Chapter 1

Introduction to a study of grammatical tone
1.1 Grammatical tone: What is it?

The purpose of this study is to provide a comprehensive typology and theory of grammatical tone. About half the world’s languages are **tone languages**, which are defined following Hyman as languages ‘in which an indication of pitch enters into the lexical realization of at least some morphemes’ (Hyman 2001:1368; Hyman 2006:229). This purposely broad definition includes tonally ‘dense’ languages with extensive tonemic contrast such as Cantonese and Vietnamese, as well as privative-culminative tone languages such as Japanese which only contrast high tone (H) vs. Ø, with one H per domain.

This definition emphasizes tone as part of the units of contrast which define different morphemes within a language. In the majority of tone languages, tone also shows an incredible breadth of **tonological operations**: toneme addition, deletion, replacement, displacement, assimilation, dissimilation, polarization, docking, spreading, floating, simplification, and many others. In many cases, these tonological operations are part of the general phonological system. For example, in the Nigerian language Yoruba, H (high) and L (low) tone spreads rightward onto an adjacent L or H tone.

\[
/ \text{máyòmì rà wé} / \rightarrow [\text{máyòmì rà wé}]
\]

\[
\begin{array}{cccccc}
H & L & H & L & H \\
\end{array}
\]

‘Mayomi bought books’


In contrast, this study focuses on those tonological operations which are **not** part of the general phonological system and are only licensed by specific grammatical conditions. This is what I refer to as **grammatical tone (GT)**, defined as a tonological operation which is restricted to the context of a specific morpheme or construction, or a natural class of morphemes or constructions. In order words, grammatically-conditioned toneme addition, deletion, replacement, shifting, assimilation, dissimilation, etc.

To exemplify, in the fellow Nigerian language Izon tone also spreads rightward but in a very different way from Yoruba. Morphemes fall into various tone classes depending on their tonal effect in context. Tone class A spreads a LH melody rightwards, class B spreads a H tone, and class C spreads L tone. In [**MODIFIER NOUN**] constructions, modifiers idiosyncratically belong to one of these three tone classes, shown in the table below (data collected during fieldwork by author on the Gbarain dialect). These operations cannot be attributed to general phonology.

<table>
<thead>
<tr>
<th>Modifier</th>
<th>Noun</th>
<th>Tone patterns in isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>èbíₐ ‘good’</td>
<td>èbíₐ</td>
</tr>
<tr>
<td>B</td>
<td>èndíₐ ‘that’</td>
<td>èndíₐ</td>
</tr>
<tr>
<td>C</td>
<td>káláₐ ‘small’</td>
<td>káláₐ</td>
</tr>
</tbody>
</table>

[Izon – Author fieldnotes]
Notice two things which distinguish it from the Yoruba case: (i) the tones of the target (the noun) are completely overwritten and thus underlying tone is neutralized, and (ii) the spreading tone can be different from the tone of the trigger e.g. L-toned modifier spreading H and a H-toned modifier spreading L. GT data such as these constitute this study’s empirical focus.

1.2 Why (grammatical) tone?

Tonal phenomena are part of the human capacity to use changes in pitch to convey meaning, together with stress, intonation, and prosody in general. Tonal phenomena are particularly important to linguistic inquiry by exhibiting a range of effects less often encountered in segmental phonology, e.g. the ability of tone to be ‘mobile’ and appear in a location different from its sponsor (Yip 2002: 133ff.), the ability of tone to ‘interact at a distance’ with much looser locality demands (Hyman 2011:225), and the ability of tonal operations to not be phonetically grounded, often radially (what Hyman 2011:238 calls its ‘arbitrariness’).

Tonal languages are rich with grammatical tone, which once established can blossom into some of the most intricate phonological patterns known to human language. A recent surge of in-depth descriptive and analytic work on GT has further fed our understanding, including African families Dogon (Heath 2008, a.o., McPherson 2014, McPherson & Heath 2016), Gur (Hyman & Olawsky 2004, Roberts 2016), Ijoid (Efere 2001, Harry 2004, Harry & Hyman 2014), Bantu (Odden & Bickmore 2014, Marlo et al. 2015), and Nilotic (Andersen 1995, Trommer 2011), as well as families outside of Africa such as Oto-Manguean in Mexico (Cruz 2011, McKendry 2013, Campbell 2014, Villard 2015, McIntosh 2015, Sullivant 2015, Palancar & Leonard 2016, Zimmermann 2016) and Japonic lects across the Japanese islands (Kubozono 2016, Kubozono & Giriko 2018).

At the same time, we are still in a relatively young period for tonology in general and grammatical tone specifically, and do not yet have a clear sense of GT’s ‘axes of variation’. No comprehensive tonal typology has been worked out which delimits different types of GT and distinguishes them from tone sandhi phenomena, intonation, and demarcative boundary tones, to name some major ‘landmarks’ in the tonal literature. Sometimes this boils down to terminology: for the Izon case, what might be called replacive or construction tone by the Africanist might equally be described as left-dominant tone sandhi by a scholar of Chinese. But it also can be attributed to the fact that the state of ‘prosodic documentation’ is quite poor.

Approximately 50% of the world’s languages are tonal, concentrated in several parts of the world with extensive documentation needs, e.g. Sub-Saharan Africa, Southeast Asia, Southcentral Mexico, and parts of Amazonia and New Guinea (Hyman 2011:198). Hammarström (2014:16) surveys the linguistic documentation levels of the world, highlighting the eleven countries with the lowest average documentation level (approximately averaging no more than a dictionary for each language in their country). From lowest to highest these are Laos, Nigeria, Bhutan, Papua New Guinea, Indonesia (Papua), Vietnam, the Philippines, Benin, Liberia, Cameroon, and Chad. All of these countries (except the Philippines) are areas where tone is either omnipresent or at least widespread. There is therefore a great amount of prosodic description still required before we can confidently assume a stable empirical target at which our typologies and theories can be aimed.

1.3 What are the typological parameters for grammatical tone?

One of the goals of this study is to establish core terminology for GT and the parameters along which GT systems vary, which is the topic of the first part of this study. I assume a property-driven approach to phonological typology (Plank 2001, Hyman 2009), in which individual instances of grammatical tone are deconstructed into a set of properties and the full typology is drawn from that inventory of GT tokens. As a starting point, we can differentiate the GT trigger as the morpheme or construction which licenses the tonological operation, the GT tune as the
toneme sequence which covaries with the trigger, and the GT target as the morpheme which is the intended undergoer of a tonological operation. In the Izon case above /ɛndìB/ ‘that’ + /wárì/ ‘house’ $\rightarrow$ [ɛndìB wárì] ‘that house’, the trigger is the modifier, the target is the noun, and the tune is the assigned pattern [HH].

In this study, I fully articulate these components (as well as others) by comparing and contrasting them against one another. What results is a list of ‘axes of variation’ which we can assess for each token of GT. As a sample, these include the following:

(3) Sample of axes of variation of GT:
   a. **Tune-target relations**: how does the tune interact with the tone of the target? Hypothetical possibilities include concatenation, replacement, deletion, blocking due to markedness, coalescence, among others.
   b. **Tune-trigger relations**: do these form one ‘exponent’ jointly? how different can the tonal value of the tune be from that of the trigger? how consistently does the tune co-occur with the trigger?
   c. **Trigger-target relations**: how local do the trigger and target need to be? should locality be defined structurally (morpho-syntactically) or linearly (in the phonological string)? Are there asymmetries as to what can be a potential trigger and what a potential target?
   d. **Allotuny**: does a GT tune exhibit ‘allotunes’ in complementary distribution? if so, is this conditioned by properties of the trigger? target? something else?
   e. **Conditioning triggerhood and targethood**: are triggers/targets conditioned by their environment? are there exceptional triggers (normally non-triggering morphemes) and exceptional targets (non-undergoing units in the target domain)?
   f. **Expression**: which grammatical categories can GT express? derivation/inflection? structural configurations such as [OBJECT VERB]? etc.

In this study, I frame the interaction between GT triggers, targets, and tunes in terms of morphological **dominance effects** (Kiparsky & Halle 1977, Kiparsky 1984, Inkelas 1998). A major typological generalization of my study is dividing GT patterns into two main types: **dominant GT** and **non-dominant GT**. Each of these has two sub-types. Dominant GT is split into **replacive-dominant GT** and **subtractive-dominant GT**, while non-dominant is split into **recessive non-dominant GT** and **neutral non-dominant GT**. These categories emerge from properties of the triggers, defined as the following:

(4) Definitions of GT triggers (slightly redefined in chapter 3)
   a. **Replacive-dominant**: the automatic replacement of the underlying tone of the target, revalued with a grammatical tune (whether via a floating tone, spreading from the sponsor, etc.)
   b. **Subtractive-dominant**: the automatic deletion of the underlying tone of the target, without revaluation by a grammatical tune
   c. **Recessive-non-dominant**: the automatic non-application of the tune when a target is valued (occurs within privative-culminative systems)
   d. **Neutral-non-dominant**: the lack of automatic replacement/deletion of the underlying tone of the target or automatic non-application of the grammatical tune (i.e. simple toneme concatenation)

It is a major typological finding of this survey that the GT type is controlled by the trigger, and not the target or tune.
An example of dominant GT was the Izon case in (2) above where the tone of the target were deleted and revalued. A case of non-dominant GT is found in another Nigerian language Hausa where the suffix / -n / REFERENTIAL triggers a L tone which concatenates at the right edge of the noun without deletion and revaluation, shown below.

(5)  
   a. / jààkìí + -n /  →  jààkììn  [jààkîn]  ‘the donkey’  
   b. / hársùnàà + -n /  →  hársùnààn  [hársùnàn]  ‘the languages’  

Concatenation results in a falling tone when next to /H/ (as in a.) or vacuously applies with a /L/ tone (as in b.).

Two guiding questions which I address in this study are: (i) ‘when there are more than one trigger, which wins?’ (as asked in McPherson 2014 and Hyman 2016), and (ii) ‘are there any restrictions on what can be a GT target and what can be a GT trigger?’. For the first question, the typology reveals that the properties of the outermost trigger wins, with the properties of triggers (e.g. whether dominant, recessive, or neutral) maintained regardless of the content of the target. I call this the outer dominance principle for grammatical tone, supporting a common finding in dominance systems in general (Inkelas 1998). Cases which violate this principle are also identified and typologized.

Regarding the second question, a major finding of the survey is that dominant GT shows a trigger/target asymmetry but non-dominant GT does not. I refer to this as the dominant GT asymmetry, defined as in (6) and exemplified in (7).

(6)  

**Dominant GT asymmetry**: within a multi-morphemic constituent, the dominant trigger is a dependent, and the target is a lexical head or a dependent structurally closer to the lexical head

(7)  

<table>
<thead>
<tr>
<th>Trigger → Target</th>
<th>Tone pattern</th>
<th>Non-dominant (e.g. docking)</th>
<th>Dominant (e.g. replacive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammatical/Dependent → Lexical head</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>a. Affix → Root</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>b. Modifier → Noun</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>c. Object → Verb</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>Lexical head → Grammatical/Dependent</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>d. Root → Affix</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>e. Noun → Modifier</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
<tr>
<td>f. Verb → Object</td>
<td>✓ Yes</td>
<td>✓ Yes</td>
<td></td>
</tr>
</tbody>
</table>

This asymmetry is framed in typological neutral terms ‘lexical head’ (e.g. N of NP, V of VP) and ‘dependent’ which includes affixes and modifiers (following Nichols 1986). Thus in many cases, the trigger will be a grammatical item and the target will be a lexical item. In this table, row a. shows that if the trigger of the tonal pattern is an affix (such as a functional head) and the target is a lexical root, then the pattern can be either dominant or non-dominant. If the trigger and target are flipped (row d.), then only the non-dominant pattern is found. Parallel asymmetries exist with \[MODIFIER NOUN\] and \[VERB OBJECT\] constructions, illustrating that this asymmetry holds both within the word and also between words in phrases.
The dominant GT asymmetry is an important typological finding for two reasons. First, it strongly supports Alderete’s (2001b:214) principle of ‘Strict Base Mutation’ developed for accentual systems, which concluded that affixes can be dominant over roots but roots are never dominant over affixes. Second, the fact that affixes (as well as modifiers) can systematically replace the tones of roots but not vice versa contradicts the widely discussed typological notion that root faithfulness takes precedence over affix faithfulness (McCarthy & Prince 1995, Beckman 1998, Krämer 2007, Urbanczyk 2011, Hall et al. 2016).

In total, by couching the survey of GT in terms of dominance we can profitably explore the parameters of GT as laid out in (3), while also tying GT to the extensive dominance literature based principally on stress/accent systems (as well as other dimensions, e.g. vowel length - Willard 2004), thereby connecting otherwise disconnected literature.

1.4 Theoretical importance: Again, why (grammatical) tone?

Tone stands at the “outer limits of what is possible in phonology” (Hyman 2011:198), and is thus fertile testing grounds for phonological theory and the relationship of phonology to morphology and syntax. It has been instrumental in shaping phonological theory, e.g. establishing phonological representations as multi-tiered under Autosegmental Theory (Goldsmith 1980) and also establishing the existence of phonological scales and tone circles in tone sandhi (Chen 1987), seemingly without phonetic motivation.

In its ability to express grammatical meaning, grammatical tone is part of the large family of non-concatenative morphology which also includes segmental deletion, gemination, truncation, ablaut, consonant mutation, root-and-pattern morphology (e.g. Semitic templates), among others (Inkelas 2014:60ff for exemplification). Such phenomena equally stand at the ‘outer limits’ of morphology. Despite this, however, the contributions of grammatical tone to formal morphological and morphosyntactic theory have been less apparent - e.g. in Paradigm Function Morphology (Stump 2001), Distributed Morphology (Halle & Marantz 1993), Construction Morphology (Booij 2010a, 2010b), a.o. - theories which have largely developed based on morphemes as segments. GT has long been ignored in morphology textbooks (Matthews 1974, Booij 2005, Lieber 2009, Haspelmath & Sims 2010, Aronoff & Fudeman 2011), and is only marginally discussed in morphology handbooks and overviews (Spencer & Zwicky 1998, Hippisley & Stump 2017). This outsider status is further solidified due to much of the GT literature presented descriptively with specialists as the target audience, limiting cross-pollination with theoreticians of different stripes.

So, let us ask the question: what is the theoretical importance of grammatical tone? In the second part of this study I address this question directly, presenting a novel theory of grammatical tone with an emphasis on dominance effects. Grammatical tone directly touches on a number of tensions within morphological and phonological theory which play a recurrent role in model design throughout the literature. Some of these tensions are listed in (8) below, all of which walk the line between maximal restrictiveness and empirical coverage.

(8) Tensions in morphological and phonological theory

   a. **Locality**: how much sensitivity should our model have to non-local information? how is locality defined, e.g. linearly vs. hierarchically?
      i. Globalism vs. localism (Bobaljik 2000, Embick 2010)
      ii. Long distance effects and conditioning (Hyman 2011)
b. **Directionality**: how much sensitivity should our model have linearly (e.g. right to left vs. left to right conditioning) and hierarchically (e.g. inward vs. outward relations within morphological constituents)? is this sensitivity symmetrical or asymmetrical?

   i. Inside-out derivations vs. global derivations

c. **Modularity**: how separate are syntactic and phonological modules? is morphology a separate module? how much syntactic information can phonology access, and vice versa?


   ii. What is the role of c-command in determining phonological patterns? conversely, what is the role of prosodic well-formedness in determining syntactic patterns?

d. **Constituency**: what kind of phonological constituents are formed, and on what evidence? how much is this conditioned by syntactic structure?

   i. Relationship between syntax and prosodic hierarchy (Match Theory - Selkirk 2009, 2011)

   ii. Non-isomorphy between representations, e.g. bracketing paradoxes (Cohn 1989, Inkelas 2014:316ff.)

e. **Serialism vs. parallelism**: within an input-output mapping, do constraints apply in parallel (Optimality Theory – Prince & Smolensky 1993), as opposed to rule-based serialism (e.g. as evidenced by extensive opacity)

f. **Cyclicity (and cyclic effects)**: within a given derivation, is there one or more than one input-output mappings? if more than one, do the same exact constraints/rules apply, or can different ones apply?

   i. Cyclic effects captured through output-output correspondence (Benua 1997), vs. Stratal OT (Kiparsky 2000, 2015, Bermúdez-Otero 2008, 2012)

g. **Procedure vs. representation**: for a given output, how much should be attributed to the representation of the input (the primitives) vs. the procedure itself (the combinatorics)? (discussion in Bermúdez-Otero 2012:8)


Grammatical tone provides a critical empirical phenomenon to examine each of these tensions.

1.5 **Overview of major claims**

1.5.1 **Starting point: A series of problems inherent to dominant GT**

A theory of GT starts with identifying the specific problems that any theoretician must address. I will focus on capturing the difference between dominant GT and non-dominant GT, and the asymmetries they show. To that end, consider the following example of replacive-dominant GT from the Nigerian language Kalabari.

(9) námá + wář[r̥̃]+ améè –> námá wář améè
  animal  house  PLURAL  ‘the animal(‘s) houses’
  [ N₁ N₂ PL ]

[Kalabari – Harry & Hyman 2014]

These morphemes are shown on the left with their underlying tones and meaning, and on the right with their meaning and tone pattern in context. [N₁ N₂] constructions in Kalabari exhibit replacive GT, whereby the tone of N₂ (here underlying /H*H/) changes to a surface pattern [HL]
(the grammatical tune). We can isolate parts of this example and identify where the ‘problems’ (i.e. challenges – Trommer 2011) are for any GT model, as shown below.

**Erasure problem**

\[ \text{Origin problem} \]

(10)

a. [ wáˈɾi ]

b. [ námá wáɾi ˈame̞ ˈe̞ ]

**Scope problem**

First, the **erasure problem** addresses by what mechanism are the underlying tones of the target deleted (i.e. go unrealized – N₁ H*H at left in a.) when in the context of the trigger (to the right in b.). Second, the **origin problem** addresses where the grammatical tune [HL] comes from within in the derivation (e.g. from constraint ranking, floating tones in the input, simple allomorphy, etc.). Third, the **scope problem** addresses why the [HL] grammatical tune falls on N₂, and not on the other morphemes N₁ and the plural marker. In other words, by what principle is the target of the GT operation established?

1.5.2 Substance of spell-out at the interface

To successfully address these problems, I develop a model of the syntax/phonology interface by using a collection of familiar parts from several different theories synthesized to form a novel theory. I assume the general architecture of the Minimalist Program (Chomsky 1995) couched within non-Lexicalist Distributed Morphology (Halle & Marantz 1993). One goal in service towards understanding GT is to fully articulate the substance of spell-out, conventionally understood as the mapping from syntax to phonology in the feed-forward modular conception of grammar adopted here. In addressing the substance of spell-out, I seek to add to our understanding from the perspective of phonology and phonological phenomena such as tone (‘swimming upstream’ so to speak), as it is my opinion that conceptions of spell-out suffer from syntactic bias.

I emphasize three distinct components of this interface: the **morpho-syntactic module**, the **morpho-phonological module**, and spell-out which relates the two modules.

(11) Morpho-syntactic module maps to morpho-phonological module via spell-out
The morpho-syntactic module (in blue) consists of morpho-syntactic feature bundles (its primitives) subject to syntactic operations such as Merge (its operations). This is mapped to the morpho-phonological module (in purple) consisting of phonological strings and subject to a phonological grammar. Syntactic operations apply cyclically, and the output of last cycle is the input to spell-out (the red arrow). Spell-out maps this syntactic image /S/ input to what I refer to as to a phonological image (an output \$\Sigma\$, which serves as the input to further phonological computation.

At the very least, spell-out consists of operations involved in what I call the actuation of phonology (as well as a cast of familiar DM/interface operations).

(12) **Actuation of phonology**

<table>
<thead>
<tr>
<th>Spell-out operation</th>
<th>Provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vocabulary insertion</td>
<td>Phonological material/substance</td>
</tr>
<tr>
<td>b. Linearization</td>
<td>Phonological precedence</td>
</tr>
<tr>
<td>c. Prosodification</td>
<td>Phonological constituency</td>
</tr>
<tr>
<td>d. Hierarchy exchange</td>
<td>Phonological operation scope</td>
</tr>
</tbody>
</table>

All of these spell-out operations take place in parallel formalized within an Optimality Theoretic model, following what I call the morphology-in-parallel hypothesis (MPH).

(13) **Morphology-in-parallel hypothesis (MPH)**

Spell-out operations involved in mapping the syntactic image /S/ to the phonological image \$/sq\$ take place in parallel within an OT architecture.

Thus, while input-output mapping within a module is cyclic, the mapping from one module to another takes place strictly in parallel and as such is not cyclic. Although this premise of parallelism is at odds with the majority of DM (Embick & Noyer 2001, Arregi & Nevins 2012), a growing body of literature supports such a hybrid OT-DM model (Trommer 2001a, further detailed in Rolle accepted). Further, although I do not integrate this model within phase theory (Chomsky 2001), they are compatible if one still allows for parallelism at each phase cycle.

Two of these operations are critical for understanding grammatical tone: **vocabulary insertion** which inserts vocabulary items (VIs) containing phonological material, i.e. phonemes, tonemes, etc. (essentially phonological exponence), and **hierarchy exchange** which establishes morpho-phonological hierarchical relations (the morpho-phonological tree). I discuss these now.

1.5.3 **GT claim 1: Dominant GT is floating tone plus a special cophonology**

Let’s return to the contrast between dominant and non-dominant GT, e.g. replacive-dominant GT replaces all tone of the target while neutral-non-dominant GT simply concatenates with the tone of the target. The first theoretical claim I make in this study is that these GT types are representationally equivalent: they both involve floating tones. This addresses the origin problem. For example, consider the following data from Hausa (Newman 1986, Inkelas 1998).

(14) a. Dominant /jìnínáá + -\$\text{úú}$/ $\rightarrow$ [jìnínúú] ‘ostriches’
    b. Non-dominant /jààkíí + -\$\text{n}$/ $\rightarrow$ [jààkín] ‘the donkey’

The suffix /-\$\text{úú}$/ PLURAL in a. is idiosyncratically specified as dominant. The tones of the target noun are deleted and the floating \$\text{úú}$ docks to it (shown in bold and boxed in the output). In contrast, the suffix /-\$\text{n}$/ REFERENTIAL in b. is non-dominant, and as such the floating tone docks
to the target without replacement. The difference between the two is that the vocabulary item (≈ lexical item/morpheme) corresponding to dominant /-úú/ is endowed with a special cophonology which results in target tone deletion (Cophonology Theory – Inkelas & Zoll 2007, Sande & Jenks 2017). In contrast, non-dominant /-n/ is endowed with no special cophonology, and covaries with only default phonology. Hypothetical vocabulary items (VIs) are below, where the shorthand for the special cophonology is DOMINANT » DEFAULT within the VI.

(15) Vocabulary items with and without special cophonologies

\[
\begin{align*}
\text{Dominant Hausa VI} & \quad \text{vs.} \quad \text{Non-dominant Hausa VI} \\
\{ \text{PLURAL} \} & \quad \{ \text{REFERENTIAL} \} \\
/\text{-úú}/ & \quad /\text{-n}/ \\
\text{DOMINANT} » \text{DEFAULT} & \quad \text{DEFAULT} » \text{DOMINANT}
\end{align*}
\]

A noted advantage of Cophonology Theory is its ability to handle morphologically-conditioned phonological operations such as dominant GT (Inkelas 2014:80). However, unlike mainstream Cophonology Theory couched within construction grammar and item-and-process morphology (e.g. Inkelas & Caballero 2013), I implement it within DM where the triggers of cophonologies are VIs and not the constructions themselves.

The central insight which I seek to formalize in this chapter is that dominant GT should be characterized as a special type of paradigm uniformity effect. I call this hypothesis dominance as transparadigmatic uniformity. In short, within dominant GT all outputs have a uniform tone shape which has the advantage of providing a more consistent cue for the grammatical category of the trigger, but sacrifices the lexical contrast of the target. In contrast with non-dominant GT, outputs do not have a uniform form and thus maintain lexical contrast unambiguously, but at the cost of having a less delimited cue for the trigger. I take this trade-off to be the central tension in the realization of grammatical tone.

I formalize the contents of the dominant cophonology through Output-Output Correspondence (OO-Corr - Benua 1997), and in this way my model of dominance resembles Alderete’s (2001a, 2001b) Antifaithfulness theory. Under OO-Corr, outputs are in correspondence with both inputs as well as (certain) other outputs with which they are morphologically related, and by virtue of being in correspondence they may come to influence the phonological form of one another. In order to handle GT dominance effects, I develop an extension of OO-Corr called Matrix-Basemap Correspondence (MXBM-C), in which a matrix input-output mapping is in correspondence with one or more basemap input-output mappings. I argue that the traditional criteria within OO-Corr that bases be ‘real outputs’ is invalid, and in eliminating it state that matrix outputs can be in correspondence with induced basemaps consisting only of abstract phonological material. This is shown below with the Hausa data.

(16) Dominant GT via Matrix-Basemap Correspondence

The matrix input in the top left consists of the target /jìmínáá/ and trigger /úú/. Dominance is the result of this trigger subcategorizing for correspondence to an abstract basemap called the
induced basemap //ττττ ₝ūū// consisting only of abstract tone bearing units abbreviated as τ (the basemap is provided in double slashes to distinguish it from the matrix). In the basemap, the floating tone from the trigger transparently maps to the toneless target, resulting in a basemap output \τ̀τ̀τ̀τ̀-ūū\. It is to this basemap output that the matrix output must remain faithful via an OO-Corr constraint $O_{MXO_{BM}}(\text{TONE})$, which is higher ranked than IO-IDENT and markedness constraints due to the special cophonology in the dominant VI. This enforces correspondence between the matrix and basemap outputs, resulting in the attested surface form [jìmìn úu].

The most important take-away from this brief discussion is that dominance is due to faithfulness to a related output form (albeit an abstract one). I will contrast this view with several others. One set are culminativity+competition, theories such as Revithiadou’s (1999) Headmost Wins, in which dominance results from competition between the underlying tones of the target and the grammatical tune co-varying with the trigger. I show that such theories are inadequate on the grounds that the majority of GT patterns do not involve culminativity and freely allow co-occurring tones sponsored from different morphemes (e.g. non-dominant GT in Hausa in (14)b.). Another model attributes the origin of the grammatical tune to a markedness constraint (Inkelas 1998) or a construction constraint (McPherson 2014, McPherson & Heath 2016). I show that while this successfully accounts for the erasure problem, it suffers with respect to what we discuss next: the scope problem.

1.5.4 GT claim 2: The scope of the grammatical tune is established at spell-out

The second theoretical claim I make in this study is that the scope of dominant GT patterns is established at spell-out, via the operation hierarchy exchange. Consider a toy example illustrating spell-out below. The syntactic image from the morpho-syntactic module is at the left, which maps via spell-out (the red arrow) to the phonological image at right.

(17) Syntactic structure mapped to a morpho-phonological tree

As said above, vocabulary insertion maps terminal syntactic heads to vocabulary items with phonological substance (i.e. the string of { } bundles). Given our assumptions of spell-out as morphology-in-parallel, phonological operations conceivably could (i) apply as a part of spell-out in parallel to morphological operations, (ii) apply after spell-out but globally where all VIs are in the phonological input simultaneously, or (iii) apply cyclically. It is this last option which I advocate for.

If phonology applies in cycles, what defines the cycles? I claim that cycles are defined by the operation hierarchy exchange, which translates a hierarchical syntactic structure (created by cyclic application of Merge) to a morpho-phonological tree which connects vocabulary items at binary nodes (as shown in the diagram above). Informally, this operation exchanges syntactic
notions of ‘upward’ and ‘downward’ for morphological notions of ‘outward’ and ‘inward’. The most embedded elements of the syntactic tree are also the most embedded elements within the morpho-phonological object, i.e. roots/lexical heads. Higher heads and specifiers which merge with the lexical head are mapped to ‘outer’ positions within the morpho-phonological tree.

Hierarchy exchange preserves the inside-out derivational history of the syntactic module by referencing **asymmetrical c-command**. In this way, I conclude that interface models which appeal to c-command are essentially correct, the most relevant being McPherson (2014) and McPherson & Heath (2016) which derive dominant GT scope via c-command. However, I differ from this direct reference model in that my model refers to c-command only indirectly, mediated by hierarchy exchange. I provide arguments in favor for indirect reference, but the main takeaway point is this: asymmetrical c-command plays a critical role in delimiting the scope of morphologically triggered operations, a hypothesis which should be tested with data beyond GT.

The main function of hierarchy exchange is to establish what I call **cophonology-scope** (an extension of ‘stem scope’ – Inkelas & Zoll 2007). In the morpho-phonological tree above, individual nodes connecting vocabulary items are denoted with CoP standing for a cophonology. Thus, the sequence \([C-[D-B][-A]]\) has three cycles: the innermost cycle consists of VIs \([D-B]\) subject to a cophonology CoP-B triggered by the outer element, the VI \([B]\). Taken altogether, this mapping is subject to the **CoP-scope hierarchy** whereby VIs within specifiers scope over heads, and VIs within heads scope over complements (\(\dagger\) = has cophonology scope over).

\[
\text{(18) CoP-scope hierarchy}\\
\text{CoP-Spec } \dagger ( \text{CoP-Head } \dagger \text{CoP-Complement} )
\]

How this theory is cashed out with respect to GT is as follows. For dominant GT, the scope of grammatical tune will be the sister of the trigger in the morpho-phonological tree, and is the portion subject to Matrix-Basemap Correspondence as described above. This naturally accounts for the dominant GT asymmetry established in (6)-(7) above. Lexical heads do not impose a dominant GT pattern onto an outer affix or modifier because they are not within the cophonology scope of the lexical head. In this way, all dominance is inward, and cases of **outward dominance** would falsify this theory.

A key advantage of Cophonology Theory is that it is has **intrinsic scope** built in by virtue of applying cyclically, an advantage which carries over to this model involving Matrix-Basemap Correspondence with cophonology-scope. This effectively guarantees the dominant GT asymmetry and predicts the lack of outward dominance in GT patterns. The majority of other patterns either do not make this prediction, or do so only by stipulation. These alternative models which I dismiss include Antifaitfulness via transderivational correspondence (Alderete 2001a, 2001b), Lexical MaxEnt with regularization and scaling (Gouskova & Linzen 2015), GT as tonal allomorphy (Archangeli & Pulleyblank 2015,) Colored containment with circumfixal floating tones (Trommer 2011), faithfulness to morphological class (Headmost Wins - Revithiadou 1999), and tonal strength/diacritic weight (Vaxman 2016a, Kushnir 2018). Three models have intrinsic scope and thus guarantee the dominant GT asymmetry: the one presented here, cophonology theory with markedness constraints (Inkelas 1998) and construction tonology with direct reference to c-command (McPherson 2014, McPherson & Heath 2016). I compare the strengths of each of these, and conclude that the one developed here best accounts for the fact that the trigger itself is not affected by a dominant grammatical tune.

**1.6 Structure of this study**

This study is organized into two parts. Part I presents a typology of grammatical tone split into two chapters. Chapter 2 “Grammatical tone (GT): What is it, where is it, and what is it for?” lays
out the empirical focus of this study, while chapter 3 “GT dominance effects (and beyond)” presents a complete overview of how GT exemplify dominance and show their effects in action, establishing several typological generalizations such as the dominant GT asymmetry.

Part II of this study is a theory of grammatical tone, split into three chapters. Chapter 4 “A model of the syntax/phonology interface: Design goals and design choices” presents the ‘master plan’ of the syntax/phonology interface, which I use to situate the treatment of GT. Chapter 5 “Dominance as transparadigmatic uniformity via Matrix-Basemap Correspondence (MxBM-C)” supports the hypothesis of dominance transparadigmatic uniformity, formalized within MxBM-C being an extension of Output-Output Correspondence. Finally, chapter 6 “Cophonology-scope (CoP-scope)” lays out how the scope of grammatical tone is established at spell-out, guaranteeing the dominant GT asymmetry.

Chapter 7 provides a brief summary of the main claims, and discusses a number of areas for future inquiry.