA/RM, GZYZ052, 1:01:45)

But there are also differences between local and third person pronouns. In the third person, the two series of pronouns stand in a systematic morphological relationship: each independent pronoun is composed of the formative *le* and a clitic, e.g., *le* + *=ba'* = *leba'*.

We take this morphological parallel seriously: while there are two pronominal series in the first and second person, there is actually only one series in the third person, the clitic pronouns (Marlett 1993, 2010; cf. Sonnenschein 2004: 41 on Zoogocho Zapotec).

	Independent	**Clitic**
1sg.	*nada'* ∼ *neda'*	*=a'*
2sg.	*lhe'*	*=o'* ∼ *=u'*
3 el(der)	–	*=e'*
3 hu(man)	–	*=ba'*
3 an(imal)	–	*=(e)b* ∼ *=ba*
3 in(animate)	–	*=(e)nh*

Table 2 Pronouns in Sierra Zapotec (reinterpreted)

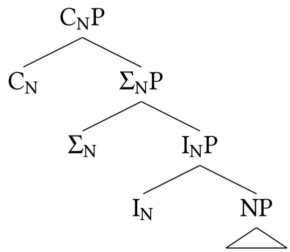
In the third person, the "independent" pronouns are constructed synthetically, by adding the formative *le* to the clitic. For first and second persons, clitic and independent pronouns are distinct elements.

As we will see, this way of viewing the morphological overlap in the third person is supported by the distribution of clitic and independent pronouns. Whereas a local independent pronoun is invariably accompanied by a clitic, as in (10), an independent third person pronoun is not, as in (11). This follows if the clitic to which the formative *le* attaches is of the same type as the clitic which accompanies the independent pronoun. There is simply no other pronominal element to do the doubling.

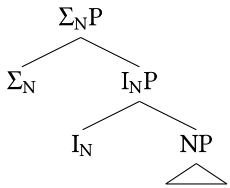
3 Some problems with pure greed

So why do some pronouns move? In a purely greed-driven theory, movement of the pronoun must be driven solely by the needs of the pronoun (Chomsky 1993; Bošković 2007). In one concrete implementation, a pronoun's need to move is associated with its structural size. Cardinaletti and Starke (1999), for instance, propose a tripartite typology of pronouns, in which strong pronouns are associated with the most amount of structure (12a), clitics are associated with the least (12c), and weak pronouns fall in between (12b).

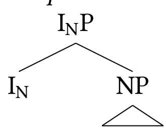
(12) a. *Strong pronoun*



b. *Weak pronoun*



c. *Clitic pronoun*

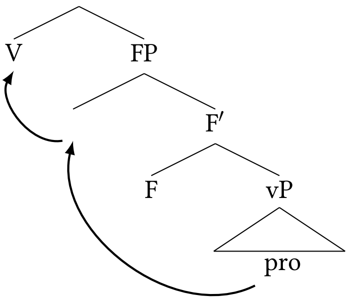


On this approach, weak pronouns and clitics are structurally deficient, while strong pronouns contain the nominal equivalent of a full CP (that is, they are DPs).

Extending Cardinaletti and Starke's typology to Zapotec, the independent pronouns would qualify as strong pronouns, generated with full nominal functional structure. Since strong pronouns are equipped with full functional structure, they are free to remain in situ, as well as surface, for instance, in A′-positions. They are also prosodically independent, bearing word or phrasal stress, and may associate with particles such as *also* or *even*.

Since clitic pronouns, on the other hand, are not equipped with elaborate functional structure (CN and ΣN), they must make up, externally, for what internal structure might otherwise provide. Most importantly, this drives clitics to move into a derived argument position (simply Spec-FP). They must then move again to find a prosodic host, e.g., the verb in initial position (see Adler et al. 2018 for the derivation of this word order in Sierra Zapotec).

(13)



Under this view, then, the clitics are greedy because of their syntactic need to move into a local relationship with a verbal functional head. While this part is shared with weak pronouns, clitics have an additional prosodic requirement, which forces them to cliticize to a host.

In a purely greed-based theory, these are the only reasons for movement; the head associated with the landing site imposes no requirements of its own. At first glance, the basic facts observed so far would seem to support such a theory. In neutral contexts, a local person pronoun must move.

(14) (Bixtse'nh xlhok Maria? 'Why is Maria upset?')

a. We'ej=**a'**$_1$ t_1 meskal tse=ba'.
drink.COMP=**1SG** mezcal of=3.HU
'I drank her mezcal.' (FA/RM, GZYZ054, 9:00)

b. *We'ej **nada'** meskal tse=ba'.
drink.COMP **1SG** mezcal of=3.HU (FA/RM, GZYZ054, 11:19)

However, a theory based purely on greed raises two immediate problems. The first set of facts shows that greed alone cannot account for the distribution of pronouns; the second set of facts shows that the requirement imposed by pronouns would not hold of all pronouns. In other words, some pronouns can fail to move; thus when they do move, this cannot be due to greed.

3.1 Problem 1

In non-neutral contexts, for local person pronouns, the subject clitic cannot be omitted; in other words, the independent pronoun cannot stand on its own.

(15) (Nhu yega'an? 'Who is going to stay?')

a. Yega'an=**o'** **lhe'**.
stay.POT=**2SG** **2SG**
'You are going to stay.' (FA/RM, GZYZ051, 53:34)

b. *Yega'an **lhe'**.
stay.POT **2SG** (FA/RM, GZYZ054, 22:47)

(16) a. Bitu yega'an=a', **lhe'**$_1$ yega'an=**o'** t$_1$.
NEG stay.POT=1SG **2SG** stay.POT=**2SG**
'I am not going to stay, you are.' (RM, GZYZ051, 57:13)

b. *Bitu yega'an=a', **lhe'**$_1$ yega'an t$_1$.
NEG stay.POT=1SG **2SG** stay.POT (FA/RM, GZYZ054, 24:15)

While focus might be a necessary condition for the presence of an independent pronoun, it is not sufficient: a clitic is also required. Thus, while a clitic is obligatory, whether accompanied by an independent pronoun or not, an independent pronoun may not be licensed without an accompanying clitic.

But why would the clitic be obligatory? This does not follow from a theory of movement as pure greed. Greed can only explain why, when a clitic is present, it must move. It cannot explain why a clitic is obligatory in the first place: in the absence of a clitic, its greedy properties cannot be invoked. Nor can the necessity of the clitic be explained as a function of the properties of the independent pronoun, since the independent pronoun can occur, in some contexts, in the absence of a clitic, as we show next. To the extent that the presence of a clitic with an independent pronoun is conditioned by the external syntactic environment, we are led to consider the contribution of a probe, as we will discuss in Section 4.

3.2 Problem 2

In the third person, clitics do not accompany independent pronouns. In neutral contexts, only a clitic on the verb is possible, just as with first and second persons.

(17) (Bixtse'nh shlhoko'? 'Why are you upset?')

a. We'ej=**ba'** meskal tsi=a'.
drink.CONT=**3.HU** mezcal of=1SG
'S/he drank my mezcal.' (FA/RM, GZYZ054, 13:48)

b. #We'ej **leba'** meskal tsi=a'.
drink.CONT **3.HU** mezcal of=1SG (FA/RM, GZYZ054, 14:50)

c. *We'ej=**ba'** **leba'** meskal tsi=a'.
drink.CONT=**3.HU** **3.HU** mezcal of=1SG (FA/RM, GZYZ054, 15:47)

In non-neutral contexts, an independent pronoun is necessary. Again, this is just like first and second person. A third person independent pronoun, however, cannot be accompanied by a clitic.

(18) (Nhu shtahs? 'Who is sleeping?')

a. Shtahs leba'.
sleep.CONT 3.HU
'S/he is sleeping.' (FA/RM, GZYZ051, 55:02)

b. *Shtahs=**ba’** leba’.
sleep.CONT=**3.HU** 3.HU (FA/RM, GZYZ054, 25:35)

Third person pronouns raise at least two general questions. First, why is an independent pronoun grammatical without a clitic, unlike the doubling that is obligatory in local persons? Second, why is doubling impossible in the third person? There are answers to both questions in the morphological parallelism between independent and clitic pronouns in the third person. If the independent pronoun contains a clitic that has not moved, then they will not be able to co-occur: they are one and the same element.

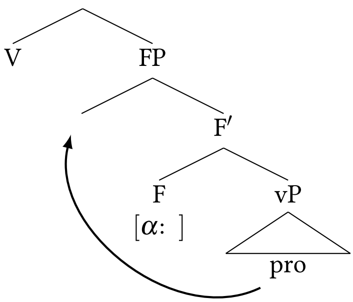
But why, then, can the clitic contained within an independent pronoun fail to move? On a theory of movement as pure greed, this is not expected. If pronouns are greedy, they have no choice but to move.

4 An attraction theory

Third person shows us, then, that not all clitic pronouns have to move in Sierra Zapotec. We take this to mean that, when a pronoun does move, its movement is motivated, first and foremost, by requirements of a functional head. These go beyond any needs the pronoun itself may or may not have. This, then, is why a clitic is obligatory in local persons, even if an independent pronoun also appears. The needs of the functional head must be satisfied. Of course, if a pronoun can fail to move, as in the third person, then this must be supplemented by an account of how the functional head’s requirements can still be satisfied in this case. But for now, the most immediate point is that, from the perspective of a theory of pronoun movement as attraction, the fact that a pronoun can fail to move is not surprising.

Concretely, following Sichel (2001, 2002), we take there to be a functional head that probes its domain for some features, likely φ-features (person, number, gender); when it finds a matching pronoun, it causes it to move.

(19)



This accounts for the asymmetry between clitics and independent pronouns in local persons. While a clitic can occur without an accompanying independent pronoun (20a), an independent pronoun is always accompanied by a clitic (20b).

(20) a. V=pro neutral, cf. (7) and (8)
b. V*(=pro) pro non-neutral, cf. (15) and (16)

In other words, for local persons, pronoun movement is obligatory because it is required by a functional head. It also explains why, once movement of the clitic is triggered by this head, there is no need for the independent pronoun to move: the independent pronoun has no needs of its own that would be satisfied via movement.

This makes pronoun movement directly parallel to wh-movement, where the case for attraction by a functional head (specifically, C) is particularly clear. In many languages, it is not sufficient that a constituent question contain a wh-phrase: a wh-phrase must also move into clause-initial position.

(21) a. What_1 will the student send t_1 to who?
b. *Will the student send what to who?

To the extent that the choice of which wh-phrase actually moves is determined by the syntax of the probe, it follows that no additional requirements are associated with the wh-phrases themselves.

The case for pronoun movement as attraction by a functional head is trickier, though, for a number of reasons. First, it is not the case that all pronouns are free to remain in situ as long as another constituent satisfies the functional head: clitics, for example, must always move. While this is not inconsistent with a theory in which a probe is associated with a movement trigger, it implies that the motivation for pronoun movement as attraction must be sought elsewhere, in the domain of non-clitic pronouns. Second, the identity of the attracting head is less clear than in wh-movement. The ultimate attachment of clitics to a prosodic host obscures, to some extent, the syntax of the attracting probe. And, third, because the identity of the attracting feature(s) is less clear: it must be a feature that can distinguish, for instance, pronouns from full DPs.

Despite these difficulties, it seems that a unified theory of movement, one that includes pronoun movement, is within reach. In the next section, we continue to develop the empirical motivation for pronoun movement as attraction, returning in Sections 6–7 to some of the challenges we have mentioned above.

5 Intervention effects and their repair

The same pronouns can also appear in object position, though object cliticization depends on the type of subject. It is permitted if the subject has also cliticized.

(22) a. Betw=a'=**b**.
hit.comp=1sg=**3.an**
'I hit it.' (RM, GZYZ011-s, 20)

b. Bdel=ba'=**b**.
see=3.hu=**3.an**
'S/he hugged it.' (RM, GZYZ012-s. 23)

But regardless of person, an object cannot cliticize across a full DP subject, as in (23a) and (24a), or onto such a subject, as in (23b) and (24b).

(23) a. *Bdel=**a'** Maria (neda').
hug.comp=**1sg** Maria 1sg
Intended: 'Maria hugged me.' (FA/RM, GZYZ051, 1:06:00)

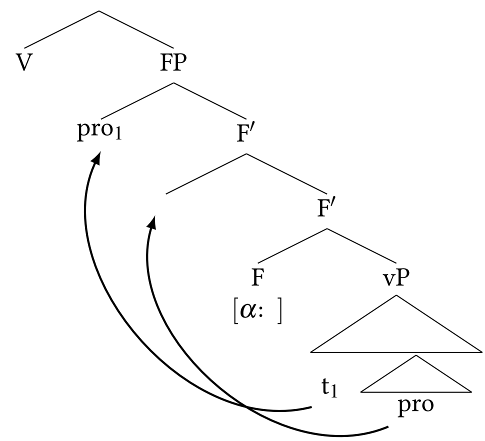
b. *Bdel Juan=**a'** (neda').
hug.comp Juan=**1sg** 1sg
Intended: 'Juan hugged me.' (FA/RM GZYZ051, 1:07:40)

(24) a. *Bdel=**b** Maria.
hug.comp=**3.an** Maria
Intended 'Maria hugged it.' (FA/RM, GZYZ012, 24:55)

b. *Bdel Maria=**b**.
hug.comp Maria=**3.an**
Intended: 'Maria hugged it.' (FA/RM, GZYZ013, 4:40)

This pattern resembles the typical locality effect expected under a theory of attraction: the object cannot be attracted before the subject.

(25)



This locality calculation, familiar from wh-movement in multiple questions, presupposes that both are attracted by the same probe. Since the subject is closest to the probe, it must move first (Attract Closest). Only then, with the intervening pronoun out of the way, can the object move (Richards 1997, a.o.). A purely greed-based theory of movement, on the other hand, has no account of this intervention effect. A pronoun's need to occupy a certain syntactic position should interact in no way with its hierarchical position relative to other related constituents.

To derive the ungrammaticality of (23) and (24) from this logic of intervention, a full DP must be able to count, in the first place, as an intervener for the attraction of a pronoun. In other words, a full DP must satisfy the needs of the probe, even though it does not itself undergo movement as a result. Sichel and Toosarvandani (2020) provide an analysis of this intervention, showing how the probe is specified so that it can Agree with both pronouns and full DPs (see Preminger 2019 for related ideas).

Importantly, when an object pronoun cannot be attracted, it is not ungrammatical: the clitic instead attaches to *le*.

(26) Blenh Maria **leba**'.
hold.COMP Maria **3.HU**
'Maria held her/him.' (FA/RM, GZYZ016, 45:50)

This repair for intervention shows, once again, that a non-moved pronoun does not cause the derivation to crash, and suggests that pronouns, in general, do not have a movement-inducing property.

6 Probes in the absence of cliticization

We have argued for a theory of pronoun movement based on attraction. This was motivated by certain patterns of subject cliticization and intervention for object cliticization in Sierra Zapotec. But such a theory is also committed to explaining how the probe is satisfied when there is no apparent cliticization.

There are at least three environments where there is no cliticization, and yet the derivation succeeds: (i) predicate nominals, (ii) intervention by a full DP, and (iii) coordination. Such gaps in the syntax of cliticization may initially appear as exceptions, challenging a theory of pronoun movement as attraction. However, if they can be understood in terms of the syntax of probing, these gaps may turn out to present the strongest evidence in favor of a theory of pronoun movement as attraction. Greed would have nothing to say about such gaps.

We consider each of these environments in turn, attributing them to one of two conditions involving the probe and its interaction with potential goals. Either the probe is completely absent in the environment where there is no cliticization or something interferes with the probing mechanism, so that cliticization becomes impossible.

6.1 Predicate nominals

In null copular constructions with a nominal predicate, pronouns fail to cliticize, for both local and third persons.

(27) (Bi llinh dzonhu'? 'What do you do?')

a. Bene' skwel **nada'**.
person school **1sg**
'I am a teacher.' (RM, GZY054-s, 3)

b. *Bene' skwel=**a'**.
person school=**1sg** (RM/FA, GZY054, 30:02)

(28) (Bi llinh dzonh Maria? 'What does Maria do?')

a. Bene' skwel **leba'**.
person school **3.hu**
'S/he is a teacher.' (FA/RM, GZYZ054, 32:50)

b. *Bene' skwel=**ba**'.
person school=**3.hu** (FA/RM, GZYZ054, 32:50)

It seems likely that, in these derivations, there is simply no probe. If the head that attracts pronouns is part of the extended verbal projection, this functional structure could simply be missing in null copular constructions.

6.2 The repair for intervention

As we saw above, when the subject is a full DP, there is no cliticization and an object pronoun can only appear as an independent pronoun.

(29) a. Dzike Maria='nh **neda'**.
love.cont Maria=def **1sg**
'Maria loves me.' (FSR, SLZ008-s, 7)

b. Blenh Maria **leba'**.
hold.comp Maria **3.an**
'Maria held her/him.' (FA/RM, GZYZ016, 45:50)

A theory of attraction must answer two questions: First, how is the probe satisfied when the subject does not cliticize? Second, when the subject does not cliticize, why can the object not cliticize either?

One approach to the first question would build on the decomposition of attraction into Agree and a separate displacement mechanism. If Agree was a prerequisite for displacement, then the probe's requirements could be stated as a need to Agree, rather than a need to trigger movement. This would mean that, in (29a–b), the probe could, in fact, Agree with and be satisfied by the higher full DP. This would just never lead to movement: a full DP in subject position can never be doubled by a clitic.

(30) *Bdel=**e'** **Pedro** bidao' nhi.
hug=**3.EL** **Pedro** child this
'Pedro hugged this child.' (FA/RM, GZYZ014, 24:18)

In this respect, full DPs behave just like third person pronouns — compare (30) to (10)–(11) above — a point we will be returning to.

For the second question, some additional assumptions must be installed to derive why cliticization of the object is blocked when the subject does not cliticize. One possibility is that the probe, after Agreeing with a full DP, is no longer able to Agree with the object. Cliticization of the object would then be blocked. Nothing then precludes the appearance of an independent pronoun, which, if we are correct, has no checking needs of its own.

6.3 Coordination

Coordination is another context where cliticization may fail to take place without ill consequences. When a third person pronoun is conjoined with a full DP, cliticization is impossible, as in (31a), due to the Coordinate Structure Constraint. Instead, it surfaces inside the coordination, supported by *le* (31b).[2]

(31) a. *Ts-ja-wi=**e'** [t_1 nha' xna'=a] taw=a'.
cont-and-visit=**3.EL** and mother=1SG grandmother=1SG
Intended: 'S/he and my mother went to visit my grandmother.'
(RM/FA, GZYZ052, 57:32)
b. Ts-ja-wia [**le'** nha' xna'=a] taw=a'.
cont-and-visit **3.EL** and mother=1SG grandmother=1SG
(RM/FA, GZYZ052, 56:25)

But then, what satisfies the probe in the grammatical coordination in (31b)? It might seem that the lack of attraction here can somehow be related to the not fully pronominal nature of this coordination. As we saw in (30) above, full DPs can never be doubled by a clitic in postverbal position.

But cliticization can also fail with a fully pronominal coordination, as in (32a). Thus, the same question arises: What satisfies the probe in this grammatical coordination?

2 There appears to be some variation within Sierra Zapotec in the nominal coordination strategies that are available. All speakers allow for a comitative-like structure with *lhenh*, but some also allow nominals to be coordinated with the clausal coordinator *nha'*. Here, we report the facts involving just the latter.

(32) a. Bzenh [le' nha' leba'] bel.
comp.catch 3.el and 3.hu fish
'S/he (elder) and s/he (non-elder) caught fish.'
(FA/RM, GZYZ087, 23:15)

b. Be-se'e-zenh=**e'** [le' nha' leba'] bel.
comp-pl-catch=**3.el** 3.el and 3.hu fish
'S/he (elder) and s/he (non-elder) caught fish.'
(FA/RM, GZYZ087, 17:20)

As (32b) shows, cliticization is not impossible; cliticization that realizes the pooled features of the entire coordination is also possible. (The expected resolution for the combination of elder and non-elder human is elder human.) Cliticization as in (32b) is expected under a theory of attraction, even if it is unclear why coordination should enable the doubling of third person pronouns, otherwise prohibited, as seen above.

The availability of cliticization in (32b) offers a way of understanding its absence in (32a), as well as in (31b). While doubling is never permitted for bare third person pronouns, they still exhibit an alternation between the presence and absence of a clitic pronoun, controlled by discourse context (neutral vs. non-neutral), as in (10)–(11) above. The same alternation could be responsible for the optionality in (32a–b), though this would happen to produce doubling when the third person pronouns are coordinated (for reasons that are still unclear). In other words, apparent non-attraction with third person coordinations is simply a product of how the probe interacts with third person arguments in general.

Some evidence for this idea comes from non-third person coordinations. When one coordinate is a local person pronoun, clitic doubling of the entire coordination becomes obligatory.

(33) a. *Bzenh [lhe' nha' leba'] bel.
comp.catch 2sg and 3.hu fish
'You and s/he caught fish.' (RM/FA, GZYZ088, 1:25)

b. Bzenh=**lhe** [lhe' nha' leba'] bel.
comp.catch=**2pl** 2sg and 3.hu fish
'You and s/he caught fish.' (RM/FA, GZYZ088, 1:30)

The absence of cliticization with coordinated third person pronouns in (32a) can be attributed, then, to the absence of cliticization with bare third person pronouns. This reduces one problem to another, but then it highlights the question of how the functional head's requirements are satisfied in this context.

7 A final context without cliticization

In our original enumeration of contexts without cliticization, we did not include non-neutral environments where a third person subject bears narrow focus. Recall that, in this context, there is no cliticization: only an independent pronoun is possible.

(34) (Nhu shtahs? 'Who is sleeping?')

a. Shtahs **leba'**.
sleep.CONT **3.HU**
'S/he is sleeping.' (FA/RM, GZYZ051, 55:02)

b. *Shtahs=**ba'** **leba'**.
sleep.CONT=**3.HU** **3.HU**
Intended: 'S/he is sleeping.' (FA/RM, GZYZ054, 25:35)

This context poses the same fundamental challenge for a theory of attraction as the three earlier contexts: How are the probe's requirements satisfied when there is no cliticization? It is somewhat more difficult, though, because merely changing the size of focus seems unlikely to affect the presence of the probe or how it is able to Agree.

One possibility is that, in this case, a pronoun is in fact attracted, though it is not pronounced in the higher position.

(35) [$_{FP}$ ⟨pro⟩ F ... pro ...]

This does not seem so improbable on its face. With local person pronouns in non-neutral clauses, cliticization that doubles a strong pronoun is obligatory.

(36) (Nhu yega'an? 'Who is going to stay?')

a. Yega'an=**o'** **lhe'**.
stay.POT=**2SG** **2SG**
'You are going to stay.' (FA/RM, GZYZ051, 53:34)

b. *Yega'an **lhe'**.
stay.POT **2SG** (FA/RM, GZYZ054, 22:47)

For third person pronouns, too, there could be attraction. The clitic would simply be invisible, presumably because of morphological idiosyncrasies of the language. However, there is no easy out along these lines, since independent third person pronouns do not behave identically to doubled local pronouns. An independent local person pronoun in non-neutral contexts does not block cliticization across it.

(37) Betw=a'$_1$=**ba'**$_2$ **neda'**$_1$ t$_2$.
hit.COMP=1SG=**3.HU 1SG**
'I hit her/him.' (FA/RM, GZYZ051, 1:10:25)

This obviation of intervention by clitic doubling is familiar from other languages, such as Greek and Spanish (see Anagnostopoulou 2006 for an overview). If third person independent pronouns in non-neutral contexts had the same underlying analysis, we would expect them also not to intervene for object cliticization. But this is not the case.

(38) *Blhe'e=**b**$_2$ **leba'**$_1$ t$_2$.
see.COMP=**3.AN 3.HU**
Intended: 'S/he saw it.' (FSR, SLZ1050, 1:00)

The presence of intervention in (38) suggests that an independent third person pronoun is not doubled by a null clitic.

There is a different possibility. As we saw in Section 6.2, when the subject is a full DP, no cliticization is possible. Whatever allows full DPs to satisfy the probe without moving might also permit third person pronouns in non-neutral contexts to satisfy the probe without movement. In other words, when a third person pronoun bears a narrow focus, it would behave just like a full DP in the relevant respects. This requires a more detailed analysis of the pronominal inventory in Sierra Zapotec, and in particular of the differences between local and non-local pronouns. But we have already seen some suggestive evidence that such an account could be on the right track. Third person pronouns are morphologically compositional, comprised of a formative *le* and a clitic pronoun. If *le* is a D head that embeds a clitic pronoun, making it inaccessible to the probe, and if the requirements of the probe can be satisfied via Agree, this larger DP constituent could satisfy the probe, just like a full DP can.

8 Conclusion

A theory of pronoun movement grounded in attraction has several empirical advantages over a theory based purely on greed. For Sierra Zapotec, it can explain the requirement for clitic doubling in local persons; it can explain why cliticization fails in certain environments, when a probe is plausibly absent; and, it is consistent with some third person pronouns not needing to move. More generally, attraction offers an explanation for the observed alternations between clitic and independent pronouns, whereas a theory stated purely in terms of greed only dictates that a clitic move when one is present.

Nevertheless, there are several details that this account leaves out. These center around the third person and the relationship between pronominal and non-pronominal arguments: Why do third person independent pronouns behave like full DPs for the purposes of cliticization? And how is this to be understood within a theory of nominal classes? Specifically, are third person pronouns full DPs, whereas local person pronouns are not? Another detail involves the shared intervention behavior of third person pronouns and full DPs: Why do they both intervene for cliticization (when they do not move)? And how is this compatible with a theory of attraction?

One promising approach to resolving this second set of questions, which we hinted at above, would build on a decomposition of attraction, with Agree serving as a prerequisite for movement. The locality considerations typically associated with attraction could then be attached to the Agree component, creating space for a constituent to disrupt the movement of other constituents even when it does not itself move. Since the constituents involved in these interactions in Sierra Zapotec are all (various kinds of) third person arguments, a fuller account along these lines would likely also have to resolve the first set of questions above. Both tasks we will leave for the future.

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