



University of
Massachusetts
Amherst

Optimal Linearization: Prosodic displacement in Khoekhoegowab and Beyond

Item Type	Dissertation (Open Access)
Authors	Kusmer, Leland
DOI	10.7275/d1w2-fp34
Rights	Attribution-ShareAlike 4.0 International
Download date	2026-06-11 06:16:05
Item License	http://creativecommons.org/licenses/by-sa/4.0/
Link to Item	https://hdl.handle.net/20.500.14394/18104

**OPTIMAL LINEARIZATION: PROSODIC DISPLACEMENT
IN KHOEKHOEGOWAB AND BEYOND**

A Dissertation Presented

by

LELAND PAUL KUSMER

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

February 2020

Department of Linguistics

© Copyright by Leland Paul Kusmer 2020

All Rights Reserved

OPTIMAL LINEARIZATION: PROSODIC DISPLACEMENT
IN KHOEKHOEGOWAB AND BEYOND

A Dissertation Presented

by

LELAND PAUL KUSMER

Approved as to style and content by:

Kyle Johnson, Co-chair

Kristine Yu, Co-chair

Ellen Woolford, Member

Meghan Armstrong-Abrami, Member

Joe Pater, Department Chair
Department of Linguistics

ACKNOWLEDGMENTS

I have had the best advisors I could possibly have hoped for on this project. Kyle Johnson started me thinking about prosody and linearization in my very first semester of grad school, and has worked with me every step of the way since. Kristine Yu has provided so much experimental, statistical, and emotional support, not to mention stuffed animals; I can't imagine having completed this dissertation without her. I wandered into Ellen Woolford's office in my first semester to ask for help with grant writing, and since then nearly every piece of writing I've done has been torn apart and put back together by her, and inevitably been better for it. Thank you all.

Of course, my dissertation committee were neither the first nor the only advisors I had. I was privileged to work with Elisabeth Selkirk for a year, where I learned the basic skills of prosodic fieldwork that underlie much of this dissertation. John Kingston, Rajesh Bhatt, and Seth Cable advised my work on Akan and Tshivenda before I found Khoekhoe, and Brian Dillon provided some very last minute advice on experimental design. Finally, I need to thank Jason Kandybowicz, who advised my undergraduate thesis at Swarthmore and taught me the fundamentals of fieldwork; I've been amused but unsurprised to find my own research interests slowly converging with his ever since.

I could not possibly have finished this project without the help of Kerrienne Devlin, who spent countless hours transcribing recordings for me. I think very few graduate students get to see their undergraduate assistants flourish as independent researchers in their own right before even defending; I feel very privileged. And while I'm thanking people for transcriptions, I got some very last minute help from Andrew Lamont, Maggie Baird, and Ivy Hauser. There's a nearly endless list of people who's conversation helped me along

the way, but I'll highlight Leah Chapman, Chris Collins, Emily Elfner, Lauren Clemens, and Sakshi Bhatia.

There are many people in Namibia to thank. Professor Levi Namaseb has helped me connect with so many of my consultants, given me access to his teaching materials, taken me book shopping, and generally made my fieldwork possible. There are a great many Khoekhoegowab speakers who have been very generous with their time and expertise, and have answered countless questions about Dandago and his pet preferences; these include Magdalena Isaak, Michelle Swartbooi, Markus Kooper, Nicoline Geingos, and Gerdrut Hevita. Two consultants in particular, though, went above and beyond: Irene ||Garoes and Nadia April invited me into their homes, took me out to poetry slams, introduced me to the wonderful Windhoek queer community, and generally made me feel welcome in Namibia. Kai aios!

I decided I wanted to do linguistics when I was 14; it's been a long road to this dissertation, but I'm so grateful to have had my family's support along the way. Mom, Dad — thank you for saying “that sounds great!” when your kid suddenly decided to go into a field you'd never heard of, and for all the wisdom you've been able to share even so. Morgan, you never once doubted I could do this, which is more than I could say sometimes. Grandma, it meant so much to me that you came all the way out for my defense; I'm so happy you could see the first Dr. Kusmer, and I just wish Grandpa could have too.

I need to say a special thanks to my friends Ivy & Maia, who both dropped everything to help me in a time of crisis. I cannot thank either of you enough.

I'm writing this a few days after moving away from Northampton, and I already miss everyone there terribly. My grad school cohort — Ivy, Coral, Sakshi, Jyoti, Caroline, David, & Katia — were a wonderful, supportive group; I feel very lucky. My housemates — Becky, Lorelei, Daria, & Nicole — were always there (hey look!) with kitchen table conversation at the end of a long day. Everyone from the Smith College belltower — Sarah, Tom, Peggy, Nina, Sam, Leah, Bela, Alan, and many others — gave me a much

needed space away from academia. The Western Mass Sacred Harp Community, especially the other Kitchen Table Singers from over the years, were a constant source of joy. Moving away from all of these people feels impossible, or at best foolhardy, and yet here I am. This does, at least, provide me an opportunity to share my favorite Khoekhoegowab proverb, which I couldn't quite squeeze in anywhere else in this dissertation:

!Hom -kha |guikha |hao tama.
mountain -3.M.DL only meet NEG.NF
“Only two mountains never meet.”

And therefore we, not being mountians, will surely meet again.

ABSTRACT

OPTIMAL LINEARIZATION: PROSODIC DISPLACEMENT IN KHOEKHOEGOWAB AND BEYOND

FEBRUARY 2020

LELAND PAUL KUSMER

B.A., SWARTHMORE COLLEGE

PH.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Kyle Johnson and Professor Kristine Yu

Understanding the relationship between syntactic structures and linear strings is a challenge for modern syntactic theories. The most complete and widely accepted models — namely, the Headedness Parameter and the Linear Correspondence Axiom (Kayne 1994) — each capture aspects of this relationship, but are either too permissive or too restrictive: A Headedness Parameter relativized to individual categories permits nearly any linear order which keeps phrases contiguous, even those that violate the Final-Over-Final Constraint (?); by contrast, the Linear Correspondence Axiom is well-known for ruling out head-final configurations generally. Subsequent models of linearization have typically been modifications of one of these two proposals, and as such inherit many of their flaws.

In recent years an interesting new hypothesis has begun to emerge. Bennett, Elfner, & McCloskey (2016) discusses an anomalous displacement in Irish in which prosodically-light pronouns are displaced to the right of their expected position, with no change in

meaning. This appears to be evidence that the linearization procedure does not operate purely on syntactic structure, but rather needs to know the phonological form of individual items in order to order them. I term this phenomenon prosodic displacement; other cases include second-position clitics in Serbo-Croatian (Schütze 1994) and clausal right-extraposition in Malagasy (?).

In this dissertation, I first describe a new case of prosodic displacement. Khoekhoegowab is a language from the Khoisan group spoken in Namibia by about 200,000 people. In Khoekhoegowab, tense, aspect, and polarity are expressed by clitic items that are separable from the verb. These items come in two classes: One class appears before the verb, while the other follows the verb. The classes are not divided along morphosyntactic lines — that is, even if you know the meaning and function of a particular particle, you cannot predict which class it will fall into. However, the classes are not arbitrary: they break down along clearly phonological lines, in that the preverbal particles are all prosodically short (one mora), while the post-verbal ones are all heavy (two moras). Based on data from original fieldwork, I argue that this is a case of prosodic displacement. First, I show that the position of the preverbal particles is an implausible candidate for syntactic movement in that they can be apparently displaced into conjuncts. Second, I show that the choice of particle has added prosodic effects: The verb only undergoes sandhi (a tonal substitution process) when one of the light tense particles precedes it.

Based on this data and the other known cases of prosodic displacement, I propose a theory of Optimal Linearization, which takes seriously the Minimalist notion that linearization is a post-syntactic (and specifically phonological) process. As such, I model linearization using the same tools used to model other phonological processes, namely violable constraints as in Optimality Theory. These constraints alone give us new insight into the linearization process: The fact that specifiers are always on the left is modeled as an emergence of the unmarked preference for head-finality, while the Final-Over-Final Constraint is captured using a domain-specific head-finality constraint. The interaction

of these linearization constraints with other specifically-prosodic constraints results in prosodic displacement whenever the “expected” order would yield a marked prosody. This model allows me to make predictions about the typology of prosodic displacement overall.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	iv
ABSTRACT	vii
LIST OF TABLES	xiv
LIST OF FIGURES	xv
ABBREVIATIONS	xvi
CHAPTER	
1. INTRODUCTION	1
1.1 Contributions of this dissertation	1
1.2 Language Background	2
1.3 Prosodic displacement	4
1.4 Theoretical background: Syntax	5
1.4.1 Syntax is unordered	8
1.5 Theoretical background: Prosody	9
1.6 Outline of Dissertation	12
2. LINEARIZATION	16
2.1 Empirical word-order typology	17
2.2 The Headedness Parameter	20
2.3 The Linear Correspondence Axiom	21
2.4 Violable Linearization	23
3. PROSODIC DISPLACEMENT	26
3.1 Diagnosing prosodic displacement	28

3.1.1	Syntactic implausibility.....	29
3.1.2	Semantic inactivity.....	30
3.1.3	Morphosyntactic heterogeneity	31
3.1.4	Prosodic homogeneity	32
3.2	Prior examples of prosodic displacement	32
3.2.1	Second-position clitics	33
3.2.2	Irish pronoun postposing	35
3.2.3	Malagasy clausal extraposition	37
3.2.4	Other proposed cases	40
3.2.4.1	PF Movement	40
3.2.4.2	Alternative analyses to syntactic movement	41
3.2.4.3	Prosodically-driven syntactic movement	42
3.2.4.4	Phonology mediating choice of structure	43
4.	PROSODIC DISPLACEMENT IN KHOEKHOE	44
4.1	Basics of Khoekhoe syntax.....	45
4.1.1	TAP particles	47
4.2	Criterion 1: Syntactic implausibility	48
4.2.1	First possibility: Lowering	48
4.2.2	Second possibility: Raising	50
4.2.3	Third possibility: Fronting	52
4.2.4	VP coordination	54
4.2.5	Summary	55
4.3	Criterion 2: Semantic inactivity	55
4.4	Criteria 3 & 4: Morphosyntactic heterogeneity, prosodic homogeneity	56
4.5	Conclusions.....	58
4.6	Appendix: Variable TAP placement	58
5.	KHOEKHOE TONE SANDHI	60
5.1	Introduction	60
5.2	Background: Khoekhoegowab tone sandhi.....	63
5.2.1	Sandhi domains	64
5.3	Experimental design & methodology	68
5.3.1	Speakers	68

5.3.2	Stimuli	68
5.3.3	Procedure	73
5.3.4	Analysis	73
5.4	Results	75
5.5	Discussion	78
5.5.1	Variation	79
5.6	Appendix: Experimental stimuli	81
5.6.1	Matrix	81
5.6.2	Nominalized	82
5.6.3	Coordination	83
5.6.4	Relative	84
5.6.5	Quotative	84
5.6.6	Question	85
5.6.7	Filler	85
6.	OPTIMAL LINEARIZATION	89
6.1	Harmonic word orders	90
6.1.1	Some housekeeping	91
6.1.2	HEADFINALITY	93
6.1.3	ANTISYMMETRY	95
6.2	Linearizing movement	98
6.3	Disharmonic word orders	104
6.4	Conclusion	109
7.	PROSODIC DISPLACEMENT WITH OPTIMAL LINEARIZATION: KHOEKHOE	112
7.1	Review: Khoekhoe prosody & displacement	113
7.2	Syntax-prosody mapping with Match Theory	115
7.2.1	Fully-Matched structures in Khoekhoegowab	119
7.3	Generalized Contiguity	120
7.3.1	Violable Contiguity	122
7.4	STRONGEDGE and prosodic displacement	125
7.4.1	STRONGEDGE	126
7.4.2	Preferred position	129

7.4.3	Interim summary	133
7.4.4	Case study: Prosody in VP coordination	134
7.5	Embedded clauses	137
7.5.1	What are clause-type markers?	138
7.5.2	Embedded clauses	141
7.5.3	Questions	144
7.6	Summary and discussion	145
7.6.1	Variability	148
8.	PROSODIC DISPLACEMENT WITH OPTIMAL LINEARIZATION: OTHER LANGUAGES	151
8.1	Irish pronoun postposing	151
8.2	Second-position clitics	158
8.3	Malagasy clausal extraposition	162
9.	CONCLUSION	168
9.1	Overview of contributions	168
9.2	Typological implications	170
9.2.1	Heads and phrases	170
9.2.2	Kinds of markedness	171
9.3	Future directions	174
9.3.1	Linearization of adjuncts	174
9.3.2	Prosodic displacement	175
9.3.3	Prosody	178
	BIBLIOGRAPHY	181

LIST OF TABLES

Table	Page
5.1 Citation melodies (Brugman 2009)	63
5.2 Sandhi forms	64
5.3 Brugman's generalization	67
5.4 Haacke's generalization	67
5.5 Results of experiment	68
5.6 List of verbs in experimental items	69
5.7 Significant coefficients	77
5.8 Results of experiment (repeated from Table 5.5)	79

LIST OF FIGURES

Figure	Page
5.1 Sample pitch tracks for all six verbs, taken from the same speaker. Solid lines are citation form; dotted lines are sandhi form. Verbs in the left column alternate between [4] & [21]; verbs in the right column alternate between [45] & [2]	70
5.2 Mean pitch tracks	75
5.3 Pitch tracks for two tokens of (18) from the same speaker, showing variation in tone of /am/ 'grill'	80

ABBREVIATIONS

1CD	1st person common dual	HF	HEADFINALITY
1CP	1st person common plural	M-XP	MATCH-PHRASE
1FD	1st person feminine dual	M- ϕ	MATCH- ϕ
1FP	1st person feminine plural	STREdge	STRONGEDGE
1MD	1st person masculine dual	STRSt	STRONGSTART
1MP	1st person masculine plural	APPL	applicative
1S	1st person singular	C.ADV	adverbial complementizer
1S.OBJ	1st person singular object clitic	C.EMPH	emphatic complementizer
2PC	second-position clitic	C.QUOTE	quotative complementizer
3CD	3rd person common dual	COMP	complementizer
3CP	3rd person masculine plural	DECL	Declarative clause-type marker
3CS	3rd person common singular	ECHO	Echo question clause-type marker
3FD	3rd person feminine dual	EMPH	Emphatic declarative clause-type marker
3FP	3rd person masculine plural	FUT	future tense
3FS	3rd person feminine singular	IMP	imperfect aspect
3MD	3rd person masculine dual	NEG.FUT	negative future tense
3MP	3rd person masculine plural	NEG.NF	negative non-future tense
3MS	3rd person masculine singular	PERF	perfect aspect
ANTISYM	ANTISYMMETRY	PST	past tense
BINMIN	BINARYMINIMALITY	RPST	remote past tense
EP	EXTENDEDPROJECTION	STAT	stative predicate marker
EP-CON	EP-CONTIGUITY	STAT.PST	past tense stative predicate marker
EP-PROM	EP-PROMINENCE	TAP	tense, aspect, & polarity
EQSIS	EQUALSISTERS		

CHAPTER 1

INTRODUCTION

1.1 Contributions of this dissertation

This dissertation has three primary goals. The first goal is an empirical one: I will provide evidence that there are cases where the linear order of words in an utterance crucially depends on prosodic factors. This phenomenon casts doubt on the explanatory adequacy of any model for linearizing syntactic structure which cannot see the phonological forms of individual lexical items. For example, in Khoekhoegowab the position of the verbal auxiliary marking tense crucially depends on the prosodic weight of that auxiliary: monomoraic ones appear before the verb, while longer ones appear after it. I term this phenomenon *prosodic displacement*; a crucial contribution of this dissertation is to show that our current models of linearization must be expanded in order to correctly predict the existence of prosodic displacement.

The second goal of this dissertation is to provide the first in-depth study of prosodic displacement in Khoekhoegowab. All data on Khoekhoegowab presented here comes from original fieldwork. In particular, I have carried out the first detailed study of tonal sandhi on Khoekhoegowab verbs, which is directly related to the linear position of tense marking. In addition to contributing new data on an understudied language, the analysis of Khoekhoegowab sandhi will show that prosodic structure is sensitive to Extended Projections in the sense of Grimshaw (1991); this implies that syntax-prosody mapping is sensitive to aspects of syntax beyond constituency and labelling.

The final goal of this dissertation is to propose a model of linearization that takes into account the idea that linear order and prosody are mutually-influencing. This model,

called **Optimal Linearization** (Kusmer to appear) uses competing violable constraints to control the mapping from syntax to string. Using violable constraints to model linearization has two primary benefits. First, it allows us to make clear predictions about typology in the form of *factorial typology*: reranking the constraints should give us the full range of typological possibilities (Prince & Smolensky 1993/2004); in particular, I will show that OL captures both the generalization that movement is always leftward and so-called Final-Over-Final Constraint (Sheehan, Biberauer, Roberts, & Holmberg 2017), which is the observation that (within extended projections) the complement of a head-final phrase cannot be head-initial. The second benefit of using a violable constraint model is that it allows us to easily integrate linearization into commonly-assumed models of prosody; I'll show that Optimal Linearization combines with Match Theory (Selkirk 2011) to correctly predict the existence of prosodic displacement in Khoekhoegowab and several other languages.

1.2 Language Background

A central contribution of this dissertation is the first detailed study of prosodic displacement & verbal sandhi in Khoekhoegowab. Khoekhoegowab, often called Khoekhoe, is a Central Khoisan (Khoe-Kwadi) language spoken primarily in Namibia by about 200,000 speakers; small communities of speakers exist in South Africa & Botswana (Lewis, Simons, & Fennig 2016). Khoekhoe is one of the official languages of Namibia and in many areas of the country its speakers benefit from native-language education up through the college level; it also serves as a *lingua franca* among some other Khoisan groups. It is typically described as having two dialects: Damara, spoken primarily in the north, and Nama, spoken predominantly in the south. It has an officially-standardized orthography (Committee for Khoekhoegowab 2003) and is widely written, though printed material is limited to educational materials, a few novels, and an occasional section of *The Namibian* newspaper.

There is a small but reasonably comprehensive descriptive literature on Khoekhoe. Hagman (1977) is a general descriptive grammar; Haacke (1976) provides detailed studies of the nominal domain, while Haacke (1999) gives an overview of the tonology. On the analytic side, Brugman (2009) provides a detailed look at the phonetics and phonology of tone in Khoekhoe. Finally, Hahn (2013) is the first to note the possibility of prosodic displacement in the language, though no thorough investigation of the actual prosody is attempted.

Unless otherwise noted, all Khoekhoegowab data in this dissertation comes from original fieldwork carried out in two trips, the first in the austral winter of 2017, and the second in the austral summer of 2019. The majority of this work was conducted in Windhoek; a small portion of the data was collected in Usakos. Data collection proceeded mostly by exploratory elicitation, supplemented by production experiments in which speakers were asked to read aloud from slides; the design and results of one such experiment are reported in chapter 5. All speakers were recorded using a Zoom H5 recorder and a Shure SM10A head-mounted microphone. Recordings were segmented using Praat (Boersma & Weenink 2001); the Montreal Forced Aligner (McAuliffe, Socolof, Mihuc, Wagner, & Sonderegger 2017) was used to align TextGrids to facilitate analysis.

Data used in this dissertation comes from eight speakers. Speakers 1 & 8 are male; all others are female. Speaker 1 is originally from south of Windhoek; speaker 3 spent her early childhood in a predominantly Hai||om-speaking region in the north. Speaker 1 self-identified as a Nama speaker; all other consultants described themselves as equally familiar with Nama & Damara dialects but primarily spoke Nama. All speakers were raised by two Khoekhoe-speaking parents and use Khoekhoe on a regular basis with friends, family, and co-workers. All were fluent in English.

1.3 Prosodic displacement

The primary phenomenon under investigation in this dissertation is what I will term *prosodic displacement*: displacement of words from their syntactically-expected position for prosodic (rather than morphosyntactic) reasons. Khoekhoegowab provides the main case study. Khoekhoegowab marks tense, aspect, and polarity (TAP) by means of a set of auxiliary particles. These particles come in two classes: Preverbal particles, like *go* in (1a), obligatorily encliticize to some preverbal element; postverbal particles, like *tama* in (1b), always occur clause-finally.

- (1) a. Khoeb ge oms |kha **go** oa.
 man DECL home to **PST** return
 “The man went back home.”
 b. Khoeb ge oms |kha oa **tama**.
 man DECL home to return **NEG.NF**
 “The man didn’t go back home.”

The existence of preverbal particles in an otherwise-head-final language is already striking on its own. But even more striking is that these two classes cannot be distinguished on morphosyntactic grounds; instead, they are distinguishable only on phonological ones: All preverbal particles are monomoraic, while all postverbal ones are bimoraic.

(2) Preverbal TAP particles

	IPA	Gloss
<i>a</i>	[ra]	present stative
<i>ra / ta</i>	[ra] / [ta]	imperfect
<i>ge</i>	[ke]	remote past
<i>go</i>	[ko]	recent past
<i>ni</i>	[ni]	future
<i>ta</i>	[ta]	negative non-finite
<i>ga</i>	[ka]	irrealis
Compound particles:		
<i>gere</i>	[kere]	remote past imperfect
<i>goro</i>	[koro]	recent past imperfect
<i>nira</i>	[nira]	future imperfect
<i>gara</i>	[kara]	irrealis imperfect

(3) Postverbal TAP particles

	IPA	Gloss
<i>tama</i>	[tama]	non-future negative
<i>tide</i>	[tite]	future negative
<i>i</i>	[i:]	non-present stative
<i>hâ</i>	[hâ:]	perfect

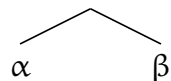
One contribution of this dissertation is to argue that the light TAP particles are being post-syntactically displaced into that position for prosodic reasons. That is, sentences with preverbal and postverbal particles are syntactically identical, but are treated differently by the linearization function for prosodic reasons. In Chapter 3, I develop a set of criteria for identifying “prosodic displacement” of this type and identify three cases other than Khoekhoegowab: Second-position clitics in the Balkan languages (Anderson 1993, and many more), light pronoun postposing in Irish (Elfner 2012; Bennett et al. 2016), and clausal extraposition in Malagasy (Edmiston & Potsdam 2017). In Chapter 6, I develop a set of violable constraints that together form the Optimal Linearization system, an Optimality-Theoretic model that allows for prosodic factors to interact with and sometimes override the basic linearization function.

1.4 Theoretical background: Syntax

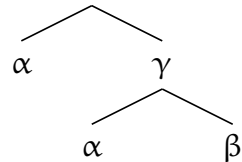
In this dissertation I will argue that, whatever general model of syntax we assume, the portion of that model responsible for determining word order must be sensitive to prosody. That conclusion holds no matter what underlying theory of syntax we assume. Similarly, Optimal Linearization as a model of linearization will generalize to any theory of syntax that generates phrase-marker trees with certain properties, namely internal nodes that are maximally binary branching and which are labeled in such a way that the two daughters can be distinguished. However, for concreteness I will adopt throughout this dissertation a Minimalist Program (Chomsky 1995b) model of syntax, in which all syntactic structure is created by the repeated application of the operation Merge to a set

of abstract lexical items (called the numeration). Merge can apply either ‘externally’, in which case it combines two distinct items from the numeration, or ‘internally’, in which case it applies to some pre-built structure and an object contained inside that structure. Internal Merge corresponds to syntactic movement — that is, it takes some syntactic object that already has a position and gives it a new, additional position in the structure. Again for concreteness I will assume a Copy Theory of movement (Nunes 1995), in which internal Merge creates a new copy of the moved item; this is illustrated below.

(4) a. **External Merge:**
Merge(α , β)



b. **Internal Merge, Copy:**
Merge(α , γ)



The one place in which the syntax assumed here differs somewhat from standard Minimalism is with regards to labelling. While various different labelling algorithms have been used in the literature (see e.g. Collins 2002; Collins & Stabler 2016; Johnson 2004; Rizzi 2016), most Minimalist theories assume that the output of the narrow syntax is the same as generated by Bare Phrase Structure (Chomsky 1995a). In particular, labels in this theory are just copies of their head (5), meaning that X' -levels are not distinguishable from XP -levels, or indeed from X^0 levels. Similarly, since all structure is built by Merging two items, there can never be any unary projections; so for example the structure of a VP with an internal argument consisting just of determiner head D (e.g. a pronoun) would be as in (6a), without the phrasal projection in (6b).

(5) X (not XP)
... X (not X')
... X

```

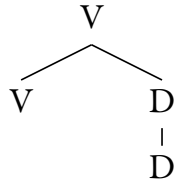
graph TD
  Root[X (not XP)] --- ellipsis1[...]
  Root --- X2[X (not X')]
  X2 --- ellipsis2[...]
  X2 --- X[X]
  
```

(6) a. No unary projection:
V
V D

```

graph TD
  Root[V] --- V[V]
  Root --- D[D]
  
```

b. With unary projection:



In this dissertation, I will modify both of these assumptions. First, I think it is necessary from the point of view of prosody that syntactic heads (X^0 s) be labelled differently from phrases (XPs). In particular, prosody often seems to treat words (corresponding to X^0 s) differently from phrases (corresponding to XPs). One example showing that this is true comes from Khoekhoegowab. That language has two distinct tonal substitution patterns, termed ‘sandhi’ and ‘flipflop’ (Brugman 2009); for now, the phonological details of these processes are not relevant. The important difference is as follows: Sandhi affects all but the **leftmost** word in a **phrase**; flipflop affects all but the **rightmost** word in a **compound**. This is briefly illustrated in (7), where the highlighted words are affected by the relevant process.

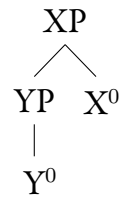
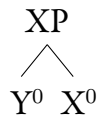
- (7) a. **Sandhi:**
 [DP kai **hais**]
 ‘big tree’
- b. **Flipflop:**
 [V^0 †**gai** - unu]
 call - change (‘rename’)

The differences between these processes show that Khoekhoegowab prosody must be able to tell whether the two words together make a phrase as in (7a) (in which case sandhi applies) or whether they together make a complex head as in (7b) (in which case flipflop applies). That is, the prosody needs to know whether the smallest node containing both words is labelled as XP or as X^0 . For this reason, I’ll assume throughout that heads and phrases are given distinct labels in the syntax; in Chapter 6 this will become relevant to how Optimal Linearization orders words.

The second modification to pure Bare Phrase Structure I will make here is less crucial. For Optimal Linearization to work correctly, heads must always asymmetrically c-

command their complements. In pure Bare Phrase Structure the common assumption is that a head X^0 can take another head Y^0 as its complement directly, without any intervening YP; this is shown in (8a). In that structure, X^0 and Y^0 symmetrically c-command each other. In order to ensure that X^0 asymmetrically c-commands Y^0 , I will instead assume the structure in (8b): Y^0 must project YP before it can be Merged with X^0 . This is similar to the assumption made by Kayne (1994), and for similar reasons. It departs from contemporary Minimalism in that it requires some unary operation responsible for creating the node YP. I will remain agnostic as to what exactly this operation is; we might imagine, for instance, that it's possible to Merge Y^0 with itself or with an empty set in order to generate YP, but the details won't matter for this dissertation.¹

- (8) a. No asymmetric c-command b. Asymmetric c-command



1.4.1 Syntax is unordered

Crucially, throughout this dissertation I will follow most contemporary Minimalist accounts in assuming that the output of the syntax is *unordered*. That is, from the point of view of the syntax the two trees in (9) are exactly equivalent. This follows in a long tradition of assuming that linear order is imposed at the interface; see, for instance, Kayne (1994); Chomsky (1995b); Fox & Pesetsky (2006) and many more. The intuition behind this choice is to allow languages with different base word orders (for example, SOV and SVO) to have the same underlying structure. Some later function transforms the output

¹Another option that would keep closer to Minimalist assumptions would be to redefine c-command such that only those heads with at least one projection can c-command anything. For example, we might say that some node α c-commands β if every node which (reflexively) dominates the minimal phrasal projection of α dominates β (and α doesn't dominate β). In the example above, since Y^0 doesn't project, it cannot c-command X^0 , and so X^0 will asymmetrically c-command Y^0 .

of the narrow syntax into an ordered string suitable for phonology; in this dissertation, that function will be Optimal Linearization, which takes as its input a syntactic tree and produces as its output a prosodic structure.



It's worth noting that there are contemporary theories of syntax which do not assume unordered trees. For example, Minimalist Grammars (Stabler 1996, e.g.) generally assumes that the Merge operation creates an ordered pair of sister nodes. However, one primary contribution of this dissertation is to show that in cases of prosodic displacement, the place that a word is pronounced and the place that it was Merged into the structure may differ; in particular, Chapter 3 shows that no syntax based purely on ordered Merge or a similar structure-building operation can generate the relevant word-order alternations. This supports the view that syntactic structure is unordered.

1.5 Theoretical background: Prosody

Modelling prosodic displacement requires some model of how syntactic structure and prosodic phenomena relate. In Chapter 7, I argue that Khoekhoegowab tonal sandhi cannot be easily predicted solely from the syntactic structure; in at least some cases, the constituency diagnosed by sandhi differs from the constituency diagnosed by syntactic tests. For this reason, I will adopt an indirect model of prosodic structure in which prosodically-sensitive phonology does not make reference to the syntax directly, but rather to some intermediate representation. That is, I assume a model of grammar like the one below: The output of the narrow syntax is passed into the Prosodic-Structure Building

module, which creates an intermediate representation; the output of this component is passed to the Structure-Sensitive Phonology.²

$$(10) \quad \begin{array}{ccccc} \text{Syntax} & \rightarrow & \text{Prosodic Structure} & \rightarrow & \text{Phonology} \\ [_{XP} X Y] & & (\varphi \ \omega \ \omega) & & /ba \ pa/ \end{array}$$

Following Selkirk (2011) & Ito & Mester (2012), I adopt a model of prosodic structure with a reduced inventory of prosodic categories. These categories are not defined by the particular phonological phenomena they are marked by (as were e.g. Accentual Phrases; Beckman & Pierrehumbert 1986) but instead are defined broadly by the size of syntactic constituent they seem to associate with: Any prosodic unit that seems to be associated with a roughly clause-sized string is an intonational phrase (ι); likewise, any constituent that seems to be associated with some syntactic unit larger than a word but smaller than a clause is a phonological phrase (φ). In (11), I've depicted the full prosodic hierarchy, down to the level of the mora; most of this dissertation will be concerned only with those levels at least as large as the prosodic word.

- (11) **The Prosodic Hierarchy:**
- ι Intonational Phrase
 - φ Phonological Phrase
 - ω Prosodic Word
 - Ft Foot
 - σ Syllable
 - μ Mora

The Prosodic-Structure Building component of the grammar is responsible for taking a syntactic structure and generating a prosodic parse consisting of constituents from the categories in (11). In keeping with much of the recent literature, I'll model this component using Match Theory (Selkirk 2011; Elfner 2012). The fundamental hypothesis of Match Theory is that prosody mimics syntax by default; mismatches between syntac-

²This model is broadly equivalent to the one described in Selkirk & Lee (2015) and assumed by many other researchers, e.g. Ito & Mester (2012); Elfner (2012). The terminology of 'Prosodic-Structure Building' and 'Structure-Sensitive Phonology' is due to Lisa Selkirk, p.c.

tic and prosodic constituency only occur when some prosody-specific wellformedness conditions intervene. This is accomplished in an Optimality Theoretic framework using the *MATCH* constraints, which penalize divergence between syntactic and prosodic constituency. There are three pairs of constraints, one for each level of the prosodic hierarchy at the word level or above. In each pair, one constraint enforces the syntax-to-prosody mapping (analogous to *MAX* in Correspondence Theory; McCarthy & Prince 1995), while the other enforces the prosody-to-syntax mapping (analogous to *DEP*). For example, the two constraints regulating the phonological phrase level are defined below:

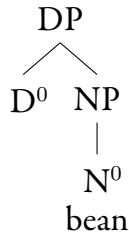
(12) Definition: A syntactic object *X* and a prosodic object α **match** iff the set of phonologically-contentful terminal nodes dominated by *X* is the same as the set of morps contained in α .

- (13) a. *MATCH-XP*: Assign one violation for each *XP* with no matching φ .
 b. *MATCH- φ* : Assign one violation for each φ with no matching *XP*.

Crucial to Match Theory is the idea that prosodic structure is sensitive to its own markedness constraints. For example, Elfner (2012) shows that Irish prosody is subject to a constraint *BINMIN*, which prevents the creation of phonological phrases (φ s) with only one daughter. For example, given a DP like *bean* ‘a woman’ as in (14), *MATCH-PHRASE* prefers the prosodic structure in (15a), where the DP is mapped to a φ .³ However, that phrase is unary in that it contains only one prosodic word; in fact, various intonational tests show that unary DPs are not mapped to φ s in Irish, but rather just to prosodic words, as in (14b). This is a case of a mismatch between syntax and prosody driven by *BINMIN*. A variety of other markedness constraints have been proposed, including *EQUALSISTERS* (Myrberg 2013); *STRONGSTART* (Selkirk 2011); and *NON-RECURSIVITY* (Selkirk 1996).

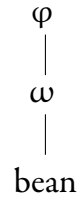
³Note that the DP and the NP both dominate the same set of phonologically-contentful terminals — i.e. just *bean*. The φ thus matches both DP and NP.

(14)

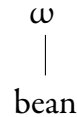


(15)

a. Fully Matched:



b. No Unary φ:



1.6 Outline of Dissertation

This dissertation is organized as follows. Chapter 2 provides background on the problem of linearizing syntactic structure. The problem of word-order typology is a fundamental one in syntax: What word orders do we expect to be possible or impossible in human language? I argue that prior models of linearization suffer from too many degrees of freedom. For example, the Linear Correspondence Axiom (LCA; Kayne 1994) restricts word-order typology in such a way as to capture the (near-)universal leftward direction of movement. In doing so, however, it rules out head-final orders; in order to recover those orders in our typology, it is necessary to allow a variety of complex movements. However, as shown by Abels & Neeleman (2012), the result of freely allowing movement is that the LCA becomes unrestricted, allowing even the word-orders it was originally designed to exclude. I conclude from this discussion that the nature of the linearization function remains an unsolved problem in contemporary syntax.

Chapter 3 introduces the notion of prosodic displacement, which is a kind of word-order alternation conditioned by prosodic factors rather than morphosyntactic ones. I propose four criteria for determining whether a particular phenomenon must be analyzed as prosodic displacement: We should prefer a prosodic displacement analysis to a syntactic one if (1) the alternation is not a syntactically-plausible movement (the cri-

teria of ‘syntactic plausibility’); (2) the alternation has no effect on compositional semantics (‘semantic inactivity’); (3) the displaced items do not form a morphosyntactic natural class (‘morphosyntactic heterogeneity’); and (4) the displaced items do form a prosodic natural class (‘prosodic homogeneity’). I survey three prior examples of word order alternations that meet all four criteria: Second-position clitics in Bosnian / Croatian / Serbian (Halpern 1992; Schütze 1994, and many others); light-pronoun postposing in Irish (Elfner 2012; Bennett et al. 2016); and clausal right-extraposition in Malagasy (Edmiston & Potsdam 2017). I conclude that all three cases are clear examples of prosodic displacement, and so any linearization scheme must be capable of accounting for this phenomenon.

Chapters 4 & 5 present the core empirical contributions of this dissertation. Chapter 4 describes the phenomenon of tense-marker displacement in Khoekhoegowab. Khoekhoe expresses all tense, aspect, and polarity information via a system of particles which are separable from the verb. I show that Khoekhoe is an overwhelmingly head-final language, which leads us to expect that tense marking, as the expression of the T^0 head, should follow the VP. However, this is not always the case. Tense markers in Khoekhoe come in two varieties: One variety follows the verb as expected, while the other variety encliticizes to some preverbal element, often interrupting the VP. I show that the positioning of these preverbal particles meets all four criteria for prosodic displacement: It is syntactically implausible and semantically inert, but most importantly the preverbal particles do not form a morphosyntactic natural class. Instead, the only predictor of where a particular particle will appear is prosodic: Light, monomoraic particles appear before the verb, while heavier particles appear in their syntactically-expected postverbal position.

Chapter 5 presents the results of a prosodic production experiment on Khoekhoe tonal sandhi. In isolation, Khoekhoe words have six contrastive tone melodies — four level tones and two rising contours. Sandhi is a process of opaque tonal substitution, in which each of the six melodies is mapped to a different melody. Sandhi applies to all

except the leftmost word in some prosodic constituent; for example, Brugman (2009) shows that in the nominal domain all but the leftmost word in a DP undergoes sandhi. However, verbs show apparently anomalous behavior with respect to sandhi. I conducted a prosodic production experiment manipulating the position of tense marking within the clause; I show that in matrix clauses verbs undergo sandhi exactly when preceded by tense-marking, even when separated from the tense particle by a considerable distance.

Chapter 6 presents the core theoretical contribution of this dissertation. Optimal Linearization is a violable-constraint model of linearization that selects a winning word order from the set of all possible permutations of the words in a given input. This is accomplished by two competing constraints: HEADFINALITY penalizes deviations from an idealized head-final order, while ANTISYMMETRY mimics the action of Kayne's LCA by enforcing correspondence between asymmetric c-command and linear precedence. I show that these two constraints work together to predict the generalization that specifier positions are always at the left edge of their phrase. I also discuss the Final-Over-Final Constraint (FOFC; Sheehan et al. 2017), a typological generalization that head-final phrases may not contain head-initial ones; I propose a domain-specific constraint HEADFINALITY- α which allows Optimal Linearization to correctly predict FOFC-respecting word orders with mixed headedness.

Chapter 7 combines Optimal Linearization with Match Theory in order to analyze prosodic displacement in Khoekhoe. In order to motivate displacement, I propose a constraint STRONGEDGE⁴ that penalizes prosodic constituents with prosodic clitics at their left or right edge. In Khoekhoe, this constraint dominates HEADFINALITY, forcing light tense markers out of clause-final position. I also show that sandhi provides evidence of a syntax-prosody mismatch in Khoekhoe: With heavy, postverbal tense markers, verbs behave as though they are leftmost in some prosodic constituent, even though they are not

⁴c.f. STRONGSTART, (Bennett et al. 2016; Selkirk 2011).

leftmost in any syntactic constituent. I propose that this is the result of a constraint `EXTENDEDPROJECTION`⁵, which requires that roots not be separated from their extended projection by phonological phrase boundaries. This not only explains the syntax-prosody mismatch in sentences with postverbal tense markers, but also explains why preverbal tense markers typically remain adjacent to the verb.

Chapter 8 extends the Optimal Linearization analysis to the other three cases of prosodic displacement discussed in Chapter 3. In the case of Irish pronoun postposing, I show that the analysis from Bennett et al. (2016) in fact incorrectly predicts that postposed pronouns will always move the minimum distance necessary to satisfy `STRONGSTART`. By contrast, an analysis using the Optimal Linearization constraints straightforwardly predicts the observed long-distance displacement; Optimal Linearization also helps solve the puzzle, noted in Elfner (2012), of why other light function words do not postpose. In the case of second-position clitics, I show that Optimal Linearization, combined with `STRONGSTART`, allows us to maintain a mixed syntax / prosody analysis as advocated by Werle (2009) and others. Finally, for Malagasy, I show that under Optimal Linearization, right-extraposition (as opposed to leftward displacement) is the predicted repair for cases where something lower on the prosodic hierarchy (i.e. φ) contains something higher on the hierarchy (i.e. ι); this extends and refines the analysis proposed by Edmiston & Potsdam (2017).

Finally, Chapter 9 concludes with some discussion of the typological predictions made by Optimal Linearization and the other constraints discussed in this dissertation.

⁵c.f. López (2009)

CHAPTER 2

LINEARIZATION

Contemporary syntactic research has largely converged on the Minimalist (Chomsky 1995b, 2005) notion that our theory of syntax should include only those elements necessary for both the interpretive component (the Logical Form) and the articulatory component (the Phonological Form). One consequence of this is that, contra earlier models, in Minimalism syntactic structures are typically taken to be inherently unordered: The LF is not generally known to be sensitive to linear order, and so our model of grammar should put linearization on the PF branch, after syntactic structure is built. This is not a new idea — the notion that a single syntactic structure might be mapped to different linear orders by different languages lead to the formulation of the Headedness Parameter in early generative inquiry — but under Minimalism the centrality of the linearization problem has increased.

If syntactic trees themselves are inherently underordered, then our model needs to include a function which maps trees to strings. This function should be sufficiently limited to generate all and only the mappings we find in natural language. Put another way, the question linearization is a question of typology: How can we get from syntactic structures to a limited set of possible word orders? This is not our only goal, however: we also seek a model which gives some insight into why we observe the typological patterns that we do.

In this chapter, I'll start by reviewing those typological patterns themselves: What word orders do and do not appear? I'll then turn to reviewing prior approaches to the problem of linearization. These fall broadly into two groups. The first group starts with

the classical Headedness Parameter; I'll show, however, that this starting point is not adequate to our typological needs. The second group starts with the Linear Correspondence Axiom (Kayne 1994), which aims to be a maximally-restrictive model deriving word order from asymmetric c-command; again, however, I'll show that this model is either much too restrictive or not restrictive enough, depending on one's ancillary assumptions. Finally, I'll briefly anticipate the next chapter by turning to a small class of recent models which have used violable constraints to enforce linearization.

2.1 Empirical word-order typology

The process of modelling word-order typology suffers from too many degrees of freedom. If we want to ensure that our model includes some particular word order, we have at least two options: We could hold constant our syntax and tweak our linearization model to produce the desired order; or we could hold constant our linearization model and propose that the word order in question is derived via syntactic movement. In some cases, syntactic research has clearly converged on a movement solution; for example, VSO word orders as in Irish (Chung & McCloskey 1987; McCloskey 2011) are almost universally derived via movement of the verb or VP, rather than a linearization scheme which somehow separates the in situ verb and object. When setting out to build a model of linearization, then, it behooves us to be conservative in choosing what phenomena we hope to explain: Our goal should be to model only those properties of word order for which syntactic theory does not currently offer any explanation.

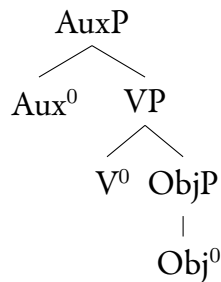
One such property is this: much research has made it clear that the specifier position, insofar as it can be coherently defined on purely syntactic grounds, is always linearized to the left of its head (e.g. Kayne 1994; Abels & Neeleman 2012, a.o). Evidence for this claim includes the universally-leftward direction of *wh* movement (e.g. Bach 1971, and

many others)¹; the general paucity of any rightward movement (see e.g. Overfelt 2015, and references therein); and the rare and often controversial status of OSV base word order. This universal doesn't follow from anything inherent to the syntax — it would change nothing substantial about our theory if specifiers were universally on the right, or alternated based on headedness direction. We should thus hope to find an explanation for this in the linearization function.

The other word order universal which will concern us in this chapter is the Final-Over-Final Constraint (Sheehan et al. 2017, FOFC;): Within an extended projection, if a phrase is head-final then its complement will be as well; but if a phrase is head-initial, its complement may have either headedness. This is illustrated with a schematic tree in (2); any part of a tree with the same geometry will have the same word order prediction. If we are allowed to set the Headedness Parameter individually for each phrase, we predict 4 possible orderings for this tree; empirically, though, the order in which VP is head-initial and AuxP is head-final seems not to occur.

(1) **The Final-Over-Final Constraint:** The complement of a head-final phrase is also head-final.

(2) a.



b.

	Aux Initial	Aux Final
V Initial	Aux V Obj (e.g. English)	* V Obj Aux
V Final	Aux Obj V (e.g. Bambara)	Obj V Aux (e.g. Hindi)

¹The one purported exception to this universal is American Sign Language; however, the data there is highly unclear and the analysis controversial. See e.g. Petronio & Lillo-Martin (1997)

The FOFC has been extensively discussed in the literature, notably in a recent book by Sheehan, Biberauer, Roberts, & Holmberg (2017); evidence for the constraint is presented there and in the references contained therein. I will present a small sample of the evidence here, however, coming from WALS (Dryer & Haspelmath 2013). WALS does not code directly for the kind of disharmonic orders that interest us here, but it does include a proxy: Feature 94A covers the placement of “adverbial subordinators”, a subset of complementizers, with respect to their embedded clause; we can take this as tracking the order of C and its complement S. We can then look at the relationship between these embedding complementizers and the headedness of the language overall (as measured by Feature 95A, “Relationship between the order of Object and Verb and the order of Adposition and Noun Phrase”). The results are tabulated in (3).

(3) **The FOFC in WALS:**

	C S	S C
Head-Initial	258 (87%)	1 (0.001%)
Head-Final	37 (13%)	85 (99.99%)

As can be seen, languages in which a head-final C embeds an otherwise head-initial clause are vanishingly rare², with only one such language listed in WALS.³ This provides evidence for only a small subset of the range of cases covered by the FOFC, and the reader is directed to the existing literature for exemplification of the other cases. Nonetheless, it can be seen that the FOFC is at least a very strong trend and likely a universal.⁴

These, then, are the typological facts we should target when designing a linearization function: Specifiers always precede heads and their complements; and the complements of head-final phrases must also be head-final.

²Difference of proportions: $\chi^2 = 227.8$, $df = 1$, $p < 0.0001$.

³The one language listed is Buduma (Lukas & Nachtigal 1939), a Chadic language.

⁴The low percentage of C S languages which are head final in this data (13%) is a sampling artifact — head-final languages are under-represented in Feature 94A generally. Note that the disharmonic case comprises 30% of the head-final languages in this sample.

2.2 The Headedness Parameter

The classical approach to linearization is the Headedness Parameter, which hypothesizes a parameter controlling whether heads occur on the left or the right of their phrase. This hypothesis doesn't account for either of the empirical generalizations above. First, the Headedness Parameter offers no explanation for why specifiers always precede their heads. Put another way, head-final languages are fully head-final in that the head does occur at the right edge of its phrase; but in head-initial languages the head is preceded by the specifier. The Headedness Parameter offers no explanation for this striking asymmetry; we are left to simply stipulate that the parameter applies only to heads and complements, but not specifiers.

The Headedness Parameter model also fails to capture the typological facts; depending on one's assumptions, it either undergenerates or overgenerates. The undergeneration case is commonly known: If we assume that the headedness parameter can't be set for individual heads (but rather is global to the entire language), we predict that all phrases in a language will have identical headedness. As we've already seen above, this is easily falsifiable: German is a frequently-studied example of a language with mixed-headedness; casting our net a bit more broadly, *WALS* (Dryer & Haspelmath 2013) lists 66 languages in which the relative ordering of the verb and its object differs from the ordering of adposition and noun. This is a small percentage of the sample, to be sure, but it represents only one of the ways that a language might display mixed-headedness; whatever model we use, it clearly must rule in these mixed cases.

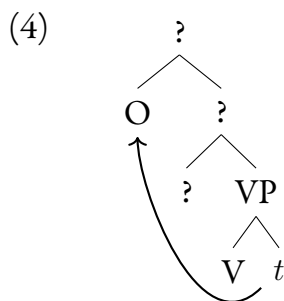
On the other hand, if we allow languages to set the Headedness Parameter differently for each individual phrase type, we overgenerate. In particular, we will fail to capture the FOFC: If parameter settings are independent for heads, a final-over-initial configuration is just as likely as an initial-over-final one. The Headedness Parameter is thus an inadequate model for linearization.

While this model has been largely abandoned in recent work, there are still a few models that follow similar lines. One example is Wouter Zwart (2011), which proposes that the Merge structure-building operation is asymmetric, generating ordered pairs; while he does address the FOFC, it is still unclear what would prevent his system from switching order in a non-FOFC-respecting way.

2.3 The Linear Correspondence Axiom

Kayne (1994) proposes the Linear Correspondence Axiom, which states that asymmetric *c*-command in the syntax is directly mapped onto precedence in the linearized string. This has the immediate benefit of explaining why specifiers are always on the left: The specifier always asymmetrically *c*-commands the head, and so everything in the specifier must precede the head. The cost, of course, is that the LCA rules out head-finality entirely: Heads always asymmetrically *c*-command the contents of their complements, and so under this model will always precede them. On first glance, then, the LCA vastly undergenerates: Of the three FOFC-compliant word orders, it seems to predict only one.

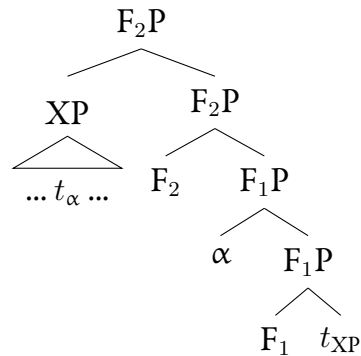
In order to escape this prediction, Kayne himself proposes that apparently head-final orders are in fact generated by movement. For example, Object-Verb word order might be generated by some kind of object raising, as in (4):



Of course, getting the entire clausal spine to be head-final then requires a sequence of roll-up movements: The object above VP, then the VP (and O) above TP, etc. These move-

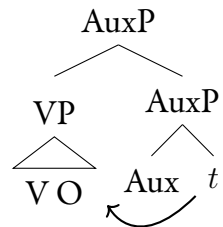
ments frequently have no independent motivation. What's more, allowing this kind of movement renders the LCA nonrestrictive. A large part of the original motivation for the LCA was to derive an apparent ban on rightward movement: If movement is always to a c-commanding position, by the LCA it must always be leftward. But Abels & Neeleman (2012) point out that, given the option of remnant movement (for which we generally have independent motivation), it is perfectly possible to generate an LCA-compliant structure giving the appearance of rightward movement. For example, in (5) some element α has moved out of XP into the specifier of a phonologically-null functional head. XP itself has then moved into the specifier of a higher functional head, giving the appearance that α has moved rightward out of XP.

(5)



Worse, for our purposes, is that it is quite easily possible to generate the missing final-over-initial disharmonic word order, without even requiring remnant movement, simply by moving VP above Aux⁰:

(6)



Despite the LCA's success in providing an explanation for the asymmetry of specifiers, it ultimately suffers the same fate as the Headedness Parameter: Depending on the particular analysis, it either undergenerates or overgenerates, with no obvious way to arrive at a happy medium.

Most contemporary approaches to linearization use the LCA as a starting point and thus inherit its flaws. For example, Fox & Pesetsky (2005) propose that linearization proceeds cyclically by phase, with each new phase adding asymmetric c-command relations (and thus precedence) to the order; crucially, they propose that this process is monotonic — once an order has been established between two words, it cannot be changed. This allows them to derive successive cyclicity and other restrictions on syntactic movement. This model gives us considerable new insight into these restrictions, but doesn't address the underlying typological issues with the LCA. Dobashi (2009) similarly shows why phase-based linearization requires the phase edge to remain accessible for later syntactic processes, but still accepts the one-to-one correspondence between asymmetric c-command and precedence. Collins & Stabler (2016) ignores asymmetric c-command, but still posits a universal specifier-head-complement order. With all its flaws, the LCA thus continues to reign as the state-of-the-art approach to linearizing syntactic structure.

2.4 Violable Linearization

To anticipate the next chapter a little, it's worth taking a look at a few linearization schemes which make use of violable constraints to model cases where non-syntactic factors seem to adjust the linearization. Morphophonology has used a variety of violable constraints to order morphemes since the introduction of Optimality Theory (Prince & Smolensky 1993/2004), and various morphosyntax analyses have adopted this for clitic ordering (e.g. Legendre 1998). These analyses generally share in common that the portion of the underlying structure of interest — generally the heads or features which are spelled out as clitics — are unordered in the input and are subject to ALIGN constraints

(McCarthy & Prince 1994a) which try to position them relative to some edge. I'm not aware of any attempt to extend this style of analysis to cover the full range of linearization, however.⁵

More directly relevant here are approaches which assume an order-enforcing constraint is in conflict with other constraints not related to word order. An early example of this is López (2009), who proposes that the LCA itself is a violable constraint in competition with various prosodic constraints. He uses this approach to explain Clitic Right Dislocation in Romance, arguing that the apparent rightward movement is in fact leftward movement to an intermediary position, but that a prosodic constraint requiring the verb to phrase together with its extended projection overrides the LCA and causes the moved item to be linearized on the right. Similarly, Elfner (2012), in analyzing Irish pronoun postposing⁶, uses an LCA constraint penalizing deviation from spec-head-comp order; in Bennett et al. (2016) this constraint is softened into NOSHIFT, which penalizes deviation from some order, determined from the syntax by a deliberately unspecified algorithm.

In fact, all three of these proposals define their respective constraints as penalizing deviations from some pre-specified linear order, rather than from a mapping between syntactic structure and linear order; this amounts to specifying the linearization in the input, rather than deriving it from constraint interaction. For example, in the model used by López (2009), for any given syntactic structure there is exactly one word order which doesn't violate the LCA constraint at all, namely the one that perfectly maps asymmetric c-command to linear order; the constraint itself simply penalizes any deviation from that order. Making this constraint violable gives us no insight into linearization itself beyond what was already present in Kayne (1994) — the useful properties of Optimality Theory

⁵See Zukoff (2017b,a) for an interesting proposal relating ALIGN constraints and syntactic structure for ordering morphemes below the word level. Kusmer (2019) shows that Optimal Linearization can accomplish the same work with less conceptual machinery.

⁶See section 3.2.2 for a more detailed discussion of the phenomenon.

are not leveraged in any way in the calculation of this base order itself. In Chapter 6 I'll propose an alternative that makes use of violable constraints more extensively in order to give us some additional insight into the linearization function.

CHAPTER 3

PROSODIC DISPLACEMENT

In the last chapter, I surveyed the prior approaches to linearizing syntactic structure. While there is a great deal of variety in these approaches, they share in common a restriction on what information is available to the linearization function. In particular, they restrict the linearization function to seeing syntactic information, i.e. constituency and labelling (as opposed to e.g. phonological form). While this restriction is generally left implicit, it follows from a view of grammar in which linearization takes place in the narrow syntax, or at latest at the interface in which syntactic form becomes phonological form.

There is a growing body of evidence that this restriction may not be tenable. For example, consider the case of Irish pronoun postposing as discussed by Elfner (2012) and Bennett et al. (2016). In Irish, some unstressed pronouns may be postposed arbitrarily late in the clause, shown in (1). If these pronouns are stressed, however, they must be pronounced in their base position.¹

- (1) Fuair sé ___ óna dheartháir an lá cheana é
get.PAST he from.his brother the-other-day it
“He got it from his brother the other day.” (Bennett et al. 2016, p. 171)

This is a case in which the phonology of the pronoun seems to affect its linearization: The linearization function treats pronouns with a particular phonological property (namely stress) differently from those without that property. In a model where the linearization

¹Note that the accent on *é* is part of Irish vowel orthography and does not indicate stress.

function only has access to the syntactic structure, this would be impossible to account for. If we're going to model cases like Irish, we need to extend our model.

The Irish pronoun postposing phenomenon is a case of what I will term *prosodic displacement*. I'll use the word 'displacement' generally to refer to all those linguistic phenomena in which some constituent seems to have more than one position — for example, being pronounced in a different position than it is interpreted, or being interpreted differently in multiple positions. We can immediately distinguish at least three classes of displacement: overt syntactic movement, covert LF movement, and PF displacement. PF displacement (or PF movement) has a long history in the literature; see, for example, Chomsky (1995b); Aoun & Benmamoun (1998); Sauerland & Elbourne (2002); Embick & Noyer (2001). I'll use the term prosodic displacement more specifically to refer to a subset of PF displacement which is apparently conditioned by the phonological or prosodic properties of the displaced item and its context, rather than some condition on the syntax-phonology interface. Since syntactic & prosodic theory both have heretofore assumed that the linearization function only sees syntactic structure, both have ignored the possibility of prosodic displacement as a systematic phenomenon.

In this chapter, I'll argue that phenomena like Irish pronoun postposing, which show a word-order alternation dependent on prosody, force us to consider a prosodic displacement analysis. I'll start by proposing a set of criteria we can use to diagnose PF displacement generally and prosodic displacement in specific. With these criteria in hand, I'll review the previously-proposed cases of prosodic displacement, building evidence that whatever linearization function we choose must have access to prosodic information; I'll also consider a number of proposed cases of PF displacement which are excluded by these criteria. In the next chapter, I'll introduce a new and particularly-extensive case of prosodic displacement from Khoekhoegowab.

3.1 Diagnosing prosodic displacement

Before I can propose an analysis of prosodic displacement, we need clear criteria for identifying it. That is, say we have some word-order alternation: A particular word (or class of words) is pronounced in one position in some cases, but a different position in others. We already have one clear mechanism for deriving such an alternation, namely syntactic movement; what could motivate us to provide a prosodic displacement analysis for a given alternation instead of a syntactic movement analysis?

In what follows, I will strive to be conservative in what I analyze as prosodic displacement. It's entirely possible that some phenomena which have previously been understood as syntactic movement would be better analyzed as prosodic displacement, but for the time being it seems wise to only include those phenomena which have no reasonable syntactic analysis. Most of the criteria proposed here then are concerned not so much with ruling *in* prosodic displacement phenomena but with ruling *out* phenomena which the narrow syntax could easily explain. The first three criteria are concerned with selecting those word-order alternations for which only a PF displacement analysis is available; the fourth and final criterion selects for a prosodic displacement analysis specifically. It's possible that there will be cases of prosodic displacement that meet only a subset of these criteria and should still be analyzed as such; but, for the purpose of this dissertation, I will address only those cases that clearly meet all four.

With that in mind, the criteria I will use for diagnosing prosodic displacement are as follows:

1. **Syntactic implausibility:** We should prefer a PF analysis if the displacement violates commonly-accepted generalizations about syntactic movement.
2. **Semantic inactivity:** We should prefer a PF analysis if the displacement involved has no effect on the compositional semantics of the utterance.

3. **Morphosyntactic heterogeneity:** We should prefer a PF analysis if the contexts in which displacement occurs do not form a morphosyntactic natural class.
4. **Prosodic homogeneity:** We should prefer a PF analysis if the contexts in which displacement occur do form a prosodic natural class.

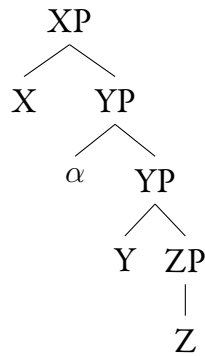
The rest of this section will discuss these criteria in greater depth; the rest of the chapter will be devoted to seeing how these criteria apply to specific examples of prosodic displacement from the literature.

3.1.1 Syntactic implausibility

The first criterion for identifying PF displacement is a basic one: Can syntactic movement easily generate the proposed structures? ‘Implausibility’ is fairly subjective, so it’s worth our while to specify at least some of the ways a given alternation might be implausible; to do this, we need to enumerate some of the typically-assumed properties of syntactic movement.

For one, syntactic movement is typically assumed to be **monotonic**. In fact, in most contemporary syntactic theory movement is assumed to always be ‘upwards’, i.e. towards less embedded positions, as in (2). There are a limited class of cases which have sometimes been analyzed as lowering (for example, English affix hopping) though it is not clear that we should analyze these as a syntactic phenomenon at all. Even allowing for syntactic lowering, however, it would be extremely surprising to see a single phenomenon which moved some constituent either up or down. For example, imagine that the structure in (2) was sometimes pronounced as (3a) and sometimes as (3b), as though α had sometimes raised to spec,XP and sometimes lowered to spec,ZP; this would be a highly implausible candidate for a syntactic movement analysis, as the movement would need to be non-monotonic.

(2)



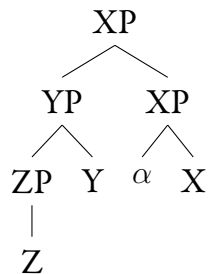
(3)

- a. α X Y Z
- b. X Y α Z

Another kind of syntactic implausibility involves **locality**. Movement is known to be subject to various locality conditions, both inter- and intra-linguistically defined. An easy example of a locality condition is islandhood: If a particular structure is known to be an island for otherwise-uncontroversial syntactic movement, we should regard a particular displacement as implausible if it apparently does not respect this island. Islandhood is a locality condition on the origin of movement, but we can also point to locality conditions on the landing site of movement. For example, consider the syntactic structure in (4a) when pronounced as (4b); the object α has apparently moved to a non-c-commanding position inside the YP. If a particular syntactic movement seems to land inside a higher (c-commanding) constituent, we should regard it as non-local and therefore implausible.

(4)

a.



b.

Y α Z X

3.1.2 Semantic inactivity

A displacement phenomenon is a good candidate for a PF analysis if it has no semantic effect. While syntactic movement does not always create changes in the compositional semantics of the sentence, it at least always has the option to. PF displacement, by virtue of

occurring derivationally after the hand-off from the narrow syntax to the interpretation and pronunciation portions of the grammar, should not have this option.

However, it should be noted that this criterion pertains only to *compositional* semantics. PF displacement should not change how the denotation of the displaced item is combined with the denotation of the rest of the clause; for example, it shouldn't allow DPs to gain new theta-roles, or quantifiers to change scope. But this still allows for the possibility that the different word orders will be associated with different pragmatic meanings (e.g. information structure). For example, in Irish, light pronouns have the option of postposing past any adjuncts; in (5a), the object pronoun *é* would typically appear immediately after the subject *sé*, but has been postposed to the end of the clause. However, this possibility goes away when the pronoun is under contrastive focus, as in (5b). Bennett et al. (2016) argue that this is the result of focus placing stress on the pronoun and thus bleeding the possibility of prosodic displacement; but this is still a case of prosodic displacement correlated with a change in information structure. This should not be construed as semantic activity, nonetheless.

- (5) a. Fuair sé ___ óna dheartháir an lá cheana **é**
 get.PAST he from.his brother the-other-day it
 “He got it from his brother the other day.” (Bennett et al. 2016, p. 171)
- b. *Fuair sé ___ óna dheartháir an lá cheana **É**
 get.PAST he from.his brother the-other-day it
 “He got *it* (as opposed to the other thing) from his brother the other day.”

3.1.3 Morphosyntactic heterogeneity

Both this criterion and the next are ultimately concerned with analytic complexity: How difficult or easy is it to state the generalization for where displacement applies? In general, we typically prefer analyses in which the relevant contexts belong to some easily-stated natural class; we typically disprefer analyses in which we need to simply list all of the relevant contexts.

From this perspective, if the contexts in which a displacement is observed do not form a morphosyntactic natural class to the exclusion of those contexts where the displacement is not observed, we should prefer a prosodic displacement analysis. For example, *wh* movement is morphosyntactically homogeneous in that it targets only and all items with *wh* features; it would be very unusual if certain *wh* items were immune to movement, or if certain non-*wh* DPs also underwent the same movement.

3.1.4 Prosodic homogeneity

The final criterion is also the only one which specifically picks out prosodic displacement, rather than PF displacement generally: the contexts in which the displacement is found should form a prosodic natural class excluding the contexts in which the displacement is not found.

3.2 Prior examples of prosodic displacement

Cases of prosodic displacement which meet all four of the criteria laid out here are rare. To some degree, this is likely because these criteria were deliberately constructed to be very conservative in what phenomena would count. To my knowledge, only three clear cases have been described so far:

- Halpern (1992); Schütze (1994); Bošković (2001), & many others: second-position clitics in Bosnian / Croatian / Serbian (and related languages) sometimes interrupt syntactic constituents.
- Elfner (2012); Bennett et al. (2016): Irish pronouns sometimes postpose when unstressed, but never when stressed.
- Edmiston & Potsdam (2017): Malagasy complement clauses are displaced to the right, unless they consist only of a single phonological phrase.

In this section, I'll lay out the evidence for each of these phenomena, evaluating them against the criteria proposed above. Afterwards, I'll review a few more cases of proposed post-syntactic displacement which fail to meet these criteria.

3.2.1 Second-position clitics

The Balkan languages, particularly Bosnian / Croatian / Serbian (BCS), have perhaps the best-studied case of prosodic displacement, namely its second-position clitics, which have a long literature going back to at least (Halpern 1992; Anderson 1993; Legendre 1998, and others). These are clitics in the phonological sense of prosodically-dependent light items which nonetheless don't show the behavior of affixes. The class of second-position clitics includes items from an array of morphosyntactic categories, including auxiliaries, a question particle, the reflexive markers, and various non-nominative pronouns. All of the clitics in a given sentence cluster in the second position of the clause, regardless of the other word order (which is fairly free):²

- (6) Taj pesnik **mi je** napisao knjigu.
That poet **me AUX** written book
"That poet wrote me a book." (Schütze 1994, p. 5, 6b)

What has typically attracted researchers to a prosodic displacement analysis for second-position clitics is the first criterion: Syntactic implausibility. In particular, the clitics do not always follow the first XP as in (6); they can alternatively follow the first word as in (7). This frequently results in clitics apparently interrupting other constituents. Halpern (1992) and others call the two positions 'second word' (2W) and 'second daughter' (2D).

³ This is illustrated below.

²Unless otherwise noted, all BCS examples are taken from (Schütze 1994).

³Schütze (1994) refers to these positions as 'first word' (1W) and 'first constituent' (1C), respectively, while Bošković (2001) calls the latter 'first phrase' (1P).

- (7) Taj **mi je** pesnik napisao knjijgu.
 That **me AUX** poet written book
 “That poet wrote me a book.” (Schütze 1994, p. 5, 6a)
- (8) a. Prošle godine **su** otvorili ugostiteljsku školu
 last year **AUX** open hotel-and-catering school
 b. Prošle **su** godine otvorili ugostiteljsku školu
 last **AUX** year open hotel-and-catering school
 “Last year they opened a hotel-and-catering school.” (Schütze 1994, p. 6, 10)

Generating any of the 2W word-orders by syntactic movement would involve either moving into an already-built XP or would involve a variety of unusual extractions from inside those XPs. BCS second-position clitics thus meet the first criterion — there does not appear to be a plausible syntactic movement analysis. The second criterion, semantic inactivity, is also easily met: None of the descriptions of the phenomena find any difference in compositional meaning between the 2D and 2W positions.⁴ Likewise, the third criterion is easily assessed: The clitics themselves, comprising everything from a question particle to pronouns, do not form any morphosyntactic natural class that would exclude all those morphemes which do not obligatorily appear in second position. Neither do the hosts for the clitics form a natural class — the first word may be from (nearly) any morphosyntactic category.

Evidence that BCS second-position clitics meet the fourth criterion, prosodic homogeneity, comes from the few cases in which the 2W order is not grammatical. For example, the clitic cluster may not come between (most) prepositions and their arguments:

⁴Though see discussion in Schütze (1994) on the factors which condition the selection of 2D or 2W position.

- (9) a. Na sto **ga** ostavi.
 on table **it** leave
 “Leave it on the table.” (Schütze 1994, p. 8, 16)
- b. *Na **ga** sto ostavi.
 on **it** table leave

Schütze (1994) notes that the relevant generalization seems to be that the host item to the left of the clitic cluster must be a prosodic word, not just any syntactic terminal. Prepositions like *na* ‘on’ seem to be proclitics themselves insofar as they do not receive an independent accent and thus do not constitute their own prosodic words. Percus (1993) notes that there are some prosodically-heavier prepositions that do have the accentual properties of prosodic words and can, at least marginally, host clitics:

- (10) ?Okolo **je** sobe trčao Marko.
 around **AUX** room run M.
 “Marko runs around the room.” (Schütze 1994, p. 9, 19)

This, then, is prosodic homogeneity: The 2W position always has a prosodic word to the left of the clitic cluster. BCS thus meets all four criteria for prosodic displacement. This fact has been well-recognized in the literature, if not in precisely the terms presented here; for example, Halpern (1992) proposes a PF operation of “prosodic inversion” which reorders a clitic and a potential host in order to satisfy the prosodic needs of the clitic. This operation works well enough for the BCS case, but we will see that it has little to say for the other cases of prosodic displacement discussed in this chapter. In Chapter 8 I will return to this issue and propose an analysis which allows us to unify the BCS case with the other examples.

3.2.2 Irish pronoun postposing

Elfner (2012), expanded by Bennett et al. (2016), shows that Irish light object pronouns often appear far to the right of where object DPs would generally be expected, with no detectable difference in semantic or pragmatic import. For example, in (11) the

pronominal object appears after the clause-final adjunct, despite the fact that Irish normally has VSOX word order:⁵

- (11) Fuair sé ___ óna dheartháir an lá cheana é
 get.PAST he from.his brother the-other-day it
 “He got it from his brother the other day.” (Bennett et al. 2016, p. 171)

Bennett, Elfner, & McCloskey (2016) present convincing evidence that this displacement lacks the signature of a syntactic movement process, contra earlier analyses by e.g. Chung & McCloskey (1987); Duffield (1995). First, the displacement is highly syntactically implausible. For example, compare the example in (11) with the example in (12). In (11), the object pronoun seems to be raising in that it is displaced past a variety of adjuncts, including the temporal adjunct *an lá cheana* ‘the other day’. In (12), by contrast, a light expletive subject pronoun has seemingly been lowered into the middle of the conjoined predicates. This is an example of non-monotonicity of movement — the same displacement phenomenon apparently moves an item either up or down in different sentences. Additionally, the example in (12) involves displacement into a coordinate structure; if this were syntactic movement, it would seemingly violate the Coordinate Structure Constraint (Ross 1967).

- (12) is cuma ___ ’na shamhradh é nó ’na gheimhreadh
 COP.PRES no.matter PRED summer it or PRED winter
 “It doesn’t matter whether it’s summer or winter.” (Bennett et al. 2016, p. 183)

On the criterion of semantic inactivity, Bennett et al. show quite convincingly that even within the same syntactic structure pronouns may freely displace to a variety of syntactic positions with no difference in meaning. It should also be clear from the previous two examples that conditions under which postposing occurs are morphosyntactically

⁵All Irish examples are drawn from Bennett et al. (2016).

heterogeneous: Pronouns displace from both object and (some) subject positions, and can land in a variety of locations.

The last criterion, prosodic homogeneity, is satisfied by the fact that pronoun postposing affects only light, stressless pronouns; stressed pronouns obligatorily appear in their base position.

- (13) *Fuair sé ___ óna dheartháir an lá cheana **É**
 get.PAST he from.his brother the-other-day it
 “He got *it* (as opposed to the other thing) from his brother the other day.”

The relevant generalization governing postposing, then, is a prosodic one; this is a clear case of prosodic displacement.

3.2.3 Malagasy clausal extraposition

Edmiston & Potsdam (2017) argue that clausal extraposition in Malagasy takes place at PF. This is particularly interesting in that it is the only clear case of prosodic displacement I am aware of which affects items heavier than a phonological clitic. Clausal extraposition is cross-linguistically quite common and is typically given a syntactic movement analysis; however, Edmiston & Potsdam (2017), expanding on Law (2007), give quite compelling evidence that the Malagasy case must be post-syntactic.

Malagasy shows VOS default word order (Keenan 1976). However, most embedded clauses obligatorily extrapose to the right edge of the clause:⁶

- (14) Nividy (fiara vaovao) Rabe (* fiara vaovao)
 PST.buy car new Rabe car new
 “Rabe bought a new car.”
- (15) Manantena (* **fa hividy fiara aho**) Rabe (**fa hividy fiara aho**)
 hope **that FUT.buy car I** Rabe **that FUT.buy car I**
 “Rabe hopes that I will buy a car.”

⁶All Malagasy examples are taken from Edmiston & Potsdam (2017).

Initially, this right-extraposition seems syntactically plausible. However, there is a language-specific test which applies here. Malagasy typically only allows matrix subjects and some adjuncts to be extracted. Objects and constituents inside objects cannot be extracted, as shown in (16). Descriptively, objects are islands for extraction (Keenan 1976, 1995).

- (16) a. Iza no hividy boky?
 who FOC FUT.buy book
 “Who will buy a book?”
 b. *Iona no hividy Rabe?
 what FOC FUT.buy Rabe
 Intended: “What will Rabe buy?”
 c. *Momba iona no hividy boky Rabe?
 about what FOC FUT.buy book about Rabe
 Intended: “What will Rabe buy a book about?”

Nonetheless, CPs can and must move from within a complex object, as illustrated in (17). Clausal extraposition thus violates an otherwise-unviolated generalization about Malagasy syntax, making a syntactic movement analysis implausible.

- (17) Nanambara ny faniran-dRabe Rasoa **fa hanambady ny faravaviny aho**
 PST.reveal DET desire-Rabe Rasoa **that FUT.marry DET daughter I**
 “Rasoa revealed Rabe’s desire that I marry his daughter.”

Turning to the second criterion, Edmiston & Potsdam (2017) present a wide variety of arguments that extraposed CPs are always interpreted in their base position within the VP⁷. That is: VOS word order in Malagasy is achieved by VP fronting; CP complements to the verb (or the object) are universally interpreted as though they are still within the VP. I’ll present only their argument from NPI licensing here: Negation in Malagasy is expressed with a preverbal particle *tsy*; this particle is unable to license NPIs in subject position (18a), implying that these NPIs are strong in the sense of requiring strict c-command by negation (Zwarts 1998). However, NPIs within embedded clauses continue to be li-

⁷Edmiston & Potsdam have a Predicate Phrase fronting for reasons not germane to this discussion; I’ll use VP for clarity.

censed (18b), showing that they are being interpreted within the VP. This, along with other arguments from binding and Condition C, establish that clausal extraposition is semantically vacuous.

- (18) a. *Tsy nanongo an' i Koto **n'iza n'iza**
 NEG PST.pinch ACC Koto anyone
 Intended: “No one pinched Koto.”
 b. Tsy mino aho [fa marary **velively** izy]
 NEG believe I that sick at.all he
 “I don’t believe that he’s sick at all.”

For the final two criteria, Edmiston & Potsdam (2017) direct us to those CPs for which extraposition is optional, which they term ‘degenerate’ CPs. For example, in (19) the embedded subject has been elided due to Topic Drop; this CP can optionally remain in situ.

- (19) Milaza [fa nahita gidro tany an-tsena Ø] Rabe
 say that PST.saw lemur LOC PREP-market Rabe
 “Rabe says that he (Rabe) saw a lemur at the market.”

Other degenerate clause types include controlled clauses, existential clauses, and subject relative clauses. There is no morphosyntactic natural class which would contain only those clauses that obligatorily extrapose and exclude the degenerate ones. There is, however, a clear prosodic natural class: Edmiston & Potsdam (2017) show that degenerate clauses are exactly those in which the subject is null, which allows the entire clause to form a single phonological phrase. Malagasy phonological phrases robustly show a distinctive final rise, and most clauses show one phonological phrase for the VP and another for the subject; degenerate clauses show only one at the end of the VP. The authors argue that intonational phrases in Malagasy are preferentially binary; without a subject in the degenerate clause, there is a preference to downgrade it from an intonational phrase to a phonological phrase. The result is prosodic homogeneity: Clauses that obligatorily extrapose are exactly the ones which constitute intonational phrases.

3.2.4 Other proposed cases

The four criteria discussed here are quite restrictive in what phenomena will count as prosodic displacement. There are several other proposals for prosodic (or PF) displacement analyses where the phenomena in question do not meet the criteria for inclusion here. This is not to say that a PF displacement analysis is not correct for those cases — merely that such an analysis is not strictly necessary. These proposals fall broadly into four classes. First, there are ‘PF movement’ analyses aiming to account for (mostly) syntactically plausible movement which have no apparent semantic effect. Second, there are proposals which aim to provide an alternative account for displacement effects which are syntactically plausible and semantically active, but nonetheless seem to lack an obvious syntactic motivation. Third, there are analyses that use broad typological factors to motivate prosodic motivations for narrowly syntactic movement. Finally, there is a growing literature suggesting ways that prosodic or other phonological effects might mediate between the choice of different syntactic structures. I’ll briefly enumerate a few of these attempts below, in order to explain why they will not be taken up in this dissertation.

3.2.4.1 PF Movement

Commonly-cited PF movement phenomena include for instance Aoun & Benmamoun (1998) & Sauerland & Elbourne (2002) on total reconstruction; or Chomsky (1995b), Chomsky (2005), & Göbbel (2007) on clausal extraposition in English. Both of these examples start with a syntactically plausible and homogeneous movement that nonetheless seems to have no semantic effect; a PF displacement analysis is thus appealing, but not necessary. A distinct but related class comes from the Distributed Morphology literature (e.g. Embick & Noyer 2001), which proposes a set of movement-like operations that occur after the narrow syntax; while the phenomena accounted for using these techniques are sometimes syntactically implausible and often semantically inactive, they are

often not prosodically homogeneous, instead apparently being driven by morphological features. Again, this doesn't rule out prosodic displacement analyses.

3.2.4.2 **Alternative analyses to syntactic movement**

The second category comprises PF displacement accounts of phenomena for which there are already syntactic analyses; in particular, these displacement phenomena are syntactically plausible and semantically active, so adopting a PF displacement analysis would rely on showing that it gives some general benefit over a syntactic one.

First, López (2009) proposes that Clitic Right Dislocation in Romance is the result of prosodic pressure overriding syntactic pressure when determining word order. In particular, he argues that there is pressure to phrase the verb together with its extended projection; this forces certain adjuncts, which would otherwise disrupt that phrasing, to be displaced out of the way. This analysis is highly interesting, but the phenomenon is still amenable to a purely-syntactic analysis. The implausibility of analyzing right dislocation as syntactic movement relies entirely on the assumption that rightward movement is never possible, which may not be warranted (see e.g. Overfelt 2015, and references therein); furthermore, Clitic Right Dislocation does in fact change the binding possibilities of the moved item, showing that this movement is not semantically inactive. Lopez's analysis relies on syntactic movement to a middlefield position being prosodically marked in that it would separate the verb from the rest of its extended projection, but that markedness is not a property of the prosody itself: Rather, he argues that this structure is marked because it fails to maintain a certain syntax-prosody relationship. That is, the relevant prosodic homogeneity here is not phonological in nature — it requires us to know something about the syntax in order to evaluate whether it is, in fact, homogeneous. This is a highly interesting proposal, but fails to meet the criteria for inclusion here.

A second such example comes from Clemens (2016), followed by Clemens & Coon (2018). Here, the target phenomenon, observed Niuean and some Mayan languages, is

the VSO / VOS word order alternation termed ‘pseudo noun incorporation’: While VSO is the default word order, syntactic & semantic properties of certain objects trigger VOS surface order. Contra the standard syntactic analyses of this phenomenon, Clemens argues that this alternation is due to a constraint ARGUMENT- ϕ , which requires that heads and their arguments occupy the same phonological phrase. Under this analysis, those objects which escape incorporation are exactly those that are headed by phasal D (rather than being bare NPs), causing them to be spelled out before their argument relation to the verb can be established. Clemens also shows convincingly that the VOS order does have a distinctive prosody, meeting the criterion of prosodic homogeneity. However, this phenomenon fails to meet any of the other criteria. The syntactic movement needed to generate the observed orders is VP movement either preceded or not by extraction of the object, which is a well-established and supported analysis (see e.g. Coon 2010). Pseudo noun incorporation does have a distinctive semantic effect, which is exactly the change Clemens & Coon are trying to capture by proposing that the incorporated objects are NPs rather than DPs. And again, like López (2009), this proposal relies on a marked syntax-prosody relation, rather than simply a marked prosodic structure, to motivate displacement. Once again, the PF displacement analysis is insightful, but not strictly necessary to capture the target phenomenon.

3.2.4.3 Prosodically-driven syntactic movement

A recent series of work by Richards (2010, 2016) proposes a model in which syntactic and prosodic structure are constructed simultaneously, and whose derivations can be mutually influencing. This allows for the prosody to drive syntactic movement. For example, for Richards the classical EPP feature driving movement of the subject to spec,TP is in fact prosodically motivated: The subject moves to spec,TP in order to provide a prosodic host for the tense affix. This allows Richards to capture certain typological correlations between prosodic structure, headedness, and syntactic movement.

This is a highly interesting proposal, but it is also highly divergent from the standard Minimalist feed-forward model, in which syntax influences prosody but not vice versa. In this dissertation, I will stick to the more conservative model. In all of the cases that Richards considers, there is independent syntactic evidence that movement has occurred; the cases I will consider, by contrast, do not seem to involve actual syntactic movement, but rather only readjustment of the linearization after the syntactic derivation is done.

3.2.4.4 Phonology mediating choice of structure

Finally, there is another class of proposals in which prosodic factors seem to mediate the choice of syntactic structure. For example, Anttila, Adams, & Speriosu (2010) show that phonological markedness factors into the choice between the double-object and prepositional frames for English ditransitives; Shih & Zuraw (2017) show from a corpus study that phonological markedness plays a role in the selection of Noun-Adjective or Adjective-Noun order in Tagalog; Breiss & Hayes (2019) finds that bigrams which produce phonologically-marked clusters at the word boundary are systematically under-represented in English corpora. Another interesting case comes from Weir (2015), who shows that English fragment answers seem to involve A'-movement that isn't possible in the absence of ellipsis; he argues that the requirement that focused items be stressed allows actual syntactic movement of the focused item in order to escape ellipsis.⁸ All of these phenomena share in common that phonology seems to mediate between sentences that have different underlying syntactic structures. This is not PF displacement I mean it here, as it cannot be accounted for by proposing a different linearization scheme for a single syntactic structure. These facts require a significantly more complicated model in which the phonology is able to give feedback to the syntax during the process of sentence-construction. Such an idea is intriguing, but well beyond the scope of this dissertation.

⁸Weir argues that the fragments move at PF, not in the narrow syntax. However, the movement in question has all the properties of syntactic movement, meaning that it cannot be an effect of the linearization function, all that's relevant to the current discussion.

CHAPTER 4

PROSODIC DISPLACEMENT IN KHOEKHOE

Khoekhoegowab, commonly called Khoekhoe, is a Central Khoisan language spoken in Namibia by around 200,000 speakers, making it the largest language in the Khoisan group. It is a language of considerable syntactic interest, but the particular phenomenon of relevance here is the unusual positioning of tense, aspect, and polarity (TAP) particles. Some but not all of these particles, which otherwise behave like the heads of their respective phrases, show up before the verb, despite Khoekhoe being an otherwise head-final language; what's more, these preverbal particles can show up in a wide range of positions, apparently without semantic or pragmatic effect:¹

- (1) a. Nesi =b ge ||na xamma ne †nū gomasa **ni** nâ.
 now =3MS DECL that lion this black cow **FUT** bite
- b. Nesi =b ge ||na xamma **ni** ne †nū gomasa nâ.
 now =3MS DECL that lion **FUT** this black cow bite
 “Now that lion will bite this black cow.”

I will show in this chapter that preverbal TAP particles meet all the criteria for prosodic displacement proposed in Chapter 3:

1. TAP particles are frequently displaced to syntactically-implausible landing sites.
2. The position of the TAP particle has no effect on compositional semantics.
3. The class of preverbal TAP particles is morphosyntactically heterogeneous.

¹Unless otherwise noted, all Khoekhoe examples are drawn from original fieldwork. Examples are presented in the standard orthography except where tone is relevant to the discussion, in which case the four tone levels are marked as <á, á, à, à> from superhigh to superlow.

4. But the preverbal particles are prosodically homogenous both in the form of the particle and in their effects on sentential tone.

4.1 Basics of Khoekhoe syntax

Khoekhoe is, in general, a strongly head-final language (Haacke 2006). In the clausal domain, verbs are final (2); auxiliary verbs follow their main verbs (3); and embedding complementizers robustly follow the clause they introduce (4).

- (2) Arib ge |hôasa ra saru.
 dog DECL cat IMP chase
 “The dog is chasing the cat.”
- (3) †Khanisa =ta ge ra khomai †gau.
 book =1S DECL IMP read want
 “I want to read the book.”
- (4) a. Mî =ta ge ra [arib ge |hôasa go mû ti.]
 say =1S DECL IMP dog DECL cat PST see C.QUOT
 “I’m saying that the dog saw the cat.”
 b. Axab ge [!garise ra ā se] ra !khoe.
 boy DECL loudly IMP cry C.ADV IMP run
 “The boy is running while crying loudly.”

Turning to the nominal domain, we find that all DPs end with a ϕ -feature-bearing enclitic encoding specificity (5); I take this to be the D^0 head. All nominal modifiers precede the noun, including demonstratives (6). Completing the picture, adpositions follow their complement (7).

- (5) a. khoe =b
 person =3MS
 “the man”
 b. khoe =di
 person =3FP
 “the women”
 c. khoe =i
 person =3CS
 “some person”
 d. khoe =khom
 person =1MD
 “we two men”

- (6) a. ne †nū goma =s (7) ‖ib om =s ‖kha
 this black cow =3FS his house =3FS to
 “this black cow” “to his house”
- b. ‖na ti !nona ‖ho =n
 those my three friend =3CP
 “those three friends of mine”

Khoekhoe shows a range of second-position clitics which divide the clause into a pre-field and a middlefield. Most prominently, root clauses typically have a second-position ‘clause type’ particle indicating the speech-act; only the declarative marker *ge* is obligatory, but ‘emphatic’ or echo questions may be marked with *kha*, while ‘emphatic’ declaratives may be marked with *kom*.

- (8) a. Netse =b ge Dandagoba ni †na.
 today =3MS DECL D. FUT dance
 “Today Dandago will dance.”
- b. Netse =b kha Dandagoba go †na?
 today =3MS ECHO D. PST dance
 “Dandago danced today? (echo / surprisal)”
- c. Dandagob kom ‖khawa ra †na o.
 D. EMPH again IMP dance C.EMPH
 “Dandago really is dancing again.”

The prefield, which I take to correspond to a specifier position in the CP layer of the clause, is typically occupied by the subject. However, topicalized constituents may be raised there, leaving the subject low in the middlefield. When this happens, a second-position clitic tracking the ϕ -features of the subject obligatorily precedes the clause-type marker. This is shown for sentences with second-position clause type markers in (8a-b); (9) shows that the subject clitic appears even when there is no (overt) clause type marker.

- (9) Netse =b Dandagoba go †na?
 today =3MS D. PST dance
 “Did Dandago dance today?”

4.1.1 TAP particles

Given the otherwise-head-final word order, it is striking that tense is frequently marked by a particle in preverbal position.

- (10) Khoeb ge oms |kha **go** oa.
man DECL home to **PST** return
“The man went back home.”

All tense, aspect, and polarity (TAP) information in Khoekhoe is expressed with a set of particles,² which are often fusional across those three domains of meaning. Most of these particles appear preverbally as in (10); some, however, appear after the verb:

- (11) Khoeb ge oms |kha oa **tama**.
man DECL home to return **NEG.NF**
“The man didn’t go back home.”

Notably, there are contexts where the preverbal particles like *go* ‘past’ may occur after the verb. First, in some cases it is possible or even preferable to front the verb and its tense marker into the prefield. When this happens, the TAP particle obligatorily follows the verb no matter which class it belongs to:

- (12) Khomai **go** =b ge Dandagoba †khanisa.
read **PST** =3MS DECL D. book
“Dandago read the book.”

Additionally, in certain embedded clauses it is possible to scramble the verb to the left of the TP; in these cases, the particle again obligatorily (immediately) follows it:

- (13) ||Amaxu **ra** netsē |apa †khanisa ti |hōs ge.
sell **IMP** today red book my friend DECL
“It’s my friend who’s selling the red book today.”

²These TAP particles appear to be phonological enclitics, as evidenced by the fact that the imperfect marker shows allomorphy based on the final consonant of the word it encliticizes to: *ta* after consonants, *ra* otherwise.

By contrast, there are no circumstances under which a postverbal TAP particle like *tama* ‘negative non-future’ can precede the verb:

- (14) *Ne taras ge !haise tama !gû.
this woman DECL quickly NEG.NF walk
“This woman doesn’t walk quickly.”

I take the TAP particles to be the (sometimes fused) heads of TP, AspectP, and PolarityP, analogous to auxiliaries; I’ll continue to refer to them with the neutral term ‘particle’. These facts make attractive an analysis in which all heads in the clausal spine are head-final, including T⁰ and the other heads expressed by the TAP particles, but where some process causes certain particles to be displaced to a preverbal position. I’ll argue that this displacement is postsyntactic and in fact has all the hallmarks of prosodic displacement.

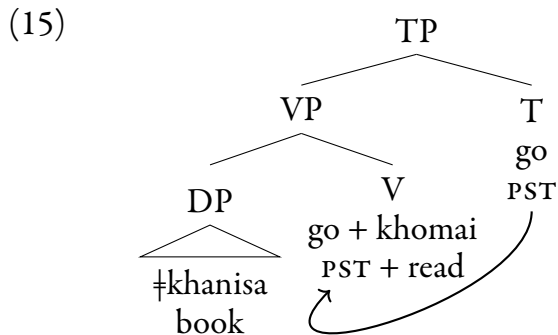
4.2 Criterion 1: Syntactic implausibility

Above, I gave evidence that, other than the case of preverbal TAP particles, Khoekhoe is uniformly head-final, motivating an analysis in which the preverbal particles achieve their position by some kind of displacement. It’s worth taking a moment to consider whether this displacement could possibly be syntactic movement. I will argue in this section that preverbal TAP placement does meet the first criterion for identifying prosodic displacement: If we were to understand it as syntactic movement, it would be movement with a highly unusual signature.

4.2.1 First possibility: Lowering

The first possible syntactic movement analysis we must consider is the simplest one: Perhaps the preverbal TAPs themselves move into a preverbal position. Under the stan-

standard assumption that T^0 is higher in the clausal spine than V^0 , this would be the result of lowering:³



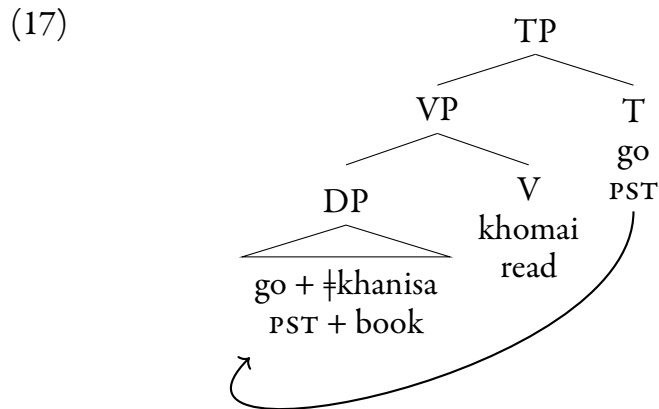
Lowering has a controversial status in syntax. In modern syntactic theory it is commonly assumed that phrasal movement only goes upward. Head movement is generally also treated as proceeding monotonically upwards, with the possible exception of certain kinds of post-syntactic operations (e.g. affix hopping in English). The case of lowering in (15) could plausibly be of this second sort, i.e. postsyntactic lowering of T^0 onto V^0 . It would be the only case of prefixing affixation in Khoekhoe, but perhaps the TAP's status as a clitic rather than an affix can explain this difference.

This analysis becomes impossible to maintain, however, in light of additional data: preverbal TAPs are not always immediately preverbal. It is possible, though rare, for the particles to appear earlier in the middlefield, separated from the verb by at least one other XP, as shown in (16). (For more discussion of this variability, see the appendix to this chapter.)

- (16) Dandagob ge go †khanisa khomai.
 D. DECL PST book read
 "Dandago read the book."

³For ease of exposition, I'm going to proceed as though all TAPs originate in T^0 , ignoring aspect and polarity heads unless they are specifically relevant. The same arguments given in this section would apply to TAPs originating in separate Asp^0 or Pol^0 heads, both of which are generally assumed to be higher than VP.

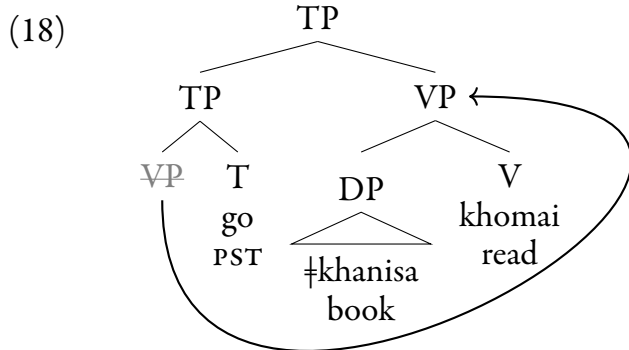
This no longer has the signature of post-syntactic lowering: The TAP particle would be lowering to attach to an arbitrary phrase.



Given the controversial status of lowering in contemporary syntactic theory, it would seem unwarranted to extend it to cover the sort of movement depicted in (17). As such, we'll dismiss the lowering analysis.

4.2.2 Second possibility: Raising

The inverse of the lowering analysis, in which the verb raises to T^0 , is also made implausible by the fact that preverbal TAP particles can be separated by the verb by arbitrary XPs in the middlefield, as shown in (16). A better raising analysis involves not head-movement but phrase-movement: Under this analysis, the VP (or some arbitrarily-large phrase containing the verb) would raise and right-adjoin to TP:

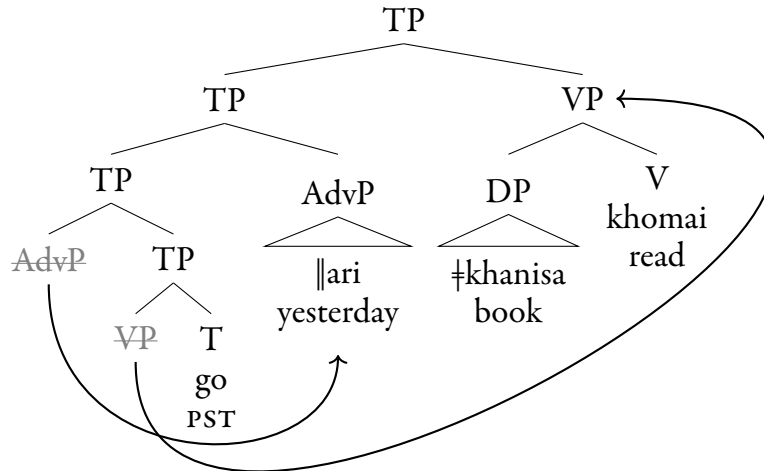


It's not clear what could motivate such a movement, nor why it should only be obligatory with particular TAPs. This problem compounds when we consider that TAP particles can precede temporal adverbs, which are commonly assumed to be adjoined to TP:

- (19) Dandagob ge go †khanisa khomai.
 D. DECL PST yesterday book read
 "Dandago read the book yesterday."

Consider the movements that would be necessary to produce this word order: First, the temporal adverb would need to raise to a right-adjoined position; then VP would raise to a higher right-adjoined position (20). These movements would need to happen in this precise order, otherwise the ungrammatical (21) would result. Given the stipulative nature of this analysis, it seems worth dismissing the raising option entirely.

(20)



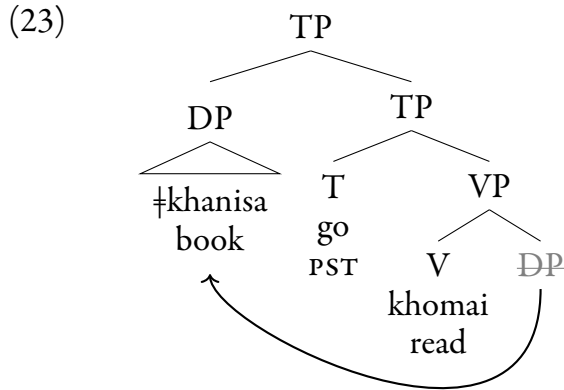
- (21) *Dandagob ge go #khanisa khomai ||ari.
D. DECL PST book read yesterday

4.2.3 Third possibility: Fronting

Washburn (2001) argues that Khoekhoe clauses are underlyingly head-initial. Under this analysis, preverbal tense particles are in their base position; instead, it is everything else in the VP that has moved. That is, to derive the word order in (22), the object DP #khanisa ‘book’ is forced to evacuate the VP and move to a specifier of TP, as shown in (23).⁴

⁴Washburn proposes that only T⁰ assigns case in Khoekhoe and that it can only do so to items in its specifier; however, he assumes that it can assign case to multiple specifier positions simultaneously. On this analysis, VP-internal material is forced to move to Spec,TP to receive case. There are some difficulties with this analysis; for one, it isn’t clear why that VP-internal adverbs would need to get case. Second, it isn’t clear that the *-a* marker that he takes to be case in fact represents anything of the sort. See Kusmer & Devlin (2018) for a more thorough summary and analysis of the distribution of the *-a* marker.

- (22) Dandagob ge †khanisa_i go khomai *t_i*.
 D. DECL book PST read
 “Dandago read the book.”



Other than the position of preverbal tense markers, Washburn’s only evidence for this analysis is the fact that weak object pronouns appear postverbally. He argues that these are the only objects allowed to retain their base position.

- (24) Taras ge †khanisa ||ari go mā *-te*.
 woman DECL book yesterday PST give *-1S.OBJ*
 “The woman gave the book to me yesterday.”

Washburn’s analysis does not account for the postverbal TAPS. If T^0 is underlyingly head-initial, why should some TAPS follow the verb? We might propose that head-movement raises V to T in these cases, but recall that Washburn’s primary evidence that VP was head-initial came from the position of light object pronouns. When there is a postverbal TAP, these object pronouns precede it:

- (25) Taras ge †khanisa ||ari mā *-te* **tama**.
 woman DECL book yesterday give *-1S.OBJ* **NEG.NF**
 “The woman didn’t give me the book yesterday.”

If the light object pronoun is in fact a DP in its base position, then (25) cannot be (only) V-to-T movement. If instead the light object pronoun is simply an agreement clitic on the verb (perhaps on v^0), then we lose our motivation for having VP (and TP) be head-initial in the first place.

4.2.4 VP coordination

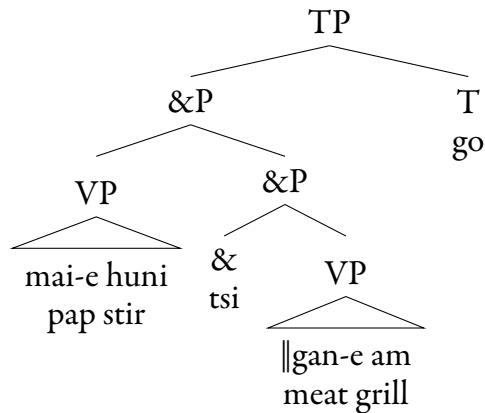
The nail in the coffin for a syntactic analysis of preverbal TAP particles comes from VP coordination. When two VPs are coordinated under a single T^0 , the postverbal tense markers obligatorily occur clause-finally (26). By contrast, the preverbal TAPs may freely occur in either conjunct (27):

(26) Aob ge mai-e huni tsi ||gan-e am **tama**.
 man DECL pap stir and meat grill **tama**
 “The man didn’t stir the pap and grill the meat.”

(27) a. Aob ge mai-e huni tsi ||gan-e **go** am.
 man DECL pap stir and meat **PST** grill
 b. Aob ge mai-e **go** huni tsi ||gan-e am.
 man DECL pap **PST** stir and meat grill
 “The man stirred the pap and grilled the meat.”

The two sentences in (27) show no difference in meaning; the TAP evidently scopes over both verbs. Syntactically, then, (27) should have a structure like (28):

(28)



None of the syntactic analyses considered above will plausibly allow us to derive the correct word orders from the tree in (28). In all cases, the relevant syntactic movement would involve extracting part of the coordinate structure (or lowering into the coordinate structure), in violation of the Coordinate Structure Constraint Ross (1967). Insofar as this constraint is believed to be universal, we should disprefer any possible syntactic analysis of preverbal TAP particles in Khoekhoe.⁵

4.2.5 Summary

In this section, I've demonstrated that the placement of preverbal TAP particles in Khoekhoe meets the first criterion for identifying prosodic displacement: All syntactic movements that could account for this word order have little to no independent motivation in the language and would need to violate the Coordinate Structure Constraint.

4.3 Criterion 2: Semantic inactivity

The final criterion for prosodic displacement is that the displacement is semantically vacuous. In at least most cases, this is trivially true for Khoekhoe preverbal TAP particles:

⁵In fact, the evidence for the Coordinate Structure Constraint in Khoekhoe is complex and mixed: The language broadly allows extraction from the first conjunct, as discussed in Kusmer (to appear). However, it universally disallows extraction from the second conjunct. Deriving the correct word order for the VP coordination case via syntactic movement would certainly involve extracting from the second conjunct, and therefore we are justified in excluding this analysis based on the Coordinate Structure Constraint.

these particles can appear before any XP in the middlefield with no change in meaning, as shown in (29). In elicitation, speakers uniformly commented that these sentences were identical in meaning and usage, and in fact frequently had trouble distinguishing them from one another even when primed to look for differences in word order.

- (29) a. Ti |hōs ge go -ro †khani-e ||khawa xoa.
 my friend DECL PST IMP book again write
- b. Ti |hōs ge †khani-e go -ro ||khawa xoa.
 my friend DECL book PST IMP again write
- c. Ti |hōs ge †khani-e ||khawa go -ro xoa.
 my friend DECL book again PST IMP write
 “My friend was writing a book again.”

4.4 Criteria 3 & 4: Morphosyntactic heterogeneity, prosodic homogeneity

The last two criteria discussed in Chapter 3 for identifying prosodic displacement are syntactic heterogeneity and prosodic homogeneity: The candidate displacement structures should show some regularity in prosodic form and a lack of any such regularity in morphosyntactic features. Khoekhoe TAP particles show prosodic uniformity in two ways. First, as initially noted by Hahn (2013), whether a given TAP particle will appear in pre- or post-verbal position is determined only by its prosodic weight, not by any morphosyntactic features; this will be shown here. Second, the position of the TAP particle predicts whether the verb will undergo sandhi or not, in ways not easily explained by reference to syntactic structure; this will be shown in detail in Chapter 5.

As noted above, Khoekhoe TAP particles come in two classes, either pre- or post-verbal. Hahn (2013) was the first to notice that the only predictor of which class a given particle will fall into is its prosodic weight: Particles with at least two moras appear postverbally, while particles with exactly one mora appear preverbally. A complete list of Khoekhoe TAP particles is presented in (30) & (31).

(30) Preverbal TAP particles

	IPA	Gloss
<i>a</i>	[ra]	present stative
<i>ra / ta</i>	[ra] / [ta]	imperfect
<i>ge</i>	[ke]	remote past
<i>go</i>	[ko]	recent past
<i>ni</i>	[ni]	future
<i>ta</i>	[ta]	negative non-finite
<i>ga</i>	[ka]	irrealis ⁶
Compound particles:		
<i>gere</i>	[kere]	remote past imperfect
<i>goro</i>	[koro]	recent past imperfect
<i>nira</i>	[nira]	future imperfect
<i>gara</i>	[kara]	irrealis imperfect

(31) Postverbal TAP particles

	IPA	Gloss
<i>tama</i>	[tama]	non-future negative
<i>tide</i>	[tite]	future negative
<i>i</i>	[i:]	non-present stative
<i>há</i>	[há:]	perfect

Note that there is no good morphosyntactic predictor of which class a given particle will take. Negative markers appear both preverbally (*ta* ‘negative infinitive’) and postverbally (*tama* ‘negative non-future’). Stative aspect markers (which are arguably copular) appear both preverbally (*a* ‘stative present’) and postverbally (*i* ‘stative non-present’). Aspect markers include both preverbal *ra* ‘imperfect’ and postverbal *há* ‘perfect’.

By contrast, though, prosodic weight is a perfect predictor of which class a particle will take. The only bimoraic particles which appear preverbally are the compound particles, transparently composed of two monomoraic particles. All monomorphemic but bimoraic particles appear postverbally.

Recall from example (12) that preverbal particles do appear postverbally under certain conditions, while postverbal ones never appear preverbally. These facts, taken to-

gether with the observation that the rest of the language is overwhelmingly head-final, meet the 3rd and 4th criteria for identifying prosodic displacement. Taken together, then, we should prefer an analysis in which Khoekhoe T^0 (and Asp^0 and Pol^0) is in some sense head-final, but under certain prosodic conditions undergoes displacement into preverbal position.

4.5 Conclusions

The placement of Khoekhoe TAP particles has all the hallmarks of prosodic displacement. The particles fall into two distributional classes based on whether they precede or follow the verb. The preverbal particles can appear in a range of positions that would be implausible landing sites for syntactic movement. Furthermore, both classes of particle are morphosyntactically heterogeneous. By contrast, both classes of particle are prosodically uniform: preverbal particles are at most one mora, while postverbal particles are at least two, the minimum number of moras the language requires of a prosodic word. Finally, this displacement has no discernible semantic or pragmatic effect. All together, the preverbal position of some Khoekhoe TAP particles seems to be derived by prosodic displacement. In the next chapter, I'll look in detail at Khoekhoegowab tone sandhi and show that it also shows uniform behavior based on the presence or absence of post-syntactic TAP displacement.

4.6 Appendix: Variable TAP placement

In section 4.2.1, I noted that the placement of preverbal TAP particles is variable: While they are typically placed immediately before the verb, they may in fact occur between any two XPs in the middlefield.⁷

⁷This variability was first noticed by Hahn (2013).

- (32) a. Ti |hōs ge go -ro †khani-e ||khawa xoa.
 my friend DECL PST -IMP book again write
 “My friend was writing a book again.”
- b. Ti |hōs ge †khani-e go -ro ||khawa xoa.
 my friend DECL book PST -IMP again write
 “My friend was writing a book again.”
- c. Ti |hōs ge †khani-e ||khawa go -ro xoa.
 my friend DECL book write PST -IMP write
 “My friend was writing a book again.”

In addition to elicitation, I have preliminary experimental evidence that the alternate (non-immediately-preverbal) word orders are acceptable and sometimes even preferable, if rare. I conducted a 2-forced-choice experiment in which 27 native speakers of Khoe-khoe were asked to choose which of two sentences, presented in writing, sounded more natural; the two choices always differed only in word order. A subset of items (9 in total) contrasted the default preverbal TAP position with one of the alternate positions; of those 243 observations, 28% of the time speakers chose the alternate word order over the default one. This experiment was not specifically examining the contrast between default and non-default word orders, and so no conclusions can be drawn about what specifically conditioned these choices; this does demonstrate, at least, that the alternate word orders are generally available.

This variability has a somewhat odd character: While speakers will always *accept* the word orders in (32b,c), they only very rarely *produce* them. In normal elicitation, I have only had an alternate order volunteered once. However, when presented with the alternate order either in writing or in speech, speakers universally state that it is grammatical. In fact, speakers often state that they do not notice a difference — even when primed to look for differences in word order, they may state that the two sentences are identical. For this reason, I will assume going forward that the word orders are in free variation; in Chapter 7 I will present an analysis that predicts the default word order, and then demonstrate how the alternate word orders may be achieved.

CHAPTER 5

KHOEKHOE TONE SANDHI

In this chapter, I'll briefly set aside the problem of linearization and turn to other aspects of Khoekhoegowab prosody. The goal is to show that TAP placement and tone sandhi crucially interact: In order to know where tone sandhi occurs, we must first know where the TAP occurs. In Chapter 7, I'll argue that this tells us something crucial about how syntactic structure in Khoekhoegowab interacts with prosodic structure; this interaction will be partly responsible for determining the placement of light TAP particles.

5.1 Introduction

Tone sandhi processes, broadly speaking, can be classified based on whether they preserve the underlying tone of the leftmost or rightmost item in a sandhi domain (Yue-Hashimoto 1987; Zhang 2007). These two classes have been correlated with a strong typological trend: “left-dominant” systems typically involve spread of the tone from the leftmost item across the domain, while “right-dominant” systems typically involve paradigmatic substitution of tones on all but the rightmost item. Shanghai Wu is a typical example of a left-dominant system (1a): The tone on the first syllable spreads across the disyllabic word, neutralizing the tone on the second syllable (Zee & Maddieson 1980; Zhu 1999, 2006). By contrast, Mandarin Tone 3 sandhi is an example of a right-dominant system (1b): The dipping tone 213 (where 1 indicates a low pitch target and 5 a high one) is substituted with a rising tone 35 exactly when followed by another 213; the rightmost 213 is preserved.

- (1) a. **Left-dominant:** Shanghai Wu
 51-X → 55-31
 b. **Right-dominant:** Mandarin
 213 → 35 / ____ 213

Khoekhoegowab (also called Khoekhoe) has a sandhi process of opaque melodic substitution (Haacke 1999; Brugman 2009). As typically described, this process is typologically unusual in that it is left-dominant but involves paradigmatic substitution: The leftmost word in each domain keeps its underlying tonal melody, while all other words have their melody replaced. For example, (2) shows that only the leftmost word in a DP retains its underlying tone, while all other words undergo sandhi. In this example, all of the words are underlying high-rising [45]; sandhi causes this melody to be replaced with a level low tone [2] whenever the word is not leftmost in the DP.¹

- (2) Sandhi in DPs (citation forms highlighted): Brugman (2009)
- a. **súúku**
 pots
- b. **!ápǎ** sùùku
 red pots
- c. **!nání** |àpa sùùku
 six red pots
- d. **||náǎ** !nàni |àpa sùùku
 those six red pots

There is a wrinkle in the description of Khoekhoe sandhi as left-dominant, however: In the default SOV word order, verbs show anomalous behavior. Prior descriptions of Khoekhoe disagree on the distribution of verbal sandhi. Brugman (2009) finds that verbal sandhi is determined purely by the syntax: Verbs in matrix clauses undergo sandhi, while verbs in embedded clauses do not. Haacke (1999), by contrast, finds that verbal sandhi

¹I will follow the tonal notation convention used for Khoekhoegowab by Brugman (2009), in which the diacritics /ǎ á à à/ correspond to superhigh ([5]), high ([4]), low ([2]), and superlow ([1]), respectively. A vowel with no tone marked indicates that no tone target is associated with it; this results in F0 interpolation between the last tone target and the next. Other than the addition of tone marking where relevant, all examples are presented in Khoekhoegowab standard orthography.

is purely determined by the linear order of elements in the clause: If the verb is preceded by a tense-marking auxiliary, it will undergo sandhi; if it is followed by such an auxiliary, it will not.

These two descriptions lead us to quite different conclusions about the nature of Khoekhoe sandhi. If Haacke is right, then Khoekhoe sandhi is post-syntactic and left-dominant: The relevant sandhi domain for the verb also includes the tense marker, and so the verb will undergo sandhi whenever it fails to be leftmost in that domain. By contrast, if Brugman is right then the relevant generalization is a purely syntactic one: Certain syntactic configurations (such as embedding) control whether the citation or sandhi form of a word is inserted, making Khoekhoe neither left- nor right-dominant as such.

This chapter presents a novel prosodic production experiment designed to adjudicate between these two analyses. The results of this experiment support a hybrid generalization: TAP position controls verbal sandhi in matrix clauses (as in Haacke 1999), but embedded verbs always resist sandhi (as in Brugman 2009). This complicates the issue of Khoekhoegowab's relevance to the generalizations described in Zhang (2007) about left- and right-dominant systems.

The rest of this chapter will proceed as follows. In Section 5.2, I will present the basic facts of Khoekhoegowab tone sandhi and discuss the generalizations proposed for verbal sandhi proposed by Brugman and Haacke. In 5.3, I will describe the design & methodology used for a prosodic production experiment aimed at deciding between the prior analyses of Khoekhoegowab verbal sandhi. Section 5.4 presents the results of this experiment, and Section 5.5 discusses some implications of Khoekhoegowab sandhi for our typology of tone sandhi and avenues for future research.

5.2 Background: Khoekhoegowab tone sandhi

All lexical items in Khoekhoegowab are associated with one of six tonal classes²; each tonal class is, in turn, associated with a particular tonal melody made up of a sequence of at most two out of the four contrastive tone levels. The word will be produced with this melody, called the “citation melody”, in isolation or in certain prosodically strong positions (defined in more detail below). The citation melodies are given in Table 5.1 along with a near-minimal sextuplet illustrating the contrast.

Table 5.1: Citation melodies (Brugman 2009)

Melody	Description	Example	Gloss
[1]	Superlow	[!àas]	‘servant’
[2]	Low	[àas]	‘tie’
[12]	Low-rising	[!nààs]	‘story’
[4]	High	[#áas]	‘plain’
[5]	Superhigh	[!náas]	‘tortoise’
[45]	High-rising	[#áás]	‘spittle’

As noted, the citation melody only surfaces in certain prosodic contexts; in most contexts a process of tonal sandhi applies. Sandhi is an opaque tonal substitution process mapping each of the six citation melodies onto another, apparently arbitrary melody. Sandhi can broadly be characterized as a weakening process in the sense that it reduces the number of cross-linguistically marked tonal melodies: The inventory of sandhi melodies has lower register overall than the inventory of citation melodies and contains fewer rising contours (which are cross-linguistically marked, see e.g. Yip 2002). The six citation melodies and their sandhi counterparts are given in table 5.2. Note that some citation tones (namely the low-rising and low-level tones) are unaffected by sandhi. Elsewhere, the effect of sandhi is unpredictable: Level tones become contours and vice versa; high-register tones sometimes become low-register ones and sometimes do not; some contrasts

²Functional items like auxiliary verbs or nominal affixes also have contrastive tone, but that tone system works differently from the tone on lexical vocabulary; see Brugman (2009) for details.

are neutralized while others are maintained. Sandhi has the effect of neutralizing the contrast between the superlow and high tone classes, and also between the low and high-rising. In at least one case, sandhi involves apparent underapplication opacity (‘counter-feeding’): Underlying high tone becomes low-falling; but underlying superhigh tone becomes high without continuing on to become low-falling.

Table 5.2: Sandhi forms

Citation		Sandhi		
Low-rising	[12]	→	[12]	Low-rising
Superlow	[1]	→	[21]	Low-falling
High	[4]	→	[21]	Low-falling
Low	[2]	→	[2]	Low
High-rising	[45]	→	[2]	Low
Superhigh	[5]	→	[4]	High

5.2.1 Sandhi domains

I have said that the citation melodies appear in prosodically strong positions, while sandhi applies everywhere else. It’s time to make that more precise. Within the nominal domain, the generalization is clear: The leftmost item in a DP (or PP) receives citation form, while all other items undergo sandhi³. This is illustrated with a set of DPs in (3), repeated from example (2). In (a) the noun surfaces with its citation melody; in (b), only the adjective ‘red’ takes citation form, while the noun undergoes sandhi; in (c) only the numeral ‘six’ keeps its citation form while both ‘red’ and ‘pots’ undergo sandhi; and in (d) only determiner ‘those’ keeps citation form while all other words take sandhi.

³All observations about the distribution of sandhi in DPs are due to Brugman (2009) and confirmed by my own fieldwork.

- (3) Sandhi in DPs (citation forms highlighted): Brugman (2009)
- a. **súúku**
pots
 - b. |**ápǎ** sùùku
red pots
 - c. **!nání** |àpa sùùku
six red pots
 - d. **||náǎ** !nàni |àpa sùùku
those six red pots

Put another way, each DP (or PP) is mapped onto a single sandhi domain. Within a sandhi domain, the leftmost position is “strong” in the sense that it resists sandhi and retains its lexically-specified form; all words not in that strong position lose their citation form and take on their sandhi form.

The association between the left edge of phrases and citation melody is preserved when the verb is moved to the left periphery (and thus winds up at the left edge of the clause): In this context, the verb takes citation melody regardless of what occurs later in the clause. In (4a), the verb *khómai* ‘read’ takes its citation tone (superhigh [5]) when fronted; (4b) shows a context in which it takes its sandhi tone (high [4]) in its base, clause-final position. This shows that verbs are subject to the same sandhi process affecting the nominal domain, and that when there is no material which could possibly precede the verb in the sandhi domain, the verb resists sandhi just as expected.

- (4) a. **Khómai** go =b ge Dandagoba †khanisa.
read PST =3MS DECL D. book
”Dandago read the book.”
- b. Dandagob ge †khanisa go **khómai**.
D. DECL book PST **read**.
”Dandago read the book.”

The situation becomes more complex when we consider in situ verbs, however. Previous work on verbal sandhi gives contradictory generalizations. Brugman (2009) states that all root-clause (in situ) verbs undergo sandhi, while all embedded clause verbs retain their

citation form. That is, for Brugman the distribution of sandhi on the verb is determined purely by the syntax: An Agree relation in the syntax between the complementizer and the verb marks the verb with a feature determining whether it will be spelled out in sandhi or citation form. Later prosodic considerations have no effect.⁴

By contrast, Haacke (1999) gives a generalization purely based on the linear order of elements. The determining factor, for Haacke, is the placement of tense-marking. As noted in Chapter 4, Khoekhoegowab marks tense, aspect, and polarity with a set of auxiliaries (TAPs). These auxiliaries come in two classes. One class of auxiliaries appears postverbally (and generally clause-finally when the verb is in situ); the other class appears before the verb, encliticizing to some XP in the middlefield. In both cases, the tense marking and the verb may be separated by other elements in the clause. For example, (5) and (6) show two coordinated VPs. In (5), the TAP *tama* ‘negative non-future’, which belongs to the postverbal class, appears clause-finally, and is thus separated from the first verb *huni* ‘stir’ by the entire second conjunct. In contrast, (6) shows that the tense marker *go* ‘past’, which belongs to the preverbal class, may freely encliticize to either the first or the second object, with no change in meaning. If it encliticizes to the second object as in (6a), it is separated from the first verb; if it encliticizes to the first object as in (6b), it is separated from the second verb.

- (5) Aob ge mai-e húní tsi ||gan-e áń tama.
 man DECL pap stir and meat grill NEG.NF
 “The man didn’t stir the pap or grill the meat.”

⁴More specifically, Brugman (2009) argues that embedding complementizers mark their verbs with a “sandhi-resistant” diacritic that prevents them from undergoing sandhi even when prosodic factors would predict it — that is, when the verb is not leftmost in a sandhi domain. This allows her to account for the facts in (4), in which verbs take citation form when topicalized, even in matrix clauses.

- (6) a. Aob ge mai-e húní tsi ||gan-e go àm.
 man DECL pap stir and meat PST grill
 “The man stirred the pap and grilled the meat.”
- b. Aob ge mai-e go hùni tsi ||gan-e àm.
 man DECL pap PST stir and meat grill
 “The man stirred the pap and grilled the meat.”

Haacke (1999) states that the tonal melody of the verb is determined by whether tense marking is preverbal or postverbal. Because the position of tense marking is determined postsyntactically, Haacke’s analysis thus holds that sandhi is a purely post-syntactic process. His analysis also maintains the characterization of Khoekhoegowab sandhi as “left-dominant”: If the verb and the TAP are assumed to form a sandhi domain together, then the verb can only be leftmost in that domain (and thus resist sandhi) if tense marking is postverbal.

Brugman (2009) and Haacke (1999) thus present very different generalizations for Khoekhoegowab sandhi, with implications for its analysis. These differences are summarized in tables 5.3 and 5.4.

Table 5.3: Brugman’s generalization

	Matrix	Embedded
Preverbal tense	Sandhi	Citation
Postverbal tense	Sandhi	Citation

Table 5.4: Haacke’s generalization

	Matrix	Embedded
Preverbal tense	Sandhi	Sandhi
Postverbal tense	Citation	Citation

In order to resolve the conflict between these generalizations, I conducted a prosodic production experiment, to be described in the next two sections. To preview the results,

the final generalization resulting from this experiment is as follows: Root clause verbs undergo sandhi whenever they are preceded by a TAP; embedded clause verbs do not undergo sandhi except in quotative clauses (marked with a special complementizer), where they behave like root verbs. This generalization is summarized in table 5.5.

Table 5.5: Results of experiment

	Matrix	Embedded
Preverbal tense	Sandhi	Citation
Postverbal tense	Citation	Citation

5.3 Experimental design & methodology

5.3.1 Speakers

The experimental subjects were 4 native speakers of Khoekhoegowab (3f, 1m), between the ages of 18 & 30. All speakers resided in Windhoek. Two were current University of Namibia graduate students studying Khoekhoegowab; the others were recruited from the author’s prior fieldwork consultants.

5.3.2 Stimuli

The primary experimental manipulation was the position of tense marking. 15 pairs of sentences differing only in the position of tense marking were constructed, yielding 30 total test items. All of the sentences used the verbs listed in Table 5.6; these verbs were selected to be mostly sonorant⁵ (to aid in F0 tracking) and to have either High or High-Rising citation melodies, which are the two melodies showing the most detectable change under sandhi. Sample pitch tracks for each verb, all taken from the same speaker, are presented in figure 5.1. In addition to the test items, 12 filler pairs (24 items) were added, which differed only in whether the direct object of the verb had scrambled past

⁵/huni/ ‘stir’ is often produced as [uni].

another XP; fillers thus superficially resembled test items in showing only word-order differences. Between fillers and test items, there were 54 items in total.

Table 5.6: List of verbs in experimental items

Verb	Gloss	Citation	Sandhi		
oa	‘return’	High	[4]	Low-falling	[21]
ā	‘cry’				
om	‘build’				
mû	‘see’	High-rising	[45]	Low	[2]
huni	‘stir’				
am	‘grill’				

The test items were further subdivided into 6 **syntactic frames**, 3 matrix and 3 embedded: MATRIX declarative clauses (7); matrix constituent QUESTION clauses (8); RELATIVE clefts (9);⁶ NOMINALIZED embedded SOV clauses (10); QUOTATIVE embedded SOV clauses (11); and matrix VP COORDINATION clauses (12).⁷

The **VP coordination** syntactic frame had one systematic difference from the others: Because there were two verbs, tense marking could be in three locations: Before both verbs (12)[a]; between the verbs (12)[b]; or after both verbs (12)[c]. Because of this, test items in this syntactic frame were constructed in triplets (rather than pairs as described above); in the final analysis, each verb was treated as a separate trial and coded as either preverbal or postverbal.

⁶Brugman (2009) analyses these OVS sentences as a kind of TP fronting. My analysis of them as relative clause clefts hinges on three facts. First, the subject obligatorily undergoes sandhi in this context, as though the noun is not leftmost within its own phrase; this implies that the preceding material (i.e. the embedded clause) is contained within the DP. Second, OVS word order is ungrammatical when the subject is immediately preceded by a demonstrative. This is unexpected if OVS is derived by TP fronting, but expected if the OV constituent is a subject relative clause within the DP — determiners precede DP-internal relatives. Finally, this word order has a unique pragmatic meaning: it is used to convey that the subject is new information while the rest of the clause is given, parallel to cleft structures in other languages.

⁷In examples (7) – (11), the first subexample has a TAP in preverbal position while the second has a TAP in postverbal position. In example (12), [a] has the TAP preceding both verbs; [b] has it preceding only the second; and [c] has it fully postverbally.

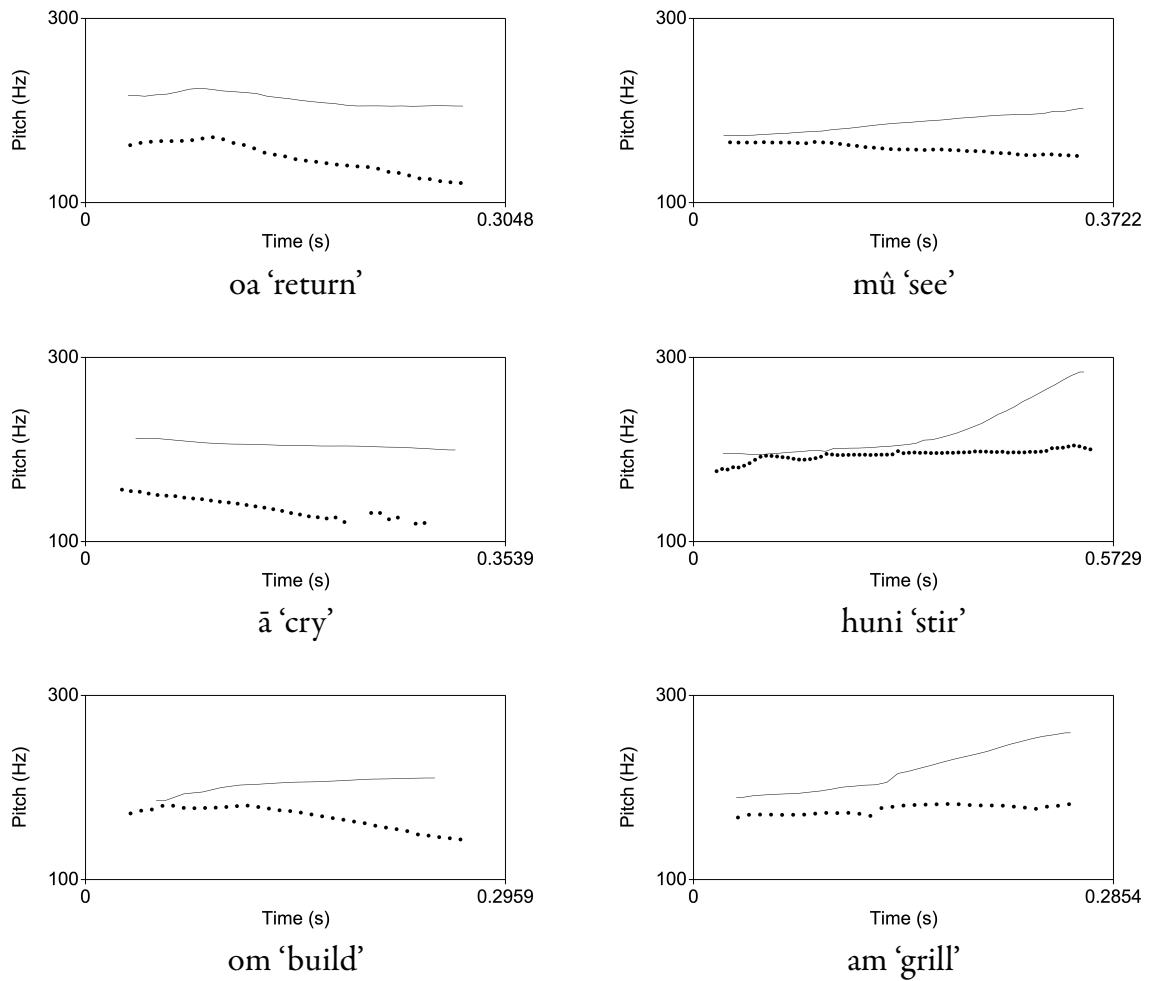


Figure 5.1: Sample pitch tracks for all six verbs, taken from the same speaker. Solid lines are citation form; dotted lines are sandhi form. Verbs in the left column alternate between [4] & [21]; verbs in the right column alternate between [45] & [2]

(7) MATRIX

- a. Khoeb ge oms |kha **go** oa.
 man DECL home to **PST** return
 “The man went home.”
- b. Khoeb ge oms |kha oa **tama**.
 man DECL home to return **NEG.NF**
 “The man didn’t return home.”

(8) QUESTION

- a. ||Na tarasa **go** tae-e am?
that woman **PST** what grill
“What did that woman grill?”
- b. ||Na tarasa tae-e am **tama**?
that woman what grill **NEG.NF**
“What didn’t that woman grill?”

(9) RELATIVE

- a. Oms |kha **go** oa khoeb ge.
home to **PST** return man DECL
“It was that man who returned home.”
- b. Oms |kha oa **tama** khoeb ge.
home to return **NEG.NF** man DECL
“It was the man who didn’t return home.”

(10) NOMINALIZED

- a. Mî ta ge ra Dandagob **go** oms |kha oa sa.
say I DECL IMP D. **PST** home to return -COMP
“I am saying that Dandago returned home.”
- b. Mî ta ge ra Dandagob oms |kha oa **tama** sa.
say I DECL IMP D. home to return **NEG.NF** -COMP
“I am saying that Dandago didn’t return home.”

(11) QUOTATIVE

- a. Mî ta ge ra arib ge |hôasa **go** mû ti.
say I DECL IMP dog DECL cat **PST** see C.QUOT
“I am saying that the dog saw the cat.”
- b. Mî ta ge ra arib ge |hôasa mû **tama** ti.
say I DECL IMP dog DECL cat see **NEG.NF** C.QUOT
“I am saying that the dog didn’t see the cat.”

(12) COORDINATION

- a. Aob ge mai-e **go** huni tsi ||gan-e am.
man DECL pap **PST** stir and meat grill
“The man stirred the pap and grilled the meat.”

- b. Aob ge mai-e huni tsi ||gan-e **go** am.
 man DECL pap stir and meat **PST** grill
 “The man stirred the pap and grilled the meat.”
- c. Aob ge mai-e huni tsi ||gan-e am **tama**.
 man DECL pap stir and meat grill **NEG.NF**
 “The man didn’t stir the pap or grill the meat.”

These 6 syntactic frames were selected to fully distinguish between the two prior analyses. Most embedded clauses in Khoekhoegowab are nominalized; the contrast between the **matrix** and **nominalized** frames is thus crucial. Under Brugman’s analysis, all items in the **matrix** frame should undergo sandhi, while no items in the **nominalized** frame should; under Haacke’s analysis the items with preverbal tense marking in both frames should show sandhi, while the items with postverbal tense marking should not.

The other syntactic frames are present in order to test variations on the two analyses. Matrix declaratives in Khoekhoegowab always have a second-position clitic marking the clause type (Hagman 1977); embedded clauses do not have such a marker. A possible variation on Brugman’s analysis is to hypothesize that it is the presence or absence of such a marker that correlates with verbal sandhi, not the clause type itself. Matrix questions in Khoekhoegowab typically lack a clause-type marker (and thus superficially resemble embedded clauses); by contrast, quotative embedded clauses, which take a special complementizer only available under verbs of reported speech, exceptionally do take a clause-type marker (and thus superficially resemble matrix clauses). If it is the clause-type marker that controls verbal sandhi, we predict the **quotative** frame to uniformly undergo sandhi and the **question** frame to uniformly fail to do so.

The VP coordination frame serves to disambiguate two interpretations of Haacke’s generalization. In one interpretation, the presence of a tense-marker from the preverbal class triggers sandhi on the verb regardless of its actual relative positions. In the other interpretation, it is the linear order of TAP and verb that matters, not the class to which the TAP belongs. If the former analysis is correct, preverbal TAPS will trigger sandhi on

the first verb even when they linearly follow it; if the latter analysis is correct, preverbal TAPs will only trigger sandhi on that verb when they linearly precede it.

Finally, the relative cleft frame serves to confirm that it is embedded clauses in general, rather than nominalized clauses in specific, that resist sandhi under Brugman's analysis.

A full list of all stimuli, including fillers, is presented in the appendix.

5.3.3 Procedure

Sentences were presented on a laptop screen; only one sentence was on screen at time, and speakers could advance to the next sentence at their own pace. Each speaker saw all 54 sentences in a random order, and were then instructed to take a short break, after which this was repeated with a different randomized order such that each speaker saw each item twice. The entire procedure took between 15 and 30 minutes, depending on speaker.

Speakers were asked to read each sentence aloud as naturally as possible. The sentences were all recorded on a Zoom H5 recorder using a Shure SN10A-CN head-mounted microphone.

5.3.4 Analysis

After recording, individual items were segmented and then force-aligned using the Montreal Forced Aligner (McAuliffe et al. 2017), which was trained on a dataset of the author's fieldwork elicitation encompassing roughly 4.5 hours of transcribed Khoekhoe-gowab speech from 8 speakers. A preliminary investigation showed that the acoustic data had too much noise for direct quantitative analysis; in particular, two of the speakers used a very limited F0 range with frequent non-modal voice, which made extraction of F0 contours difficult. As such, an alternate means of analysis was deployed. After alignment, the TextGrid boundaries of each verb were hand-adjusted in Praat (Boersma & Weenink 2001) and a script was used to extract the audio of each verb token into its own file; in this process, 5 tokens were rejected because the resulting recording was inaudible due to

the speaker reducing the verb.⁸ The remaining 283 tokens were coded for tense position (preverbal or postverbal) and syntactic frame. Tokens from the VP coordination frame were coded based on whether the TAP linearly preceded the verb in question, not whether the TAP was drawn from the preverbal or postverbal class. For example, in (13) the first verb *huni* ‘stir’ was coded as having postverbal tense marking because *go* ‘past’ linearly follows it, even though *go* is from the preverbal class. (*Am* ‘grill’ was coded as preverbal, as normal.)

- (13) Aob ge mai-e huni tsi ||gan-e **go** am.
 man DECL pap stir and meat **PST** grill
 “The man stirred the pap and grilled the meat.”

To exclude the possibility of confirmation bias in my own transcriptions, I used the following procedure to code the results: Three phonetically-trained naive transcribers (all native English speakers with no prior experience Khoekhoegowab) were asked to sort the tokens into “high” (citation form) and “low” (sandhi form). Transcribers were given the tokens sorted by speaker and lexical item, with all information about syntactic frame and tense-marker position removed, so as to blind them to the experimental manipulation. Additionally, I hand selected two tokens of each surface tone contour used in the experiment (High-rising, Low, High, & Low-falling) that I felt were prototypical examples, to serve as reference points for the transcribers. To provide one additional datapoint, I performed the same blind transcription.

There was broad agreement between the transcribers; the transcriptions overall showed a Fleiss’ Kappa⁹ of 0.77, indicating substantial agreement. What disagreement exists is

⁸Speakers frequently partially devoiced the vowel of the verb when it was clause-final; the 5 rejected items all had a fully devoiced vowel.

⁹Fleiss’ Kappa is a measure of inter-transcriber agreement; see Fleiss (1971). It generalizes the widely-used Cohen’s Kappa to datasets with more than 2 transcribers.

likely due to the effects of voice quality obscuring perceptions of tone; in particular, Speaker 3 spoke predominantly in breathy voice, while Speaker 4 spoke primarily in creak.

In order to confirm that the transcribers were attending to the intended phonetic differences, the smoothed mean pitch tracks in Figure 5.2 were created. A Praat script was used to extract F0 at 20 evenly-spaced points across each verb. For the purpose of constructing these graphs, individual recordings were treated as having undergone sandhi only if a majority of transcribers marked that item as “low”; all others were treated as having citation form. Loess smoothing was used to construct an average pitch track across all items. From this, it can be seen that transcribers are in fact distinguishing the citation and sandhi forms: For both tone classes the citation forms (HR and H) are distinctly higher than the sandhi forms (L and LF); HR does show a distinctive final rise, while H is level. Both the L and LF forms fall only slightly, but are still distinguishable by level.

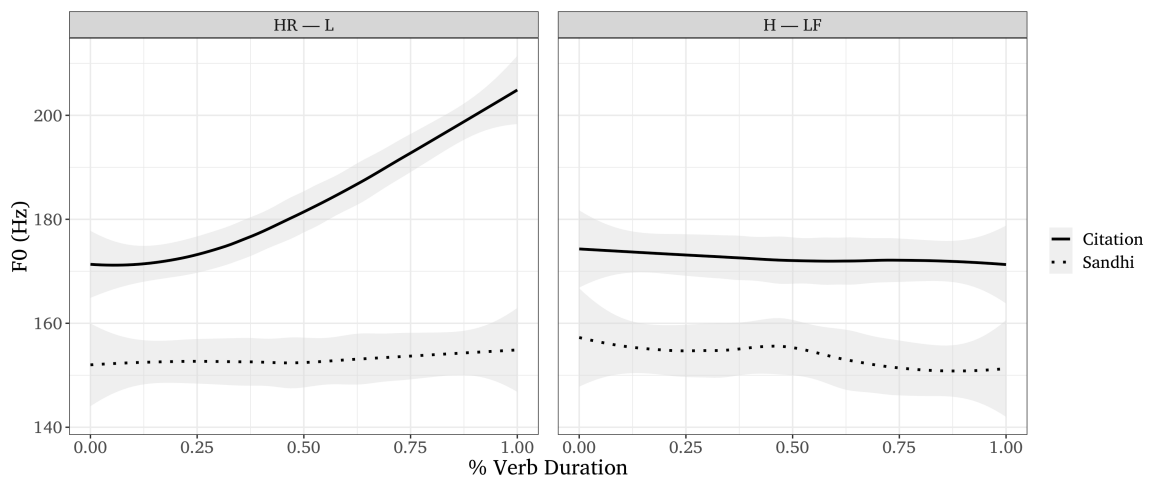


Figure 5.2: Mean pitch tracks

5.4 Results

Having confirmed that transcribers were distinguishing the relevant tone classes, the hypotheses discussed above were tested against these blind transcriptions using a logistic regression model. The dependent variable was whether a given observation was tran-

scribed as “low” (i.e. “sandhi”); the model looked for fixed effects of syntactic frame (6 levels: MATRIX, QUESTION, COORDINATED, QUOTATIVE, NOMINALIZED, & RELATIVE) and TAP position (2 levels: PRE and POST), plus interactions between these.

(14) **Model:** Sandhi ~ Frame * Position

In order to distinguish the various alternatives to Brugman’s generalization, a custom contrast matrix (Bruin 2011) was used for the syntactic frame variable to make the following comparisons:

- (15) Frame[a] : Group mean of MATRIX, QUESTION, COORDINATED, & QUOTATIVE (‘matrix-like’ clauses) vs. group mean of NOMINALIZED & RELATIVE
 Frame[b] : Mean of MATRIX vs. mean of QUESTION
 Frame[c] : Mean of MATRIX vs. mean of QUOTATIVE
 Frame[d] : Mean of MATRIX vs. mean of COORDINATED
 Frame[e] : Mean of NOMINALIZED vs. mean of RELATIVE

This model allows us to distinguish between 3 competing hypotheses (and some sub-cases):

- (16) a. **Hypothesis A: Haacke’s generalization**
 The verb undergoes sandhi iff...
 (i) ...it is preceded by tense-marking.
Prediction: Main effect of POSITION; no main effect of FRAME[D].
 (ii) A’: ...it is associated with a tense-marker from the “preverbal” class.
Prediction: Main effects of POSITION and FRAME[D].
- b. **Hypothesis B: Brugman’s generalization**
 The verb undergoes sandhi iff...
 (i) ...it is in a matrix-like clause.
Prediction: Main effect of FRAME[A]
- (ii) B’: ...it is in a clause with a second-position clause type marker.
Prediction: Main effect of FRAME[B]; no main effect of FRAME[C].
- c. **Hypothesis C: Hybrid**
 The verb undergoes sandhi iff it is both preceded by tense marking and in a matrix-like clause.
Prediction: Main effect of POSITION and interaction between POSITION & FRAME[A].

The results of the model are presented in Table 5.7.

Table 5.7: Significant coefficients

	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-2.3326	0.2100	-11.107	< 2e-16	***
Pos[Pre]	3.2699	0.2837	11.524	< 2e-16	***
Frame[a]	0.5480	0.5539	0.989	0.32252	
Frame[b]	0.5312	0.5371	0.989	0.32268	
Frame[c]	0.6855	0.3925	1.747	0.08069	
Frame[d]	-0.3645	0.4258	-0.856	0.39189	
Frame[e]	2.8904	1.0522	2.747	0.00601	**
Frame[a]:Pos[Pre]	3.9183	0.7060	5.550	2.86e-08	***
Frame[b]:Pos[Pre]	0.3840	0.7898	0.486	0.62684	
Frame[c]:Pos[Pre]	0.3645	0.8402	0.434	0.66436	
Frame[d]:Pos[Pre]	0.7444	0.6075	1.225	0.22048	
Frame[e]:Pos[Pre]	-0.1030	1.3010	-0.079	0.93689	

The significant main effect of position is compatible with Hypothesis A (Haacke’s generalization). The positive coefficient indicates that preverbal tense-marker position does correlate with higher rates of sandhi on the verb. That there is no main effect of FRAME[D] supports Hypothesis A over Hypothesis A’ — it is the absolute position of the TAP with respect to the verb that matters, not which positional class it belongs to.

The lack of significance for a main effect of FRAME[A] (which compares matrix-like syntactic frames to embedded ones) is incompatible with Hypothesis B (Brugman’s generalization): If sandhi were conditioned by the embedded status of the clause, this coefficient should be significantly positive. Similarly, the lack of a main effect of FRAME[B] is incompatible with Hypothesis B’.

However, there is also a significant interaction between Frame[a] (which compares “matrix-like” syntactic frames to embedded clauses) and TAP position. The positive coefficient indicates that transcribers were significantly more likely to mark a verb as having undergone sandhi if it was in a matrix-like syntactic frame and had preverbal tense-marking. This is compatible with Hypothesis C, the hybrid model: preverbal TAPS trigger sandhi

on the verb only in matrix-like clauses; embedded clauses systematically resist sandhi, regardless of TAP position.

The significance of FRAME[E] (NOMINALIZED vs. RELATIVE) is due to a confound in the experimental design. Examples of both these syntactic frames are repeated below, with the verb highlighted. Note that in the RELATIVE case, the verb is significantly closer to the start of the utterance than in the NOMINALIZED case. This means that downdrift (see e.g. Connell 2001) has had longer to apply in the NOMINALIZED case; in other words, the overall F0 range of verbs will be both smaller and lower in the NOMINALIZED case than the RELATIVE one. This likely lead to more verbs being transcribed as low (i.e. having undergone sandhi) regardless of ground truth.

(17) a. RELATIVE:

Oms |kha go **oa** khoeb ge.
home to PST **return** man DECL

“It was that man who returned home.”

b. NOMINALIZED:

Mî ta ge ra Dandagob go oms |kha **oa** sa.
say I DECL IMP D. PST home to **return** -COMP

“I am saying that Dandago returned home.”

Overall, then, the results of the model support the hybrid model Hypothesis C: In most embedded clause types, verbs resist sandhi; elsewhere, verbs undergo sandhi exactly when preceded by tense marking.

5.5 Discussion

Khoekhoegowab sandhi, at first glance, appears to be left-dominant in the sense discussed by Zhang (2007): Within some domain, the leftmost item retains its underlying tone while all other items undergo sandhi. However, Khoekhoegowab is typologically

unusual within this class: left-dominant sandhi systems most typically involve spreading of the leftmost tone over the non-leftmost elements; Khoekhoe sandhi instead involves paradigmatic melodic substitution, which is typically characteristic of right-dominant systems.

Khoekhoegowab verbs present a problem for the characterization of this sandhi process as left-dominant. The experiment reported here shows that verbal sandhi obeys the generalization repeated in Table 5.8. In matrix clauses, verbal sandhi is plausibly left-dominant: If the verb and its tense marking are taken to form a sandhi domain¹⁰, then the verb will only be leftmost in that domain when it precedes the TAP. However, this apparent relationship is disrupted in embedded clauses: In most embedded clause types, verbs resist sandhi regardless of the position of tense. This draws into question the relevance of Khoekhoegowab sandhi to the typology discussed in Zhang (2007) and elsewhere.

Table 5.8: Results of experiment (repeated from Table 5.5)

	Matrix	Embedded
Preverbal tense	Sandhi	Citation
Postverbal tense	Citation	Citation

5.5.1 Variation

The data reported here expands on previous descriptions of Khoekhoegowab prosody in another respect: All previous descriptions have said that Khoekhoe sandhi is categorical¹¹, while the results of this experiment leave open the possibility that it is variable: No two transcribers agreed on 100% of the tokens.

¹⁰For example, as the result of a constraint requiring Extended Projections to be prosodically phrased together (as proposed by López 2009), or as the result of a constraint requiring argument-selection relations to be maintained in prosody (as proposed by Clemens 2019).

¹¹Brugman (2009) does acknowledge variability in one limited respect: nouns preceded by a relative clause sometimes anomalously resist sandhi. Verbal sandhi, though, is said to be categorical.

Some of this variability is certainly due to transcriber error. All transcribers were non-Khoekhoegowab-speaking, and thus it is highly likely that the transcriptions are not perfectly accurate to the true phonological form of the token. That is, there certainly some tokens which have phonologically undergone sandhi but which were transcribed as having citation form, and vice versa.

But transcriber error cannot fully explain the variability in the data. For example, Figure 5.3 presents the F0 pitch tracks for two tokens of the same verb from the same speaker in the same condition (one from each block) — in both cases, the sentence in (18). Even if we allow for variability in F0 range between utterances, the two tokens here have different contours; it seems likely that one is High-Rising (citation form) while the other is Low (sandhi form). This seems to be a case of intra-speaker variability in verbal sandhi.

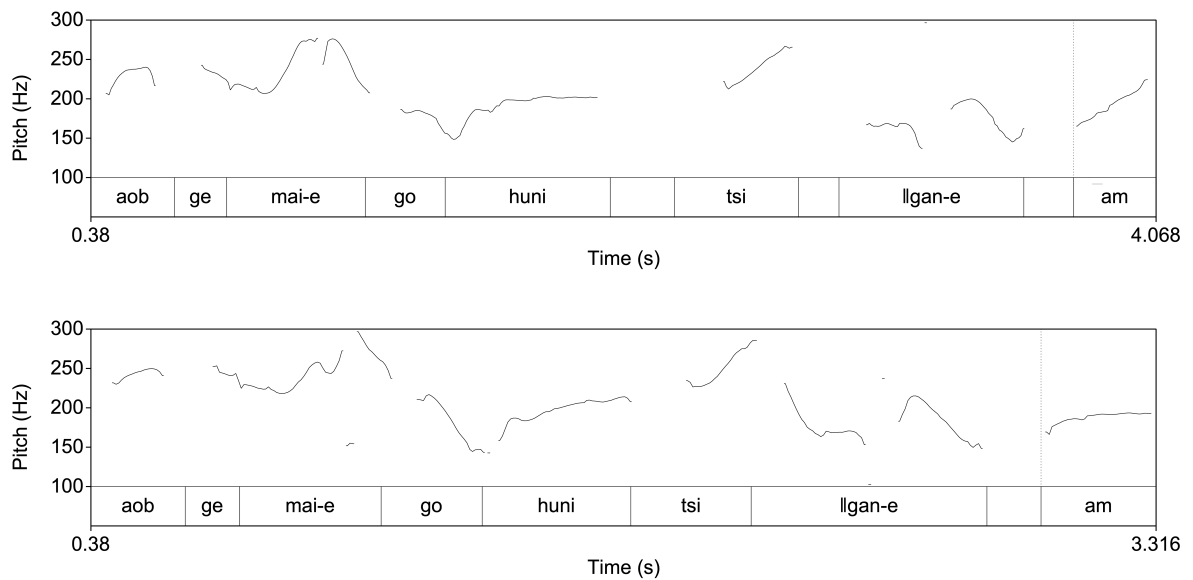


Figure 5.3: Pitch tracks for two tokens of (18) from the same speaker, showing variation in tone of /am/ ‘grill’

- (18) Aob ge mai-e go huni tsi llgam-e **am**.
 man DECL pap PST stir and meat **grill**
 “The man stirred the pap and grilled meat.”

There are a variety of known sources of variation that this experiment was not designed to control for. For example, speech rate is known to affect prosodic phrasing, with higher speech rates being associated with fewer prosodic boundaries (Fougeron & Jun 1998). It's possible that, at slower speech rates, speakers may insert a prosodic break before the verb, allowing it to retain citation form (by virtue of being at a left edge) even when the syntactic structure would normally lead to a different prosodic structure. It's also possible that this variation is either disfluency (i.e. the speaker simply misspoke) or an effect of the experimental task (for example, list intonation).

However, the experimental results do show that the generalizations reported here are strong trends and seem to reflect the normal case. As such, further research is required to determine the sources and extent of variation in Khoekhoegowab tone sandhi. Because variation is outside the scope of this dissertation, I will mostly precede as though verbal sandhi is in fact categorical and will seek to model only the generalizations presented above. First, though, in Chapter 6, we'll briefly leave Khoekhoe behind in order to consider how prosodic displacement, and linearization more generally, might be accounted for; in Chapter 7 we'll return to Khoekhoe to see how to derive the linear order and prosodic structure of preverbal TAPS.

5.6 Appendix: Experimental stimuli

5.6.1 Matrix

- (19) Khoeb ge oms |kha **go** *oa*.
 man DECL home to **PST** *return*
 “The man returned home.”
- (20) Khoeb ge oms |kha *oa* **tama**.
 man DECL home to *return* **NEG.NF**
 “The man didn't return home.”

(21) Khoeb ge oms |kha **go -ro** *oa*.
 man DECL home to **PST -IMP** *return*
 “The man was returning home.”

(22) Khoeb ge oms |kha *oa* **hâ**.
 man DECL home to *return* **PERF**
 “The man has returned home.”

(23) |Gôab ge mai-e **go** *huni*.
 boy DECL pap **PST** *stir*
 “The boy stirred the pap.”

(24) |Gôab ge mai-e **go -ro** *huni*.
 boy DECL pap **PST -IMP** *stir*
 “The boy was stirring the pap.”

(25) |Gôab ge mai-e *huni* **tama**.
 boy DECL pap *stir* **NEG.NF**
 “The boy didn’t stir the pap.”

(26) |Gôab ge mai-e *huni* **hâ**.
 boy DECL pap *stir* **PERF**
 “The boy has stirred the pap.”

5.6.2 Nominalized

(27) Mî ta ge ra [Dandagob **go** oms |kha *oa* -sa.]
 say I DECL IMP D. **PST** home to *return* -COMP
 “I am saying that Dandago returned home.”

(28) Mî ta ge ra [Dandagob oms |kha *oa* **tama** -sa.]
 say I DECL IMP D. home to *return* **NEG.NF** -COMP
 “I am saying that Dandago didn’t return home.”

(29) Mî ta ge ra [|gôab **go** mai-e *huni* -sa.]
 say I DECL IMP boy **PST** pap *stir* -COMP
 “I am saying that the boy stirred the pap.”

(30) Mî ta ge ra [|gôab mai-e *huni* **tama** sa.]
 say I DECL IMP boy pap *stir* **tama** -COMP
 “I am saying that the boy didn’t stir the pap.”

5.6.3 Coordination

(31) Aob ge [mai-e *huni*] tsi [||gan-e **go** *am.*]
 man DECL pap *stir* and meat **PST** *grill*
 “The man stirred the pap and grilled the meat.”

(32) Aob ge [mai-e **go** *huni*] tsi [||gan-e *am.*]
 man DECL pap **PST** *stir* and meat *grill*
 “The man stirred the pap and grilled the meat.”

(33) Aob ge [mai-e *huni*] tsi [||gan-e *am* **tama.**]
 man DECL pap *stir* and meat *grill* **NEG.NF**
 “The man didn’t stir the pap or grill the meat.”

(34) Khoedages ge [omsa *om*] tsi [||gam-e **go** *ā.*]
 K. DECL house *build* and water **PST** *drink*
 “Khoedage built the house and drank water.”

(35) Khoedages ge [omsa **go** *om*] tsi [||gam-e *ā.*]
 K. DECL house **PST** *build* and water *drink*
 “Khoedage built the house and drank water.”

(36) Khoedages ge [omsa *om*] tsi [||gam-e *ā* **tama.**]
 K. DECL house *build* and water *drink* **NEG.NF**
 “Khoedage didn’t build the house and drink water.”

5.6.4 Relative

- (37) [Oms |kha **go** *oa*] khoeb ge.
home to **PST** *return* man DECL
“It was the man who returned home.”
- (38) [Oms |kha *oa* **tama**] khoeb ge.
home to *return* **NEG.NF** man DECL
“It was the man who didn’t return home.”
- (39) [Mai-e **go** **-ro** *huni*] |gôab ge.
pap **PST -IMP** *huni* boy DECL
“It was the boy who stirred the pap.”
- (40) [Mai-e *huni* **hâ**] |gôab ge.
pap *huni* **PERF** boy DECL
“It is the boy who has stirred the pap.”

5.6.5 Quotative

- (41) Mî ta ge ra [arib ge |hôasa **go** *mû* ti.]
say I DECL IMP dog DECL cat **PST** *see* C.QUOT
“I am saying that the dog saw the cat.”
- (42) Mî ta ge ra [arib ge |hôasa *mû* **tama** ti.]
say I DECL IMP dog DECL cat *see* **NEG.NF** C.QUOT
“I am saying that the dog didn’t see the cat.”
- (43) Mî ta ge ra [ne khoes ge ||gan-e **go** *am* ti.]
say I DECL IMP this woman DECL meat **PST** *grill* C.QUOT
“I am saying that this woman grilled the meat.”
- (44) Mî ta ge ra [ne khoes ge ||gan-e *am* **hâ** ti.]
say I DECL IMP this woman DECL meat *grill* **PERF** C.QUOT
“I am saying that this woman has grilled the meat.”

5.6.6 Question

- (45) ||Na tarasa **go** tae-e *am*?
that woman **PST** what *grill*
“What did that woman grill?”
- (46) ||Na tarasa tae-e *am* **tama**?
that woman what *grill* **NEG.NF**
“What didn’t that woman grill?”
- (47) ||Na |gôaba **go -ro** tae-e *ā*?
that boy **PST -IMP** what *drink*
“What did that boy drink?”
- (48) ||Na |gôaba tae-e *ā* **hâ**?
that boy what *drink* **PERF**
“What has that boy drunk?”

5.6.7 Filler

- (49) ||Ari =b ge ne khoeba ||naba †na tama.
yesterday =3MS DECL this man there dance NEG.NF
“This man didn’t dance there yesterday.”
- (50) ||Ari =b ge ||naba ne khoeba †na tama.
yesterday =3MS DECL there this man dance NEG.NF
“This man didn’t dance there yesterday.”
- (51) Nesi =b ge ariba |hôasa nâ tide.
now =3MS DECL dog cat bite NEG.FUT
“Now the dog will not bite the cat.”
- (52) Nesi =b ge |hôasa ariba nâ tide.
now =3MS DECL cat dog bite NEG.FUT
“Now the dog will not bite the cat.”

- (53) Netsē =b ge khoeba oms |kha go oa |khi.
today =3MS DECL man home to PST return come
“Today the man came back home.”
- (54) Netsē =b ge oms |kha khoeba go oa |khi.
today =3MS DECL home to man PST return come
“Today the man came back home.”
- (55) ||Naba =s ge tarasa !gâise go -ro ||nae.
there =3FS DECL woman well PST -IMP sing
“The woman was singing well there.”
- (56) ||Naba =s ge !gâise tarasa go -ro ||nae.
there =3FS DECL well woman PST -IMP sing
“The woman was singing well there.”
- (57) Netsē =b ge axaba !haese †û hâ.
today =3MS DECL boy quickly eat PERF
“Today the boy has eaten quickly.”
- (58) Netsē =b ge !haese axaba †û hâ.
today =3MS DECL quickly boy eat PERF
“Today the boy has eaten quickly.”
- (59) Tsī =b ge |gôaba |hūsa go mû.
and.then =3MS DECL boy spider PST see
“And then the boy saw the spider.”
- (60) Tsī =b ge |hūsa |gôaba go mû.
and.then =3MS DECL spider boy PST see
“And then the boy saw the spider.”

- (61) Dandagob ge †khanisa ‖îb |gôasa khomai -ba hâ.
 D. DECL book his daughter read -APPL PERF
 “Dandago has read the book to his daughter.”
- (62) Dandagob ge ‖îb |gôasa †khanisa khomai -ba hâ.
 D. DECL his daughter book read -APPL PERF
 “Dandago has read the book to his daughter.”
- (63) Khoedages ge ‖gau!na-aoba ‖naba ra !hoa-u.
 K. DECL teacher there IMP talk.to
 “Khoedage is talking to the teacher over there.”
- (64) Khoedages ge ‖naba ‖gau!na-aoba ra !hoa-u.
 K. DECL there teacher IMP talk.to
 “Khoedage is talking to the teacher over there.”
- (65) Tita ge †khanisa ‖khawa ra xoa.
 I DECL book again IMP write
 “I am writing a book again.”
- (66) Tita ge ‖khawa †khanisa ra xoa.
 I DECL again book IMP write
 “I am writing a book again.”
- (67) |Hôas ge ariba netsē mû tama.
 cat DECL dog today see NEG.NF
 “The cat didn’t see the dog today.”
- (68) |Hôas ge netsē ariba mû tama.
 cat DECL today dog see NEG.NF
 “The cat didn’t see the dog today.”

- (69) ||Na |gôa-i ge khoe-e †anebega-se nâ tama.
 that child DECL someone on.purpose bite NEG.NF
 “That child bit someone on purpose.”
- (70) ||Na |gôa-i ge †anebega-se khoe-e nâ tama.
 that child DECL on.purpose someone bite NEG.NF
 “That child bit someone on purpose.”
- (71) ||Gaulna-aos ge ne axaba netsē !hoa-u tide.
 teacher DECL this boy today talk.to NEG.FUT
 “The teacher didn’t talk to this boy today.”
- (72) ||Gaulna-aos ge netsē ne axaba !hoa-u tide.
 teacher DECL today this boy talk.to NEG.FUT
 “The teacher didn’t talk to this boy today.”

CHAPTER 6

OPTIMAL LINEARIZATION

In Chapter 2, I argued that extant models of linearization don't provide good explanations for typological effects. In chapters 3 & 4, I showed that whatever linearization model we choose to adopt must be capable of accounting for PF displacement. In this chapter, I will propose a model of linearization which begins to provide some explanation for these two problems. I start from the perspective that linearization is a PF phenomenon (Kayne 1994; Chomsky 1995b) and should be modelled the same way we model other phonological processes, namely with violable constraints. This allows us to model PF displacement by having constraints on linearization come into competition with prosodic markedness constraints. In contrast to the violable linearization models mentioned in Chapter 2, however, I propose that the mapping from syntactic structures to linear strings occurs fully post-syntactically: Rather than proposing a single "word order faithfulness" constraint penalizing deviance from a pre-specified order, I propose a family of constraints which enforce certain relationships between syntactic structure and word order, working together to derive the correct output. Modelling linearization in this way has the benefit of making clear, well-defined typological predictions in the form of factorial typology: Different rankings of constraints should predict all and only the classes of word order actually observed.

I will call this general approach Optimal Linearization, and will demonstrate that, given the right constraint set, we can predict the typological gap described as the FOFC

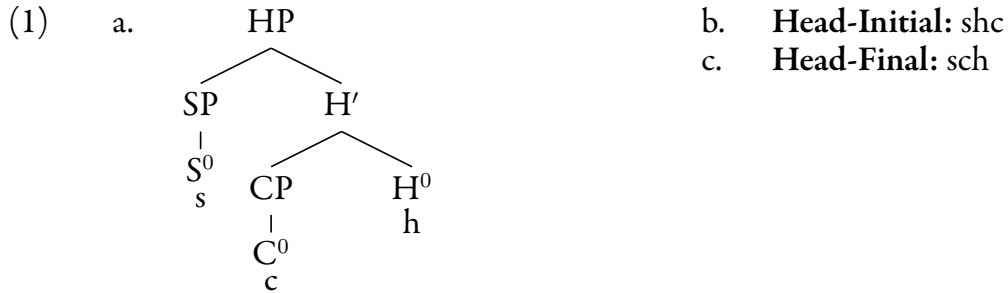
while still offering a coherent explanation for why specifiers are always left.¹ My proposed constraint set models word order typology as arising from the competition of two core constraints: One, **HEADFINALITY**, encodes a general preference for heads and their non-maximal projections to follow their sisters. The other, **ANTISYMMETRY**, encodes a competing preference for syntactic objects higher in the tree to be linearized earlier in the string; it closely mimics the effect of the familiar Linear Correspondence Axiom (LCA) (Kayne 1994). These are both violable constraints; in some cases satisfaction of one constraint will entail violation of the other. Competition of these two constraints will derive the two harmonic word orders (head-initial and -final). Within this framework, the leftward position of specifiers occurs not because the specifier *c*-commands the head, but rather because the terminals within the specifier *fail* to *c*-command the head; specifiers are therefore placed on the left as the grammar tries to achieve the “most head-final” ordering possible with heads still preceding their complement. Finally, a third constraint **HEADFINALITY- α** is identical to **HEADFINALITY** except that it considers only the order of those heads dominated by some node α . The addition of this constraint allows us to derive exactly those disharmonic orders compatible with the FOFC. In chapters 7 & 8, I’ll show that these same constraints allow us to account for PF displacement phenomena, and in fact fair better than the previous violable-linearization models.

6.1 Harmonic word orders

I’ll introduce Optimal Linearization by illustrating how it models a subset of the complete typology. In particular, I will start by considering only the “harmonic” word orders — those word orders that are consistently head-initial or head-final in all phrases. Intuitively, we want the Optimal Linearization procedure to take a syntactic structure like

¹In particular, I aim to capture the ordering of specifiers and complements; I will not take up the positioning of adjuncts here. See Chapter 9 for thoughts on how this system might be extended to address the ordering of adjuncts.

(1a) and produce one of the two orders in (1b) (and no others). (The nodes have been named corresponding to their structural position — so the specifier is SP, the head is HP, and the complement is CP.)



In a violable-constraint framework, it's natural to have these two orders be generated by interaction between two constraints which may be ranked differently by different languages: In languages where one constraint (call it HEADFINALITY) is dominant, the output will be the head-final order *sch*; in languages where the other constraint (call it ANTISYMMETRY) is dominant, the output will be the head-initial order *shc*. Further, we want this to extend to all phrases — that is, if there is more material in SP or CP, we want those phrases to be linearized the same way as HP. The goal of this section will be to define the constraints HEADFINALITY and ANTISYMMETRY to achieve exactly this result.

Before getting to the constraints themselves, however, I first need to introduce the rest of the Optimal Linearization model.

6.1.1 Some housekeeping

Before getting into the constraints themselves, it's worth taking a second to formalize what exactly the complete model looks like.² The general architecture of OT involves two core components: GEN takes an input and generates from it a number of *candidates* (i.e. potential outputs); EVAL takes the input and candidate set and, using a set of ranked

²While I endeavor to introduce the formal mechanisms of OT in this text, readers unfamiliar with the framework are referred to McCarthy (2002) for a more complete introduction.

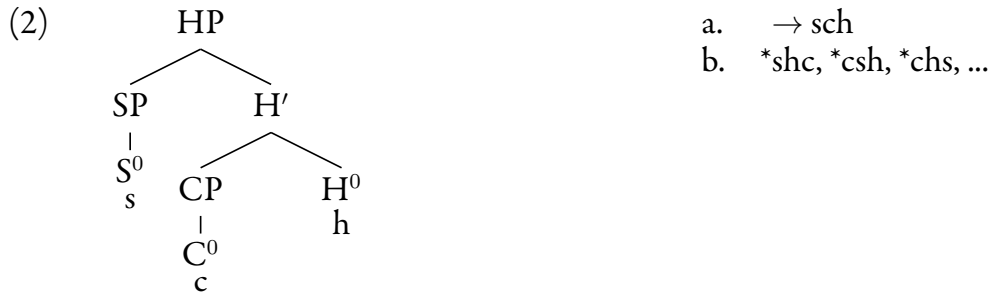
violable constraints, selects a winner, which is the output of the model overall. Any given language is taken to have a fixed ranking of constraints. Taken together, GEN, EVAL, and the ranked constraints are a function from the possible inputs in the language to the possible outputs.

In Optimal Linearization, the input to GEN is the output of the narrow syntax, i.e. a phrase marker produced by some particular theory of syntax. While Optimal Linearization is compatible with a variety of syntactic theories, I will use structures compatible with Merge-based derivations and the Minimalist Program generally (Chomsky 1995b). I will assume that the candidates created by GEN are strings composed of whatever phonologically-contentful Vocabulary Items are produced by the Spell-Out of the set of syntactic terminals in the input. I'll refer to these vocabulary items generically as "words". The set of candidates produced by GEN will be the full set of possible orders of words, so if there are n syntactic terminals mapped to phonologically-contentful words, there are $n! = n(n - 1)(n - 2) \dots$ candidates from which a single unique winner will be selected. Phonologically null syntactic terminals remain part of the input to the linearization component, but are never present in any of the candidates.

As a matter of notational convention, I will use capital letters to denote syntactic terminals (A, B) and lower case letters to refer to the words corresponding to them (a, b). In addition, I will reserve the letters $\{X, Y, Z\}$ for variables ranging over syntactic labels; letters from the beginning of the alphabet denote specific syntactic objects. The symbol $<$ denotes string precedence, so $x < y$ means some word x precedes some word y . As a last notational convention, I will draw all syntactic trees in a head-final fashion; remember, however, that syntactic trees have no order!

6.1.2 HEADFINALITY

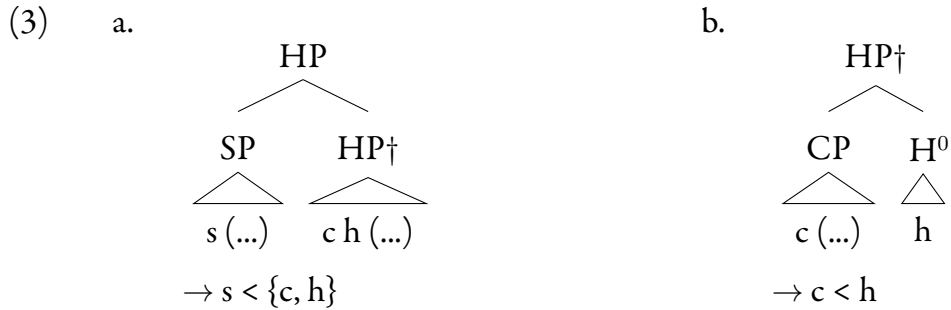
Having dispensed with the preliminaries, let's now turn to the derivation of head-final orders. This will be accomplished by a constraint HEADFINALITY which, given the input shown in (2), prefers the order in (2b) to all other possible orders (2c).³



Let's think about what properties the winning order *sch* has that the other possible orders don't. First, it orders the specifier *s* before everything that isn't the specifier; any order that doesn't have *s* initial will be dispreferred. Put another way, the correct output has H' following its sister. Second, the correct output orders the complement *c* before the head *h*; any order that has $h < c$ will be dispreferred. Put another way, H⁰ follows its sister.

By visualizing each branching node separately, as in (3), it can be seen that these two ordering conditions share a structural description. One ordering relation relates the daughters of HP to each other; the other relates the daughters of H' to each other. In each case, the daughter that shares a label with the node in question (H' for HP; H for H') is set to follow the daughter that doesn't (SP for HP; CP for H').

³Optimal Linearization requires that we be able to distinguish minimal (non-phrasal) nodes from non-minimal (phrasal) ones. To help visually distinguish these classes, I've labelled all non-minimal (phrasal) nodes as "XP", here and in all other trees; however, this should be understood to be purely notational — the constraints will function identically if nodes are labelled as in Bare Phrase Structure (Chomsky 1995a) or similar models. For expositional reasons it will be convenient to have unique labels for each node; accordingly, I've marked the phrasal, non-maximal nodes with †; again, this is purely notational and should not be understood to refer to some special theoretical status for these nodes.



It's going to be useful to have a pair of terms that distinguish these two structural relations. I'm going to call the daughter that shares a label with its parent the 'descendant' or 'endogenous daughter'; the one that doesn't share a label with it I'll call the 'in-law' or 'exogenous daughter'. When two nodes undergo Merge, the one which projects becomes the descendant and the one that doesn't becomes the in-law. Specifiers and complements will always be in-laws of the nodes immediately dominating them; heads and their non-maximal projections will always be descendants.

Intuitively, then, HEADFINALITY is a constraint that prefers orders in which, for every branching node, the material dominated by its in-law precedes all material dominated by its descendant. Optimality Theory constraints are generally stated in terms of the output configurations they disprefer, i.e. the configurations which incur violations of the constraint. Putting HEADFINALITY into that form:

- (4) HEADFINALITY : Assign one violation for each branching node XP (recursively) dominating a pair of terminal nodes X^0 & Y^0 such that:
- a. Y^0 is dominated by the in-law of XP;
 - b. X^0 is not dominated by the in-law of XP; and⁴
 - c. $x < y$.

I'll illustrate the action of this constraint in an OT tableau. The candidate orders are listed in the leftmost column; the next column lists which branching nodes incur violations of

⁴If X^0 is dominated by XP but not dominated by the in-law of XP, then it is by definition dominated by the descendant of XP. Once we turn to linearizing movement structures in section 6.2, we will encounter cases in which a particular head is dominated by both the in-law and the descendant of XP; defining the constraint as shown here will prevent it from giving contradictory orders in these cases.

HEADFINALITY. In this input, there are only two branching nodes and so the constraint scores a maximum of two violations — that is, this constraint assigns violations by counting the branching nodes in the syntax that are not linearized fully head-finally (rather than by counting pairs of words). The manicule (☞) indicates the winning candidate *sch*, the only candidate which scores no violations. Violations are indicated by a *, followed by the branching node which scored that particular violation.

(5) a.

b.

(a)	HEADFINALITY
a. shc	*H†
b. ☞ sch	
c. csh	*HP
d. chs	*HP
e. hcs	*HP *HP†
f. hsc	*HP *HP†

While this is a simple example, it serves to illustrate the action of HEADFINALITY generally. The constraint will linearize any XP in the same fashion as HP in this example — with everything contained in the specifier foremost, and X⁰ final.

6.1.3 ANTISYMMETRY

The constraint HEADFINALITY suffices for deriving harmonically head-final word orders (i.e. where every XP is head-final). In order to derive the head-initial orders we need a constraint that opposes HEADFINALITY. That is, we want some constraint ANTISYMMETRY such that the same tree in (5) is mapped to the order *sch* whenever ANTISYMMETRY \gg HEADFINALITY. It may at first seem tempting to make ANTISYMMETRY the inverse of HEADFINALITY — that is, have it require the descendant to precede the in-law. However, this won't work, as head-initial orders and head-final ones are not symmetric: In both orders, the specifier must precede everything that follows it. We need to

look for something else that will create head-initial orders than just the reverse of HEAD-FINALITY.

I propose that we follow Kayne 1994 and make ANTISYMMETRY a constraint that enforces correspondence between asymmetric c-command and precedence. Unlike Kayne, however, I will only consider relationships between terminal nodes. This frees us from making the stipulations about segments & categories that Kayne makes, and will also have some other benefits that I will make clear momentarily. Intuitively, then, the constraint that we're looking for is one that penalizes words that occur in the opposite order as the asymmetric c-command relation between their terminals. More formally:⁵

- (6) ANTISYMMETRY: Assign one violation for each pair of terminal nodes X^0 & Y^0 , where:
- a. X^0 asymmetrically c-commands Y^0 ; and
 - b. $y < x$.

The domain of this constraint is pairs of nodes that stand in an asymmetric c-command relationship. In the basic Spec-Head-Comp structure we've been investigating so far, there is only one such pair: The head H^0 asymmetrically c-commands everything in CP (namely C^0). As such, ANTISYMMETRY will score a maximum of one violation whenever $c < h$. However, ANTISYMMETRY will not order the specifier S^0 with respect to either of the other heads — while the phrase SP asymmetrically c-commands both h and c , S^0 itself does not. How, then, will the system order the specifier? Conveniently, we already have a constraint which accomplishes this: HEADFINALITY requires that HP be linearized such that everything in SP precedes everything in HP^\dagger . In a violable constraint system

⁵The definition of ANTISYMMETRY given here assumes that heads will always asymmetrically c-command the contents of their complement. In contemporary syntactic theories based on Merge (Chomsky 1995b), this is problematic in that it requires non-branching complements to project a unary phrasal node. However, it is possible to redefine ANTISYMMETRY so that it will order non-branching complements correctly even without this unary projection: If ANTISYMMETRY only considers c-command relationships from minimal, *non-maximal* nodes (i.e. only those heads that have projected at least one phrasal node), then heads will asymmetrically c-command non-branching complements in the relevant sense. For ease of exposition I will continue to draw unary projections so that the c-command relationships will be intuitive.

like OT, low-ranked constraints remain active even when dominated by a higher ranked constraint; even when $\text{ANTISYMMETRY} \gg \text{HEADFINALITY}$, then, HEADFINALITY is still active and can enforce the leftward position of the specifier. I've presented this in tableau form below. ANTISYMMETRY eliminates the three candidates in which $c < h$; of the three that remain, only one fails to incur a violation of HEADFINALITY for HP, namely the one that orders the specifier on the left.⁶

(7) a.

$$\begin{array}{c}
 \text{HP} \\
 \diagup \quad \diagdown \\
 \text{SP} \quad \text{H}' \\
 | \quad \diagup \quad \diagdown \\
 \text{S}^0 \quad \text{CP} \quad \text{H}^0 \\
 | \quad | \quad | \\
 \text{s} \quad \text{C}^0 \quad \text{h} \\
 \quad \quad | \\
 \quad \quad \text{c}
 \end{array}$$

b.

	(a)	ANTISYMMETRY	HEADFINALITY
a.	shc		*HP†
b.	sch	* $h < c$	
c.	csh	* $h < c$	*HP
d.	chs	* $h < c$	*HP
e.	hcs		*HP *HP†
f.	hsc		*HP *HP†

This is a case of “the emergence of the unmarked” (McCarthy & Prince 1994b): The lower-ranked constraint acts to select the winner exactly when the higher-ranked one fails to choose. In this case, the higher-ranked ANTISYMMETRY doesn't select between the different placements of the specifier s within the string — it only requires that the head precede its complement. The fact that the specifier is on the left in the winning candidate is a reflection of the system choosing the “most head-final” order among those compatible with the order $h < c$. Optimal Linearization thus gives us new insight into a previously-mysterious fact about word order typology, namely that specifiers are always left-most even in otherwise “head-initial” languages. Put another way, it has always been somewhat problematic that so-called head-initial languages are never fully head-initial, but rather always require specifiers to precede the head. Optimal Linearization lets us

⁶In tableaux including ANTISYMMETRY , the notation $*x < y$ means that a violation was scored because x preceded y — i.e. that the constraint prefers the order $y < x$.

understand this fact as a preference for head-finality emerging even in otherwise head-initial languages.⁷

So far we've considered only a single, abstract tree where the specifier and the complement contain only a single word. Hopefully it is clear that adding more words to either specifier or complement will behave in the expected way: HEADFINALITY will provide pressure to linearize all the specifier material before head & complement and also all the complement material before the head; ANTISYMMETRY, likewise, will provide pressure to linearize the head before all the complement material — the head, after all, does asymmetrically c-command all of its complement. The same general pattern of linearization will be replicated within each XP, just as we'd expect.⁸ There is one class of syntactic structure not yet accounted for, however, namely structures involving movement. This is what I'll turn to in the next section.

6.2 Linearizing movement

One of the goals of any linearization algorithm must be to explain why moved items appear in the location that they do (and only that one). That is: Once an XP has moved, what prevents it from being linearized according to its base position? And what prevents

⁷A reviewer for Kusmer (to appear) points out that Optimal Linearization is in this regards similar to the Basic Branching Constraint (BBC) of Haider 1992, 2012. In Haider's model, syntactic trees themselves are ordered and are universally head-final at their base; but all movement (including head-movement) is universally leftward, allowing for derived head-initial environments. Optimal Linearization also comes to the conclusion that head-initial orders are in some sense 'more complex' than head-final ones, but locates this complexity differently: Whereas for Haider head-initial orders involve additional syntactic structure, in Optimal Linearization they involve a constraint interaction.

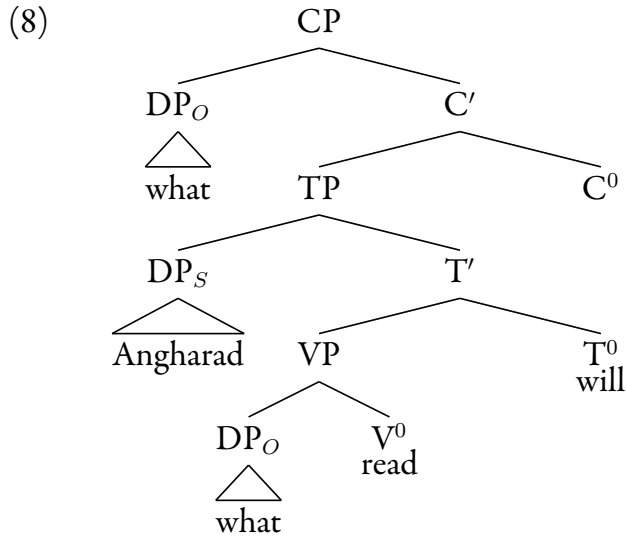
⁸A reviewer for Kusmer (to appear) asks how Optimal Linearization might account for lexical exceptions to language-wide word order, for example the limited set of postpositions in German. A benefit of using a violable-constraint framework is that markedness constraints can override the 'default' word order in specific cases. These markedness constraints might target some general property shared by the exceptional vocabulary items (for instance, a particular prosodic property), or might simply be indexed to particular vocabulary items. For cases like German *entlang* 'alongside', which alternates between prepositional and postpositional use, we might hope to find systematic differences between the two positions (for instance, in prosodic phrasing), which would indicate a markedness constraint penalizing one order. Alternatively, we might use a variable-output model (for example, a MaxEnt grammar — Hayes & Wilson 2008) and a lexically-indexed constraint.

it from being spelled out twice, once according to each position? In most traditional theories of linearization there is an operation of “copy-deletion” which applies before linearization and transforms the tree at PF such that moved items are only in one position. However, Johnson (2016) outlines some possible undesirable consequences of introducing this extra transformation between the syntax and the linearization. Instead, I propose to keep to the original intuition that it is linearization itself that forces moved items to be spelled out in a particular location. The input to Optimal Linearization, then, will still have moved items in all of their positions. I will assume for the moment that GEN only creates candidates that have exactly one word for each (phonologically-contentful) syntactic terminal, even if that terminal has multiple copies. In other words, when confronted with multiple copies of some syntactic object, GEN will only access the lexical entry for that syntactic terminal once; the candidates generated by GEN are then all possible orders of the lexical entries accessed.⁹ This prevents moved items from being linearized in multiple positions (a.k.a. multiple exponence). This may or may not be a desirable assumption, as multiple exponence of movement chains has been proposed as an analysis of resumption (e.g. Sichel 2014) and verb-doubling predicate clefts (e.g. Koopman 1984; Kandybowicz 2006; Cable 2004). If we want to capture these phenomena using multiple exponence, we would need to relax this restriction on GEN but then add additional constraints to enforce single spellout in all but the relevant contexts. Such a project is beyond the scope of this paper, so for the moment I’ll use the constrained version of GEN.

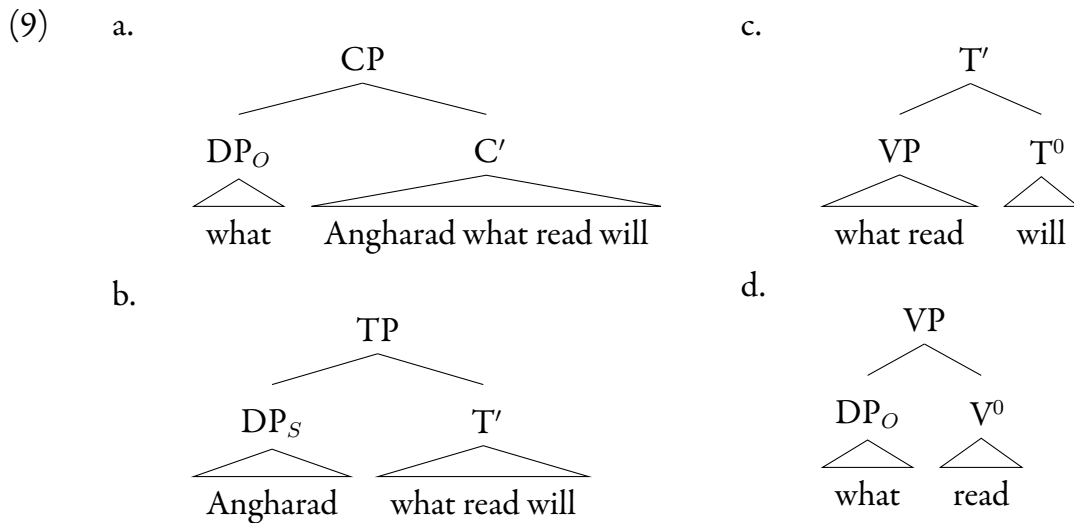
With that in mind, let’s consider what we want the Optimal Linearization constraints to do in the case of movement structures. I’ll use English *wh*-movement as an illustrative example; (8) presents a simplified structure for an object *wh*-question.¹⁰

⁹Note that this model of GEN means that movement does not increase the size of the candidate set: Moving some item does not add any more words to the candidates, and therefore the number of permutations does not increase. If GEN were allowed to generate multiple copies of words, the candidate set would become infinite.

¹⁰More specifically, this is an embedded question.



Let's first consider how we want HEADFINALITY to treat the moved item. Recall that HEADFINALITY scores violations based on branching nodes. There are 5 branching nodes in (8), but one of them (C') has a branch with no phonologically-contentful words (C^0) and so will never score a violation. The remaining 4 branching nodes are as follows:¹¹



At once we can see that there's a problem. HEADFINALITY will score a violation for any branching node for which material in its descendant precedes material in its in-law.

¹¹The trees in example (9) show the words that would correspond to the syntactic objects dominated by a given node. In (a), the word *what* is repeated because the terminal node it spells out appears in both CP and C', not because GEN would generate a candidate containing two occurrences of *what*.

(9a) shows that the constraint will score a violation for CP if *Angharad* (which is in the descendant C') precedes *what* (which is in the in-law DP_O). (9c), however, shows that the constraint will score a violation for TP whenever *what* (which is in the descendant T') precedes *Angharad* (which is in the in-law DP_S). This produces a contradictory ordering for this tree.

Of course, the problem is that the constraint as defined can't distinguish between the 'high' and 'low' positions of the moved item. We want *what* to be linearized according to its higher position,¹² namely spec,CP. In other words, we want the constraint HEAD-FINALITY to consider DP_O only when it is evaluating the node CP; the contents of DP_O should not be relevant for the linearization of any lower branching node. In order to accomplish this, I will borrow from Abels 2003 the idea of *total domination*. Intuitively, some node X dominates a node Y only if it dominates all copies of Y. Formally:

(10) X **totally dominates** Y iff all copies of Y are dominated by a copy of X.

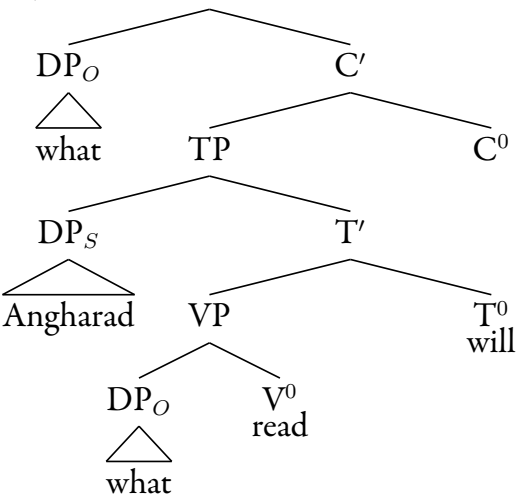
In (8), DP_O is totally dominated by only two items: itself (total domination is reflexive) and CP. All of the other terminal nodes are totally dominated by everything which (non-totally) dominates them — in the absence of movement, domination and total domination are identical. This allows us to revise our definition of HEADFINALITY to linearize the moved item according to its highest position:

¹²This may not always be true if for instance *wh-in situ* languages covertly raise the *wh* item (e.g. Watanabe 1992; Cole & Hermon 1998) — in covert movement in general it seems that the linearization scheme must pick the lower copy, or possibly an intermediate one. Fully accounting for these facts is beyond the scope of this paper, but we might propose that for instance there are two versions of each of the Optimal Linearization constraints, one which sees the lower copy and one the higher; the ranking of these versions relative to each other would determine whether movement overt or covert. Spellout of intermediate copies, if necessary, could be achieved by appealing to cyclic spellout of a phase before the object in question has finished moving. Further refinement would be needed to ensure that overt and covert movement could coexist in the same language.

- (11) HEADFINALITY (revised): Assign one violation for each branching node XP **totally dominating** a pair of terminal nodes X^0 & Y^0 such that:
- Y^0 is dominated by the in-law of XP;
 - X^0 is not dominated by the in-law of XP; and
 - $x < y$.

Because CP is the only branching node which totally dominates *what* in (8), the only way for *what* to violate HEADFINALITY is for it to follow anything contained in CP but not in DP_O , i.e. any word in C' other than itself. As such, *what* (and in fact all of DP_O , if it were larger) will be linearized leftmost, in accordance with its moved position. I've illustrated this in the tableau in (12); space does not permit me to include all 24 candidate orders, so I've chosen a representative set. The winning candidate is a fully head-final pseudo-English.¹³

(12) a.



b.

(a)	HF
a. what what Angharad read will	
b. Angharad what read will	*CP
c. what Angharad will read	*T'
d. Angharad will read what	*CP *T'

Of course, to achieve the correct head-initial order for English we need to consider ANTISYMMETRY. Here, we face a similar problem: V^0 still asymmetrically c-commands

¹³Here we see the relevance of defining HEADFINALITY such that the material in the in-law must precede the material 'not in the in-law' (as opposed to 'in the descendent'), as mentioned in fn. 4: *what* is contained in both CP's in-law and descendent. If the constraint were defined in terms of the descendent, it produce the nonsensical ordering of *what* > *what*. The problem gets worse if the moved item has multiple words, for example if DP_O were *which book*: Here the constraint would both require *which* > *book* (since *which* is in the in-law and *book* is in the descendent) and *book* > *which* (since the reverse is also true).

everything (non-reflexively) dominated by DP_O , and so ANTISYMMETRY will exert pressure for $read < what$ as though wh -movement had never occurred. Again, what we want is a notion of *total c-command* parallel Abels 2003: V^0 fails to c-command $what$ in all of its positions, and therefore won't be ordered before it. Total c-command is easy to formalize:


- (13) a. **X totally c-commands Y** iff:
 (i) X does not dominate Y; and
 (ii) everything that totally dominates X also totally dominates Y.
 b. **X asymmetrically totally c-commands Y** iff X totally c-commands Y and Y does not totally c-command X.

In (8), V^0 does not totally c-command DP_O : for one, V^0 's immediate mother VP does not totally dominate DP_O . In fact, there is nothing that totally c-commands the moved item. All that remains, then, is to update our definition of ANTISYMMETRY to use total c-command:

- (14) **ANTISYMMETRY (revised)**: Assign one violation for each pair of terminal nodes X^0 & Y^0 , where:
 a. X^0 asymmetrically **totally c-commands** Y^0 ; and
 b. $y < x$.

Again, I've illustrated the action of this constraint in a tableau; as before, it fails to order any specifier, but HEADFINALITY emerges to accomplish that.

(15)

	ANTISYMMETRY	HEADFINALITY
a. what Angharad read will	* <i>will < read</i>	
b. Angharad what read will	* <i>will < read</i>	*CP
c.  what Angharad will read		*T'
d. Angharad will read what		*CP *T'

With this last modification to the constraints, Optimal Linearization will now linearize all moved phrases according to their highest position.¹⁴

6.3 Disharmonic word orders

Up to this point, I've restricted my attention to only the two harmonic word orders. There is a third order compatible with the Final-over-Final Condition: A head-initial phrase can embed a head-final one (but not the reverse). For example, German embedded clauses have a head-initial complementizer but are otherwise head-final¹⁵ (16a); for an example lower in the clause, verbal auxiliaries in many of the Mande languages (Kastholz 2003) precede the VP, while the verb itself follows its complement (16b).

(16) a. German:

... dass Fritz mich gesehen hat.
 that Fritz me seen has

“...that Fritz has seen me.”

b. Evenki: (Bulatova & Grenoble 1999)

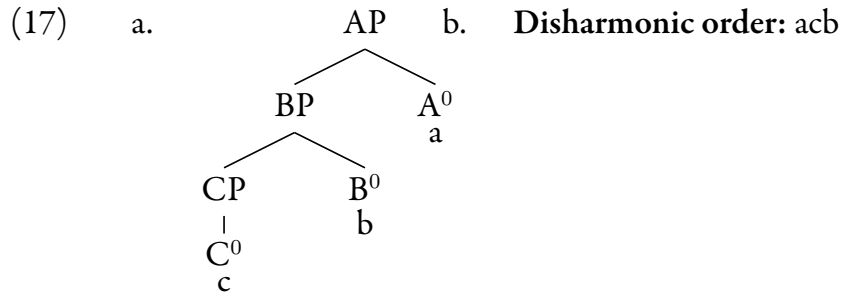
atirka:n ə -či -n sukə-βa ga -mu: -ra
 old.man NEG -AOR -3SG ax -ACC take -A.DESID -RA

“The old man did not want to take the ax.”

¹⁴A reviewer for Kusmer (to appear) asks to what extent the winning candidate is affected by details of the syntactic analysis, in particular by the addition or subtraction of functional material; for example, in (8) I have omitted vP; how would the linearization change if it were included? If the additional material is phonologically contentful, then the resulting candidates will be different and no direct comparison is possible; on the other hand, if the additional material is phonologically null, it will have no affect on the linearization whatsoever: Because only contentful words are present in the output candidates (by assumption), no violations will ever be scored involving a node dominating no contentful material. In essence, linearization operates on a “flattened” structure with null heads (and their immediate projections) are removed; this is reminiscent of the way the MATCH constraints as defined in Elfnér 2012; Bennett et al. 2016 flatten syntactic structure to prosodic structure.

¹⁵Under the most common analyses of V2, matrix clauses are also an example of a mixed-headed order; I'll stick to embedded clauses here in order to avoid the complexities of head movement.

Abstractly, the FOFC-compliant disharmonic order follows the schema in (17), where the unordered syntactic tree is mapped to the linearization shown: AP is linearized in a head-initial fashion, while BP is head-final.



At present, the Optimal Linearization constraint set includes just two constraints, giving a maximum of two rankings / language classes. In order to allow for the disharmonic order, we'll need to add an additional constraint. I propose that this constraint is a relativized version of HEADFINALITY which only considers those nodes (reflexively) dominated by some node α . For example, in (17), α is BP; the constraint would score a violation for BP (which does reflexively dominate itself) if $b < c$, but would not consider the ordering of a at all. This leaves ANTISYMMETRY free to order AP head-initially.

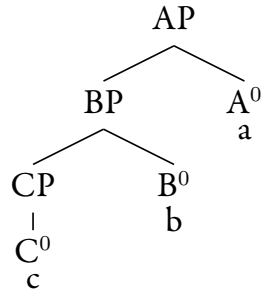
This constraint captures the core generalization of the FOFC: head-finality “propagates down” the tree such that any node dominated by a head-final node will also be head-final itself. Formally, HEADFINALITY- α is defined nearly identically to HEADFINALITY except for a clause specifying its domain of application:

- (18) HEADFINALITY- α : Assign one violation for each branching node XP **dominated by** α and totally dominating a pair of terminal nodes X^0 & Y^0 such that:
- a. Y^0 is dominated by the in-law of XP;
 - b. X^0 is not dominated by the in-law of XP; and
 - c. $x < y$.

HEADFINALITY- α and HEADFINALITY are in a subset (“stringency”) relationship: HEADFINALITY- α will always assign a strict subset of the violations assigned by HEADFINALITY. In practical terms, this means that whenever they are ranked “together” (i.e. both

above or both below ANTISYMMETRY), their effects will be indistinguishable. Only under the ranking HEADFINALITY- α \gg ANTISYMMETRY \gg HEADFINALITY will they give rise to the disharmonic order. This is illustrated in the tableau in (19):

(19) a.



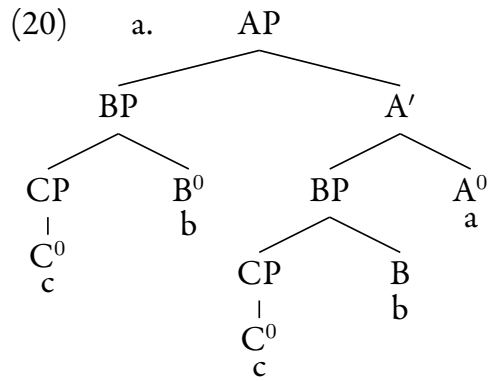
b.

(a)	HF-BP	ANTISYM	HF
a. abc	*BP		*AP *BP
b. bac	*BP	*a < b	*AP *BP
c. bca	*BP	*a < b *a < c	*BP
d. cba		*a < b *a < c *b < c	
e. cab		*a < c *b < c	*AP
f. acb		*b < c	*AP

Undominated HEADFINALITY- α effectively divides the syntactic structure into two domains: everything below α is linearized purely by HEADFINALITY- α , while everything above it is linearized by the combination of ANTISYMMETRY and HEADFINALITY, just as in the harmonic word order case. It's worth taking a moment to demonstrate that this applies even when movement is involved. There are two relevant cases: Movement of α itself, and movement of some phrase within α to a position outside of it. In both cases, we want the moved item to be head-final within itself, but positioned in a head-initial fashion with respect to the rest of the clause.

The case where α itself moves is illustrated in (20), where BP has moved to the specifier of AP. Both copies of BP (reflexively) dominate themselves, and so both are linearized head-finally; likewise, both copies of CP are dominated by a copy of BP, and so CP would also be linearized head-finally (if there were any other material in it). The only change is

that A^0 no longer totally c-commands B^0 and C^0 , so ANTISYMMETRY will fail to order it before them; instead, the general constraint HEADFINALITY will emerge to order the specifier on the left.

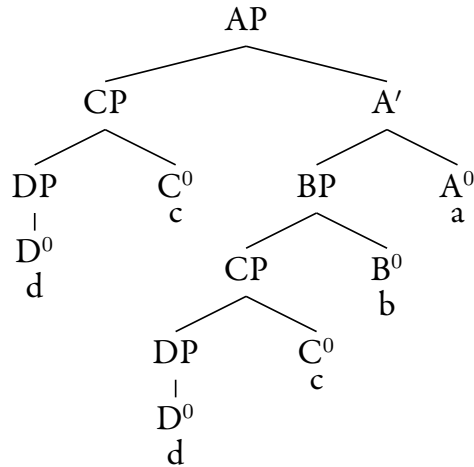


b.

(a)	HF-BP	ANTISYM	HF
a. abc	*BP		*AP *BP
b. bac	*BP		*AP *BP
c. bca	*BP		*BP
d. cba		* $b < c$	
e. cab		* $b < c$	*AP
f. acb		* $b < c$	*AP

Movement from within α requires a slightly larger tree to see fully. In (21), $\alpha = BP$ as before; this time, the complement of BP has moved up to the specifier of AP. Once again, HEADFINALITY-BP applies within CP, which is dominated (though not totally dominated) by BP; only the general HEADFINALITY orders the material in CP with respect to a and b , however, putting the moved item on the left.

(21) a.



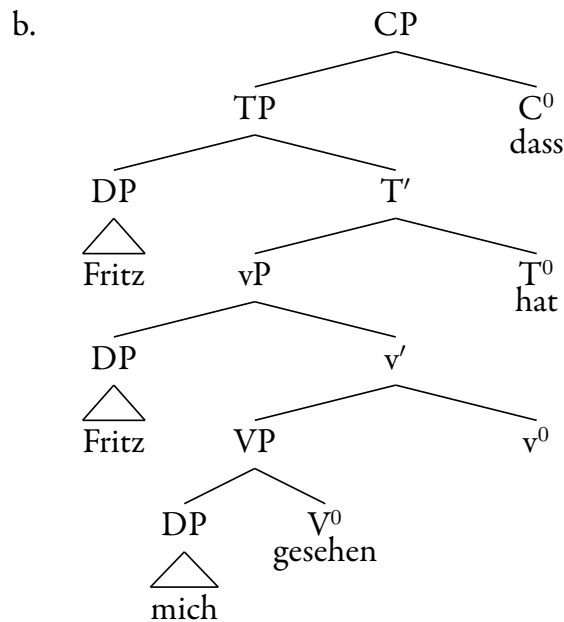
b.

(a)	HF-BP	ANTISYM	HF
a. dcab			*A'
b. cdab	*CP		*A' *CP
c. adcb	*CP		*AP *A'
d. abdc			*AP *A' *BP
e. dcba		*a < b	

I'll close this section by illustrating how the constraints described here linearize embedded clauses in German. German is a well-known case of a disharmonic word order: Complementizers are on the left, but the rest of the clausal spine is head-final. Thus, the domain of head-finality is TP; that is, HEADFINALITY-TP is undominated. I've given a simplified syntactic structure in (22).¹⁶

¹⁶For the purposes of this illustration, I'm ignoring the morphology of the verb itself. A reviewer for Kusmer (to appear) asks how the model presented here might interact with the morphology component of the grammar. In general, Optimal Linearization requires that vocabulary insertion happen prior to or simultaneous with linearization. Since Optimal Linearization is a violable constraint framework, it seems particularly attractive to pursue a similar model for vocabulary insertion, such as Optimal Interleaving (Wolf 2008), which would allow the spell-out of individual morphemes to interact with linear order. Integrating Optimal Linearization with a derivational model of morphology like Distributed Morphology (Embick & Noyer 2001) would be challenging insofar as that model performs operations on ordered trees; thus, the success of Optimal Linearization as a model for morphology rests somewhat on whether similar empirical coverage can be obtained without such a derivation.

- (22) a. ... dass Fritz mich gesehen hat.
 that Fritz me seen has
 "...that Fritz has seen me."



(23)

(22b)	HF-TP	ANTISYM	HF
a. \mathbb{S} dass Fritz mich gesehen hat		3: *V < O, *Aux < V, *Aux < O	*CP
b. Fritz mich gesehen hat dass		7: ... *C < S, *C < O, *C < V, *C < Aux	
c. dass Fritz hat gesehen mich	*TP, *VP	0	*TP, *VP, *CP
d. dass Fritz hat mich gesehen	*TP	1: *V < O	*TP, *CP

As shown in (23), the constraint HEADFINALITY-TP eliminates all candidates in which any head below TP is not final within its phrase. ANTISYMMETRY further eliminates those candidates where C⁰, the only head not in the domain of head-finality, is not initial. The interaction of these two constraints derives the correct disharmonic word order.

6.4 Conclusion

Optimal Linearization is the proposal that linearization is accomplished at PF by a set of violable constraints which make reference to the syntactic structure I've shown that

this model is capable of making detailed predictions about word order typology; I've also shown that it gives new insight into the asymmetric positioning of specifiers, allowing us to understand it as an emergence of an unmarked preference for head-finality.

There is one aspect of the FOFC that these constraints do not capture: it only applies within certain domains. For example, German DPs appear to be head-initial, even though they are often contained inside the head-final TP; more generally, DP-internal ordering and the ordering of elements in the clausal spine seem to be independent of one another as far as the FOFC is concerned. Biberauer, Holmberg, & Roberts (2014) codify this by restricting the FOFC to looking at heads within one Extended Projection (Grimshaw 1991). Optimal Linearization is certainly compatible with such a notion; one possible analysis would involve a stringent version of HEADFINALITY that is relativized not to some node but rather to an entire Extended Projection — for instance, in the case of German, one that examined only nodes in the verbal EP. There's also another possible explanation: Perhaps linearization precedes by phase (as in e.g. Fox & Pesetsky 2005), with the possibility that the linearization constraints are ranked differently for the DP-phase and the CP-phase. Without committing to this particular analysis, I will leave further investigation of these options aside for now.

This is far from the first time that PF constraints have been proposed which make reference to the syntax. There is a large family of “prosodic faithfulness” constraints which enforce correspondence between syntactic and prosodic structures. For example, the MATCH constraints (Selkirk 2011) ensure that syntactic constituents are matched by prosodic constituents that dominate the same set of terminal nodes. These constraints must have access to the syntactic structure, and in fact must even have access to the labelling of syntactic nodes in order to distinguish words, phrases, and clauses. Similarly, Clemens 2014 proposes the constraint ARG- φ , which penalizes prosodic structures in which heads and their arguments are not phrased together; this constraint needs access to selection relations.

The Optimal Linearization constraints fit this pattern: They use c-command, dominance, and labelling to choose between differently-ordered candidates. In so doing, they accomplish three main things. First, they capture the same empirical facts about linearization that are encoded in the classical Headedness Parameter, but do so using a constraint-based model consistent with how other PF-branch phenomena are treated. This frees us from having to stipulate properties like the placement of specifiers, instead allowing these properties to emerge from constraint interactions. Second, Optimal Linearization additionally allows for the disharmonic orders consistent with the FOFC without needing to stipulate any new syntactic principles — we can build syntactic trees exactly as before while still deriving the correct orders. And finally, as I'll show in the next few chapters, Optimal Linearization provides a model for interactions between linearization and phonological or prosodic markedness that allows us to capture PF displacement phenomena.

CHAPTER 7

PROSODIC DISPLACEMENT WITH OPTIMAL LINEARIZATION: KHOEKHOE

In Chapter 4, I argued that the positioning of Khoekhoe light Tense-Aspect-Polarity (TAP) particles must be analyzed as prosodic displacement. In Chapter 5, I showed that the placement of the TAP marker is indeed correlated with the prosodic structure of the sentence, in particular with the presence or absence of sandhi on the verb. The goal of this chapter is to provide a unified analysis of these two facts: What pressures condition prosodic structure in Khoekhoegowab, and why do they force TAPs to displace? I'll propose that Khoekhoegowab is subject to a constraint *STRONGEDGE*, similar to *STRONGSTART* (Selkirk 2011), which penalizes clitics at the left or right edge of prosodic constituents; this constraint will drive prosodic displacement of light TAP particles away from the phrase edge.

The rest of this chapter will proceed as follows. In section 7.1, I'll briefly review the basic facts that I aim to account for. In section 7.2, I'll introduce Match Theory (Selkirk 2011), the basic framework I will use to mediate syntax-prosody mapping, and will show that some other factor beyond simple syntax-prosody matching is at play in Khoekhoegowab. In section 7.3, I'll propose that we can capture this additional factor using Contiguity Theory (Richards 2016). Section 7.4 then introduces *STRONGEDGE*, the primary constraint responsible for driving prosodic displacement in Khoekhoegowab. Section 7.5 extends the analysis to embedded clauses; along the way, it will include the proposal that second-position clause-type markers in Khoekhoegowab are another instance of prosodic displacement. Finally, section 7.6 summarizes and concludes.

7.1 Review: Khoekhoe prosody & displacement

The Khoekhoegowab data is complex, so it's worth pausing at this point to review exactly what we're trying to model.

First, our goal should be to explain the basic distribution of sandhi. Within some relevant prosodic domain, the leftmost word retains its citation form while all others undergo sandhi. In most cases, the relevant domain corresponds roughly to the XP — for example, each DP always forms its own sandhi domain, with only the leftmost word in a DP retaining citation tone (1). I'll call the domain of sandhi a **phonological phrase** (notated φ); see section 7.2 for more discussion of this terminology. The desideratum of our model, then, is that it correctly place all the left edges of phonological phrases (i.e. the words with citation form). Most broadly, this means mapping every XP (excepting VPs, which will be discussed below) to its own phonological phrase; this is summarized in (2).

- (1) Sandhi in DPs (citation forms highlighted): Brugman (2009)
- a. **súúku**
pots
 - b. |**ápǎ** sùùku
red pots
 - c. |**nání** |àpa sùùku
six red pots
 - d. ||**náǎ** !nàni |àpa sùùku
those six red pots

- (2) **Desideratum A:** The model maps each constituent to its own phonological phrase (except where Desiderata B & C apply).

The second point concerns how sandhi affects verbs. Recall from Chapter 5 that verbal sandhi is crucially dependent on TAP position and clause type:

- (3) **Desideratum B:** The model always places the verb at the left edge of a phonological phrase when it is followed by a TAP, and never places the verb at the left edge of a phonological phrase when it is preceded by a TAP (except where Desideratum C applies).
- (4) **Desideratum C:** In embedded clauses, the model always places the verb at the left edge of a phonological phrase.

These three points together account for the distribution of sandhi. The remaining desiderata more specifically concerns prosodic displacement: Light TAPs displace to preverbal position, while heavy TAPs don't. More specifically, we aim to account for the preferred position of preverbal TAPs: In most clauses, this is immediately preverbal; in (most) embedded clauses it is in second position. In both cases, however, alternative positions are possible.

- (5) **Desideratum D:** Light TAP particles obligatorily displace to a preverbal position.
- (6) **Desideratum E:** In matrix clauses, light TAP particles prefer to appear immediately before the verb (but may optionally appear earlier).
- (7) **Desideratum F:** In embedded clauses, light TAP particles prefer to appear in second position.

The goal of this chapter is to develop a model that fully meets these six criteria. The next section introduces Match Theory, which I will use to mediate the syntax-prosody mapping generally; the following sections will then discuss the individual constraints that create deviation from the basic mapping and allow us to account for the six points discussed here.

7.2 Syntax-prosody mapping with Match Theory

Match Theory is a general framework for modelling syntax-prosody mapping with violable constraints (Selkirk 2011; Elfner 2012). Under Match Theory, prosody is assumed to be isomorphic to syntax by default; deviations from this basic isomorphism can be driven by various prosodic markedness constraints. One general difference between syntax and prosody, however, is that prosody typically involves small, finite number of categories. Whereas syntactic constituents take the properties of their head (and are thus as numerous as there are categories of head), most researchers assume a significantly reduced number of possible prosodic categories. I will follow Selkirk (2011) and others in assuming a simple prosodic hierarchy as in (8), although very little in the present analysis depends on the details of this hierarchy.

- (8) **The Prosodic Hierarchy:** (above the syllable)
- ι Intonational Phrase
 - φ Phonological Phrase
 - ω Prosodic Word
 - σ Syllable

The only aspects of this hierarchy that are crucial for Khoekhoegowab are as follows. First, we must be able to distinguish prosodic words from prosodically-dependent elements like clitics. Brugman (2009) shows that clitics in Khoekhoegowab (including the light TAPs) have a significantly reduced distribution compared to full lexical items (in particular, they can never be phrase-initial) and also have a reduced tonal inventory (with only two level tones and a falling tone). In this chapter, I will assume that clitics are exactly those items which are not lexically-specified as affixes and yet fail to be mapped onto prosodic words; I will notate such elements as σ s (i.e. unparsed syllables). Second, we must have some level of prosodic organization which corresponds to the domain of sandhi. Since sandhi domains always encompass multiple words but are typically smaller than the entire clause, I will identify them with the phonological phrase (φ). As far as I am aware there are no prosodic phenomena in Khoekhoegowab which correspond specifically to clause-sized

units, and thus I won't have anything in particular to say about the intonational phrase (t).

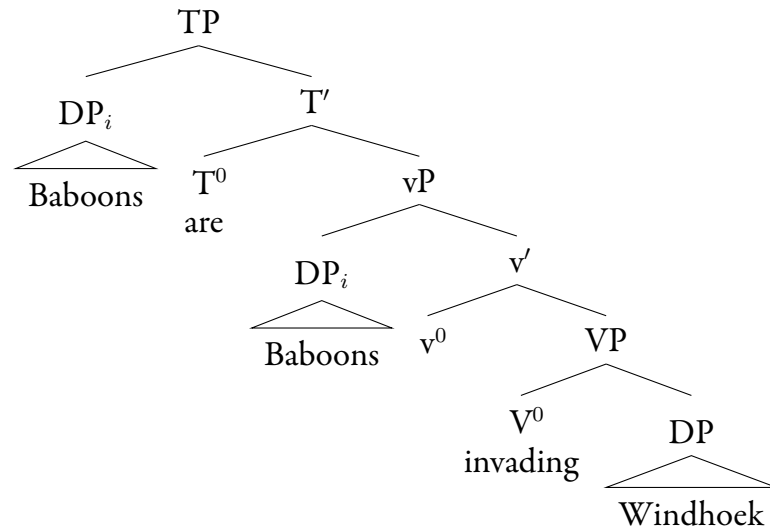
In Match Theory, syntax-prosody mapping is mediated by the MATCH constraints (Selkirk 2011; Elfner 2012), which penalize nonisomorphism between syntactic and prosodic structure. In this system, a syntactic item and a prosodic item are considered to match just in case they both dominate the same set of phonologically-contentful terminals. For example, given the simplified syntactic structure in (9a)¹, a fully-Matched prosodic structure looks like (9b):² Each XP has a φ that totally dominates the same words.³ Notice that because v^0 is phonologically empty (i.e. there is no morpheme that Spells Out v^0) and because vP does not totally dominate the subject *baboons*, it is possible for a single φ to match VP, vP , and v' : $\varphi_{vP,v',VP}$ matches all three of these syntactic constituents in the sense that it totally dominates exactly the same set of terminal nodes.

¹I am not assuming that X' levels have any special status — that is, X' behaves exactly like XP for the purposes of Matching. However, I'll continue to use the X' notation simply to help provide unique labels for nodes.

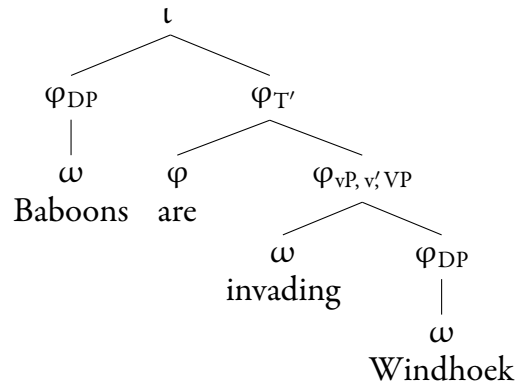
²The subscripts on prosodic constituents here indicate what syntactic constituents they Match; these diacritics have no formal standing in the theory, and do not indicate different categories of prosodic constituent.

³Or, rather, each XP has a φ that contains the words which Spell Out all and only the terminals totally dominated by XP.

(9) a.



b.



Match Theory is couched within the broader framework of Optimality Theory, so the syntax-prosody mapping is determined by a set of violable constraints. In this model, GEN takes as its input the syntactic structure, and the outputs are all possible prosodifications of the string of words that Spells Out that structure; the MATCH constraints then select only the fully-Matched candidate as the winner. The MATCH constraints come in pairs: One constraint counts how many syntactic objects of some type (i.e. X⁰s, XPs, or clauses) fail to be matched by a prosodic constituent; the other constraint counts how many prosodic objects of some type (i.e. ω, φ, or ι) fail to be matched by a syntactic constituent. For example, take the constraints below: MATCH-PHRASE counts how many XPs fail to

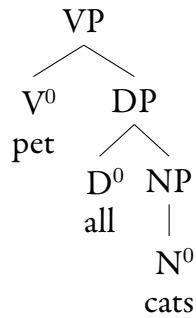
be matched by a φ , while $\text{MATCH-}\varphi$ counts how many φ s fail to match any XP in the input.⁴

- (10) Definition: A syntactic object X and a prosodic object α **match** iff the set of phonologically-contentful terminal nodes dominated by X is the same as the set of morphs contained in α .
- (11) a. MATCH-XP : Assign one violation for each XP with no matching φ .
b. $\text{MATCH-}\varphi$: Assign one violation for each φ with no matching XP.

The tableau below illustrates the action of these constraints on the schematic structure in (12); in the candidates, parentheses are used to mark phonological phrase boundaries. The winning candidate (a) matches all of the syntactic constituents. In candidate (b), there is no prosodic constituent Matching NP: NP dominates only the terminal N^0 , which is Spelled Out by the word *cats*; however, there is no phonological phrase in the candidate which contains only *cats*, and so MATCH-PHRASE assesses one violation. Similarly, candidate (c) fails to match either NP or DP — there is no phonological phrase containing just all and cats — and so MATCH-PHRASE assesses two violations. Candidates (d) and (e) illustrate the action of $\text{MATCH-}\varphi$. In (d), there is a prosodic constituent containing only the word *pet*; however, there is no XP in the syntactic structure which contains only the corresponding terminal V^0 , and so $\text{MATCH-}\varphi$ assesses one violation. Candidate (e) similarly adds a prosodic constituent containing only *all*, which has no matching XP in the input.

⁴In more traditional OT terms, MATCH-PHRASE is analogous to MAX in that it asserts that every item in the input must have some expression in the output, while $\text{MATCH-}\varphi$ is analogous to DEP . In fact, see Ito & Mester (2018) for a suggestion that we should regulate the syntax-prosody interface via traditional Correspondence constraints (McCarthy & Prince 1995) rather than the categorical MATCH constraints. This is a highly interesting proposal that I think has particular merits in the analysis of PF displacement, but for this chapter I will stick to the more standardly-assumed Match Theory.

(12)



(13)

(12)	MATCH-PHRASE	MATCH- φ
a. $\text{pet} (\text{all} (\text{cats}))$	0	0
b. $(\text{pet} (\text{all cats}))$	1: NP	0
c. (pet all cats)	2: NP DP	0
d. $((\text{pet}) (\text{all} (\text{cats})))$	0	1: (pet)
e. $((\text{pet}) ((\text{all}) (\text{cats})))$	0	2: (pet) (all)

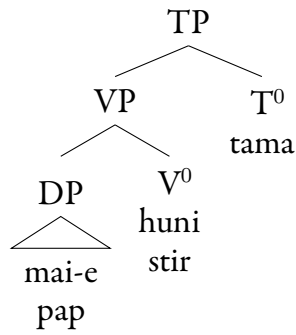
7.2.1 Fully-Matched structures in Khoekhoegowab

The prosodic structure predicted for Khoekhoegowab by MATCH-PHRASE and MATCH- φ alone fails to meet the criteria laid out in section 7.1. To see this, start with a basic transitive verb with a postverbal TAP (and hence no prosodic displacement). (14) is such a sentence, with the left edges of phonological phrases (as diagnosed by the presence of citation tone words) illustrated.

(14) (|gôab ge (mai-e (huni tama
 boy DECL pap stir NEG.NF
 “The boy didn’t stir the pap.”

For the moment, syntax above the level of T^0 — including the subject and the left periphery — need not concern us — we only care about how material inside TP is prosodified. The syntactic structure of TP will be roughly as in (14) (with phonologically null heads, which do not affect the outcome of Matching, suppressed).

(15)



Notice that there is a mismatch between the syntax and the prosody, here: There is no XP in (15) which has V^0 as its leftmost element, and yet the sandhi facts tell us that the verb must be leftmost in some φ ; one possible prosodification with this property is shown in (16a). The fully-Matched prosodic structure would be (16b). In this case, then, there must be some prosodic markedness constraint dominating the MATCH constraints which is responsible for “promoting” the verb and TAP into their own prosodic phrase.⁵ In the next section, I’ll argue that this mismatch is driven by Contiguity in the sense coined by Richards (2016).

(16)

	[[[O] V] T]	MATCH-PHRASE	MATCH- φ
a. ☞	((O) (V T))	1	1
b. ☹	(((O) V) T)	0	0

7.3 Generalized Contiguity

Match Theory, as a theory of the syntax-prosody interface, generally holds that syntactic constituents be preserved in the prosody — if some collection of syntactic terminals make up a constituent in the syntax, then the corresponding words should make up a constituent in the prosody. Recent work, however, has proposed that there are other syn-

⁵In this tableau and all that follow, I’ll use the following conventions: square brackets [] indicate syntactic constituents; parentheses () indicate phonological phrase boundaries; all words are assumed to be prosodic words unless annotated with σ . For reasons of space, I’ll use the generic labels S(ubject), O(bject), V(erb), & T(ense), rather than the actual Khoekhoe words.

tactic relationships that also are preserved by the prosody. For example, Clemens (2014) proposes the constraint ARGUMENT- φ , which requires that certain selectional relationships must be preserved: If X^0 selects Y^0 , then the corresponding words x and y should be grouped together in the prosody (even if they do not form a constituent in the syntax at the time of prosodification, for instance due to movement).

Richards (2016) takes this a step further in developing Contiguity Theory. Contiguity Theory holds that both selection and Agreement relations in the syntax must be preserved in the prosody; what's more, it holds that the *asymmetry* of these relationships (between selector and selectee, or between probe and goal) must also be preserved. To accomplish this, Richards relies on the notion of "prosodically-active edges": The edge of a prosodic constituent is active just in case it is marked in the speech signal in some way.⁶ It has long been noted that most languages prefer to mark one edge or the other of prosodic units, but not both. For example, Selkirk (1986) finds that Japanese marks the left edges of some level of the prosodic hierarchy with a low boundary tone; by contrast, Bresnan & Kanerva (1989) argue that Chichewa marks the right edges of constituents with e.g. penultimate lengthening. For Richards, this makes Japanese a language with active left edges and Chichewa one with active right edges; thus, there may be certain syntactic relations in Japanese sensitive to left edges of prosodic constituents (but not right ones), and the reverse for Chichewa. Some languages do mark both edges (e.g. Irish, Elfner 2012) in different contexts, in which case the relevant processes may be sensitive to any active edge (regardless of direction).

Richards develops the notion of Generalized Contiguity to capture how the prosody maps active edges to certain syntactic relations:

⁶Technically, Richards considers an edge active if the language might mark that edge in some contexts, even if it is not marked in this specific one.

- (17) **Generalized Contiguity:** If α either agrees with or selects β , α and β must be dominated by a single prosodic node, within which β is [at an active edge]. (Richards 2016).

Richards' goal is to capture certain typological correlations between activity direction (i.e. whether left or right edges are active), headedness, and various syntactic processes. To do this, Richards proposes a model in which syntax & prosody are constructed simultaneously, and are mutually influencing. In this model, syntax-prosody interface factors (such as Generalized Contiguity) can drive movement in the pure syntax.

One example that Richards takes up is whether *wh* items move or remain in situ. Richards argues that, when they move, this is to better satisfy Generalized Contiguity: A complementizer head C^0 enters into an Agreement relation with the *wh* item that must be preserved in the prosody. In a head-initial language, C^0 will by default be to the left of the *wh* item. If the right edges of prosodic phrases are active, then the *wh* item can remain in situ: Generalized Contiguity can be satisfied simply by constructing a prosodic constituent spanning from C^0 to the *wh* item; this is illustrated in (18a). However, if the left edges are active, then the only way to satisfy Generalized Contiguity is to first move the *wh* item past C^0 , as illustrated in (18b), before constructing a prosodic constituent grouping them.

- (18) a. ... ($C^0_{[wh]}$... *wh*)_{active} ...
 b. ... (_{active} *wh*_{*i*} C^0_{wh}) ... *t*_{*i*} ...

7.3.1 Violable Contiguity

The full Contiguity Theory model — in which syntax and prosody are mutually influencing — is beyond the scope of this dissertation. However, I will show that Contiguity, if treated as a violable constraint and limited to what syntactic relationships it can see, is the tool that we need for Khoekhoe prosody and displacement. In particular, I will join Richards in considering only a certain kind of selection relationship, namely the selection that occurs between members of an Extended Projection (Grimshaw 1991; c.f.

López 2009). This captures the relationship between verb and tense, and thus will be an important tool in controlling the prosody and position of TAPS. (It is possible that the other parts of Generalized Contiguity (Agreement relations; selection across extended projections) may also be usefully treated as violable constraints, even in Khoekhoe itself; I will leave this for future consideration.)

- (19) EXTENDEDPROJECTION(to be revised): If X is in the Extended Projection of Y, assign one violation if there is no prosodic constituent that:
- a. contains both *x* and *y* (the CONTIGUITY condition); and
 - b. has *y* at its active edge (the PROMINENCE condition).

Before illustrating how this constraint works to create the syntax-prosody nonisomorphism discussed in the last section, it's necessary to further clarify the notion of prosodic activity for the case of Khoekhoegowab. In particular, I will argue that left edges of φ s are prosodically active, which might at first seem strange — indeed, they are the only place that sandhi *fails* to apply. But by the same token, they are the edge that is phonologically marked in the speech signal: A listener, having just heard a citation form word, can be confident that they have just heard the left edge of a prosodic constituent; if they have just heard a sandhi form word, by contrast, they cannot be sure whether it was at the right edge of a constituent. The left edge of a Khoekhoe φ s are prosodically “strong” in the additional sense that they preserve the maximum number of tonal contrasts; all other positions neutralize at least some of the tonal classes.⁷ So in this sense, the left edges of φ s are clearly active in Khoekhoe.

The tableau in (20) illustrates the action of EXTENDEDPROJECTION on V & T, assuming that left edges are active and that T is in the extended projection of V. Candidate (a) fully satisfies EXTENDEDPROJECTION: There is a single prosodic constituent containing both V & T, and V is at its left edge. The prosodic constituent in candidate (b)

⁷Compare this with e.g. English, in which the marked, “stressed” syllables are the domain in which the maximum number of vowel contrasts are preserved; vowel reduction applies everywhere else.

scores a violation by virtue of not having V at its left edge; likewise, the constituent in candidate (c) scores a violation by virtue of not including T. Finally, candidate (d) shows that when T precedes V, this constraint cannot be satisfied: There is no way to include both T & V in one constituent with V at its left edge. EXTENDEDPROJECTION, then, is the tool that we need to meet Desideratum A: The verb will always be at the left edge of a φ when followed by the TAP, but not when preceded by it.

(20)

...V...T...	EXTENDEDPROJECTION
a. $\text{...}_{(\text{active V...T...})}$	0
b. $(\text{active ...V...T...})$	1
c. $\text{...}_{(\text{active V...})}\text{T...}$	1
d. ...T...V...	1

Let's return to the issue of syntax-prosody non-isomorphism in Khoekhoe. Recall that, when the TAP is postverbal, the verb winds up at the left edge of a prosodic constituent (even though it is not at the left edge of any syntactic constituent); some constraint must be driving deviation from the fully matched structure. The tableau in (21) shows that EXTENDEDPROJECTION accomplishes this task: It penalizes the fully-matched structure, which does not have V at the edge of a φ containing T.

(21)

$[[[[O] V] T]$	EXTPROJ	MATCH-PHRASE	MATCH- φ
a. $\text{...}_{((O)(VT))}$	0	1	1
b. $(((O)V) T)$	1 W	0 L	0 L

Generalized Contiguity, and more specifically EXTENDEDPROJECTION, is the tool that we need to drive syntax-prosody mismatches in basic Khoekhoegowab clauses without displacement. In the next section, we'll turn to the issue of motivating prosodic displacement of light TAPS.

7.4 STRONGEDGE and prosodic displacement

At this point, we have enough of a model of Khoekhoegowab prosody to begin to tackle the issue of prosodic displacement. In particular, this section will address Desiderata D & E, repeated below:

- (22) **Desideratum D:** Light TAP particles obligatorily displace to a preverbal position.
- (23) **Desideratum E:** In matrix clauses, light TAP particles prefer to appear immediately before the verb (but may optionally appear earlier).

Addressing these issues first requires us to address a more basic issue: What differentiates light TAPs from heavy ones? In answer to the first question, Brugman (2009) notes that in Khoekhoe, monomoraic words behave differently from multimoraic words in at least two respects: They have a different (reduced) tonal inventory, and they cannot appear clause-initially. The light TAPs are exactly those that are monomoraic and thus are restricted in this way. We can capture this natural class by saying that prosodic words in Khoekhoegowab must be minimally binary at the level of the mora:

- (24) $\text{BINMIN}(\omega, \mu)$: Assign one violation to each prosodic word which has fewer than 2 moras.

If $\text{BINMIN}(\omega, \mu) \gg \text{MATCH-WORD}$ (the constraint similar to MATCH-PHRASE responsible for mapping each X^0 to a ω), no monomoraic lexical items will be mapped to prosodic words; that is, these items will remain as unparsed syllables (σ). This is illustrated in the tableaux below.

(25) a.

	[_T go]	BINMIN(ω, μ)	MATCH-WORD
a.	$\iota \text{ go}_\sigma$	0	1
b.	$(\omega \text{ go}_\sigma)$	1 W	0 L

b.

	[_T tama]	BINMIN(ω, μ)	MATCH-WORD
a.	$\text{ta}_\sigma \text{ma}_\sigma$	0	1 W
b.	$\iota (\omega \text{ ta}_\sigma \text{ma}_\sigma)$	0	0

This, then, allows us to restate the description of prosodic displacement in Khoekhoe-gowab: It is not light TAPs in particular that are banned from the right edge of the clause, but rather unparsed syllables. (I'll show in section 7.5.1 that there are other, non-TAP particles that are also banned from the clause edge.)

7.4.1 STRONGEDGE

Of the three other clear cases of prosodic displacement, two involve displacement of prosodic clitics, a.k.a. unparsed syllables. In the Irish case reported by Bennett et al. (2016), clitics are banned from being at the left edge of a φ by the constraint STRONGSTART, which penalizes prosodic constituents whose leftmost daughter is a σ ;⁸ the Bosnian / Croatian / Serbian case is plausibly motivated by a similar constraint.

- (26) STRONGSTART: Assign one violation for each φ or ι that has an unparsed syllable as its leftmost daughter.

STRONGSTART will not work for the Khoekhoe case: While it is true that clitics are banned from clause-initial position, the specific dislocation that concerns us here is from clause-*final* position. To ban clitics from both positions in Khoekhoe, I propose the constraint STRONGEDGE, defined in (27). This follows earlier literature in maintaining an asymmetry in phonology between the left and right edges: see for instance Nelson (2003) for arguments that faithfulness at the word level is to the left edge or to both edges, but

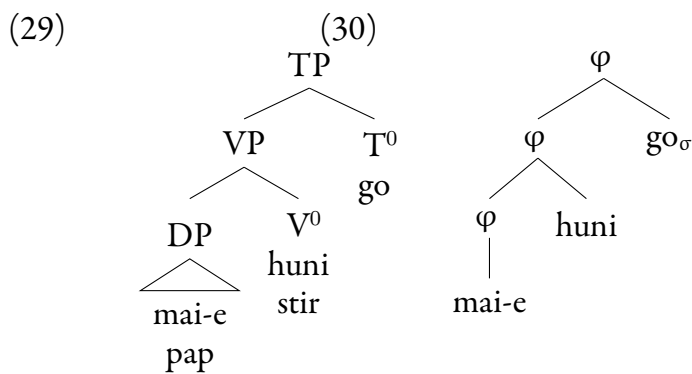
⁸Bennett, Elfner, & McCloskey (2016) specifically formulate STRONGSTART to penalize φ s which begin with a σ ; however, their data does not rule out the possibility that ι s are also so penalized.

never to the right edge alone; Ito & Mester (2018) argue that this generalization can and possibly should be maintained for prosody, as well.

- (27) **STRONGEDGE**: Assign one violation for each φ or t^9 that has an unparsed syllable σ as an edgemoat daughter.

Let's look at the effect of this constraint on the word order and prosody of a simple sentence. Just as in the non-displacing case, we do not need to be concerned with the structure of the left periphery, including the position of the subject.

- (28) (|gôab ge (mai-e go huni
 boy DECL pap PST stir
 "The boy didn't stir the pap."



A fully-matched structure for (29) is given in (30): TP, VP, and DP are all Matched by phonological phrases. Note, however, that this places the light TAP at the right edge of a φ , in violation of **STRONGEDGE**.

Up to this point, we've only been considering the candidates that standard Match Theory would consider, i.e. all possible prosodifications of some fixed string. But with prosodic displacement at play, it's time to also consider other possible linearizations. The candidate set, then, will be all possible prosodifications of all possible word orders. The combination of Match Theory and Optimal Linearization will select the output word

⁹It is possible that this constraint also affects ω s, in which case it would militate against recursive ω s for affixes; I'll leave this to further investigation for now.

order. This is illustrated for the example in (29) below. The winning candidate, (31a), Matches the object DP and the TP with phonological phrases, while displacing the light TAP into a phrase-medial position. The fully-Matched candidate, (31b), is ruled out by high-ranked STRONGEDGE, even though it is preferred by HEADFINALITY. Finally, candidate (31c) displaces the light TAP all the way into phrase-initial position, as preferred by ANTISYMMETRY, but this is also ruled out by STRONGEDGE: The φ matching TP now has a clitic at its left edge rather than its right. (Candidate (31d) is included just to show the ranking argument for HEADFINALITY \gg ANTISYMMETRY — i.e. the ranking deriving head-finality generally in the language.)

(31)

[_{TP} [_{VP} [_{DP} O] V] T _σ]	STR _{EDGE}	M-XP	HF	ANTISYM
a. φ ((O) T _σ V)	0	1	2	3
b. (((O) V) T _σ)	1 W	0	1 L	4 W
c. (T _σ ((O) V))	1 W	0	2	2 L
d. (V T _σ (O))	0	1	3 W	2 L

Earlier, I motivated the constraint EXTENDEDPROJECTION, based on Contiguity Theory (Richards 2016). EXTENDEDPROJECTION requires that the verb and TAP be phrased together, and that the verb be at the active left edge of that prosodic constituent. This constraint was responsible for driving syntax-prosody mismatch in the postverbal case, but the prominence condition will universally penalize candidates in which the TAP precedes the verb. All three candidates in (31) thus violate this constraint, showing that we need the ranking STRONGEDGE \gg EXTENDEDPROJECTION:

(32)

[_{TP} [_{VP} [_{DP} O] V] T _σ]	STR _{EDGE}	EXT _{PROJ}	M-XP	HF	ANTISYM
a. φ ((O) T _σ V)	0	1	1	2	2
b. ((O) (V T _σ))	1 W	0 L	1	1 L	3 W

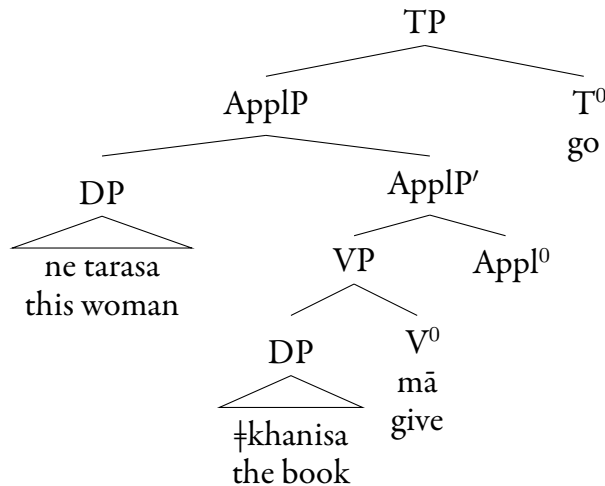
This also helps explain why displacement of light TAPs affects the prosodic realization of the verb: The constraint responsible for “promoting” the verb to being at the left edge of a prosodic constituent can only be satisfied if tense follows the verb.

7.4.2 Preferred position

Desideratum E states that light TAPs in matrix clauses prefer to appear immediately before the verb. In the last section, I showed that with a monotransitive verb, STRONGEDGE causes light TAPs to appear in that preferred position. However, a complication arises when we consider sentences with more material in the middlefield (i.e. between the clause-type marker and the verb). I’ll illustrate this with a ditransitive verb.¹⁰

- (33) (Dandagob ge (ne tarasa (‡khanisa go mā.
 D. DECL this woman book PST give
 “Dandago gave this woman the book.”

(34)



The problem arises from the fact that HEADFINALITY is a categorical constraint: It scores one violation per non-head-final XP, regardless of how far from the right edge of

¹⁰For this illustration, I’ve assumed that the second argument of a ditransitive introduced by a silent applicative head. This head would need to be distinct from Khoekhoe’s overt applicative /-ba/. The analysis here is compatible with other interpretations of ditransitive structure.

XP the head is. By contrast, *ANTISYMMETRY* is gradient: It will score additional violations the further right a given head is displaced. Once *STRONGEDGE* forces the *TAP* out of final position, *HEADFINALITY* will not score additional violations if it is pushed further to the left; however, *ANTISYMMETRY* will score more violations the further the *TAP* is from initial within its phrase.¹¹ The result is that the *TAP* will prefer to be in second position within *TP*.

This is illustrated in the tableau in (35). The desired winner is candidate (a). Note, however, that under our current definition this candidate doesn't Match the VP: The φ containing the verb and direct object also contains the *TAP*, thus incurring a violation of *MATCH-PHRASE*.¹² Candidate (b) similarly fails to match the VP — there is no φ containing just the verb and direct object — but fares better on *ANTISYMMETRY*: *T*⁰ does c-command the direct object, and so *ANTISYMMETRY* prefers that the *TAP* precede it.

(35)

(34)	STREDGE	EXTPROJ	M-XP	HF	ANTISYM
a. ☞ ((book) ((woman) T give))	0	0	1	2	3
b. ☹ ((book) T (woman) give)	0	0	1	2	2 L

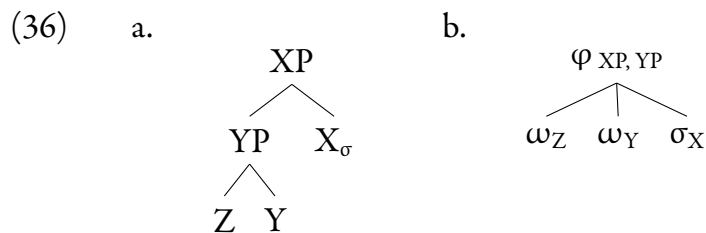
Displacing the *TAP* causes two problems with constructing a prosodic structure. First, because *T* is to the left of *V*, *EXTENDEDPROJECTION* provides no pressure to group them prosodically. Second, because the *TAP* is between the direct object and the verb, there is no contiguous substring corresponding to the VP, and so no prosodification can match the VP.

I'll propose that the solution to the matching problem lies in the idea of prosodic adjunction. Previous authors have proposed that “prosodically-dependent” elements (i.e. clitics) have the option of adjoining to φ s in a way that prosodic words do not. For example,

¹¹For more details on why this is so, see section 6.1.3. It's not entirely clear how a gradient version of *HEADFINALITY* could be implemented, nor that such a constraint would be desirable: The categorical nature of *HEADFINALITY* is what allows Irish postposing to go to arbitrary distance.

¹²This candidate also incurs a violation of *MATCH- φ* , for the same reason.

Bennett et al. propose that prosodic adjunction of a σ to a φ involves the creation of two distinct “segments” of the φ ; alternatively, many studies have proposed a distinct unit on the prosodic hierarchy called the “Clitic Group” (e.g. Nespor & Vogel 1986). I propose a simpler system for capturing the special options available to clitics: They are invisible to the MATCH constraints. In particular, I’ll propose MATCH-PHRASE and MATCH- φ simply ignore clitics when deciding whether a particular φ matches a particular XP. For example, in (36b), the φ matches YP in (36a), despite the fact that it contains the clitic σ_X ; likewise, there’s no pressure to match XP separately, because from the point of view of the MATCH constraints X^0 is phonologically contentless.



Formally, this change is accomplished by redefining the MATCH constraints to use the following definition:

- (37) Definition (revised): A syntactic object X and a prosodic object α *match* iff every **prosodic word** contained in α matches a syntactic terminal dominated by X , and there are no terminals dominated by X matched by a prosodic word not contained in α .

This comes close to solving the problem of TAP positioning. In (38a), the φ containing the object, verb, and TAP is now considered to match the VP, and so (38a) is in fact the fully-matched candidate, incurring no violations of MATCH-PHRASE. This rules out candidate (b), which fails to match the VP. However, nothing rules out candidate (c), which puts the TAP closer to the left edge (thereby better satisfying ANTISYMMETRY).

(38)

(34)	STREdge	EXTPROJ	M-XP	HF	ANTISYM
a. ☞ ((book) ((woman) T give))	0	1	0	2	3
b. ((book) T (woman) give)	0	1	1 W	2	2 L
c. ☹ ((book) T ((woman) give))	0	1	0	2	2 L

The problem here is that, with T preceding the verb, there is no pressure at all to prosodically group the verb and the TAP — as noted above, EXTENDEDPROJECTION as currently defined simply cannot be satisfied in this circumstance. Here, I propose that the solution is to split the EXTENDEDPROJECTION constraint in two: If we allow independent satisfaction of the *contiguity* requirement and the *prominence* requirement, then the former will provide pressure to keep light TAPs in their preferred, immediately-preverbal position.

- (39) a. EP-CONTIGUITY: If X is in the Extended Projection of Y, assign one violation if the smallest φ containing y doesn't contain x .
 b. EP-PROMINENCE: If X is in the Extended Projection of Y, assign one violation if y is not at the active edge of a φ containing x .

The tableau in (40) shows that separating these two parts of the constraint correctly rules out the candidate in which the light TAP displaces further to the left. Candidate (c), which fully matches the syntactic structure but also places the TAP outside of the VP, violates EP-CONTIGUITY. Candidate (b) satisfies EP-CONTIGUITY by failing to match VP — here, the smallest φ containing the verb is the one matching ApplP (i.e. containing the entire string), and so EP-CONTIGUITY is satisfied even when the TAP is not immediately preverbal; however, as shown above, MATCH-PHRASE correctly rules this candidate out in favor of the winning candidate (a).

(40)

(34)	EP-CON	EP-PROM	M-XP	HF	ANTISYM
a. μ ((book) ((woman) T give))	0	1	0	2	3
b. ((book) T (woman) give)	0	1	1 W	2	2 L
c. ((book) T ((woman) give))	1 W	1	0	2	2 L

The combination of making clitics invisible to the MATCH constraints with split EP-CONTIGUITY and EP-PROMINENCE constraints means that the TAP will always be positioned within the smallest φ containing the verb, whatever that φ matches. The result, then, is to capture Desideratum E: light TAPs prefer to be immediately preverbal.¹³

7.4.3 Interim summary

At this point, the model developed will correctly account for both the prosody and word order of all simple matrix clauses. The table in (41) summarizes all of the constraint-rankings involved in this model, along with a reference to the tableau in which the relevant ranking argument can be found and a brief description of what that ranking accomplishes.

¹³For the moment, I'm ignoring the potential variation in position — i.e. that TAPs can optionally appear further to the left than this position. See section 7.6.1 for discussion of this.

(41) Summary of ranking arguments:

Ranking	Location of argument
BINMIN-(ω, μ) \gg MATCH-WORD → Ensures that monomoraic TAPs do not form prosodic words on their own.	(25)
HEADFINALITY \gg ANTISYMMETRY → Creates head-final default word order.	(31)
STRONGEDGE \gg HEADFINALITY → Forces light TAPs away from the right edge.	(31)
STRONGEDGE \gg EP-CONTIGUITY → Allows prosodic displacement to prevent verb from being at left edge of φ .	(32)
EP-CONTIGUITY, MATCH-PHRASE \gg ANTISYMMETRY → Ensures that light TAPs stay close to the verb.	(40)
EP-CONTIGUITY, EP-PROMINENCE \gg MATCH-PHRASE → Ensures correct prosodic phrasing of the verb with respect to the TAP.	(21)

7.4.4 Case study: Prosody in VP coordination

One of the most complex cases considered in Chapter 5 is VP coordination. Here, preverbal TAPs may occur immediately before either verb, and trigger sandhi on only the verbs that follow (42); heavy TAPs must occur after both verbs, and likewise require citation form on both verbs (43).

- (42) a. Aob ge mai-e **húní** tsi ||gan-e go *ám*.
man DECL pap stir and meat PST grill
“The man stirred the pap and grilled the meat.”
b. Aob ge mai-e go *hùni* tsi ||gan-e *ám*.
man DECL pap PST stir and meat grill
“The man stirred the pap and grilled the meat.”

- (43) Aob ge mai-e **húní** tsi ||gan-e **ám** tama.
man DECL pap stir and meat grill NEG.NF
“The man didn’t stir the pap or grill the meat.”

The constraint set we currently have is sufficient to generate the correct result in all three cases. Let's first consider the postverbal case, as in (43). The tableau in (44) shows that EP-CONTIGUITY and EP-PROMINENCE disfavor the fully-matched candidate (b): T is in the extended projection of both verbs, and so independent violations are scored for failing to prosodically group it with both verbs.¹⁴

(44)

[[O ₁ V ₁] & [O ₂ V ₂] T]	STREdge	EP-CON	EP-PROM	M-XP	HF
a. $\varphi (O_1 (V_1 \& (O_2 (V_2 T))))$	0	0	0	1	0
b. $((O_1 V_1) \& (O_2 V_2) T)$	0	2 W	2 W	0 L	0

Now let's turn to the interesting case, where the TAP is light. We'll start by considering the two possible positions (before V₁ and before V₂) separately. The tableau in (45) only considers the "late" position, i.e. where the TAP appears after V₁ but before V₂. The winning candidate (a) satisfies EP-PROMINENCE fully: The prosodic constituent containing each verb also contains the TAP. Because the TAP precedes V₂, there is no way for this candidate to fully satisfy EP-PROMINENCE; however, since violations of this constraint are counted separately for each verb, it does succeed in motivating a mismatch in constituency from the syntax — V₁ is placed at the left edge of a φ , as desired.

(45)

[O ₁ V ₁] & [O ₂ V ₂] T _σ	STREdge	EP-CON	EP-PROM	M-XP	HF
a. $\varphi (O_1 (V_1 \& (O_2 T_\sigma V_2)))$	0	0	1	1	1
b. $((O_1 V_1) \& (O_2 V_2) T_\sigma)$	1 W	2 W	2 W	0 L	0 L

Similar facts hold when the light TAP is placed in the early position. The only change in violations here is that, because the TAP precedes both verbs, EP-PROMINENCE cannot be satisfied in either case — there is no way to group either verb with the TAP while having

¹⁴In the tableau in this section, I omit all syntactic & prosodic constituents not directly relevant to the case at hand; this is for reasons of space & exposition. The actual syntactic structure, and thus the winning candidate, would have a more elaborated structure; the result would be additional violations of MATCH-PHRASE. No other violations would change, and the choice of winner would not be affected.

the verb at the left edge of that φ . However, STRONGEDGE and EP-CONTIGUITY still favor the displacement candidate over the faithful candidate (b).

(46)

[O ₁ V ₁] & [O ₂ V ₂] T _σ	STREDGE	EP-CON	EP-PROM	M-XP	HF
a. $\mathbb{E} \left((O_1 T_\sigma V_1) \& O_2 V_2 \right)$	0	0	2	1	1
b. $\left((O_1 V_1) \& (O_2 V_2) T_\sigma \right)$	1 W	2 W	2	0 L	0 L

So far, I've shown how both of the displacement options (to immediately before V₁ and immediately before V₂) are more optimal than the non-displacement candidate, and why they both have the resulting prosodic effects. What's most interesting about the VP coordination case, however, is that both of these options are available. Comparing the tableaux, it at first seems that the late candidate is more optimal overall: It better satisfies EP-PROMINENCE in that at least one verb winds up at a prominent left edge. However, there is another constraint that favors the early candidate: ANTISYMMETRY, being a gradient constraint, prefers candidates in which the TAP is displaced as far to the left as possible. Crucially, EP-PROMINENCE and ANTISYMMETRY are, as far as can be determined from the facts of the language, not ranked with regards to each other: The summary of ranking arguments in (41) shows that no such argument has been found between these two constraints. In (47), this is indicated with the jagged line — the two rankings on either side are independent of one another. From this, it isn't immediately obvious which candidate should win.

(47)

[O ₁ V ₁] & [O ₂ V ₂] T _σ	STREDGE	EP-PROM	M-XP	STREDGE	HF	ANTISYM
a. $\left(O_1 (V_1 \& (O_2 T_\sigma V_2)) \right)$	0	1	1	0	3	6
b. $\left((O_1 T_\sigma V_1) \& O_2 V_2 \right)$	0	2	1	0	3	3

If Khoekhoe selected only one of these candidates, that would be an argument for ranking EP-PROMINENCE and ANTISYMMETRY. However, given that these are in variation, we instead should look for a model that allows for such variation. There have been many extensions of OT to allow for indeterminacy in the output. For example, Stochastic OT (Boersma 1998) allows rankings to be partially indeterminate, with a definite

ranking selected with some probability each time an output is chosen; alternatively, Harmonic Grammar and MaxEnt (Goldwater & Johnson 2003) allow for fixed weights of constraints to determine a probability distribution over candidates, rather than picking a fixed winner. Deciding between these possibilities is well outside the scope of this dissertation, but hopefully I have shown that the constraint set here under-determines the output order in VP coordination cases, exactly as Khoekhoe speakers do. Selection of some model for variable output from OT will allow this constraint set to correctly model the variation of TAP position in VP coordination.

7.5 Embedded clauses

So far, I've shown how to account prosody and word order in matrix clauses, both with and without displacement. But, as noted at the beginning of the chapter, embedded clauses work differently. The ways in which embedded clauses are different are most easily exemplified with a nominalized embedded clause with a light TAP, as in (48). There are two notable differences from matrix clauses. First, the light TAP *go* 'past' prefers to appear in second position, rather than immediately before the verb. Second, the verb *oa* 'return' retains its citation form — that is, unlikely matrix verbs, embedded verbs wind up at the left edge of a φ even when preceded by the TAP. These points are summarized in Desiderata C & F.

- (48) Mí ta ge ra [Dandagob **go** oms |kha (*óa*) -sa.
 say I DECL IMP D. **PST** home to *return* -COMP
 "I am saying that Dandago returned home."

- (49) **Desideratum C:** In embedded clauses, the model always places the verb at the left edge of a phonological phrase.

- (50) **Desideratum F:** In embedded clauses, light TAP particles prefer to appear in second position.

So far, the explanation I've given would lead us to expect embedded verbs to behave like matrix ones. What causes their exceptional behavior? I think one clue comes from clauses with the special quotative embedding complementizer. These clauses, as noted in Chapter 5, behave like matrix clauses despite being embedded. The only way in which quotative clauses differ from other embedded clauses, other than what is captured by Desiderata C & F, is that they retain a second-position clause-type marker, like matrix clauses. This is illustrated in (51); the clause type marker *ge* 'declarative' only appears in matrix clauses and quotative ones. Embedded clauses like (51) behave like matrix clauses insofar as light TAPs prefer to appear immediately before the verb, and verbal sandhi depends on the TAP position.

- (51) Mî ta ge ra [|gôab go mai-e huni -sa.]
 say I DECL IMP boy PST pap stir -COMP
 "I am saying that the boy stirred the pap."

The exceptional status of embedded clauses, then, seems to be tied to the presence of a second-position clause-type marker. I'll argue that we can understand all of these facts if we posit that, in clauses where no clause-type marker is merged, T^0 raises into the C-layer. This head-movement means that the TAP is spelled out in a different phase from the verb, and thus at the point that the verb is prosodified T^0 cannot affect the outcome; this will result both in the change in prosody we see, but also the change in preferred position of the TAP.

7.5.1 What are clause-type markers?

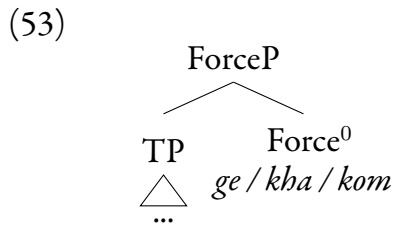
It's finally time to examine the structure of the left-periphery a bit more carefully. Khoekhoegowab has three overt clause-type markers that appear in second position; all are shown in (52). In terms of their meaning, all relate to illocutionary force, and make good candidates for being expressions of the Force⁰ head Cinque (1999) of an articulated

C-layer.¹⁵ However, there's another notable attribute shared by all three clause-type markers: They are all monomoraic, and thus we expect them to be prosodically-dependent and subject to STRONGEDGE.

(52) Khoekhoe (overt) clause-type markers:

ge	/ke/	DECL
kha	/kx̩a/	ECHO
kom	/kɪ̯/	EMPH

For the purposes of our present discussion, the exact cartographic structure of the left periphery doesn't matter. All that matters is that there be a head hosting the clause-type markers (call it Force⁰) that sits above TP:

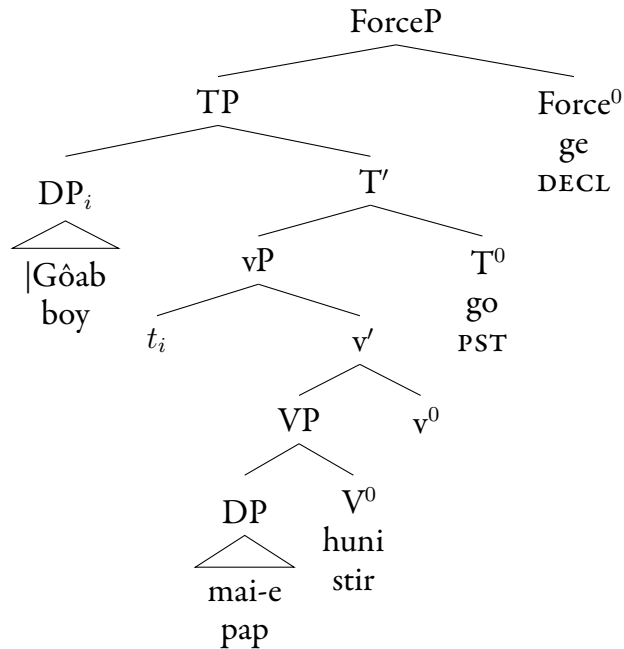


Given this, the constraint ranking we have already deduced above will predict that these clause-type markers should appear in clausal second position. To see this, let's consider a simple matrix clause as in (54).

(54) |Gôab ge mai-e **go** *huni*.
 boy DECL pap **PST** *stir*
 “The boy stirred the pap.”

¹⁵Note that Kusmer & Devlin (2018) have independently argued for the necessity of an articulated C-layer for Khoekhoe.

(55)



For this clause, the fully-matched (and faithfully-linearized) prosodic structure is shown in (56b). This structure, however, has two prosodic constituents ending with clitics, violating STRONGEDGE. The winning candidate, (56a), displaces both of these items, but displaces them to different positions. Because HEADFINALITY is categorical, once the clause-type marker is displaced from final position, the gradient constraint ANTISYMMETRY will act to force it as far left as possible; this is shown in (56c), which displaces *ge* to immediately-preverbal position. Candidate (56d) shows the result of displacing *ge* all the way to the left edge: While this minimizes violations of ANTISYMMETRY (because *ge* now precedes all heads that Force⁰ asymmetrically c-commands), it incurs a violation of high-ranked STRONGEDGE. In this way, the clause-type marker is forced into second position.

(56)

(55)	STREdge	EP-CON	HF	ANTISYM
a. $\text{☞} (S \text{ ge } (O \text{ go } V))$	0	0	3	3
b. $((S (O V) \text{ go }) \text{ ge })$	2 W	1 W	1 L	6 W
c. $(S ((O \text{ go } \text{ ge } V)))$	0	0	3	4 W
d. $(\text{ ge } S ((O \text{ go } V)))$	1 W	0	2 L	2 L

This logic, however, crucially relies on one assumption: Clause-type markers cannot be subject to the constraints EP-CONTIGUITY and EP-PROMINENCE with regards to the verb; in other words, Force^0 cannot be part of the extended projection of the verb. This runs contrary to the original proposal of Extended Projections by Grimshaw (1991); however, it is perhaps in line with more recent proposals of Spellout by phase (as in e.g. Fox & Pesetsky 2005). If C^0 (or rather something in the left-periphery above TP but at most as high as Force^0) is a phase head triggering Spellout of its complement, then at the point that the verb is spelled out Force^0 is not accessible to the EXTENDEDPROJECTION constraints. Working out such a system would require a more detailed look at how prosodification & linearization can happen phase-by-phase, which I will leave for future work; for present purposes, it is enough to note that Force^0 is not treated as being part of the extended projection of the verb by the Contiguity constraints.

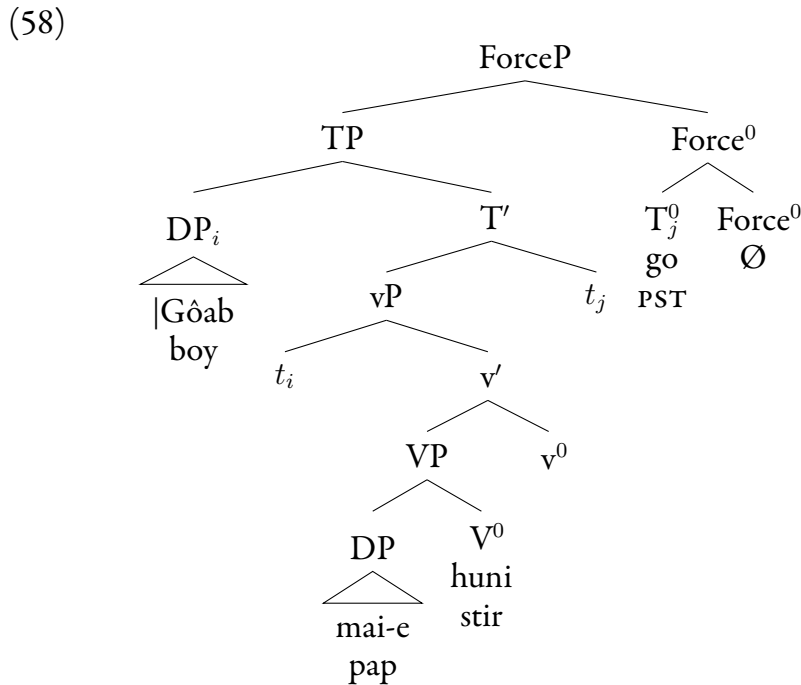
7.5.2 Embedded clauses

With the exception of the special quotative clauses, all embedded clauses lack a clause-type marker — nothing is merged into Force^0 . I propose that this is the crucial distinction that induces the other differences between embedded and matrix clauses. Say that there is a restriction in Khoekhoegowab that requires that Force^0 always be filled. In the case where something is externally merged into that position, this condition is trivially satisfied. If not, then T-to-C head movement raises tense up to Force^0 . This has the effect of removing tense from the phase in which the verb is spelled out, causing it to no longer count as being part of the verbal extended projection as far as EP-CONTIGUITY and EP-

PROMINENCE are concerned. Additionally, since T^0 is spelled out as part of Force^0 , the linearization constraints will treat it the same as the clause-type markers, with the same result — light TAPs will become second-position clitics.

I'll illustrate this with the embedded clause (57), which I take to have the structure shown.¹⁶

- (57) Mí ta ge ra [|gôab go mai-e huni] -sa.
 say I DECL IMP boy PST pap stir] -COMP
 “I am saying that the boy stirred the pap.”



T-to-C movement alone achieves the result that the light TAP preferentially shows up in second position. Based on just the constraints discussed so far, candidate (59a) will win; this candidate correctly linearizes the TAP in second position for exactly the same

¹⁶So far, I have not dealt with the linearization of head-movement structures. The details of this will need to be left for future work, but the constraints currently defined will do the job just as long as the definition of c-command includes the following statement: X^0 c-commands Y^0 just in case the maximal head containing X^0 c-commands Y^0 . In the specific case here, this will have the result that T^0 c-commands everything in TP because the maximal Force^0 does.

reason that clause-type markers wind up there in matrix clauses. However, this still isn't quite the right winner: Desideratum C, which states that embedded verbs always wind up at the left edge of a φ , is not met. One more constraint will be required to force promotion of the verb into its own φ .

(59)

(58)	STREdge	EP-CON	HF	ANTISYM
a. $\ominus (S \text{ go } (O V))$	0	0	2	3
b. $((S (O V)) \text{ go })$	2 W	0	1 L	6 W
c. $(\text{ go } S ((O V)))$	1 W	0	1 L	2 L

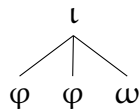
I propose that this constraint is EQUALSISTERS, as proposed by Myrberg (2013) for Stockholm Swedish, which penalizes prosodifications that have sisters at multiple levels of the prosodic hierarchy. A formal definition is given in (60).

- (60) EQUALSISTERS: Assign one violation to each prosodic constituent with daughters π_i, π_j , where π_i & π_j are at different levels on the prosodic hierarchy (e.g. ω & φ , or φ & ι).

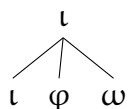
This formalism assigns violations to the *mothers* of unequal sets of prosodic sisters, not to pairs of unequal sisters themselves. For example, the two structures in (61) both violate EQUALSISTERS exactly once: In each case, the root has unequal daughters. The structure in (62), by contrast, violates EQUALSISTERS twice: Both of the highlighted constituents have unequal daughters.

- (61) One violation of EQUALSISTERS (each):

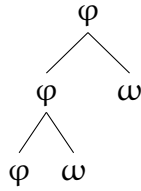
a.



b.



(62) Two violations of EQUALSISTERS:



As long as EQUALSISTERS dominates MATCH-φ (the constraint responsible for penalizing the creation of φs which don't match anything in the syntax), this will have the effect of promoting the verb into its own φ: Because the object (or other VP-internal XP) is matched by a φ (as required by MATCH-PHRASE), then the φ matching the entire VP will be unequal. This is illustrated in (63). (Both candidates score an additional violation of EQUALSISTERS for the outermost φ, which has the clitic *go* as a daughter in addition to the other φs.)

(63)

	EQUALSISTERS	MATCH-φ
a. $\text{☞} ((S) \text{ go } ((O) V))$	2	0
b. $((S) \text{ go } ((O) (V)))$	1 W	1 L

This meets Desiderata C & F: EQUALSISTERS forces promotion of the verb, exactly when T-to-C movement has occurred.¹⁷

7.5.3 Questions

In light of the analysis presented in this chapter, Khoekhoe questions look somewhat odd: By default they have no clause-type marker, like embedded clauses; however, they behave identically to matrix clauses with respect to word order and sandhi:

¹⁷Why doesn't EQUALSISTERS cause promotion of the verb in matrix clauses with prosodic displacement? Promotion of the verb to a φ on its own, of necessity, separates the verb from the TAP. In matrix clauses, where T⁰ is still accessible for the purposes of calculating violations of EP-CONTIGUITY, this would incur a violation. This gives us a ranking argument for EP-CONTIGUITY ≫ EQUALSISTERS.

- (64) (|Goa-e (!garise-i ra !khoe?
 child quickly IMP run
 “Is the child running quickly?”

If T-to-C raising occurs whenever nothing is merged into Force⁰, we might expect it to occur in questions: There is not obviously any clause type marker present. However, unlike embedded clauses, Khoekhoe questions do permit some clause type markers, as in (65a); embedded clauses (except for the special quotative type) never do (65b):

- (65) a. Aoba **kha** oms ai go ||om?
 man ECHO home at PST sleep
 “The man is sleeping at home?”
 b. Mî ta ge ra [|gôab *ge **go** mai-e *huni*] -sa.
 say I DECL IMP boy *DECL **PST** pap *stir*] -COMP
 “I am saying that the boy stirred the pap.”

I’ll propose that all matrix questions do in fact Merge a clause-type marker, but that this marker is typically silent. This satisfies whatever it is that triggers T-to-C movement, and thus ensures that questions will behave like other matrix clauses as regards TAP position and verbal sandhi.

7.6 Summary and discussion

At this point, I have developed a model that successfully meets all of the desiderata set out at the beginning. Because this model is somewhat complex — involving Match Theory, Optimal Linearization, Contiguity Theory, and interactions between them — it will be worthwhile to go through the desiderata point by point and summarize exactly how each is met.

- (66) **Desideratum A:** The model maps each constituent to its own phonological phrase (except where Desideratum B & C apply).

This point is met by Match Theory: MATCH-PHRASE requires that every syntactic constituent be mapped to its own phonological phrase, while MATCH- \varnothing requires that each

phonological phrase have a matching XP. The exceptions for Desiderata B & C are ensured by Optimality Theory generally: Higher-ranked constraints can override the MATCH constraints, forcing different prosodic structures.

- (67) **Desideratum B:** The model always places the verb at the left edge of a phonological phrase when it is followed by a TAP, and never places the verb at the left edge of a phonological phrase when it is preceded by a TAP (except where Desideratum C applies).

This point is ensured by Contiguity Theory, in particular by the constraints EP-CONTIGUITY and EP-PROMINENCE. The TAP is part of the Extended Projection of the verb, and so these constraints require a particular prosodic relationship between the verb and the TAP. EP-CONTIGUITY requires that the smallest φ containing the verb also contain the TAP; this means that, whenever the TAP precedes the verb, the verb cannot be at the left edge of a phonological phrase. EP-CONTIGUITY requires that the verb be “prominent”, i.e. at the left edge, of the phrase containing both it and the TAP; this can only be satisfied when the TAP follows the verb, but will result in the verb being at the left edge of a φ whenever it can be.

- (68) **Desideratum C:** In embedded clauses, the model always places the verb at the left edge of a phonological phrase.

T-to-C raising in embedded clauses breaks the Extended Projection relationship between the verb and TAP (at least as far as the EXTENDEDPROJECTION constraints are concerned). EQUALSISTERS then forces promotion of the verb into its own φ in order to be equal with any other XPs inside the VP. (If there are no other XPs inside the VP, then the verb is already at the left edge of a φ — the one matching the VP itself.)

- (69) **Desideratum D:** Light TAP particles obligatorily displace to a preverbal position.

Light TAP particles, by virtue of being monomoraic, are prosodically dependent (i.e. clitics). STRONGEDGE requires that prosodically dependent items not be an edgemost daughter of a prosodic constituent. If a light TAP particle remained in postverbal (clause-final) position, it would definitionally be at the right edge of some prosodic constituent. Because STRONGEDGE is ranked higher than HEADFINALITY, light TAPS are displaced into preverbal position.¹⁸

- (70) **Desideratum E:** In matrix clauses, light TAP particles prefer to appear immediately before the verb (but may optionally appear earlier).

The Contiguity constraint EP-CONTIGUITY requires that the verb and TAP be phrased together. Light TAPS, by virtue of being prosodically dependent, are ignored by the MATCH constraints; this means that it is possible to both match the VP with a φ and include the light TAP in that φ (even though T^0 is not part of VP in the syntax). Together, this means that the most harmonic position for the light TAP will be as close to the verb as possible — within the smallest φ containing the verb, generally the one matching the VP.

Desideratum E allows for optionality in the position of light TAPS. While I have discussed the optionality in the case of VP-coordination, I have not yet discussed how this optionality comes about in ordinary clauses; this will be explored more in section 7.6.1, below.

¹⁸One aspect of TAP placement that hasn't been discussed up to this point is the linearization of compound TAP particles such as *go-ro* 'past imperfect'. These particles are transparently composed of a light tense marker (either *go* 'past', *ge* 'remote past', or *ni* 'future') plus the imperfect marker *ra*, sometimes with apparent vowel harmony between the two TAPS. These compound TAPS behave exactly like light TAPS — they appear preverbally and trigger sandhi on the verb. This is expected under the current model if the tense and aspect parts of the compound particles are spelling out different heads: They'll both independently be parsed as light syllables and accordingly displaced into preverbal position; the vowel harmony must then be a post-lexical effect happening in a later cycle (i.e. in Structure-Sensitive Phonology rather than Prosodic Structure Building). The model here also correctly captures the internal order of morphemes within the compound particles: T^0 is commonly assumed to be higher in the structure than Asp^0 , and therefore to asymmetrically c-command it; the order *tense* < *aspect* is thus expected: STRONGEDGE foils HEADFINALITY (which would order aspect before tense), allowing the emergence of the unmarked ANTISYMMETRY-derived order.

- (71) **Desideratum F:** In embedded clauses, light TAP particles appear in second position.

T-to-C raising applies in embedded clauses. This has the dual effect of removing the TAP from the scope of EP-CONTIGUITY (which requires that the verb and TAP be phrased together) and moving it into the same position as clause-type markers. The same process that puts those clause-type markers into second position then applies here: STRONGEDGE forces the clitic out of final position; HEADFINALITY, being a categorical constraint, no longer has any influence on where the marker is positioned; and ANTISYMMETRY requires it to be as close to the left edge as possible without violating STRONGEDGE, i.e. second position.

7.6.1 Variability

As noted in Desideratum E, the position of light TAPs is subject to some variability: While they typically appear in immediately preverbal position, they may optionally appear earlier, with no change in meaning.

- (72) a. Tita ge †khanisa ‖khawa **ra** xoa.
I DECL book again IMP write
- b. Tita ge †khanisa **ra** ‖khawa xoa.
I DECL book IMP again write
- c. Tita ge **ra** †khanisa ‖khawa xoa.
I DECL IMP book again write
“I am writing a book again.”

This optionality was first noted in Hahn (2013). In my own fieldwork, I have found that, while speakers broadly *accept* examples like (72b) and (c) in elicitation contexts — i.e. find them acceptable in both speech and writing — they hardly ever produce them unprompted. My fieldwork so far has relied heavily on elicited (rather than naturalistic) data, and so it is difficult to say to what extent the alternative word orders are used in

day-to-day speech. But it seems desirable that our model permit these alternate orders, even while privileging the default order in (72a). How can this be accomplished?

Recall that the explanation for the immediately-preverbal default (Desideratum E) relies on EP-CONTIGUITY requiring the verb and TAP to be sisters in some φ , and on the idea that clitics do not affect the MATCH constraints. What keeps the TAP close to the verb, then, is the combination of EP-CONTIGUITY with MATCH-PHRASE, which will require that the VP be matched. This is shown in (73): The winning candidate both matches the VP and keeps the light TAP inside the resulting φ , even though this incurs a violation of ANTISYMMETRY: T^0 does asymmetrically c-command the object, and so ANTISYMMETRY prefers that the TAP precede it.

(73)

	EP-CON	M-XP	HF	ANTISYM
a. $\text{☞} (S(O T_\sigma V))$	0	0	2	2
b. $(S T_\sigma(O V))$	1 W	0	2	1 L

In other words, the default position of the light TAP relies on the speaker having a recursive φ matching the VP. But speakers frequently change prosodic phrasing due to various non-syntactic factors; for example, higher speech rate is typically associated with fewer prosodic boundaries (Fougeron & Jun 1998). Imagine, then, that some factor — possibly speech rate — prevented the speaker from matching the VP. The result is as in (74): ANTISYMMETRY will force the light TAP into an earlier position.

(74)

	EP-CON	M-XP	HF	ANTISYM
a. $\text{☞} (S T_\sigma O V)$	0	1	2	1
b. $(S O T_\sigma V)$	0	1	2	2 W

The model developed here thus makes the prediction that the rate at which speakers produce early TAPs should be directly correlated with other factors known generally to induce speakers to use fewer prosodic boundaries. For example, if it is true that Khoekhoe speakers produce fewer prosodic boundaries at higher speech rates, then they should pro-

duce more early TAPs when speaking quickly. Considerable further investigation is necessary in order to test this prediction; however, the model developed here clearly allows for the optionality in light TAP position while still privileging the default, immediately-preverbal position.

CHAPTER 8

PROSODIC DISPLACEMENT WITH OPTIMAL LINEARIZATION: OTHER LANGUAGES

In the previous chapter, I presented an analysis of prosodic displacement in Khoekhoe-gowab in terms of Optimal Linearization, in which prosodic markedness constraints are allowed to interact with linearization constraints to derive the surface word order. In this chapter, I'll briefly sketch similar analyses for the other three cases of prosodic displacement discussed in chapter 3, namely Irish pronoun postposing (Bennett et al. 2016), Bosnian / Croatian / Serbian second-position clitics (e.g. Bošković 2001), and Malagasy clausal extraposition (Edmiston & Potsdam 2017). In all three cases, I'll show that prior analyses of the phenomenon extend easily to an Optimal Linearization system, and that in some cases the OL approach offers better empirical coverage.

8.1 Irish pronoun postposing

Elfner (2012), expanded by Bennett et al. (2016), show that Irish light object pronouns often appear far to the right of where object DPs would generally be expected, with no detectable difference in semantic or pragmatic import. For example, in (1) the expletive subject appears in the middle of the following predicate.

- (1) is cuma ___ 'na shamhradh é nó 'na gheimhreadh
COP.PRES no.matter PRED summer it or PRED winter
“It doesn't matter whether it's summer or winter.” (Bennett et al. 2016, p. 183)

Because postposing only affects light, unaccented pronouns, Elfner (2012) proposes that the postposing is a kind of prosodic repair: A constraint **STRONGSTART** (Selkirk 2011)

militates against phonological phrases which begin with a light (sub-minimal word) element; this constraint outranks some relevant constraint enforcing linearization, and the result is that light pronouns are pronounced later in the sentence in order to achieve a more harmonic prosody. The definition of **STRONGSTART** given by Bennett et al. is in (2); paraphrased, it will assign one violation for each node in the prosodic parse that is at least as big as a word but which begins with something smaller than a word. Stressless pronouns are argued to be clitics rather than prosodic words, and hence are affected by **STRONGSTART**.

- (2) **STRONGSTART**: Prosodic constituents above the level of the word should not have at their left edge an immediate sub-constituent that is prosodically dependent [i.e. smaller than a word]. (Bennett et al. 2016, p. 198).

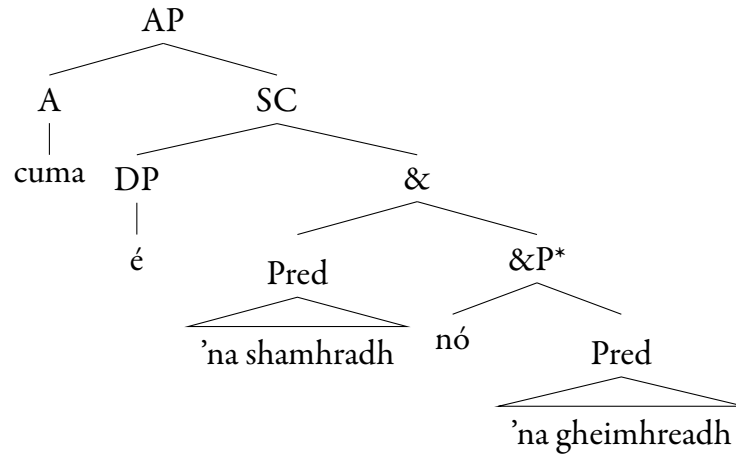
In the analyses offered in both Elfner (2012) and Bennett et al. (2016), linearization is enforced in the prosody by what we might term a “linearization faithfulness” constraint: The input to the prosody is already ordered in some way, and there is a constraint which penalizes deviations from this underlying ordering. In Elfner (2012) this constraint is termed **LINCORR**, which explicitly penalizes deviations from the word order determined by the Linear Correspondence Axiom (Kayne 1994); in Bennett et al. (2016) the precise implementation of linearization is left purposely vague:

- (3) **NOSHIFT**: If a terminal element α is linearly ordered before a terminal element β in the syntactic representation of an expression E , then the phonological exponent of α should precede the phonological exponent of β in the phonological representation of E . (Bennett et al. 2016, p. 202)

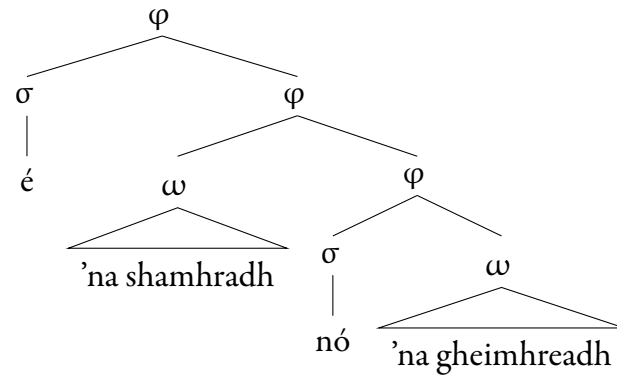
To illustrate how this enables them to account for pronoun shift, let’s consider the schematized syntactic structure of (1) given by Bennett et al. The details of their prosodic analysis are beyond the scope of this chapter, but the “faithful” prosody they predict is given in (5); the weak pronoun *é* winds up at the left edge of the phrase corresponding to the small clause.

(4) Syntactic structure of (1):

(Bennett et al. 2016, p. 184)

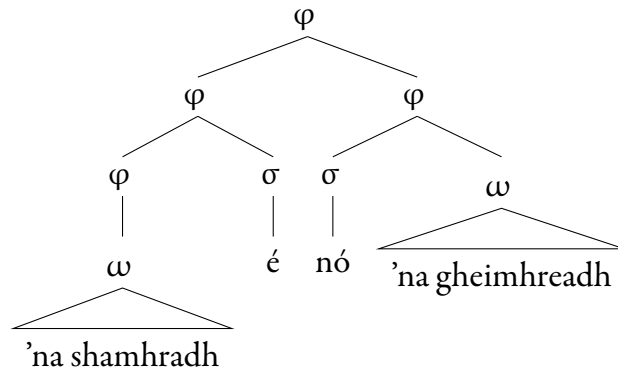


(5) Partial prosodic structure of (1): (Bennett et al. 2016, p. 216)



This structure, preferred by NOSHIFT and the other constraints enforcing prosodic phrasing, fares poorly with STRONGSTART: The highest phonological phrase has a subword element as its leftmost daughter. If STRONGSTART dominates NOSHIFT, a postposing structure like (6), in which no φ begins with a σ , is preferred:

(6) STRONGSTART-respecting word order:

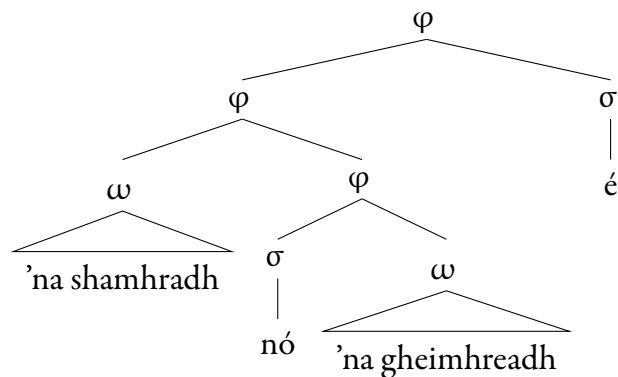


(7)

(4)	STRST	NO SHIFT
a. (é ('na shamhradh (nó 'na gheimhreadh))) = (5)	1	0
b. ☞ ((('na shamhradh) é) (nó 'na gheimhreadh)) = (6)	0	1

This is the desired result — the pronoun has been postposed from its base position. However, note that the postposing is only partial, whereas in (1) the pronoun is postposed all the way to the right edge of the clause. Empirically, these two word orders are in free alternation; in general, the landing site of pronoun postposing can be arbitrarily far to the right, with a possible landing site after each XP. Bennett et al. state that their proposed analysis correctly predicts the alternative structure in (8), which corresponds to the word order in (1):

(8) Alternative ordering of (1) (Bennett et al. 2016, 218):



However, it is not clear from their proposal that this result is, in fact, predicted. The `NOSHIFT` constraint, as written, assigns additional violations for each pair of syntactic elements which get reordered. But what counts as a syntactic element? If the answer is “all syntactic terminals” or even “all XPs”, the result should be that additional violations will be assigned the further right the pronoun is displaced. Put another way, in the winning order of (7), the pronoun has only changed orders with the first predicate; in the order in (8) it has changed orders with the disjunction and the second predicate as well, and so `NOSHIFT` should assign additional violations. The result is that the candidate with minimal linear displacement should always win (modulo other prosodic factors). This is illustrated below: Candidate (b) will always win with these constraints, but in reality candidate (c) is also a possibility.

(9)

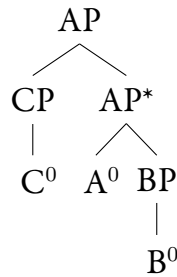
(4)	<code>STRST</code>	<code>NOSHIFT</code>
a. (é ('na shamhradh (nó 'na gheimhreadh))) = (5)	1	0
b. ☞ ((('na shamhradh) é) (nó 'na gheimhreadh)) = (6)	0	1
c. ☺ (('na shamhradh) (nó 'na gheimhreadh) é)) = (8)	0	3

Empirically, this seems to be the wrong prediction in the Irish case, and in fact Bennett et al. never show more than one violation of `NOSHIFT` being assigned to any given candidate. The definition of `NOSHIFT` given is deliberately intended to cover a number of possible ways of arriving at the desired linearization; given this, we might understand Bennett et al. to be assuming some linearization scheme which assigns at most one violation for postposing this pronoun.¹

¹This is somewhat difficult to accomplish with a single constraint. The violable linearization scheme given in Bennett et al. 2016 is essentially a “string edit distance” function, i.e. a function that calculates how many changes would need to be made to one string of characters in order to produce another. In this system, some linearization (i.e. a string) is given by the syntax, and `NOSHIFT` scores each candidate on how “distant” it is from the target linearization. A distance function based on swapping characters in the string will always run into the problem described above: Every swap incurs additional penalties, and so there will always be pressure for extremely local displacement.

Optimal Linearization is such a scheme. While Irish is generally head-initial and so should have *ANTISYMMETRY* \gg *HEADFINALITY*, I've shown that the ordering of specifiers is controlled by *HEADFINALITY*. That constraint crucially assigns violations by counting branching nodes in the syntax which are not linearized head-finally, rather than by counting pairs of words. Take the simplified example in (10). *HEADFINALITY* will assign a single violation whenever AP is not linearized head-finally, i.e whenever either *a* or *b* precedes *c*. No further violations are assigned as *c* is displaced rightward — the first two candidates each receive only one violation.

(10) a.



b.

	(a)	HEADFINALITY
a.	bac	1
b.	bca	1
c. ☞	cba	0

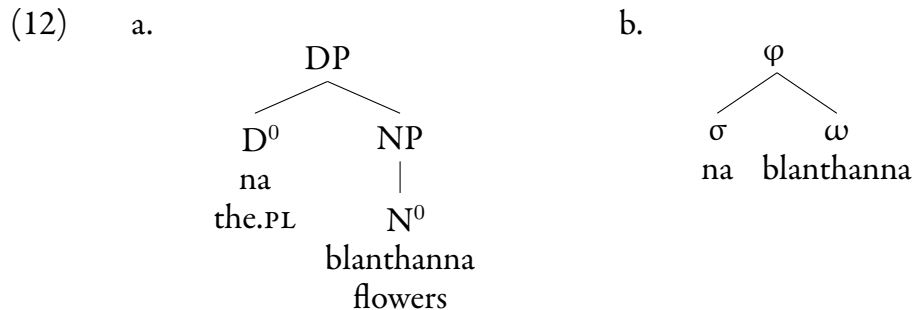
HEADFINALITY, then, is the tool with which to analyze the Irish postposing case: No additional violations are assigned as the pronoun is displaced further rightward. If both *STRONGSTART* and *ANTISYMMETRY* dominate *HEADFINALITY*, we achieve the correct result.

(11)

(1)	ANTISYM	STRST	HF
a. (é ('na shamhradh (nó 'na gheimhreadh))) = (5)	0	1	0
b. ☞ ((('na shamhradh) é) (nó 'na gheimhreadh)) = (6)	0	0	1
c. ☞ (('na shamhradh) ((nó 'na gheimhreadh) é)) = (8)	0	0	1

Both of the winning candidates in (11) respect both *STRONGSTART* and *ANTISYMMETRY*. Both violate *HEADFINALITY* in that some element of the conjunction precedes the pronoun, but crucially they both violate this equally and so both emerge as winners. Thus, the Optimal Linearization constraints fare better than the plain *NOSHIFT*.

There's one more way that the Optimal Linearization constraints can help with Irish pronoun postposing, concerning a puzzle noted in Elfner (2012) but not Bennett et al. (2016): Why don't all light functional heads postpose? Elfner shows that function words in Irish are not prosodic words; for example, the plural definite article *na* as in (12) cannot receive accent and otherwise behaves like a proclitic rather than a prosodic word. As such, the prosodic structure assigned to this DP will be as in (12b).² But this violates STRONG-START: The phonological phrase has the prosodically-dependent σ *na* at its left edge. The analysis Bennett et al. proposed for pronoun postposing thus incorrectly predicts that determiners should always follow the noun, as shown in the tableau in (13).



(13)

[na [blanthanna]]	STRONGSTART	NO SHIFT
a. ☹ (na _σ blanthanna)	1	0
b. ☺ (blanthanna na _σ)	0	1

Elfner proposes to account for this distribution by splitting the constraint LINCORR in two: One constraint, LINCORR(WORD) only considers syntactic heads as c-commanders, while LINCORR(PHRASE) only considers syntactic phrases. STRONGSTART is then allowed to dominate LINCORR(PHRASE) (forcing postposing of pronouns, which are assumed to be phrasal) but not LINCORR(WORD) (preventing postposing of heads). This split correctly captures the generalization, but nothing else — there is no independent motivation for having linearization treat these categories differently.

²The lack of a φ matching NP is due to BINMIN.

But this same insight is already included in Optimal Linearization, where it plays a crucial and independently-motivated role: *ANTISYMMETRY* only considers c-command relationships between heads, which allows the underlying preference for *HEADFINALITY* to emerge. As shown above, the relevant ranking for allowing pronoun postposing is *STRONGSTART* \gg *HEADFINALITY*. However, the constraint responsible for ordering functional heads like the determiner in (13) is *ANTISYMMETRY*, which roughly corresponds to Elfner’s *LINCORR(WORD)*. As such, we can prevent determiners from postposing by ranking *ANTISYMMETRY* \gg *STRONGSTART*:

(14)

[na [blanthanna]]	<i>ANTISYMMETRY</i>	<i>STRONGSTART</i>
a. na_σ blanthanna)	0	1
b. (blanthanna na_σ)	1 W	0 L

The ranking *ANTISYMMETRY* \gg *STRONGSTART* \gg *HEADFINALITY* thus correctly allows Irish pronouns to postpose an arbitrary distance while disallowing postposing of other phrase-initial function words, and does so without stipulating any additional linearization constraints beyond those needed to model word-order typology.

8.2 Second-position clitics

Second-position clitics, particularly those found in Bosnian / Croatian / Serbian (hereafter BCS), have been subject to considerable analytic scrutiny. Werle (2009, chp. 5) gives a detailed overview of prior approaches to BCS clitics, discussing eight different approaches ranging from the purely-syntactic to the purely-phonological. Most contemporary analyses fall somewhere in the middle, and indeed Werle presents compelling evidence that a mixed syntactic and phonological approach is necessary. My goal in this section is to outline how an Optimal Linearization approach might work to develop such a mixed analysis; for a much more thorough discussion of the facts such an analysis would need to account for, I direct readers to Werle (2009) & Bošković (2000).

The crucial fact motivating a prosodic-displacement analysis of BCS second-position clitics is the alternation between the so-called ‘second word’ (2W) and ‘second daughter’ (2D) positions.³ That is, sometimes the clitics are in second-position with respect to the first XP (15a); other times, they apparently interrupt that XP in order to be second with respect to the first word (15b).

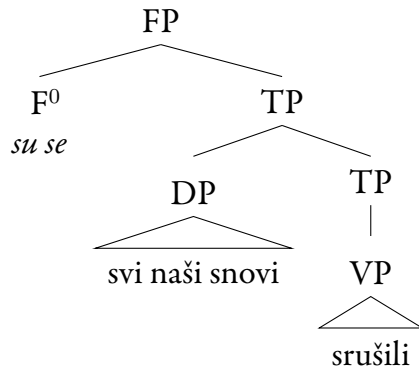
- (15) a. [Svi naši snovi] **su se** srušili
 [all our dreams] **AUX REFL** fell
- b. [Svi **su se** naši snovi] srušili
 [all **AUX REFL** our dreams] fell
 “All our dreams were dashed.” (Werle 2009, p. 273)

Most contemporary analyses agree that the 2D position is syntactically derived, while the 2W position is phonologically derived. I’ll sketch an analysis here based on Schütze (1994); Werle’s analysis follows similar lines.

Say that the relevant clitics — for example, the **AUX** and **REFL** clitics in (15) — are exponents of some relatively-high heads in the clausal structure. For our purposes presently the precise position doesn’t matter, so I will simply say that clitics expone some functional head F^0 high in the clause (though see Bošković (2000) and Werle (2009) for arguments that clitics do not all originate in the same location); we might alternatively imagine that the clitics arrive there by head-movement. Regardless, the result is a syntactic structure of the form in (16):

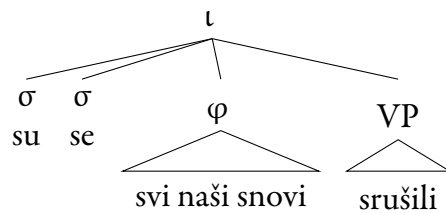
³These terms are taken from Halpern (1992) by way of Werle (2009). Schütze (1994) refers to these positions as ‘first word’ (1W) and ‘first constituent’ (1C), respectively, while Bošković (2001) calls the latter ‘first phrase’ (1P).

(16)



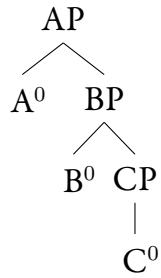
Given this syntactic structure, the constraint ANTISYMMETRY will prefer the linearization in (17), where the clitics (which asymmetrically c-command everything else in the clause) are clause-initial. However, it will inevitably violate the constraint STRONG-START: The clitics, which are not full prosodic words, will be at the left edge of some prosodic constituent, probably an intonational phrase.

(17)



Recall that ANTISYMMETRY is ‘gradient’ in the sense that it scores a violation for each pair of heads that are not ordered by asymmetric c-command. That is, unlike HEADFINALITY, ANTISYMMETRY scores additional violations the further some item is displaced. For example, in (18), ANTISYMMETRY prefers the order *abc*; placing *a* after *b* will score one violation, while placing it after both *b* and *c* will score 2. If some higher-ranked constraint were to eliminate the winning candidate *abc*, ANTISYMMETRY would still provide pressure to keep *a* close to the left edge.

(18) a.



b.

(a)	ANTISYMMETRY
a. abc	0
b. bac	1
c. cba	2

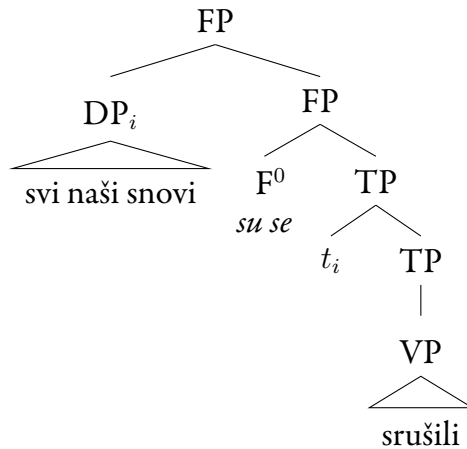
Given this, it is easy to derive the 2W pattern in BCS. If STRONGSTART dominates ANTISYMMETRY, then the candidate which places the clitics clause-initially will be eliminated; however, placing the clitics any further to the right than necessary incurs additional violations of ANTISYMMETRY. The result is that the clitics follow the first word of the clause:

(19)

[su se [[svi naši snovi] [srušili]]]	STRONGSTART	ANTISYMM
a. (su_σ se_σ (svi naši snovi) (srušili))	1 W	0 L
b. $\text{((svi su}_{\sigma} \text{ se}_{\sigma} \text{ naši snovi) (srušili))}$	0	1
c. $\text{((svi naši su}_{\sigma} \text{ se}_{\sigma} \text{ snovi) (srušili))}$	0	2 W

The 2D position, by contrast, can be generated by additional syntactic movement applies: Some XP (in this case the subject DP) is raised into the left periphery, as shown in (20); the constraint HEADFINALITY will then prefer an order in which the raised XP precedes the clitics. In this configuration, there is no violation of STRONGSTART, and no prosodic displacement occurs:

(20)



This achieves the desired result: Both 2D and 2W orders are possible, but clitics will never be clause-initial.

8.3 Malagasy clausal extraposition

The final case of prosodic displacement discussed in Chapter 3 is the right-extraposition of clauses in Malagasy. Edmiston & Potsdam (2017) present a compelling case that clauses extrapose from object position post-syntactically. In particular, they note that only “degenerate” clauses lacking a subject may (optionally) remain in situ. In (21), an embedded clause with an overt subject must extrapose; in (21), a clause with a null subject due to topic drop can optionally remain in its base position after the verb.

(21) Manantena (***fa hivity fiara aho**) Rabe (**fa hivity fiara aho**)
hope **that FUT.buy car I** Rabe **that FUT.buy car I**
“Rabe hopes that I will buy a car.”

(22) Milaza [**fa nahita gidro tany an-tsena** \emptyset] Rabe
say **that PST.saw lemur LOC PREP-market (he)** Rabe
“Rabe says that he (Rabe) saw a lemur at the market.”

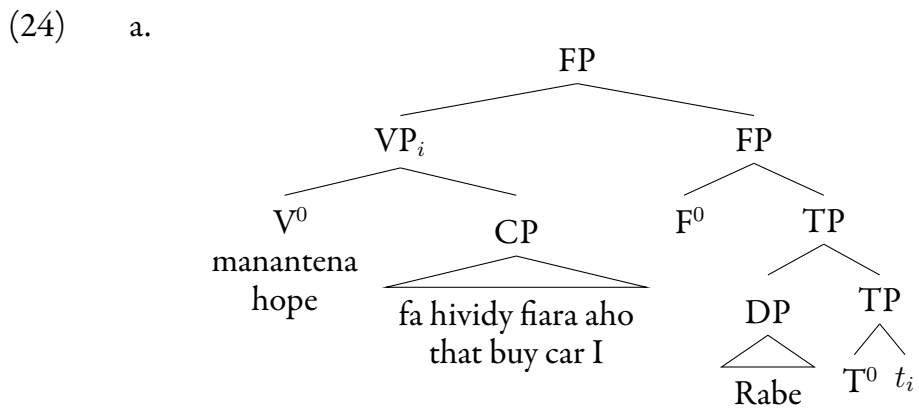
Edmiston & Potsdam (2017) argue that the relevant difference between degenerate and non-degenerate clauses is a prosodic one. Malagasy phonological phrases robustly show a distinctive final intonational rise, and most clauses have two phonological phrases —

one for the VP and one for the subject. They argue that intonational phrases in Malagasy are minimally binary; that is, there is a constraint $\text{BINMIN-}\iota$ that disallows unary intonational phrases. This means that without a subject in the embedded clause, if $\text{BINMIN-}\iota$ outranks MATCH-CLAUSE , the winning prosodification will ‘demote’ a clause from an intonational phrase to a phonological phrase, as shown in (23).

(23)

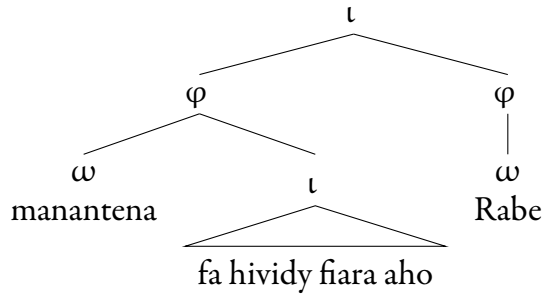
...[[V O] \emptyset]	$\text{BINMIN-}\iota$	MATCH-CLAUSE
a. $((V O)_\varphi)_\iota$	1 W	0 L
b. $\text{☞} (V O)_\varphi$	0	1

With this in mind, let’s consider what happens when this demotion fails to apply, i.e. when the embedded clause does have a subject and so does form an intonational phrase. If the syntactic structure is as in (24a),⁴ then the fully-matched prosodification (i.e. the one that fully obeys all of the MATCH constraints) will be as in (24b): both the matrix CP and the embedded CP are matched by intonational phrases, while the VP is matched by a φ .



⁴I’m following Edmiston & Potsdam (2017) in assuming that VOS order is derived by fronting of VP (or rather PredP, for reasons not germane to the present discussion) to some functional projection FP. See below for further discussion.

b.

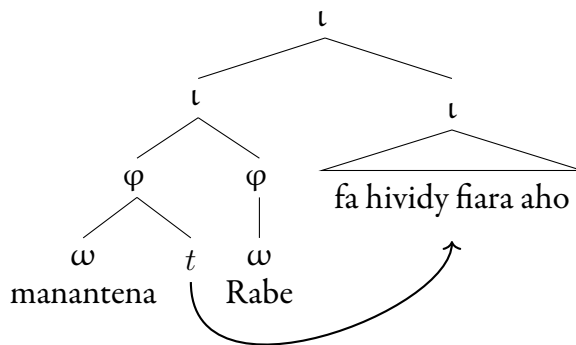


Edmiston & Potsdam (2017) argue that the structure in (24b) violates LAYEREDNESS (Selkirk 1996; Féry 2015), which penalizes prosodic constituents which dominate a constituent higher on the prosodic hierarchy. Intonational phrases are higher on the hierarchy than phonological phrases, so the VP-matching φ in (24) will score a violation for dominating a ʌ.

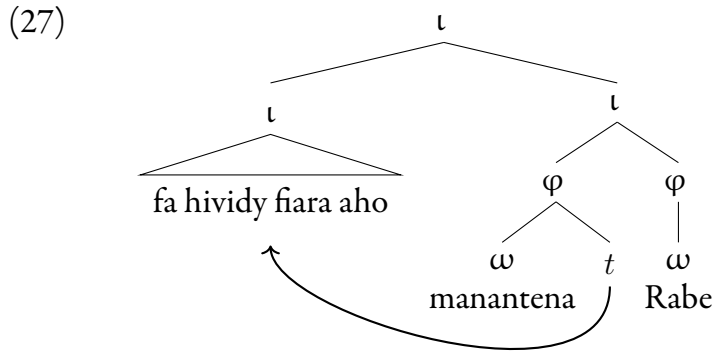
- (25) LAYEREDNESS: Assign one violation for each prosodic constituent of level i on the prosodic hierarchy which immediately dominates a prosodic constituent of level j , where $j > i$.

The authors propose an operation of PF EXTRAPOSITION, which removes a prosodic constituent from its base-position and right-adjoins it to the root node. This takes the structure in (24b) and transforms it into the structure in (26):

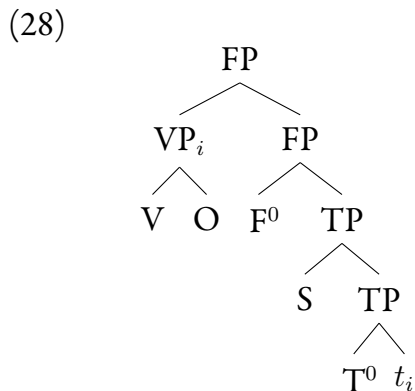
(26)



But why is this extraposition to the right? We could just as easily imagine an operation PF FRONTING that adjoins the moved constituent on the left; this equally satisfies LAYEREDNESS:



If we recast this analysis in Optimal Linearization, the answer becomes clear. Malagasy is a broadly head-initial language; this implies the ranking ANTISYMMETRY \gg HEADFINALITY. However, the language also has VOS word order; Edmiston & Potsdam (2017) follow Rackowski & Travis (2000) and others in adopting a predicate-fronting analysis of this word order: The entire VP moves to the specifier of some high functional projection, FP. This results in a structure as in (28). The crucial point for our discussion here is that the complement of the verb is embedded inside a specifier position. This means that the order of object and subject is determined not by ANTISYMMETRY, but rather by HEADFINALITY. This is illustrated in (29).



(29)

	[[V O][[S]]]	ANTISYMMETRY	HEADFINALITY
a. \Rightarrow V O S		0	0
b. V S O		0	1

Returning to extraposition, once we place LAYEREDNESS into the same ranking as the Optimal Linearization constraints the answer to why extraposition is rightward becomes clear. Compare the three candidates in (30). Candidate (30a) faithfully linearizes the output, but violates LAYEREDNESS. Candidate (30b) right-extrapolates the embedded clause, satisfying LAYEREDNESS at the expense of HEADFINALITY. Finally, candidate (30c) fronts the embedded clause. This satisfies LAYEREDNESS, but incurs (many) additional violations of ANTISYMMETRY⁵: The verb does asymmetrically c-command everything inside the embedded clause, so fronting fares much worse. Since ANTISYMMETRY \gg HEADFINALITY (as must be the case to achieve head-initial order), the right-extraposition candidate wins over the fronting candidate. Thus, Optimal Linearization correctly predicts the direction of extraposition.

(30)

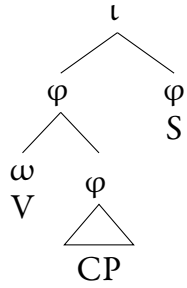
	[[V CP][[S]]]	LAYER	ANTISYM	HF
a. (V CP _t S) _t		1 W	0	1 L
b. \Rightarrow ((V S) _t CP _t) _t		0	0	2
c. (CP _t (V S) _t) _t		0	>1 W	0 L

What about degenerate clauses? Recall from above that intonational phrases are minimally binary. If demotion occurs, the embedded clause is mapped to a ϕ instead of a ι , as in (31); here, there is no violation of LAYEREDNESS. The fact that degenerate clauses do sometimes extrapose implies that this demotion is optional: Sometimes non-binary ι s are tolerated, resulting in extraposition. A full discussion of how variability can be ac-

⁵In the table in (i), I'm using the notation '>1' to mean 'at least one violation'; in reality, this candidate will score one violation for each head inside CP.

counted for in a constraint-based framework is outside the scope of this dissertation; see Coetzee & Pater (2011) for an overview of the topic.

(31)



CHAPTER 9

CONCLUSION

9.1 Overview of contributions

This dissertation has offered both theoretical and empirical contributions to the study of linearization and prosody. The first contribution was to develop the notion of ‘prosodic displacement’: variation in word order attributable to prosody but not to syntax. This is a descriptive term for phenomena with a particular empirical signature, but it also implies a certain style of analysis, one which relies on phonological and prosodic theory rather than (or at least in addition to) syntactic theory. I developed four criteria for identifying phenomena for which prosodic displacement seems to be the only available analysis: When some particular word order alternation is implausible in existing syntactic theories, has no effect on compositional semantics, and involves heterogeneous morphosyntactic objects but homogeneous prosodic ones, I argue that we should label that alternation prosodic displacement and avoid trying to use syntactic movement as an analytical tool as far as possible.

Armed with those criteria, I presented evidence for prosodic displacement in four languages. Three of those examples have existing analyses in the generative literature: Bosnian / Croatian / Serbian second position clitics have a long history of generative analysis in both syntactic and prosodic frameworks, while Irish pronoun postposing and Malagasy clausal extraposition have relatively new analyses in terms of syntax-phonology interactions. To the best of my knowledge, this is the first time these three examples have been discussed together and given analyses in the same framework.

Beyond those three examples, I also contributed a new empirical description of prosodic displacement, and prosody generally, in Khoekhoegowab. Khoekhoegowab is an understudied language, especially in the generative literature, and this dissertation is one of the first in-depth Minimalist analyses of the language. Additionally, the description of verbal sandhi given here builds on and extends the earlier descriptive work on Khoekhoegowab tone, offering a new empirical generalization about its distribution.

The core theoretical contribution of this dissertation is a new model of the linearization function mapping syntactic structures to strings. Optimal Linearization takes seriously the notion that linearization happens post-syntactically at PF and accordingly uses the theoretical framework most commonly used to model other phonological phenomena, namely Optimality Theory. Understanding linearization as being mediated by competition amongst violable constraints gives us new insight into why the linearization function has certain properties; for example, I show that the leftward position of specifiers can be seen as an underlying preference for head-finality emerging even in otherwise head-initial languages. Modelling linearization in Optimality Theory comes with another benefit as well: Optimality Theory is an inherently typological theory, so any formalization of a constraint set automatically makes typological predictions. Optimal Linearization allows us to make clear predictions about what word orders should be possible or impossible cross-linguistically.

Finally, this dissertation uses Optimal Linearization to develop a unified model for prosodic displacement. Prosodic displacement is modelled as an interaction between the linearization constraints and prosodic markedness constraints. I show that this model can account for all four cases of prosodic displacement discussed here, bringing together disparate phenomena in four languages using the same constraint set. As with all violable-constraint frameworks, modelling prosodic linearization in this way has the benefit of making typological predictions about what prosodic displacement alternations should be possible; see section 9.2 for further discussion of this point.

9.2 Typological implications

As noted above, a significant benefit of modelling prosodic displacement using viable constraints is that such a model comes along with typological predictions: Any reranking of constraints should correspond to a real language. I've already discussed the typological predictions of Optimal Linearization on its own, but when the linearization constraints interact with prosodic markedness constraints, we get a new, more complex set of predictions. What kind of prosody-induced word order alternations can we expect? A full discussion of this typology deserves more space than I can give it here, but I will survey some of the parameters to consider.

9.2.1 Heads and phrases

I showed in Chapter 6 that the ranking of **ANTISYMMETRY** and **HEADFINALITY** determines whether head-initial or head-final linearizations are selected. There's a crucial asymmetry between these constraints, however: **HEADFINALITY** fully determines the order (i.e. it alone selects a unique winner) while **ANTISYMMETRY** interacts with **HEADFINALITY** to select the winning order. If we consider how these two constraints interact with one prosodic markedness constraint (e.g. **STRONGEDGE**), this means that in head-initial languages there are two rankings that will give rise to prosodic markedness, while in head-final languages there is only one. In head-initial languages (i.e. ones where **ANTISYMMETRY** \gg **HEADFINALITY**), the markedness constraint can either dominate both linearization constraints or intervene between them. The former case is the Bosnian / Croatian / Serbian case, in which heads displace; that is, this is the ranking that gives rise to second-position clitics. The latter, where the markedness constraint intervenes between the two linearization constraints, is the Irish case: phrases may displace (in Irish, light pronouns), but heads do not (in Irish, determiners and prepositions). In head-final languages, there is no such contrast: Either the markedness constraint dominates **HEAD-**

FINALITY, in which case both heads & phrases displace, or not. These rankings are summarized in (1).

(1)	Ranking	Description	Example
	Markedness \gg ANTISYM \gg HF	Head-initial, heads & phrases displace	BCS
	ANTISYM \gg Markedness \gg HF	Head-initial, only phrases displace	Irish
	Markedness \gg HF \gg ANTISYM	Head-final, heads & phrases displace	Khoekhoe
	(all other rankings)	No prosodic displacement	English

All of the languages in this typology are attested, though in BCS and Khoekhoegowab it is not immediately clear that phrases do displace — in both cases there is direct evidence for heads displacing, and at least in BCS it is plausible that some of the second-position clitics are in fact light pronouns. But a sample of four languages hardly inspires confidence; until more cases of prosodic displacement are identified and analyzed, the empirical typology reported here remains provisional.

9.2.2 Kinds of markedness

The rankings above leave the specific markedness constraint unspecified. In this dissertation, markedness constraints which I've proposed can motivate prosodic displacement include STRONGSTART, STRONGEDGE, & LAYEREDNESS. These constraints fall into two broad categories: STRONGEDGE and STRONGSTART are *order-sensitive* in the sense that violations can be ameliorated purely by reordering; by contrast, LAYEREDNESS is *order-insensitive* in the sense that reordering alone will not ameliorate violations — something about the hierarchical structure must change. For example, in (2) there is a φ containing two prosodic words and a clitic; simply by reordering its daughters we can change which constraints it violates. By contrast, in (2) there is a φ containing a ι and two ω s; every possible ordering of its daughters violates LAYEREDNESS, because violations of LAYEREDNESS depend purely on hierarchy, not on linear order.

- (2) a. $(\sigma \omega \omega)_\varphi$ *STRONGSTART, *STRONGEDGE
 b. $(\omega \sigma \omega)_\varphi$
 c. $(\omega \omega \sigma)_\varphi$ *STRONGEDGE

- (3) a. $(\iota \varphi \varphi)_\varphi$ *LAYEREDNESS
 b. $(\varphi \iota \varphi)_\varphi$ *LAYEREDNESS
 c. $(\varphi \varphi \iota)_\varphi$ *LAYEREDNESS

Both of the order-sensitive markedness constraints discussed in this dissertation, namely STRONGSTART and STRONGEDGE, are specifically sensitive to the position of *prosodically-dependent* items, i.e. clitics. This is not a coincidence. I am not currently aware of any cases of order-sensitive prosodic displacement that specifically target anything larger than a prosodic clitic; and introducing order-sensitive markedness constraints able to target higher options will inevitably allow such languages into our typology. For example, let's consider what would happen if we had a STRONGSTART- φ , as defined in (4):

- (4) STRONGSTART- φ : Assign one violation to each phonological phrase φ whose leftmost daughter is lower on the prosodic hierarchy than its sister immediately to the right. (c.f. Kalivoda 2018)

This constraint, when combined with Optimal Linearization and other commonly-assumed prosodic constraints, will inevitably produce a pathology. I'll illustrate this with the simple Verb-Object phrases in (5), in which the object DP consists either of just a single word (say, a pronoun) or of two words (say, determiner and noun). To see the pathological case, we need one more markedness constraint, namely BINMIN- φ ; this is a well-supported markedness constraint that has been argued for extensively in the literature (e.g. Mester 1994; Selkirk 2000; Elfner 2012), and can be defined as follows:

- (5) BINMIN- φ : Assign one violation to each φ with fewer than two daughters.

If BINMIN- φ dominates MATCH-PHRASE, then the single-word object will not be matched by its own φ , while the two-word object will be; this is shown in the prosodic structures in (6).

- (6) a. $[_{VP} V [_{DP} D]_{DP}]_{VP} \rightarrow (v d)_\varphi$
 b. $[_{VP} V [_{DP} D N]_{DP}]_{VP} \rightarrow (v (d n)_\varphi)_\varphi$

With this in mind, consider what happens if STRONGSTART- φ dominates ANTISYMMETRY (which in turn dominates HEADFINALITY — i.e. this is a head-initial language). In the single-word object case, illustrated in (7), we get the expected head-initial outcome: the markedness constraint is satisfied, so no displacement occurs. In the two-word object case, illustrated in (8), the markedness constraint penalizes the head-initial structure because the verb, which is matched only by a prosodic word, is lower on the prosodic hierarchy than the object, a phonological phrase. This conditions displacement of the verb past the object.

(7)

$[_{VP} V [_{DP} D]_{DP}]_{VP}$	STRONGSTART- φ	ANTISYMMETRY
a. $\curvearrowright (v d)$	0	0
b. $(d v)$	0	1 W

(8)

$[_{VP} V [_{DP} D N]_{DP}]_{VP}$	STRONGSTART- φ	ANTISYMMETRY
a. $(v (d n))$	1 W	0 L
b. $\curvearrowright ((d n) v)$	0	2

In short, if we include STRONGSTART- φ in the same constraint-set as Optimal Linearization and BINMIN, we predict the existence of a language in which verb phrases are head-initial whenever the object consists of a single word, but head-final otherwise. This kind of weight-dependency in linearization is, to my knowledge, unattested. If we exclude STRONGSTART- φ , and in fact all order-sensitive markedness constraints which penalize prosodic constituents larger than a clitic, our constraint set will not include such patholo-

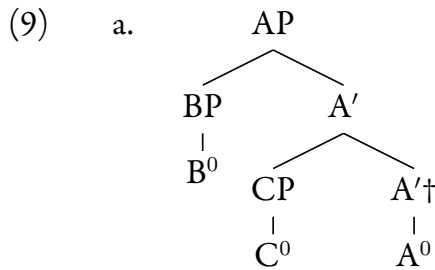
gies. Put another way: All order-sensitive markedness constraints must only consider sub-minimal words.¹

9.3 Future directions

This dissertation is, in many ways, only the beginning of the development of Optimal Linearization. There are a number of problems left for future investigation, both in the linearization scheme itself and its interaction with prosody.

9.3.1 Linearization of adjuncts

There is one notable aspect of linearization which has not been taken up at all in this dissertation, namely the ordering of adjuncts. The Optimal Linearization constraints as presently defined will treat adjuncts identically to specifiers. For example, in (9), take CP to be some modifier phrase adjoined to AP. Similar to the specifier case, C^0 neither c-commands nor is c-commanded by any other head in this structure, and so **ANTISYMMETRY** is silent on its ordering; **HEADFINALITY** will prefer to order A' head-finally, i.e. with $c < a$. Similar logic results in $b < c$. From this we can generalize that adjuncts will universally be linearized before their head but after the specifier, regardless of constraint ranking.



b.

	(a)	ANTISYM	HEADFINALITY
a.	abc	0	2
b.	bac	0	1
c.	bc a	0	0
d.	cba	0	1
e.	cab	0	1
f.	acb	0	2

¹Constraints like **STRONGSTART- ϕ** have been used extensively in the literature — see, for example, Elfner (2012); Selkirk (2011); Kalivoda (2018). However, there is an independently-argued-for alternative: The constraint **EQUALSISTERS** (Myrberg 2013) is order-insensitive, but will still correctly penalize all of the cases that I am aware of where **STRONGSTART- ϕ** has been used.

This is not a desirable result, insofar as right-adjunction is quite common. Perhaps more interestingly, adjuncts are known to be extremely variable in their distribution (Ernst 2001), both across and within specific kinds of adjuncts. Untangling this complex distribution will require other factors beyond the three constraints presented here. In some cases, the complex distribution of adjuncts has been taken to reflect more complex syntactic structure (as in e.g. Cinque 1999). In other cases, it seems that the syntactic (or possibly prosodic) weight controls whether adjuncts are on the left or the right of their head, as in English examples like *a big dog* vs. *a dog bigger than me*. Roberts (2017) presents evidence that the positioning of adjuncts is, in fact, subject to the FOFC, so the constraints presented here still have a role to play in any analysis of their distribution, but considerably more refined tools will be needed.

9.3.2 Prosodic displacement

In this dissertation, I have been deliberately conservative about what phenomena should be treated as prosodic displacement. The criteria laid out in Chapter 3 are intended to pick out only word-order alternations for which there is likely no viable syntactic analysis. But once linearization is allowed to interact with prosodic structure building, it becomes natural to wonder what phenomena which have previously received a syntactic analysis might be better understood as prosodic displacement. Richards (2016) argues that certain prosodic constraints are responsible for controlling certain phenomena which might otherwise have been understood as being conditioned by a syntactic parameter. For example, he presents evidence that *wh* in situ and V-to-T raising each have cross-linguistically consistent prosodic signatures. In order to capture this, Richards develops a model in which prosody and syntax are mutually-influencing; but one can imagine that a model in which prosodic markedness interacts with linearization could also account for this without potentially allowing prosody to trigger syntactic movement.

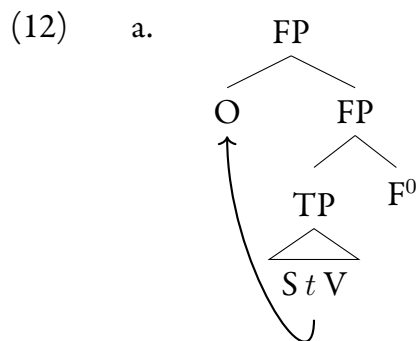
Such an account would likely rely on prosodically-conditioned copy spell-out. For example, in the case of *wh* movement, we could imagine that the prosodic homogeneity of moved vs. in situ *wh* items might be captured by always moving the *wh* word in the syntax, but then allowing prosodic constraints to decide whether the high or low copy is spelled out. This is not a new idea: Hsu (2016) argues that the position of a certain embedding complementizer in Bangla is determined by the prosody, which spells out the highest copy or an intermediate copy in order to satisfy STRONGSTART.

The Optimal Linearization constraints as currently defined only see the highest copy of any moved item. That is, for these constraints, spelling out a lower copy would be equivalent to displacing the highest copy — it would violate the constraint to whatever extent the position of the moved item differs from the preferred position of its highest copy. There are several possible ways the system could be extended to support lower-copy spell-out. Possibly the most straightforward is to allow different versions of the constraints to compete. For example, (10) defines two versions of the constraint HEADFINALITY — one that sees only the highest copy, and one that sees only the lowest copy.

- (10) HEADFINALITY-HIGH : Assign one violation for each branching node XP **totally dominating** (i.e. dominating all copies) a pair of terminal nodes X^0 & Y^0 such that:
- a. Y^0 is dominated by the in-law of XP;
 - b. X^0 is not dominated by the in-law of XP; and
 - c. $x < y$.
- (11) HEADFINALITY-LOW : Assign one violation for each branching node XP **dominating** (i.e. dominating any copy) a pair of terminal nodes X^0 & Y^0 such that:
- a. Y^0 is dominated by the in-law of XP;
 - b. X^0 is not dominated by the in-law of XP; and
 - c. $x < y$.

If HEADFINALITY-LOW dominates HEADFINALITY-HIGH, syntactic movement will be ‘undone’ at PF in the sense that linearization will ignore it. If the constraints are ranked in the opposite order, more interesting effects can be derived. For example, consider the

contrived example in (12), where the object has raised into the specifier of some functional head in the left periphery (for example, due to topic fronting). Imagine that there is some markedness constraint, here called generically *OBJECTLEFT, that opposes having the moved object at the left edge of the clause; this could be something like STRONG-START if the object is a clitic, or perhaps a constraint like ARG- φ (Clemens 2016) that requires that the verb and object be phrased together. In this case, HEADFINALITY-HIGH is stymied — it can't put the object in the location it wants, and therefore allows it to appear anywhere. But HEADFINALITY-LOW is not stymied — it wants to keep the object in its lower position, which doesn't violate *OBJECTLEFT. The result is an emergence of the unmarked: The object is linearized in its low position due to prosodic markedness, rather than simply being prosodically displaced to an arbitrary position.



b.

(a)	*OBJLEFT	HF-HIGH	HF-LOW
a. o s v	1 W	0 L	1 W
b. o s o v	0	1	0
c. s v o	0	1	1 W

This strategy is a blunt instrument: having two versions of HEADFINALITY would mean that either all movement was linearized high or all movement was linearized low. This is clearly not descriptively sufficient — for example, Khoekhoegowab is a *wh* in situ language that nonetheless has topic fronting. The constraints defined above also never see intermediate positions, only the highest or lowest ones. But perhaps these constraints

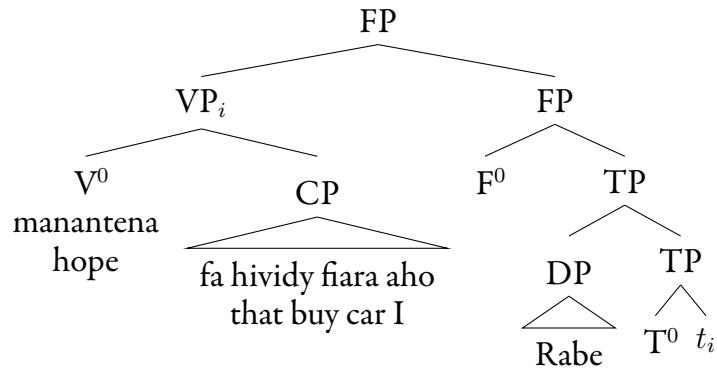
can point the way to a more flexible solution to prosodically-conditioned copy spell-out, which in turn might open the door to better understanding a variety of phenomena like the ones discussed in Richards (2016), where syntax and prosody apparently interact.

9.3.3 Prosody

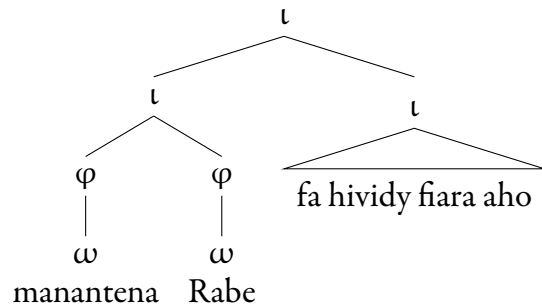
Finally, there remain some technical challenges to understanding prosodic structure in the face of prosodic displacement. Prosodic displacement in general creates structures in which it is possible that the terminals contained in some syntactic constituent will be non-contiguous in the prosodic structure. Insofar as prosodic constituents are contiguous by definition, it becomes impossible to match syntactic constituents that are discontinuous. In chapter 7, I argued that the constraints *MATCH-PHRASE* and *MATCH-CLAUSE* ignore clitics when deciding whether a given syntactic phrase matches some prosodic constituent. In Khoekhoe, this allows the VP to be matched even when disrupted by a displaced *TAP* particle. But this is only a partial solution: What about cases of prosodic displacement that don't involve clitics?

Malagasy is such a case, and in fact the analysis presented here leaves unresolved the issue of how to match VPs that have had (something contained in) their complement displaced. For example, consider the example in (13a), repeated from Chapter 8. After prosodic displacement applies, there will be no contiguous substring containing all and only the words in VP. And yet from Edmiston & Potsdam (2017) we know that the VP (now containing only the verb) still has the final rising boundary tone associated with the right edges of phonological phrases. That is, the surface prosodic structure is as in (13b). But, as shown in (14), the *MATCH* constraints as currently defined will oppose this: *MATCH-PHRASE* cannot be satisfied, and *MATCH- φ* prevents a non-matched φ from being constructed.

(13) a.



b.



(14)

(14a)	MATCH-PHRASE	MATCH-φ
a. $\ominus ((l (l V S_\phi) (l CP)))$	1	0
b. $\boxtimes ((l (l V_\phi S_\phi) (l CP)))$	1	1

The solution presented for Khoekhoegowab will not work here. For one, the displaced material is much bigger than a clitic; for another, the XP that is anomalously-matched is the origin, not the landing site, of displacement. The problem is that the MATCH constraints are categorical; matching is all-or-nothing. But it's possible to imagine similar constraints that are gradient. For such a constraint, the ϕ in (13b) containing only the verb would be the *VP less well*, but would still match it. One way to implement this is discussed by Ito & Mester (2018): Instead of Match Theory, they propose Syntax-Prosody Correspondence in the sense of McCarthy & Prince (1995). In that system, each candidate comes with an arbitrary relation between syntactic objects and prosodic objects, meaning that a syntactic object and a prosodic one can be in correspondence even without containing exactly the same material. An independent constraint then enforces similarity between

objects that are in correspondence, and can do so in a gradient fashion — for instance, scoring more constraints for each syntactic terminal not contained in the prosodic constituent. The existence of prosodic displacement lends support to such a model insofar as it requires some means of controlling syntax-prosody mapping that is more flexible than Match Theory; exactly how to implement such a model will require considerable further research.

BIBLIOGRAPHY

- Abels, Klaus. 2003. Successive cyclicity, anti-locality, and adposition stranding. Doctoral Dissertation, University of Connecticut.
- Abels, Klaus, & Ad Neeleman. 2012. Linear asymmetries and the LCA. *Syntax* 15:25–74.
- Anderson, Stephen R. 1993. Wackernagel's revenge: clitics, morphology, and the syntax of second position. *Language* 69:68–98.
- Anttila, Arto, Matthew Adams, & Michael Speriosu. 2010. The role of prosody in the english dative alternation. *Language and Cognitive Processes* 25:946–981.
- Aoun, Joseph, & Elabbas Benmamoun. 1998. Minimality, reconstruction, and PF movement. *Linguistic Inquiry* 29:569–597.
- Bach, Emmon. 1971. Questions. *Linguistic Inquiry* 2:153–166.
- Beckman, Mary, & Janet Pierrehumbert. 1986. Intonational structure of Japanese and English. *Phonology* 3:255–309.
- Bennett, Ryan, Emily Elfner, & James McCloskey. 2016. Lightest to the right: An apparently anomalous displacement in Irish. *Linguistic Inquiry* 47:169–234.
- Biberauer, Theresa, Anders Holmberg, & Ian Roberts. 2014. A syntactic universal and its consequences. *Linguistic Inquiry* 45:169–225.
- Boersma, Paul. 1998. *Functional Phonology: Formalizing the interactions between articulatory and perceptual drives*. The Hague: Holland Academic Graphics.
- Boersma, Paul, & David Weenink. 2001. Praat, a system for doing phonetics by computer.
- Bošković, Željko. 2000. Second Position Cliticisation: Syntax and/or Phonology? In *Clitic Phenomena in European Languages*, ed. Frits Beukema & Marcel den Dikken, volume 30 of *Linguistics Today*. John Benjamin Publishing Company.
- Bošković, Željko. 2001. *On the nature of the syntax-phonology interface: Cliticization and related phenomena*. Amsterdam: Elsevier Science.
- Breiss, Canaan, & Bruce Hayes. 2019. Phonological markedness effects in sentence formation. In submission.

- Bresnan, Joan, & Jonni Kanerva. 1989. Locative inversion in Chichewa: a case study of factorization in grammar. *Linguistic Inquiry* 20:1–50.
- Brugman, Johanna Christina. 2009. Segments, tones and distribution in Khoekhoe prosody. Doctoral Dissertation, Cornell University.
- Bruin, J. 2011. R library contrast coding systems for categorical variables. Technical report, UCLA. URL <https://stats.idre.ucla.edu/stata/ado/analysis/>.
- Bulatova, Nadezhda, & Lenore Grenoble. 1999. *Evenki*. Lincom Europa.
- Cable, Seth. 2004. Predicate clefts and base-generation: Evidence from Yiddish and Brazilian Portuguese. Unpublished manuscript.
- Chomsky, Noam. 1995a. Bare phrase structure. In *Government and binding theory and the minimalist program*, ed. Gert Webelhuth, 383–439. Oxford: Oxford University Press.
- Chomsky, Noam. 1995b. *The Minimalist Program*. Cambridge, Massachusetts: MIT Press.
- Chomsky, Noam. 2005. Three factors in language design. *Linguistic Inquiry* 36:1–22.
- Chung, Sandra, & James McCloskey. 1987. Government, barriers, and small clauses in Modern Irish. *Linguistic Inquiry* 18:173–237.
- Cinque, Guglielmo. 1999. *Adverbs and functional heads: a cross-linguistic perspective*. New York: Oxford University Press.
- Clemens, Lauren Eby. 2014. Prosodic noun incorporation and verb-initial syntax. Doctoral Dissertation, Harvard University.
- Clemens, Lauren Eby. 2016. Argument- ϕ : A prosodic account of pseudo noun incorporation. In *Proceedings of NELS 46*, ed. Brandon Prickett & Christopher Hammerly, 217–226.
- Clemens, Lauren Eby. 2019. Prosodic noun incorporation: The relationship between prosody and argument structure in Niuean. *Syntax*.
- Clemens, Lauren Eby, & Jessica Coon. 2018. Deriving verb initial word order in Mayan. *Language* 94.2:237–280.
- Coetzee, Andries W, & Joe Pater. 2011. The place of variation in phonological theory. *The Handbook of Phonological Theory, Second Edition* 401–434.
- Cole, Peter, & Gabriella Hermon. 1998. The typology of wh-movement. Wh-questions in Malay. *Syntax* 1:221–258.
- Collins, Chris. 2002. Eliminating labels. In *Derivation and explanation in the Minimalist Program*, ed. Samuel Epstein & T. D. Seely, 42–64. Wiley.

- Collins, Chris, & Edward Stabler. 2016. A formalization of Minimalist syntax. *Syntax* 19:1:43 – 78.
- Connell, Bruce. 2001. Downdrift, downstep, and declination. In *Proceedings of Typology of African Prosodic Systems Workshop*. Bielefeld University, Germany.
- Coon, Jessica. 2010. VOS as predicate fronting in Mayan. *Lingua* 120:345 – 378.
- Dobashi, Yoshihito. 2009. Multiple spell-out, assembly problem, and syntax-phonology mapping. *Phonological Domains: Universals and Deviations*. Berlin: Mouton de Gruyter 195–220.
- Dryer, Matthew S., & Martin Haspelmath, ed. 2013. *WALS Online*. Leipzig: Max Planck Institute for Evolutionary Anthropology. URL <http://wals.info/>.
- Duffield, Nigel. 1995. *Particles and projections in Irish syntax*. Dordrecht: Kluwer.
- Edmiston, Daniel, & Eric Potsdam. 2017. Linearization at PF: Evidence from Malagasy extraposition. In *Proceedings of NELS 47, University of Massachusetts Amherst*, ed. Andrew Lamont & Katerina Tetzloff.
- Elfner, Emily. 2012. Syntax-prosody interactions in Irish. Doctoral Dissertation, University of Massachusetts Amherst.
- Embick, David, & Rolf Noyer. 2001. Movement operations after syntax. *Linguistic Inquiry* 32:555–595.
- Ernst, Thomas. 2001. *The syntax of adjuncts*, volume 96. Cambridge University Press.
- Féry, Caroline. 2015. Extraposition and prosodic monsters in German. In *Explicit and implicit prosody in sentence processing*, ed. L. Frazier & E. Gibson, volume 46 of *Studies in Theoretical Psycholinguistics*. Springer.
- Fleiss, JL. 1971. Measuring nominal scale agreement among many raters. *Psychological Bulletin* 76:378–81.
- Fougeron, Cécile, & Sun-Ah Jun. 1998. Rate effects on French intonation: prosodic organization and phonetic realization. *Journal of Phonetics* 26:45–69.
- Fox, Danny, & David Pesetsky. 2005. Cyclic linearization of syntactic structure. *Theoretical linguistics* 31:1–45.
- Fox, Danny, & David Pesetsky. 2006. Cyclic linearization of shared material. Talk given Berlin.
- Göbbel, Edward. 2007. Extraposition as PF movement. In *Proceedings of WECOL 2006*, 132 – 145. California State University, Department of Linguistics Fresno.

- Goldwater, Sharon, & Mark Johnson. 2003. Learning OT constraint rankings using a maximum entropy model. In *Proceedings of the Workshop on Variation within Optimality Theory*, ed. Jennifer Spenader, Anders Eriksson, & Östen Dahl, 111 – 120. Stockholm University.
- Grimshaw, Jane. 1991. Extended projection. Unpublished manuscript, Brandeis University.
- Haacke, Wilfrid. 1976. A Nama Grammar: The Noun-Phrase. Master's thesis, University of Cape Town.
- Haacke, Wilfrid H. G. 1999. *The tonology of Khoekhoe (Nama/Damara)*. Köln: Rüdiger Köppe Verlag. Quellen zur Khoisan-Forschung 16.
- Haacke, Wilfrid HG. 2006. Syntactic focus marking in Khoekhoe (“Nama/Damara”). *ZAS Papers in Linguistics* 46:105–127.
- Hagman, Roy. 1977. *Nama Hottentot Grammar*. Indiana University.
- Hahn, Michael. 2013. Word order variation in Khoekhoe. In *Proceedings of the 20th International Conference on Head-Driven Phrase Structure Grammar*, 48–68.
- Haider, Hubert. 1992. Branching and Discharge. In *Working Papers of the SF13 340*, 23.
- Haider, Hubert. 2012. *Symmetry Breaking in Syntax*. Cambridge: Cambridge University Press.
- Halpern, Aaron Lars. 1992. Topics in the placement and morphology of clitics. Doctoral Dissertation, Stanford University Ph. D. dissertation.
- Hayes, Bruce, & Colin Wilson. 2008. A maximum entropy model of phonotactics and phonotactic learning. *Linguistic Inquiry* 39:379–440.
- Hsu, Brian. 2016. Syntax-prosody interactions in the clausal domain: Head movement and coalescence. Doctoral Dissertation, University of Southern California.
- Ito, Junko, & Armin Mester. 2012. Recursive prosodic phrasing in Japanese. *Prosody matters: Essays in honor of Elisabeth Selkirk* 280–303.
- Ito, Junko, & Armin Mester. 2018. Syntax-Prosody Faithfulness. Presented at the Western Conference on Linguistics, California State University Fresno.
- Johnson, Kyle. 2004. Towards an etiology of adjunct islands. *Nordlyd* 31.
- Johnson, Kyle. 2016. Towards a multidominant theory of movement. Lectures presented at ACTL, University College.
- Kalivoda, Nicholas. 2018. Syntax-prosody mismatches in Optimality Theory. Doctoral Dissertation, UC Santa Cruz.

- Kandybowicz, Jason. 2006. On fusion and multiple copy spell-out: The case of verb repetition. In *The Copy Theory of Movement on the PF Side*, ed. Jairo Nunes & Norbert Corver. Oxford University Press.
- Kastenholz, Raimund. 2003. Auxiliaries, grammaticalization and word order in Mande. *Journal of African Languages and Linguistics* 24:31 – 53.
- Kayne, Richard S. 1994. *The Antisymmetry of Syntax*, volume 25 of *Linguistic Inquiry Monographs*. Cambridge, Massachusetts: MIT Press.
- Keenan, Edward. 1976. Remarkable subjects in Malagasy. In *Subject and Topic*, ed. Charles Li, 247 – 301. New York: Academic Press.
- Keenan, Edward. 1995. Predicate-argument structure in Malagasy. In *Grammatical Relations: Theoretical approaches to empirical questions*, ed. C. Burgess et al., 171 – 216. Stanford: CSLI.
- Committee for Khoekhoegowab, Curriculum. 2003. *Khoekhoegowab 3||ǀ Xoa|gaub (Orthography 3)*. Windhoek, Namibia: Macmillan Education Namibia.
- Koopman, Hilda. 1984. *The syntax of verbs*. Dordrecht, The Netherlands: Foris Publications.
- Kusmer, Leland Paul. 2019. Word and affix ordering with Optimality Theory. Presented at the LSA Annual Meeting.
- Kusmer, Leland Paul. to appear. Optimal Linearization: word-order typology with violable constraints. *Syntax*.
- Kusmer, Leland Paul, & Kerriane Devlin. 2018. Default case in Khoekhoegowab. Presented at the Annual Conference on African Linguistics.
- Law, Paul. 2007. The syntactic structure of the cleft construction in Malagasy. *Natural Language and Linguistic Theory* 25:765–823.
- Legendre, Géraldine. 1998. Second position clitics in a verb-second language: Conflict resolution in Macedonian. In *Proceedings of ESCOL 1997*, 138 – 149.
- Lewis, M. Paul, Gary F. Simons, & Charles D. Fennig, ed. 2016. *Ethnologue: Languages of the world*. Dallas, TX: SIL International, 19 edition. Online version: <http://www.ethnologue.com>.
- López, Luis. 2009. Ranking the linear correspondence axiom. *Linguistic Inquiry* 40.2:239–276.
- Lukas, J., & G. Nachtigal. 1939. *Die sprache der buduma im zentralen sudan: auf grund eigener studien und des nachlasses von g. nachtigal*. Abhandlungen für die Kunde des Morgenlandes. Deutsche morgenländische gesellschaft, Kommissionsverlag F.A.Brockhaus. URL <https://books.google.com/books?id=ZzQpOwAACAAJ>.

- McAuliffe, Michael, Michaela Socolof, Sarah Mihuc, Michael Wagner, & Morgan Sonderegger. 2017. Montreal Forced Aligner: trainable text-speech alignment using Kaldi. In *Proceedings of the 18th Conference of the International Speech Communication Association*.
- McCarthy, John J. 2002. *A Thematic Guide to Optimality Theory*. Cambridge University Press.
- McCarthy, John J., & Alan Prince. 1994a. Generalized alignment. In *Yearbook of morphology 1993*, 79 – 153. Dordrecht: Springer.
- McCarthy, John J., & Alan Prince. 1995. *Faithfulness and reduplicative identity*, chapter 7, 218–309. Cambridge University Press. UMass Amherst.
- McCarthy, John J., & Alan S Prince. 1994b. The emergence of the unmarked: Optimality in prosodic morphology. In *Proceedings of the North East Linguistic Society 24*. GLSA (Graduate Linguistic Student Association), Dept. of Linguistics, University of Massachusetts.
- McCloskey, James. 2011. The shape of Irish clauses. In *Formal approaches to Celtic linguistics*, ed. Andrew Carnie, 143 – 178. Newcastle upon Tyne: Cambridge Scholars Publishing. URL <http://oh1one.ucsc.edu/jim/papers.html>.
- Mester, R. Armin. 1994. The quantitative trochee in Latin. *Natural Language and Linguistic Theory* 12:1–62.
- Myrberg, Sara. 2013. Sisterhood in prosodic branching. *Phonology* 30:73.
- Nelson, Nicole Alice. 2003. Asymmetric anchoring. Doctoral Dissertation, Rutgers, The State University of New Jersey.
- Nespor, Marina, & Irene Vogel. 1986. *Prosodic phonology*. Dordrecht, Holland ; Riverton, N.J.: Foris.
- Nunes, Jairo. 1995. The copy theory of movement and linearization of chains in the Minimalist Program. Doctoral Dissertation, University of Maryland.
- Overfelt, Jason. 2015. Rightward movement: A study in locality. Doctoral Dissertation, University of Massachusetts, Amherst, MA.
- Percus, Orin. 1993. The captious clitic: Problems in Serbo-Croatian clitic placement. Phonology generals paper.
- Petronio, Karen, & Diane Lillo-Martin. 1997. Wh-movement and the position of spec-CP: Evidence from American Sign Language. *Language* 73:18–57.
- Prince, Alan, & Paul Smolensky. 1993/2004. *Optimality Theory: Constraint interaction in generative grammar*. Blackwell Publishers.

- Rackowski, Andrea, & Lisa Travis. 2000. V-initial languages: X or XP movement and adverbial placement. In *The Syntax of Verb Initial Languages*, ed. Andrew Carnie & Eithne Guilfoyle, 117–141. Oxford: Oxford University Press.
- Richards, Norvin. 2010. *Uttering Trees*, volume 56 of *Linguistic Inquiry Monographs*. MIT Press.
- Richards, Norvin. 2016. *Contiguity Theory*, volume 73 of *Linguistic Inquiry Monographs*. MIT Press.
- Rizzi, Luigi. 2016. Labeling, maximality and the head-phrase distinction. *The Linguistic Review* 33:103–127.
- Roberts, Ian. 2017. The Final-over-Final Condition and Adverbs. In *The Final-over-Final Condition*, ed. Michelle Sheehan, Theresa Biberauer, Ian Roberts, & Anders Holmberg, chapter 6, 97 – 120. MIT Press.
- Ross, John. 1967. Constraints on variables in syntax. Doctoral Dissertation, Massachusetts Institute of Technology.
- Sauerland, Uli, & Paul Elbourne. 2002. Total reconstruction, PF-movement, and the derivational order. *Linguistic Inquiry* 33:283–319.
- Schütze, Carson T. 1994. Serbo-Croatian second position clitic placement and the phonology-syntax interface. In *MIT Working Papers in Linguistics*, ed. Andrew Carnie, Heidi Harley, & Tony Bures, volume 21, 373–473. MIT Press.
- Selkirk, Elisabeth. 2000. The interaction of constraints on prosodic phrasing. In *Prosody: Theory and Experiment*, ed. M. Horne, 231–261. Dordrecht: Kluwer.
- Selkirk, Elisabeth. 2011. The Syntax-Phonology Interface. In *The Handbook of Phonological Theory*, ed. John Goldsmith, Jason Riggle, & Alan Yu, volume 2, chapter 14, 435–483. Oxford: Blackwell Publishing.
- Selkirk, Elisabeth, & Seunghun J Lee. 2015. Constituency in sentence phonology: an introduction. *Phonology* 32:1–18.
- Selkirk, Elisabeth O. 1986. On derived domains in sentence phonology. *Phonology* 3:371–405.
- Selkirk, Elisabeth O. 1996. Sentence prosody: intonation, stress and phrasing. In *The Handbook of Phonological Theory*, ed. J. A. Goldsmith. London: Blackwell Publishers.
- Sheehan, Michelle, Theresa Biberauer, Ian Roberts, & Anders Holmberg. 2017. *The Final-over-Final Condition: A Syntactic Universal*, volume 76. MIT Press.
- Shih, Stephanie S., & Kie Zuraw. 2017. Phonological conditions on variable adjective and noun word order in Tagalog. *Language* 93:317 — 352.

- Sichel, Ivy. 2014. Resumptive pronouns and competition. *Linguistic Inquiry* 45:655–693.
- Stabler, Edward. 1996. Derivational minimalism. In *International Conference on Logical Aspects of Computational Linguistics*, 68–95. Springer.
- Washburn, Paul. 2001. A Minimalist approach to Khoekhoe declaratives. *Cornell Working Papers in Linguistics* 18:28–56.
- Watanabe, Akira. 1992. Subjacency and S-structure movement of *wh*-in-situ. *Journal of East Asian Linguistics* 1:255–291.
- Weir, Andrew. 2015. Fragment answers and exceptional movement under ellipsis: a PF-movement account. In *Proceedings of NELS*, ed. Christopher Hammerly & Brandon Prickett, volume 45, 175 – 188.
- Werle, Adam. 2009. Word, phrase, and clitic prosody in Bosnian, Serbian, and Croatian. Doctoral Dissertation, University of Massachusetts Amherst.
- Wolf, Matthew Adam. 2008. Optimal Interleaving: Serial phonology-morphology interaction in a constraint-based model. Doctoral Dissertation, University of Massachusetts Amherst.
- Yip, Moira. 2002. *Tone*. New York: Cambridge University Press.
- Yue-Hashimoto, Anne O. 1987. Tone sandhi across Chinese dialects. In *Wang Li memorial volumes, English volume*, ed. Chinese Language Society of Hong Kong, 445–474. Hong Kong: Joint Publishing Co.
- Zee, Eric, & Ian Maddieson. 1980. Tones and tone sandhi in Sanghai: Phonetic evidence and phonological analysis. *Glossa* 14:44–88.
- Zhang, Jie. 2007. A directional asymmetry in Chinese tone sandhi systems. *Journal of East Asian Linguistics* 16:259–302.
- Zhu, Xianong. 1999. *Shanghai Tonetics*. München: Lincom Europa.
- Zhu, Xianong. 2006. *A Grammar of Shanghai Wu*. München: Lincom Europa.
- Zukoff, Sam. 2017a. Arabic nonconcatenative morphology and the Syntax-Phonology interface. In *Proceedings of the 47th Annual Meeting of the North East Linguistic Society*, ed. Andrew Lamont & Katerina Tetzloff, volume 3, 295–314. Amherst, MA: Graduate Linguistics Student Association.
- Zukoff, Sam. 2017b. The Mirror Alignment Principle: Morpheme ordering at the morphosyntax-phonology interface. In *Papers on Morphology (MIT Working Papers in Linguistics 81)*, ed. Snejana Iovtcheva & Benjamin Storme, 105–124. Cambridge, MA.

Wouter Zwart, Jan. 2011. Structure and order: asymmetric Merge. In *The Oxford Handbook of Linguistic Minimalism*, 96 – 118. Oxford University Press.

Zwarts, Frans. 1998. Three types of polarity. In *Plurality and quantification*, ed. F. Hamm & E.W. Hinrichs, 177 – 238. Dordrecht: Kluwer.