Part I

A typology of grammatical tone

Chapter 2

Grammatical tone (GT): What is it, where is it, and what is it for?

2.1 What is it: The anatomy of grammatical tone

2.1.1 Underlying tone

The use of pitch is universal across the world's languages, and approximately half of them use pitch in such a way that warrants classifying them as 'tonal languages' (Hyman 2011). Tonal languages are defined as languages 'in which an indication of pitch enters into the lexical realization of at least some morphemes' (Hyman 2001:1368; Hyman 2006:229). The pitch information carried by a morpheme is normally represented as a series of **tonemes** which form part of the underlying representation of a morpheme, which I abbreviate throughout as T. Tonemes are linked to a specific **tone-bearing unit** (**TBU**) which I will abbreviate with τ (tau) (following Trommer 2011:53).

For example, in a language which contrasts high, mid, and low pitch, we can say there are three tonemes /H/ /M/ /L/, as in Yoruba /kɔ́/ 'build', /kɔ̄/ 'sing', and /kɔ̀/ 'reject'. Throughout, I will refer to these tones as the **underlying tone** of a morpheme, defined as the following:

[Def 1] **Underlying tone**: the tonemes and tonemic structure inherently connected to a particular morpheme (in its underlying representation)

I do not use the term 'lexical tone' in order not to confuse tone associated with lexical morphemes (e.g. nouns, verbs, etc.) versus general underlying tone on morphemes.

Morphemes can have a number of distinct **tonal values**. Their TBUs can be **valued**, meaning they have a toneme T linked (pre-docked) to a TBU τ. TBUs can also be **unvalued** meaning they do not have a linked toneme T (= 'free TBU' – Clements & Goldsmith 1984), or can be **mixed** and have both types. Finally, tonemes can also be **floating**, meaning that a toneme is not pre-docked to a TBU τ. For clarity, I will designate floating tones as superscripted and circled ⓣ, e.g. ᴸ for a floating L toneme (I will later show that a circled but non-superscripted Ⓣ indicates a floating tone which has docked to a TBU). Floating tone is of course an analysis, but is an invaluable descriptive tool in understanding tone patterns and therefore is employed throughout this study.

Valued				**Unvalued**	**Mixed**		**Floating**		
L	H L	H L	L		H	H L	ᴸ	ᴸ	H ᴸ
|	∨	| |	∧		|	∨			|
τ	τ	τ τ	τ τ	τ	τ τ	τ τ		τ	τ

Table 1: Sample of underlying tonal values

In this way, underlying tone is no different from other underlying structure (consonants, vowels, stress) and excludes non-contrastive and predictable phonological structure acquired in the course of a derivation.

In general, this work adopts the general principles of 'Autosegmental Phonology' (Goldsmith 1976, 1980; Clements & Goldsmith 1984) in which tonal representation is on a separate tier from other phonological content (e.g. moras, vowels, etc.). In many tone languages, tonemes are typically singleton tones /H/, /M/, and /L/ wherein surface contours can be decomposed, e.g. surface falling as underlying /H/+/L/. In contrast, in the Sinitic tonosphere many contours are less readily decomposable, e.g. as underlying /H͡L/ (analogous to a diphthong /a͡ɪ/). This thesis will not discuss such issues, but they will be acknowledged when they are encountered and pertinent to discussion of grammatical tone. An important take-away point here is that splitting up tone into tonemes T and TBUs τ captures the many ways tone differs quantitatively (and qualitatively) from other phonological phenomena (e.g. with respect to

toneme mobility, stability, one-to-many and many-to-one relations, underspecification, etc. – Yip 2002:65).

Further, this definition naturally includes many so-called 'pitch accent' systems such as Japanese (Hyman 2009). These languages are therefore also within the scope of typologizing grammatical tone. Moreover, note that tonemes often are realized phonetically as suprasegmental packages including pitch and another feature (e.g. phonation). Within this work, we will abstract away from the phonetic realization of tone and concentrate on the role it plays in grammatical systems, especially phonology, morphology, and syntax, and their interfaces.

2.1.2 Tonological operations

When morphemes are combined to form larger constituents to express complex meanings, a number of **tonological operations** can take place. A tonological operation refers to a case where an input shows some change in tonal structure in the output. For example, consider the table below.

	/ m_1 + m_2 / → \ m_1 m_2 \	Surface	
a.	L H | + | → | | τ τ	[L H]	No tonological operation
b.	L H | + | → |⟍| τ τ	[L L͡H]	Horizontal assimilation
c.	Ⓛ H + | → ⟍| τ τ	[L͡H]	Floating tone docking

Table 2: Tonological operations

In row a., the input consists of two morphemes: morpheme m_1 has a docked low tone /L/ and morpheme m_2 has a docked high tone /H/. When they are concatenated in context, this results in a straightforward input-to-output mapping /L H/ > \L H\ (note that backslashes \ \ are used to indicate an output, while square brackets [ ] are reserved for actual surface forms). No tonological operation takes place here as there is no change in the tonal structure from input to output.

In contrast, consider rows b.-c. which exhibit tonological operations. In row b., the input-to-output mapping is /L H/ → \L L͡H\ with an allotonic rising tone ('horizontal assimilation' - Hyman 2007). Further, c. shows an instance of a 'deficient input', as summarized below:

(1)

a. Deficient inputs: i. Unvalued TBU: / τ / ii. Undocked toneme: Ⓛ / /

b. Non-deficient input: Valued TBU: / L \| τ /

Deficient inputs include unvalued TBUs which consist of only a TBU τ with no toneme and undocked tonemes which consist of only a undocked toneme, i.e. a **floating tone**. When these appear in an input, various tonological operations can take place. For instance in row c. in Table

2, the floating tone docks to the only TBU available ('floating tone docking'), and thus makes a deficient input non-deficient.

Deficient inputs are nearly always subject to a tonological operation but note that this need not be the case. For example, there are languages in which unvalued TBUs are permitted as a phonological output and are only filled in post-phonologically within the phonetic implementation via 'tonal interpolation', e.g. in Tommo So [dto] (Dogon – McPherson 2014:15), and one interpretation of Mandarin toneless morphemes, e.g. /de/ POSS (Yip 2002:71-72). Conversely, floating tones may sometimes remain floating in the output, although many languages have *FLOAT constraints militating against this.

A working definition of a tonological operation is as follows:

[Def 2] **Tonological operation**: A phonological operation where there is a change to tonal structure in the input-to-output mapping (e.g. tone addition, deletion, replacement, shifting/displacement, assimilation, dissimilation/polarization, docking, spreading, absorption/simplification, *etc*.)

I use the term *phonological* operation here on purpose: tonological operations are part of the phonological grammar of a language, and as such are not merely the articulatory implementation of pitch targets in running speech. There is no doubt that many tonological operations have their origins in phonetic articulation and perception, but our focus here is only on those which have been fully 'phonologized' as part of the phonological grammar.

The literature on tone system typology reveals that the majority of tonal languages have tonological operations. I classify them into two major types: those which are **phonologically-conditioned** and those which are **morphologically-conditioned**.

[Def 3] **Phonologically-conditioned tonological operation**: A tonological operation conditioned by a particular phonological context (or natural class of phonological contexts)

[Def 4] **Morphologically-conditioned tonological operation**: A tonological operation conditioned by a particular morpheme (or natural class of morphemes), or morpho-syntactic construction (or natural class of constructions)

Throughout, I make no strict/formal distinction between syntax and morphology and use the term 'morphologically' as neutrally as possible.

2.1.3 Defining grammatical tone

2.1.3.1 What is it?

In tonal languages, tone is consistently found to function in the marking of grammatical categories and grammatical relations[1]. I collectively refer to such tonological operations as **grammatical tone** (**GT**), which I define as the following:

[1] I use the term 'grammatical' somewhat as a proxy for morphological/morphosyntactic grammar, and its interface with form and meaning. The use of 'grammatical' does not refer to phonological constituents such as those marked by boundary tones, though these are unquestionably part of a language's grammar. The use of 'grammatical' in the term 'grammatical tone' has never been used to refer to *phonological* grammar to my knowledge, and as such this convention has pre-existing currency.

[Def 5] **Grammatical tone (GT):** a tonological operation which is not general across the phonological grammar, and is restricted to the context of a specific morpheme or construction, or a natural class of morphemes or constructions (i.e. grammatically conditioned tone addition, deletion, replacement, shifting, assimilation, dissimilation, *etc*.)

A more technical definition is below.

(2)

a. **Given** a construction C_1 consisting of {x , y}, where {x} and {y} are
   i. a grammatically natural class of morphemes $\{m_1 , m_2\}$ or
   ii. a grammatically natural class of constructions $\{C_2 , C_3\}$
b. **If** there is a change in the tonal value of one of {x} or {y} in an output \ x^T y^T \ compared to the values in inputs / x^T / and / y^T /
c. **And** constructions $\neg C_1$ do not condition this change in the tonal value
d. **Then** the tonal operation can be called **grammatical tone**

All tonological operations have the potential to be grammatical tone, as long as they are restricted to a particular grammatical context and not phonologically general throughout the grammar. A schematized sample of GT operations is below. The different morphemes are highlighted in different colors for clarity.

	Grammatical construction C_1					Output	GT operation
	/ m_1	+	m_2	/ → \	m_1 m_2 \		
a.	Ⓛ	+	H | τ	→	ⓁH | τ	L̃H	Floating tone docking 1
b.	M Ⓛ | τ	+	H | τ	→	M ⓁH | | τ τ	M L̃H	Floating tone docking 2
c.	M | τ	+	H | τ	→	M | τ τ	M Ø	Deletion
d.	M | τ	+	H | τ	→	M ⓁⓂ | ∨ τ τ	M LM	Replacement
e.	M | τ	+	H | τ τ	→	M H | | τ τ τ	M ØH	Shifting
f.	L | τ	+	L | τ	→	L H | | τ τ	L H	Dissimilation
g.	L | τ	+	τ	→	L H | | τ τ	L H	Polarization
h.	H L ∨ τ	+	L | τ	→	H L | | τ τ	H L	Absorption
i.	L | τ	+	H | τ	→	L H | | τ τ	L L̃H	Horizontal assimilation
j.	L | τ	+	H | τ	→	L M | | τ τ	L M	Vertical assimilation
k.	H | τ	+	τ	→	H | τ τ	H H	Tone spreading

Table 3: Possible grammatically conditioned tonological operations

In this way, grammatical tone is a special type of morphologically-conditioned tonological operation, and in fact constitutes the fact majority of such cases. In section 2.2.1, I will show examples of morphologically-conditioned operations which are *not* technically grammatical tone because they involve floating tones on lexical items, e.g. a noun with floating Ⓛ after it.

Grammatical tone can express all types of grammatical meaning, and as such functions to manipulate the lexical meaning expressed by core lexical categories nouns and verbs. This includes nominal grammatical categories (definiteness, specificity, demonstratives, numerals, quantification, plurality, classification, case, etc.) as well as verbal ones (auxiliaries, tense, aspect, mood, agreement, etc.), and the various other inflectional and derivational categories. Relatedly, grammatical tone can signal grammatical relations which are not necessarily marked with a segmental morpheme, e.g. [OBJECT + VERB] construction in a transitive clause, a [POSSESSOR + POSSESSED] construction in a genitive clause, a [DEMONSTRATIVE + NOUN] clause,

among others. In many of these cases, the only phonological signal to the construction (other than linear order) is grammatical tone.

The majority of cases in this study involve GT interpreted as 'tonal morphemes', where a specific tonal pattern co-varies with a meaning consisting across contexts. Consider two types of 'tonal morphemes': **replacive tone** and **floating tone**. Two examples of replacive tone are from Jumjum [jum] (Andersen 2004:161, Trommer 2011:13) and Kalabari [ijn] (Harry & Hyman 2014). The Jumjum data are in (3)-(4).

(3) Jumjum replacive tone: L-replacement in modified nouns

	Underlying	Absolutive	Modified	Surface	Meaning
a.	/H/	ɖɛ́ːŋ	**ɖɛ̀ːŋ**	[**L**]	'cow'
b.	/L/	kùːn	**kùːn**	[**L**]	'thorn.SG'
c.	/HL/	cícàm	**cìcàm**	[**LL**]	'knife'
d.	/LH/	cʌ̀w-nʌ́	**cʌ̀w-nʌ̀**	[**LL**]	'arrow-SG'

(4) / bɔ̀rɔ́ŋ-gɔ́ ʔɔ̂ɔn / → [**bɔ̀rɔ̀ŋ-gɔ̀** ʔɔ̂ɔn]
cloth-PL man.SG 'the man's clothes'

[*Jumjum* – Andersen 2004:161]

In Jumjum, nouns have underlying tone shown at the left in (3), i.e. /H/, /HL/, /L/, /LH/. When the noun is modified in various contexts, the underlying tones of the noun are replaced by an all [L] pattern, e.g. /cícàm/ → \cìcàm\ 'knife', which Anderson says expresses the 'antigenitive case'. This constitutes GT as it involves a tonological operation mapping an input tone to an output low \L\, and it is restricted to a natural class of grammatical contexts, i.e. modified noun contexts. Example (4) shows that this tonal replacement is not restricted to a single morpheme, but targets all elements within the relevant domain such as a plural suffix.

The Kalabari case shows replacive tone consisting of more than a simple L.

(5) Replacive tone

				/ mí / 'this' (neut.)	/ mí˩˥ná / 'these'
				[H **LH**]	[H˩˥H **LH**]
a.	HH	/ námá /	'meat'	[mí **nàmá**]	[mí˩˥ná **nàmá**]
b.	LL	/ pùlò /	'oil'	[mí **pùló**]	[mí˩˥ná **pùló**]
c.	HL	/ bélè /	'light'	[mí **bèlé**]	[mí˩˥ná **bèlé**]
d.	LH	/ gàrí /	'garri (food)'	[mí **gàrí**]	[mí˩˥ná **gàrí**]
e.	H˩˥H	/ ɓá˩˥rá /	'hand'	[mí **ɓàrá**]	[mí˩˥ná **ɓàrá**]

[*Kalabari* - Harry & Hyman 2014:6]

As in Jumjum, nouns contrast for underlying tone values shown at the left. When they appear with demonstratives (e.g. *mí* 'this'), these underlying tones are replaced by a LH melody. Harry & Hyman show that modifiers idiosyncratically assign a replacive tone by class, e.g. possessive pronounces assign a H˩˥H~HLH while quantifiers assign an all L replacive tone.

In contrast, what are often called 'floating tones' in the literature (or 'concatenative' tone) do not involve this kind of replacement. Kalabari also illustrates this type with floating ⒽⓁ which expresses IMPERATIVE.

(6) Non-dominant GT / _ + ⒽⓁ/ IMPERATIVE

a.	/H/	/ só /	‘go’	\ **sô** \	‘go!’	
		/ ɓó /	‘come’	\ **ɓô** \	‘come!’	
		/ mú /	‘go’	\ **mû** \	‘go!’	
b.	/L/	/ sɔ̀ /	‘cook’	\ **sɔ̃** \	‘cook!’	
		/ bɛ̀ /	‘say’	\ **bɛ̃** \	‘say (it)!’	
		/ tù /	‘set’	\ **tû** \	‘set (a trap)!’	
c.	/HH/	/ ɔ́lɔ́ /	‘cough’	\ ɔ́**lɔ̂** \	‘cough!’	
		/ sáɓá /	‘cross’	\ sá**ɓâ** \	‘cross!’	(= [sáwâ])
		/ kúró /	‘fall’	\ kú**rô** \	‘fall!’	
d.	/LL/	/ lɛ̀gì /	‘sit down’	\ lɛ̀**gî** \	‘sit down!’	
		/ pìrì /	‘give’	\ pì**rî** \	‘give (it)!’	
e.	^{x}/HL/	-		-		
f.	/LH/	/ dʊ̀kó /	‘tell, talk’	\ dʊ̀**kô** \	‘tell (it)!’	
		/ sàkí /	‘get up’	\ sà**kî** \	‘get up!’	
g.	/H^{+}H/	/ ɔ́ˈlɔ́ /	‘hold’	\ ɔ́ˈ**lɔ̂** \	‘hold (it)!’	

[*Kalabari* – author fieldnotes]

Like nouns, verbs in Kalabari also contrast for underlying tone values shown at the left (note that there are no /HL/ verbs in row e. – Harry 2004:98). Every form of the verb in the imperative ends in a HL falling tone on the final TBU, illustrating the effect of the floating tone sequence. But unlike with the demonstratives in (5) above, the imperative does not replace the entire tone sequence and rather co-occurs with it. Lexical contrast is maintained, e.g. the minimal pair \ɔ́lɔ̂\ ‘cough!’ in (6)c. versus \ɔ́ˈlɔ̂\ ‘hold (it)!’ in (6)g. Lexical contrast maintenance, in fact, creates super marked structures such as three tonemes docking to a single TBU, e.g. L-toned /sɔ̀/ ‘cook’ → \sɔ̃\ ‘cook!’ in (6)b (with subsequent lengthening in the surface form to accommodate).

Replacive tone and floating tone represent two ends of a single cline. Some cases of GT only partially replace underlying tones, often subject to markedness and other phonological restrictions. Consider the Igbo dialectal data below [igbo1259] (Hyman & Schuh 1974:98-99; Hyman 2011).

(7)

a. Central Igbo: / àgbà + Ⓗ + èŋwè / → \ àgbá èŋwè \ ‘jaw of monkey’
b. Aboh Igbo: / ẹ̀gbà + Ⓗ + èŋwè / → \ ẹ̀gbà ẹ́ŋwè \ ‘jaw of monkey’

Here, two nouns in an associative construction are linked via a tonal morpheme, below represented as a floating tone Ⓗ between the nouns. This links to an underlying all-/L/ noun /àgbà/~/ẹ̀gbà/ ‘jaw’ or /èŋwè/ ‘monkey’, but only replaces one of the /L/ tones, not both. Hyman & Schuh point out that it docks to the left in Central Igbo, but to the right in Aboh Igbo.

Replacing a single toneme can be local or non-local, shown in San Miguel el Grande Mixtec [mig] (data from Mak 1950 and McKendry 2013, theorized in Zimmermann 2016 where this data was taken from).

(8)

a.

	MM			HM
/ kəbə	bīkō /	→	kəbə	**bí**kō
day	fiesta		‘fiesta day’	

b.

	LH		**H**H
/kʷāʔà	sùtʃî /	→	kʷāʔà **sú**tʃî
many	children		‘many children’

[*San Miguel el Grande Mixtec* – Zimmermann 2016:274]

San Miguel el Grande Mixtec has a ‘perturbation’ effect wherein words appear with H tone not present in the underlying form. Example (8) shows that this H tone replaces only the initial M and L tonemes of the second word in the phrase, a single toneme. The effect of this H tone perturbation for all possible two-TBU inputs is below (note that there are no / LL / forms).

(9)

	Underlying	Perturbed output	
a.	* / LL /		
b.	/ LM /	\ **H**M \	
c.	/ LH /	\ **H**H \	
d.	/ ML /	\ **H**L \	if (C)CVʔ(C)V or CV_1:
		\ M**H** \	if (C)CVCV or CV_1V_2
e.	/ MM /	\ **H**M \	
f.	/ MH /	\ MH \	
g.	/ HL /	\ HL \	
h.	/ HM /	\ HM \	
i.	/ HH /	\ HH \	

[*San Miguel el Grande Mixtec* – Zimmermann 2016:275]

In rows b.-e. the H tone replaces a single toneme, whereas in f.-i. the H tone does not replace one (or if it does, it replaces an underlying /H/ and is thus vacuous replacement). Importantly in row d., the H tone does not replace the initial TBU if the input is /ML/ with a specific segmental profile, but replaces the non-local TBU resulting in \M**H**\. Regardless of analysis, in all of these cases at most only a single toneme is replaced.

We can therefore place floating tone and replacive tone on a single cline, shown in Figure 1 below.

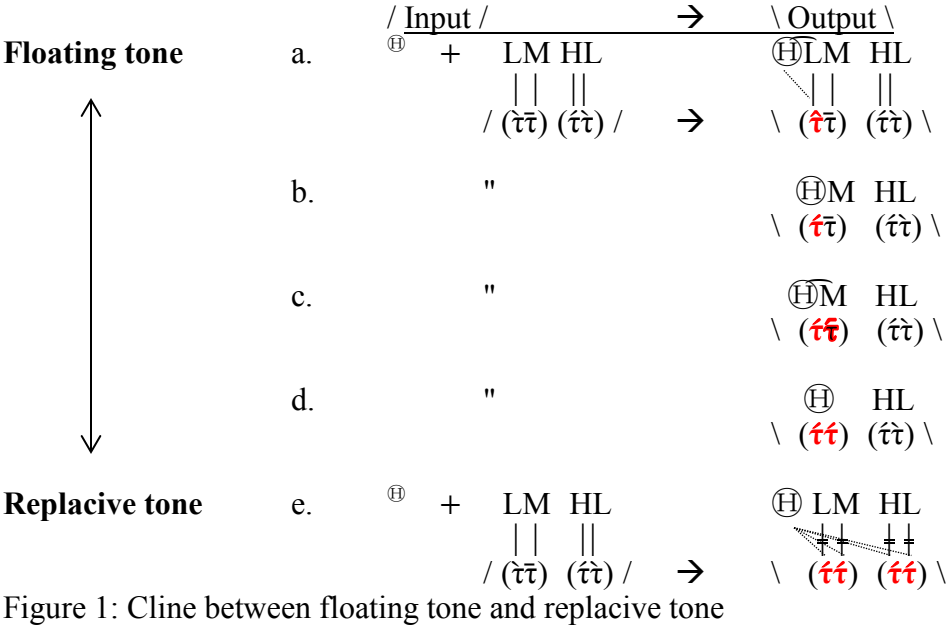

Figure 1: Cline between floating tone and replacive tone

At one end is a typical situation with a floating tone where it docks to a single TBU and does not replace any toneme. This is shown in row a. in this figure, where the input involves a floating tone ᴴ plus a two word unit in parentheses with underlying tone. The floating tone docks to the initial TBU of the first word, resulting in a falling contour \t̂\ (where it docks is shown in red and bold in the output). At the other end is 'replacive tone' which replaces all tonemes within the relevant domain, often over several words/morphemes. This is shown in row e., where H tone replaces all underlying tones from the input, resulting in an all high output over both words. Between these two end points is replacing only a portion of the input, whether the first TBU (row b.), the first TBU plus spreading onto the second (c.), or replacing all TBUs of the first word but not the second (d.). Such cases are attested, as will be seen throughout this study. Replacive tone is represented as floating tone in the diagram above, but other conceptions are possible and indeed advocated for (e.g. McPherson 2014 derives them through construction constraints).

For the purposes of this typology, I will treat *all* instances of replacement tone and floating tone as constituting grammatical tone. This is slightly at odds with the definition of GT in [Def 5] in which GT was defined as a tonological operation restricted to a particular grammatical context. In the Jumjum and Igbo cases, although the [L] and [H] tonemes are straightforwardly linked to the construction, the actual replacement/addition/docking/spreading operation might be seen as phonologically general and therefore not restricted to this context. In many cases, this boils down to whether one derives the patterns via a floating tone analysis, or via an alternative operation. To avoid this complication, I treat all such cases uniformly as GT.

Note that this definition does not say that grammatical tone is necessarily the *realization* (i.e. exponence) of a specific grammatical category itself, although it may be. From these Jumjum data alone, it is equally plausible to say that the toneme L is the realization of a grammatical category [MODIFIER], or to say that a tonological process of L-replacement takes place in this grammatical context. The difference amounts to saying that there is an exponence rule akin to MODIFIER ↔ /L/, or that L tone is merely licensed in modificational contexts but comes in for different reasons. In order to avoid deciding this for each GT token, I retain the broadest definition which encompasses both interpretations. I will discuss GT as exponence further in section 2.2.3 below.

Finally, having the definition of grammatical tone formulated in [Def 5] above allows us to have a single criterion for typologizing over grammatical tone patterns, which have different names depending on the analyst, phenomenon, and linguistic tradition. A sample of such names is provided below.

Name	**Notes**	**Source**
tonal morpheme	Co-occurs with no segments	[Welmers 1969, 1973; Yip 2002:106]
tonal affix/affixal tone		[Yip 2002:115]
tonal particle		[Yip 2002:114]
tonal suprafix		[Remijsen 2010: 289-290]
inflectional tone		[Palancar & Léonard 2016]
replacive tone	Africanist Literature	[Welmers 1973:132-133]
meaningful tone	Hmong literature	[Ratliff 2010]
morphological tone		[Zimmermann 2016]
morphosyntactic tone		[Palancar 2016:113]
melodic tone	Bantu	[Odden & Bickmore 2014]
floating tone		[Voorhoeve 1971; Hyman & Tadadjeu 1976]
tonal overlay		[McPherson & Heath 2016]
grammatical use of tone		[Ladefoged & Johnson 2011]

Name	Notes	Source
morphological use of tone		[Gussenhoven 2004:46]
syntactic use of tone		[Gussenhoven 2004:46]
tonosyntax		[Heath & McPherson 2013]
construction tonology		[Harry & Hyman 2014]
phrasal grammatical tone		[McPherson & Heath 2016]
melody replacement		[Rodewald 1989]
construction-specific tonology		[Yip 2002:107]
compacité tonale	Mande literature	[Green 2018]
tone perturbation	Americanist Tradition	[Pike 1948:25; Mak 1950]
tone change	Chinese: *bianyin* (cf. tone sandhi, *biandiao*)	[Chen 2000:30-31]
semantic-tonal process	SE/East Asian	[Kam 1980]

Table 4: Names for tonal phenomena associated with 'grammatical tone'

2.1.3.2 What is it *not*?

GT should not merely be considered the presence of underlying tone on a morpheme; some type of tonological operation must be present. In Standard Yoruba [yor] (Akinlabi & Liberman 2000), possessive pronouns have inherent underlying tone: the grammatical marker /ìrɛ̄/~/V̀rɛ̄/ 2SG.POSS 'your' has underlying /LM/ tone while the segmentally identical /īrɛ̀/~/V̄rɛ̀/ 3SG.POSS 'his/her' has /ML/ tone. The possessive pronoun paradigm is below, with the most relevant data being in rows b. and c. In this case, no tonological operation takes place because there is no change to the tonal structure in the input-to-output mapping.[2]

(10) *Not* grammatical tone - Yoruba possessive pronouns (non-clitic forms)

		/ ɔ̄kɔ̀ / 'car'		/ ɔ̄kɔ́ / 'hoe'		/ ɔ̄kɔ̄ / 'husband'	
a.	/ V̀mī / 'my'	\ ɔ̄kɔ̀	ɔ̀mī \	\ ɔ̄kɔ́	ɔ̀mī \	\ ɔ̄kɔ̄	ɔ̀mī \
b.	/ **V̀rɛ̄** / 'your'	\ ɔ̄kɔ̀	**ɔ̀rɛ̄** \	\ ɔ̄kɔ́	**ɔ̀rɛ̄** \	\ ɔ̄kɔ̄	**ɔ̀rɛ̄** \
c.	/ **V̄rɛ̀** / 'his/her'	\ ɔ̄kɔ̀	**ɔ̄rɛ̀** \	\ ɔ̄kɔ́	**ɔ̄rɛ́** \	\ ɔ̄kɔ̄	**ɔ̄rɛ̀** \
d.	/ V̄wā / 'our'	\ ɔ̄kɔ̀	ɔ̄wā \	\ ɔ̄kɔ́	ɔ̄wā \	\ ɔ̄kɔ̄	ɔ̄wā \
e.	/ V̄yḭ́ / 'your' (pl.)	\ ɔ̄kɔ̀	ɔ̄yḭ́ \	\ ɔ̄kɔ́	ɔ̄yḭ́ \	\ ɔ̄kɔ̄	ɔ̄yḭ́ \
f.	/ V̄w̄ / 'their'	\ ɔ̄kɔ̀	ɔ̄w̄ \	\ ɔ̄kɔ́	ɔ̄w̄ \	\ ɔ̄kɔ̄	ɔ̄w̄ \

[Akinlabi & Liberman 2000]

For these data, one cannot decompose the tonemes into a separate exponent, i.e. 2nd ↔ /LM/ and 3rd ↔ /ML/, given the differences in the plural forms. Parallel facts are seen in the San Ildefonso Tultepec dialect of Northern Otomi [otq] (Palancar 2016:113) where grammatical clitics can be distinguished by their underlying tone, e.g. minimal pair /dá=/ 1.CPL (completive) vs. /dà=/ 3.IRR (irrealis). Therefore, even though these examples involve a grammatical contrast involving tone (e.g. person, aspect, etc.), these cases do not meet the definition of grammatical tone.

Grammatical tone also is not **tonal allomorphy**. I define tonal allomorphy as the following, centered around the notion of productivity:

[Def 6] **Tonal allomorphy**:
- a. A morpheme has two or more underlying allomorphs
- b. The allomorphs have distinct tonal shapes but identical segmental shapes

[2] Note that this last statement applies only to the non-cliticized form of possessive pronouns.

c. The tonal allomorphs are found in complementary distribution conditioned by some linguistic element in its environment
d. Other morphemes which appear in this environment do not show tonal allomorphy (i.e. the alternation is not productive)

As an example of tonal allomorphy, consider the so called '*yi-bu-qi-ba* rule' in Standard Mandarin Chinese (Chang 1992:166-170; Chen 2000:22; Wang 2014; Yang 2015:14). Simplifying for our purposes, this rule applies only to four morphemes, namely *yī* /T1~55~H/ 'one', *bù* /T4~51~HL/ 'not', *qī* /T1~55~H/ 'seven', and *bā* /T1~55~H/ 'eight'. This rule obligatorily changes these morphemes into surface shape [35] when followed by a surface [53] TBU. Chen points to the following minimal pair with *bù* 'not' in (11)a. versus *bù* 'division, unit' in (b.), showing that this tonological process does not apply regularly.

(11) Tonal allomorphy in Mandarin Chinese with the *yi-bu-qi-ba* rule

a. *bù* *duì* 'not correct' <不对>
[35 53]

b. *bù* *duì* 'troops' <部队>
[53 53]

For these data, we can posit multiple tonal allomorphs for these morphemes, allomorphy not found for other morphemes, i.e. a morpheme *bù* with two tonal allomorphs /bu^{51}/ (elsewhere) and /bu^{35}/ (/__ 53). As such, this does not constitute a tonological rule or process, but rather selection akin to common segmental allomorphy such as English *sleep* with allomorphs /slɛp/ in the context of /-t/ PAST, and /slip/ elsewhere. In short, tonal allomorphy involves segmental and tonal units which enter the input as a single bundle, i.e. /bu^{35}/, whereas grammatical tone involves cases when the segmental and tonal structure enters the input separately, i.e. /cícàm/ + /Ⓛ/ (→\cìcàm\) in the Jumjum case in (3).[3]

Further, I also consider grammatical tone to be distinct from **tone sandhi**, defined as the following:[4]

[Def 7] **Tone sandhi**:
a. For a sequence of tonemes /T1 T2/ (often restricted to a specific phonological domain *D*)
b. There are a set of tonal alternations in the mapping of /T1/→\T1'\ and/or /T2/→\T2'\
c. Which are not conditioned by a grammatical property of either /T1/, /T2/, or the construction which /T1 T2/ forms

[3] There are several attempts to reduce *all* tonal alternations (and morphophonemic alternations generally) to allomorphy regardless of predictability and productivity, e.g. Archangeli & Pulleyblank (2015) and Anghelescu et al. (2017) for tone, as well as Green (2006) for consonant mutation (discussed in McPherson 2014:48-50). I will not consider this approach here, if only for the fact that it is too radical a departure from this study to provide any succinct criticism. I return to these models at the end of chapter 6.

[4] Other attempts to define tone sandhi can be vague, e.g. Chen's (2000:19) definition of it as a process which 'alter[s] the phonetic shape of adjacent tones, when they come into contact with each other in connected speech'. His definition reflects the fact that he sees no essential difference between TS (by hypothesis a phonological operation part of the phonological grammar) and tonal coarticulation (articulatory implementation of a motor plan fed from the phonological module) (Chen 2000:27).

d. But rather, is triggered by the underlying tonological value of /T1/ and/or /T2/, or from being in a specific phonological position (e.g. non-final or non-initial within a domain)
e. And therefore the alternation is phonologically general

A famous example of tone sandhi which meets this definition is Beijing Mandarin 'third tone sandhi'. Mandarin has four tonemes (where 5 = highest pitch): T1 /5/ (/ma^{55}/ 'mother'), T2 /35/ (/ma^{35}/ 'hemp'), T3 /214/ (/ma^{214}/ 'horse'), and T4 /51/ (/ma^{51}/ 'to scold'). The third tone T3 /214/ dissimilates to T2 /35/ when it precedes another T3 /214/, shown in (12) below. This tone change is conditioned by the underlying tonological value of the second unit and is not triggered by grammatical context (contexts which are diverse, e.g. [ADJ N], [N ADJ], [V OBJ], etc.).

(12) Tone sandhi in Chinese

a.	/ T3 T3 /	→	\ **T2** T3 \
	/ τ^{214} τ^{214} /	→	\ τ^{35} τ^{214} \
b.	/ xiao^{214} gou^{214} /	→	\ xiao^{35} gou^{214} \
	small dog		'small dog, puppy'
c.	/ dan^{214} xiao^{214} /	→	\ dan^{35} xiao^{214} \
	gall small		'coward'
d.	/ mai^{214} ma^{214} /	→	\ mai^{35} ma^{214} \
	buy horse		'to buy a horse'

[*Beijing Mandarin* - Chen 2000:20-21]

We will return to cases of **grammatical tone sandhi** in chapter 3, which are like tone sandhi in being triggered by the underlying tonological value of a toneme, but are like grammatical tone in that they only occur in a highly restricted set of grammatical contexts. At this point, we should merely understand that tone sandhi and grammatical tone are distinct phenomena.

The final two prosodic phenomena which I distinguish from grammatical tone are **boundary tones** and **intonation**. Boundary tones demarcate prosodic constituents, and are phonologically licensed and not limited to particular grammatical contexts. A definition of boundary tones is below:

[Def 8] **Boundary tone**: A toneme which is inserted at the edge of a phonological constituent
e.g. / (ϕ τ … τ) / > \ (ϕ τ … $\acute{\tau}$) \

Further, intonation is like GT in that it involves isolatable prosodic units which can be associated with specific meaning, albeit expressing sentence-level meanings (e.g. declarative vs. interrogative). We may call the units of contrast 'intonemes' to distinguish them from 'tonemes' in GT. A definition adapted from Ladd (2008) and an example from Gibbon (1998) is below.

[Def 9] **Intonational tone (Intoneme)**: prosodic units of contrast which express sentence-level pragmatic meaning (definition adapted from Ladd 2008)
e.g. H-H% <-> INTERROGATIVE (German – Gibbon 1998:82)

The relationship between intonation and grammatical tone requires a study onto itself and I will not comment on it further.

2.1.4 GT components

In this section, I lay out the terminology used in describing the components of grammatical tone. To illustrate these components, I will first use a grammatical tone pattern found in Kalabari introduced above, in which a demonstrative assigns a [LH] pattern to a noun and neutralizes its underlying tones (part of a network of GT patterns in the language). The tone change here is from /TT/ > \LH\, and is not phonologically general. [Note ˈH is a downstepped H]

(13) Kalabari demonstrative GT

			/ mí / 'this' (neut.)	/ míˈná / 'these'
a.	HH	/ námá / 'meat'	\ mí nàmá \	\ míˈná nàmá \
b.	LL	/ pùlò / 'oil'	\ mí pùló \	\ míˈná pùló \
c.	HL	/ bélè / 'light'	\ mí bèlé \	\ míˈná bèlé \
d.	LH	/ gàrí / 'garri (food)'	\ mí gàrí \	\ míˈná gàrí \
e.	HˈH	/ ɓáˈrá / 'hand'	\ mí ɓàrá \	\ míˈná ɓàrá \
			\ H LH \	\ HˈH LH \

[Harry & Hyman 2014:6]

The figure below deconstructs the input-to-output mapping in (13)c.

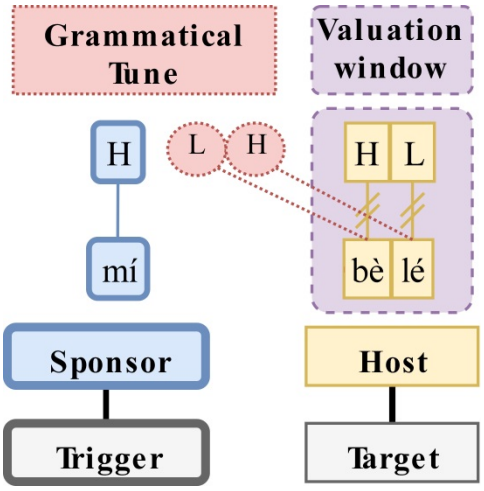

Figure 2: Full components of grammatical tone

The first component is the **grammatical tune** (or GT tune). In this case, the grammatical tune is the [LH] pattern which appears on the noun. I define it as the following:

[Def 10] **Grammatical tune**: the unique tone sequence (or set of tone sequences) which covaries with the grammatical tone construction

In the cases presented in the previous section, we can refer to the surface [L] pattern in Jumjum (3) and the docked [H] toneme in Igbo (7) as the grammatical tune. In many cases, the grammatical tune will be the same as the underlying tone value of the sponsor, in which case the most straightforward analysis is tone spreading.

Two other components are the **sponsor** and the **host** (which can be further specified as GT sponsor and GT host).

[Def 11] **Sponsor**: the morpheme (or natural class of morphemes) which covaries with the grammatical tune

[Def 12] **Host**: the morpheme or morphemes on which the grammatical tune appears

In the Kalabari example, the sponsor is the demonstrative /mí/ which covaries with the [LH] grammatical tune and the host is the noun /bélè/ 'light' on which the [LH] tune appears, i.e. [bèlé]. In such cases, the grammatical tune can said to originate from the sponsor, and as such it can be thought of as part of the underlying tonal structure of this morpheme, e.g. as /mí$^{\text{Ⓛ Ⓗ}}$/ with a pre-linked /H/ tone and a floating tone sequence.

We also need to define two related components, the **trigger** and the **target** (or GT trigger and GT target), common roles in (morpho)phonological operations.

[Def 13] **Trigger**: the morpheme or construction which licenses the tonological operation

[Def 14] **Target**: the morpheme or morphemes which is the intended undergoer of a tonological operation

In most instances of GT, the trigger will be coextensive with the sponsor and the target with the host. In the Kalabari case, the trigger of the GT pattern can be said to be the demonstrative and the target can be said to be the noun. When this is the case, I refer to the relevant morpheme(s) as the **trigger-sponsor** and **target-host** respectively. In others case it may be useful to make the distinction (see immediately below).

Finally, the portion of the target-host which is relevant for the grammatical tune docking is the **valuation window**:

[Def 15] **Valuation window**: the portion of the target-host which is evaluated with respect to whether its TBUs are valued or unvalued; this can be coextensive with the target-host, or strictly a local subconstituent

In the Kalabari case, the valuation window was the entire target-host (the entirety of which was subject to tone replacement). Next in chapter 3 on dominance effects, we will see different sized valuations windows.

The concepts of 'trigger' and 'sponsor' are very similar, as are 'target' and 'host'. I distinguish them for a number of reasons. First, the terms sponsor and host are neutral in the sense that one can reasonably infer them from the surface pattern of the language. In contrast, classifying the 'trigger' and 'target' largely constitute analytic decisions. For example, one could say that the demonstrative morpheme itself is the GT trigger, or that the construction [DEM N] is the trigger. This ambiguity is compounded by the fact that all demonstratives license this tonological operation, but no other nominal modifiers do so. This type of ambiguity is often found with constructions without overt segmental material signaling the construction. For example, in the Igbo cases above, the associative construction can be schematized as [N_1 $^{\text{Ⓗ}}$ N_2]. One might say that the associative *construction* itself is the trigger and licenses a high tone. Alternatively, one says that there is an abstract associative *morpheme* which occurs between the nouns and is segmentally null.

In many such cases, the sponsor and trigger can be differentiated. Consider associative constructions in Nkoroo [nkx] (Akinlabi, Connell, & Obikudo 2009). Here, the first noun of the [N_1 N_2] construction surfaces with its underlying tones, but the second noun bears a pattern determined by the final toneme of N_1.

(14) / + tɔ̀kú / ‘child’

a. / ánáná / ‘sheep’ ánáná **tɔ́kù** ‘lamb’
b. / wárì / ‘house’ wárì **tɔ̀kù** ‘domestic servant’
c. / ɓɔ̀ɔ̀kɔ̀ / ‘chicken’ ɓɔ̀ɔ̀kɔ̀ **tɔ̀kù** ‘chick’

[*Nkoroo* - Akinlabi, Connell, & Obikudo 2009]

If the final T of N_1 ends in /H/, N_2 bears a [HL] pattern; if it ends in /L/ it bears an all [L] pattern. This is schematized below.

N_1 \ N_2	HH	LL	HL	H↓H	LH
HH	HH HL	HH HL	HH HL	HH HL	HH HL
LL	LL LL	LL LL	LL LL		LL LL
HL	HL LL	HL LL	HL LL		HL LL
H↓H					
LH					

Table 5: Nkoroo [N_1 N_2] constructions (Grey cells = No data available)

In this case, one can say that there are two grammatical tunes in complementary distribution. One of these surface ‘allotunes’ [HL] covaries with nouns ending in /H/ while another [LL] covaries with nouns ending in /L/. We can therefore reasonably state that the N_1 is the sponsor of the grammatical tune. However, the trigger of the grammatical tone as a whole is not the first noun, but rather the associative construction itself, or equivalently a segmentally null associative morpheme. Here, the sponsor (N_1) and the trigger (an abstract associative morpheme) are not the same. Note that in many cases, one may devise alternatives to conflate the trigger and sponsor together; I maintain that such a move should be done on a case-by-case basis.

Similarly, the target endows the grammar with intention and is therefore an analytic decision, as opposed to host which is sufficiently neutral. Moreover, there are several cases where the host and target differentiate. First, in many cases a morpheme is an unsuitable host for a grammatical tune. A common reason is that docking the grammatical tune to the host would result in a marked structure banned in the grammar (although we will actually see in chapter 3 that interactions of markedness and grammatical tone are surprisingly limited). In Giphende [pem] (Hyman 2017:113-114), there are several types of grammatical $^{Ⓗ}$ tones which dock to the left-edge of a noun, each showing different behavior and expressing different meanings. One type of grammatical tone I call $^{Ⓗ}_{1}$ marks a focused object, and only docks to the left edge if no /H/ tone already exists on the noun. As shown in (15), /$^{Ⓗ}_{1}$ + L-LL/ outputs as \Ⓗ-ⒽL\ with a docked $^{Ⓗ}$. In contrast, it does not dock to nouns with underlying /L-LH/, /L-HL/, or /L-HH/.

(15)	/ L-LL /	/ L-LH /		/ L-HL /	/ L-HH /
/ $^{Ⓗ}_{1}$ /	Ⓗ-ⒽL	L-LH		L-HL	L-HH
		(*Ⓗ-LH)	(*Ⓗ-ⒽH)	(*Ⓗ-HL)	(*Ⓗ-HH)

In all four cases, the target of the grammatical tune is the noun. However, the only one in which there is an actual host of the grammatical tune are /L-LL/ inputs.

In other cases, there is evidence that one morpheme (or set of morphemes) is the target but the actual host is another morpheme (or set). In Tommo So [dto] (Dogon – McPherson & Heath 2016), many nominal modifiers are triggers of grammatical tone (their term is ‘controllers’), assigning a grammatical tune to a target. For example, the post-nominal demonstrative *nɔ́* ‘this’

assigns /L/ tone, shown in (16). I adopt the representation /Ⓛnɔ́/, but note that they do not adopt this representation. This targets any morpheme within its scope, which results in the grammatical tune L hosted on the noun in (a) and the [NOUN ADJECTIVE] construction in (b).

(16)

a.

H	Ⓛ H			Ⓛ H	
/ \	|			⋰ |	
gámmá	+ nɔ́	→		gàmmà nɔ́	
cat	this			'this cat'	

b.

H	H	Ⓛ H				Ⓛ	H
/ \	|	|				⋰	|
gámmá	+ gɛ́m	+ nɔ́	→		gàmmà gɛ̀m		nɔ́
cat	black	this			'this black cat'		

In contrast are the data in (17) which are in free variation. These examples involve an alienable possessor /ḿmɔ/ 1SG.POSS, which the grammatical tune cannot affect. This results in either the head noun hosting the Ⓛ tune while the possessor retains its underlying tones (ex. a), or the tune falling on the sponsor-trigger demonstrative *nɔ́* itself (ex. b), in which case both the noun and the possessor retain underlying tones. McPherson & Heath refer to this latter situation as 'self-control', a topic we will return to in Chapter 3 (there it is called 'self-docking').

(17)

a.

H	H	Ⓛ H				Ⓛ	H	H
/ \	|	|				⋰ |	|
gámmá	+ ḿmɔ	+ nɔ́	→		**gàmmà**		ḿmɔ	nɔ́
cat	1SG.POSS	this			'this cat of mine'			

b.

H	H	Ⓛ H				H	H	Ⓛ
/ \	|	|				/ \	|	⋮
gámmá	+ ḿmɔ	+ nɔ́	→		gámmá		ḿmɔ	**nɔ̀**
cat	1SG.POSS	this			'this cat of mine'			

[*Tommo So* – McPherson & Heath 2016:597,623]

Across Tommo So (and indeed the Dogon family as a whole), the target of the grammatical tune are whatever morphemes are in its scope, potentially resulting in multiple host morphemes. It would therefore be uniform if we adopt that the target includes the possessor *ḿmɔ* in (17) above, even though it cannot host the grammatical tune. The actual host *nɔ́* in b. is not the target but only a 'last resort option' under exceptional conditions (emphasized by the authors).

We have sketched above situations in which these components - tune, trigger, sponsor, target, and host - are overt and transparent. Recall, however, that our definition of a tonological operation was not merely adding or replacing tone, but consists of the full range of tonal phenomena which include pure deletion, tone undocking and redocking to a different TBU (horizontal shifting), scalar tone shifts in 3+ height tone systems (vertical shifting), assimilation, dissimilation, plateauing, among many other types. As such, in many of these cases it may not be appropriate to identify one or more of these components. In Japanese, when certain affixes attach to a stem, they delete underlying tone on the stem. In (18)a., the suffix itself has an underlying tone, but in b. the suffix bears no tone and the result is an entirely toneless word (this gets a default prosodic pattern on the surface, post-phonology).

(18)

a.	/ kíza + ppó-i /	→	\ kiza-p**pó**-i \	‘snobbish’
	/ HØ + H-Ø /		\ ØØ-H-Ø \	
b.	/ kéizai + teki /	→	\ **ke**izai-teki \	‘economic’
	/ HØØØ + ØØ /		\ ØØØØ-ØØ \	

[*Japanese* – Kawahara 2015:468,470]

In this case, we can call the suffix the trigger and the root the target of a tonological operation which deletes the underlying tone. However, there is no grammatical tune as such being assigned, and therefore there is no sponsor or host. Other cases involving non-straightforward grammatical tunes and hosts will be discussed as they come up below.

2.1.5 Grammatically natural classes

In many cases, a GT pattern is not restricted to a single morpheme but rather is present in the context of a number of morphemes which together form a **grammatically natural class**. For example in Kalabari in (5) above, the entire natural class of demonstratives covary with a LH replacive tone.

In many cases it may be difficult to confirm this aspect, as ascertaining grammatical naturalness often requires specialist knowledge of the language in question. Consider Giphende [pem] (Bantu – Hyman 2017:113-114), introduced above. Giphende has four types of grammatical H tones which dock to the left-edge of a noun, each showing different behavior. For example, the noun /gi-kómbó/ ‘broom’ (Fr: *balai*) in subject position surfaces as [gì-kómbó] with [LHH] (*gi-* is a nominal prefix NC7). In contrast, in ‘prédicatif’ position this is [gí-kómbó] with all high, and in object position it is [gí-ˈkómbó] with downstep. A schematic table is below. Note that the /L-/ portion of each noun is the nominal prefix.

		/ L-LL /	/ L-LH /	/ L-HL /	/ L-HH /
Ø		L-LL	L-LH	L-HL	L-HH
/ Ⓗ$_1$ /	[FOC]	H-HL	L-LH	L-HL	L-HH
/ Ⓗ$_2$ /	[GEN]	H-HL	H-LH	L-HL	L-HH
/ Ⓗ$_3$ /	[ACC]	H-HL	H-HˈH	H-ˈHL	H-ˈHH
/ Ⓗ$_4$ /	[PRED]	H-HL	H-LH	H-HL	H-HH

Table 6: Giphende floating Ⓗ grammatical tunes
(white = no docking; shades of grey = different surface values in column)

The underlying tones of nouns surface in citation, subject position, the object of a negative infinitive, and under left-dislocation, represented in the top row (with no floating tone). As seen, for all other rows the forms acquire a H tone, however with quite different properties. I label these as high tones Ⓗ$_1$-Ⓗ$_4$ and posit features for each class based on Hyman’s description, e.g. [GEN] for genitive. The grammatical distribution of the four contexts is below.

Floating Ⓗ type			Feature	Grammatical distribution
Existential OCP[5]	Ⓗ$_1$	↔	[FOC]	focused object
Adjacent OCP	Ⓗ$_2$	↔	[GEN]	genitive, second object, object after negative verb, subject after relative verb
Downstepping	Ⓗ$_3$	↔	[ACC]	object after affirmative verb, object after *na* 'with'
No OCP	Ⓗ$_4$	↔	[PRED]	predicative 'it's X'

Table 7: Giphende grammatical tones – Grammatical natural classes (?)

It is not straightforward whether the grammatical distribution forms a natural class, e.g. do the contexts of [GEN] form a natural class to the exclusion of the other contexts? In some cases, one may have to assume grammatical tone homophony, such as Ⓗ$_{2a}$ ↔ [GEN] and also Ⓗ$_{2b}$ ↔ [SUBJ.REL]. Because defining grammatical natural classes is more rightly under the purview of morphosyntax, we leave this issue aside.

2.2 Where is it and what is it for?

Like more familiar segmental units of contrast, tonemes can express the full range of grammatical meaning known to language, and can also come to cue grammatical meaning and constructions through tonological processes. In this section, I highlight the functions which GT plays in expressing grammatical meaning. It should be kept in mind that it is often an analytic decision whether to attribute a tonological change to a prosodic unit of contrast such as a toneme, as opposed to altering the phonological grammar in some way. This uncertainty extends to most cases of so called process morphology (Inkelas 2014). Therefore, even though in what follows I assume tonemes such as floating tones Ⓣ (as I have above), alternatives exist which do not involve such unit of contrasts.

2.2.1 GT as exponence

Grammatical tone can function to express grammatical meaning in three main ways. In one, a sequence of tonemes is the sole exponence of the grammatical meaning. For example, in the Igbo case in (7) above the associate construction [N1 Ⓗ N2] appears with a floating H, which we can call the exponence of a grammatical meaning 'associative', i.e. [ASSOCIATIVE] ↔ Ⓗ. I will refer to this situation as **independent prosodic exponence**, defined as follows:

[Def 16] **Independent prosodic exponence**: exponence of a grammatical category only by prosodic units of contrast (e.g. tonemes, accent, prosodemes, intonemes, *etc*.), with no segmental units of contrast (e.g. vowels, consonants, *etc*.)

I intentionally use the term 'prosodic' here to include prosodic units of contrast other than tone, although the focus of this typology will remain on GT. From the perspective of segmental exponence, independent prosodic exponence is often highlighted as remarkable and has been described with a number of special terms ('tonal affix', 'tonal morpheme', etc. – see list in Table 4 above).

In contrast is what I call **auxiliary prosodic exponence** in which a grammatical category is exponed both by segmental units of contrast and separately by prosodic units of contrast. An example of this was seen in Kalabari, in which nouns which co-occur with the demonstrative

[5] Existential refers to the fact that the mere existence of a H toneme anywhere within the domain causes the floating Ⓗ$_1$ not to dock. 'Existential OCP' is equivalent to 'skeleton-insensitive OCP' in Hyman (2012:27).

‘this’ (neut.) have their underlying tones replaced by a [LH] grammatical tune. I hypothesize in this case the exponence to be [DEM][PROX][NEUT] ↔ /mí$^{\text{Ⓛ Ⓗ}}$/, where the floating toneme sequence docks to the noun. We can define auxiliary prosodic exponence as the following:

[Def 17] **Auxiliary prosodic exponence**: the exponence of a grammatical category by segmental units of contrast (e.g. vowels, consonants, *etc*.), and by co-occurring *auxiliary* prosodic units of contrast (e.g. tonemes, accent, prosodemes, intonemes, *etc*.), separate from these segmental units of contrast

In the Kalabari demonstrative /mí$^{\text{Ⓛ Ⓗ}}$/, the auxiliary prosodic exponents are the floating tones /$^{\text{Ⓛ Ⓗ}}$/ which dock to the noun. The use of the term ‘auxiliary’ here is meant to differentiate it from ‘prosodic exponence’ generally, which includes both the floating tones and the H tone pre-linked to the segmental exponence /mí/. In several cases it will not be clear how to differentiate these, but in those cases where it is this terminology can be employed.

Auxiliary prosodic exponence is related to the family of phenomena known as ‘multiple exponence’ or ‘extended exponence’ (see Harris 2017 for a recent overview, which includes several examples of GT). I coin the term ‘auxiliary prosodic exponence’ rather than use a pre-existing term for several reasons. The first reason involves the definition of multiple exponence. The GT patterns presented above are in fact quite analogous to the early examples said to constitute multiple exponence (e.g. Matthews 1972:82; Matthews 1974), For example, in German, plurality is marked by a number of strategies including suffixes *-e*/*-er*, umlaut, and their combination:

(19)	Singular	Plural	Meaning
a.	Arm	Arm-**e**	‘arm’/‘arms’
b.	Vater	V**ä**ter	‘father’/‘fathers
c.	Hals	H**ä**ls-**e**	‘neck’/‘necks’
d.	Bild	Bild-**er**	‘picture’/‘pictures’
e.	Wurm	W**ü**rm-**er**	‘worm’/‘worms’

[*German* - Matthews 1974: 149–150; modified from Harris 2017:18]

Auxiliary prosodic exponence most closely resembles those examples in c. and e. However, it is controversial whether examples of this type constitute multiple exponence. For Harris, the definition of multiple exponence crucially involves multiple realizations of a feature:

> *“Multiple (or extended) exponence is the occurrence of* ***multiple realizations*** *of a single morphosemantic feature, bundle of features, or derivational category within a word.”*
>
> [Harris 2017:9; bolding mine]

In the German example, the suffix *–e* and umlaut can appear independent from one another (a.-b.), or together (c.), and are therefore different realizations, meeting the definition.

However, Harris also notes the following:

> *“The use of plural –*er *always coincides with the use of umlaut when possible; that is, when there is a back vowel in the last syllable of the noun stem, nouns that use an* -er *plural also undergo umlaut. Thus, the use of umlaut is predictable from the use of the* -er *plural suffix, and therefore... cannot be considered [multiple exponence].”*
>
> [Harris 2017:18]

Rather, she calls these cases 'bipartite morphemes', which constitute cases when "one of the exponents is dependent upon the other in fulfilling the function or meaning that it fulfills" (p. 20). Unlike multiple exponence, bipartite morpheme constitutes a *single* realization. I therefore use the term auxiliary exponence in order to avoid these terminological complications, but am neutral as to their relationship.[6]

We have established independent prosodic exponence and auxiliary prosodic exponence. A third way in which grammatical tone functions to express grammatical meaning is not through exponence *per se*, but rather via another tonological process. This is the most abstract way in which GT expresses meaning. One example is from Jita [jit] (Bantu – Downing 1996, 2014). Like in many Bantu languages, underlying H tones are not permitted to be adjacent. In Jita, Meeussen's Rule applies which deletes the second of two adjacent Hs, i.e. /HH/ → \HØ\. However, the prefix /amá-/ YP 'yesterday past' is exceptional: with this morpheme it is the first /H/ which deletes (that one on /amá-/) rather than the second (so-called Reverse-Meeussen's Rule). This is shown in (20) below.

(20)

a.	/ a – **amá** – gósora /	→	\ a – a**ma** – gósora\	[a:magosóra]
	SM-**YP**-visit			's/he visited'
b.	/ a – **amá** – kú – sakira /	→	\ a – a**ma** – kú – sakira \	[a:makusákira]
	SM-**YP**-OM-help			's/he helped you'
c.	/ a – **amá** – kú – gósorera /	→	\ a – a**ma** – kú – **go**sorera \	[a:makugósorera]
	SM-**YP**-OM-visit			's/he visited you'

[*Jita* – Downing 1996:64-67]

The exceptional deletion rule with /amá/ applies in all three examples when it is adjacent to a high tone. In contrast, the phonologically general Meeussen's Rule applies only in c. when the object marker (OM) /kú-/ appears adjacent to a H-toned verb stem. Locations of H tone deletion in the output are boxed. Note that in the surface form in [ ], the location of H tone moves one TBU to the right due to an independent tone shift operation.

In the Jita example, we can say that the grammatical meaning is exponed as [YP] ↔ /amá-/, but part of the indexation of this grammatical meaning is the idiosyncratic application of Reverse-Meeussen's Rule. Note that issues such as this justify enriching the substance of exponence beyond merely segmental and prosodic units of contrast. In part II 'A theory of grammatical tone', I do so via Cophonology Theory allowing morpheme-conditioned constraint reranking.

2.2.2 Where is GT located in the world?

No previous survey exists to my knowledge which appraises tonal languages for the degree to which they employ grammatical tone. This is largely due to disagreement on what constitutes a tone language (e.g. 'pitch accent' systems like Japanese), and the lack of a coherent definition of grammatical tone itself. In what follows, I present a brief overview of where GT is most found. Those less interested in this brief areal typology can turn directly to section 2.3 discussing what meaning GT expresses.

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[6] Moreover, by calling this auxiliary exponence, I avoid taking a stance as to whether the segmental material is 'primary' and the grammatical tune is 'secondary' (cf. Noyer 1997's distinction between primary and secondary exponents), or whether GT constitutes what has been called 'distributed exponence' (whose definition depends on the author). See further discussion in Baerman, Brown, & Corbett (2010) and Caballero & Harris (2012).

Given my broad definition of GT as a grammatically-conditioned tonal operation, it would be both unfeasible and uninformative to distinguish languages with and without GT as a whole. Virtually all tonal languages exhibit GT, and it is exceptional to *not* have it. I instead summarize (1) areal trends involving independent prosodic exponence and auxiliary prosodic exponence in which the GT pattern can be said to more 'directly' correspond to grammatical meaning, and (2) trends where the degree of GT (whether exponence or non-exponence) is particularly high, often involving languages with several 'layers' of grammatical tone when morphemes and constructions are combined to express higher order meaning targets. Even noting these self-imposed restrictions, it is not feasible at this point to quantify a language as to the degree to which it employs GT. Any relevant quotient of GT would only be meaningful against the number of morphemes or constructions in the language which do *not* use GT, but which hypothetically could. Therefore, as I present the typological profiles of largescale areas the reader should keep in mind the inherent shortcomings of any such survey in the absence of quantitative data.

The map in Figure 3 from the *World Atlas of Language Structures* (WALS) illustrates the distribution of tone systems in the world's languages (Maddieson 2013).

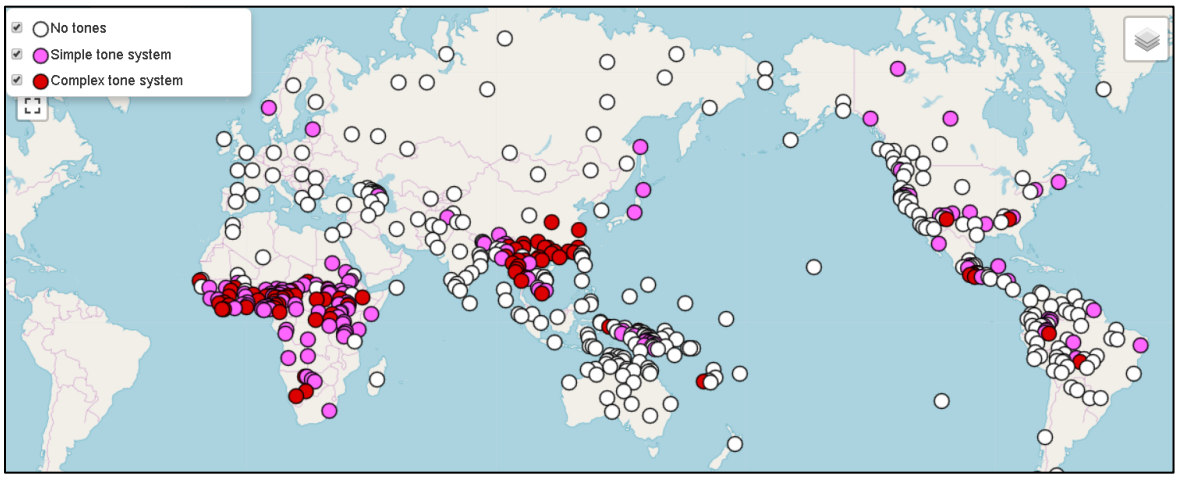

Figure 3: Map of tonal languages (WALS – Maddieson 2013)
[Simple systems = having only a two-way basic contrast, e.g. H vs. L/Ø]

From this map, areas with the highest concentrations of tone are (sub-Saharan) Africa, east and southeast Asia, and Mexico/southern USA. Smaller zones include northwest Canada, western Amazon, northern Europe, northern Pakistan, and New Guinea.

2.2.2.1 Africa

All tonal languages in Africa exhibit GT, typically robustly, and no language has been reported with only lexical tone (Hyman et al. in press). The widespread use of GT cuts across all other typological dimensions, such as toneme inventory, syllable shape phonotactics, degree of morphology, headedness parameter, *etc*. It is found robustly in both highly analytic languages such as the Ijoid family with almost no segmental morphology as well as in languages at the synthetic end e.g. Bantu, Kainji, and several Kordofanian languages. I will begin this discussion by moving west to east, discussing genetic families. I make no claim as to the validity of these groupings, and adopt them only out of convenience.

The Greenbergian stock Niger-Congo (Greenberg 1963) stretches from the Atlantic Ocean in Senegal west into Kenya/Somalia in the East, and southwardly to South Africa due to the Bantu expansion. In the far west, many Atlantic languages are toneless (e.g. Wolof, Fula, Sereer), but those that are tonal employ GT, e.g. Kisi [kiz] (South Atlantic – Childs 1995:55).

Moving eastward, GT plays a major role in both the nominal and verbal systems of the Dogon family in Mali (Prokhorov 2011; Heath & McPherson 2013; McPherson 2013, 2014; McPherson & Heath, 2016; a.o.), laid out extensively in McPherson (2014) where underlying tones of nouns and verbs are systematically overridden by modifier tones for nouns, and inflectional categories/affixes for verbs. In the same area, GT is widespread in Mande languages. Green (2018) lays out systematically the use of tone in marking [ASSOCIATIVE]~[N_1 N_2] constructions across Mande, especially in the SW Mande branch such as Liberian Kpelle [xpe] (Welmers 1969), Bandi [bza] (Rodewald 1989), and Loma [lom] (Sadler 2006). Mande languages Seenku [sos] McPherson (2016, 2017a, 2017b) and Jalkunan [bxl] (Heath 2017) in the same proximity as the Dogon languages mentioned above also show complex grammatical tone behavior, the former illustrating grammatical tone sandhi (described in chapter 3). The Gur/Senoufo family of West Africa also robustly employs grammatical tone, such as Konni [kma] (Cahill 2000), Kabiye [kbp] (Roberts 2013, 2016), Dagbani [dag] (Hyman & Olawsky 2013), and complex changes in Supyire [spp] which straddle the grammatical tone/tone sandhi distinction (Carlson 1994). In the same wider area, the Kru family is less well-described but GT still has a clear function, e.g. in Guebié [gie] (Sande 2017) where GT is used to express aspectual difference (specifically expressing imperfective).

Moving further east, GT patterns proliferate across the Kwa subgroup, e.g. in Foodo [fod] marking imperatives (Plunkett 2009) and in Asante Twi [aka] marking the verb when a noun is extracted (Korsah & Murphy 2017:3 – example in (24) below). Within the neighboring Benue-Congo subgroup to its east, GT is widespread in the families Edoid (e.g. Elugbe 1989), Igboid (see above), Platoid (e.g. Izere [izr] - Lukas & Willms 1961), Delta-Cross (e.g. the extensive function of GT in in verb paradigms in Kana [ogo] – Ikoro 1996:375-404), and of course Bantu, discussed below. Note, however, that within this vast area GT plays a much smaller role in languages along the coast between Benin and SW Nigeria, e.g. the Defoid languages (e.g. Yoruba [yor]) and Gbe languages (e.g. Ewe [ewe]). These languages are exceptional in a number of others ways compared to other languages in their family/area, e.g. their radical analyticity (McWhorter 2016) and lack of cross-height ATR Harmony (Rolle, Faytak, & Lionnet 2017).

The geographically proximate but genetically unrelated Ijoid family employs GT to an extreme degree, with frequent use of the replacive GT type, as well as independent prosodic exponence and auxiliary prosodic exponence (Jenewari 1977; Williamson 1965, 1988; Efere 2001; Harry 2004; Akinlabi et al. 2009; Harry & Hyman 2014). The example above in (13) from Kalabari [ijn] was representative of GT in this family. The grammatical tune starts from its sponsors and targets every morpheme within its relevant domain, resulting in mass neutralization. Despite this, all Ijoid languages maintain clear lexical tone contrasts.

Further east still but remaining within the Niger-Congo stock are the Adamawa, Gbaya and Ubangi families, all of which are noted as having GT, again, often robustly. These include Mambay [mcs] (Anonby 2008), Yakoma [yky] (Boyeldieu 1995), and many other Ubangian languages surveyed in Boyd (1995), as well as Gbaya languages, where floating tones are common as in Gbáyá Ɓòdòè [gya] (Roulon-Doko 1995:36). The Adamawa family is less well surveyed than the other two, but many languages transparently have GT, e.g. in Doyayo [dow] (Wiering & Wiering 1994) such as in marking valency changing in verbs (p. 120) or as auxiliary prosodic exponence marking aspect (p. 218). Note that GT in Doyayo appears to play a smaller role than in other African languages, and that this language is abundant with tonal minimal pairs (extensive list in Wiering & Wiering 1994:18-21).

In this area and moving southwardly to South Africa are the Bantoid and Bantu languages, a subgroup within Benue-Congo. Bantu GT systems constitute some of the most complex in Africa, at least on par with the extreme complexity found elsewhere (e.g. Nilotic, Otomanguean,

or (southern) Chinese tone sandhi systems). So-called 'melodic tone' marking inflectional verbal meaning is surveyed in great detail across Bantu in Odden & Bickmore (2014). It is not uncommon for lengthy descriptive books to be written titled 'tonal grammars' in which these complexities are laid out in incredible detail, e.g. of Setswana [tsn] (Creissels, Chebane, & Nkhwa 1997), Kinyarwanda [kin] (Kimenyi 2002), Sesotho [sot] (Khoali 1991), and Jita [jit] (Downing 1996). I discuss examples from Jita at several points in this thesis.

In at least one Bantu language, there is only grammatical tone and no lexical tone in any domain, namely Chimwiini [chim1312] (Kisseberth & Abasheikh 2011). Here, a single final or penultimate privative H tone is determined by the grammar, e.g. *ji:lé* 'you sg. ate', *jí:le* 's/he ate' (Kisseberth & Abasheikh 2011:1994), and although the above contrast derives from the inflectional morphology of the verb, it is realized phrasally: *jile ma-tu:ndá* 'you sg. ate fruit', *jile ma-tú:nda* 's/he ate fruit'. Other H tones are assigned by relative clauses, conditional clauses introduced by *ka-*, the negative imperative, and the conjunction *na* 'and' (pp. 1990-1992).

The three remaining Greenbergian stocks are Afroasiatic, Nilo-Saharan, and Khoisan. Within Afroasiatic, tone is widespread in the Chadic, Cushitic, and Omotic branches but virtually absent in the others. Where it exists, it plays a major role. For example, in Chadic there is extensive documentation and theory dedicated to Hausa [hau] GT (e.g. Newman 1986; Inkelas 1998), and patterns are common in other languages too such as Muyang [muy] (Smith & Gravina 2010:122) where "the tone on the root…is grammatically predictable in most forms of most verbs" and Ngamo [nbh] genitive GT (Schuh 2017:141). Similar findings can be found in the Cushitic though to a smaller degree, e.g. in Somali [som] case marking on nouns (Hyman 1981b) and has an important role in verbal inflection in Ts'amakko [tsb] (Savà 2005:32,145ff.; verb paradigms 166-170). It is important to note that in these languages, tone plays a small role at the lexical level, to such a degree that they are often not even understood to be tone languages (Klingenheben 1949, Hyman 2009). Several languages proposed to be within the Omotic family exhibit replacive tone on nouns, such as in Northern Mao [myf] (Ahland 2012) and Ganza [gza] (Smolders 2016), the latter describing it as idiosyncratically assigned tonal 'construct melodies'. Whether or not 'construct melodies' constitute GT is discussed in chapter 3.

GT is extremely widespread in the Nilo-Saharan stock as well, quite famously within the Nilotic family (Maasai [mas] – Tucker & Mpaayei 1955; Shilluk [shk] – Gilley 1992, Remijsen & Ayoker 2014; Dinka [din] – Andersen 1995), but also further west in Central Sudanic (e.g. Kabba [ksp] - Moser 2007; Baka [bdh] - Waag & Phodunze 2015). Finally, I have not thoroughly surveyed the last Greenbergian stock Khoisan (uncontroversially constituting several genetically unrelated families), and will not speculate as to the degree which it employs GT.

2.2.2.2 Asia

The other major zone for tone languages is East and Southeast Asia. In contrast to Africa, the distribution of grammatical tone in Asian tonal languages is far more restricted, although certainly present. Asian tonal systems show a different typological profile from the rest of the world, as detailed in many tonological survey work (Yip 2002, Hyman 2018b).

Starting in the west, northern Pakistan has a number of tonal languages with GT, e.g. Kohistani Kalam [gwc] (Baart 1999a,b, 2004; analyzed in Zimmermann 2016). Moving into the Sino-Tibetan languages (which includes Chinese), the Tibetan languages have some degree of what can be called GT in their nominal compounds (see Duanmu 1992 and references therein), as do at least some Naga languages (minimal GT in Karbi [mjw] – Konnerth 2014), some Kuki-Chin languages (Kuki-Thaadow [tcz] - Hyman 2007), and the Na-Qiangic language Yongning Na [nru] (Michaud 2017). In general, however, languages within the Sinosphere have been heavily influenced by Chinese descriptive practices in which tonal manipulations are often characterized as tone sandhi. Major Chinese languages such as Mandarin and Cantonese have

widespread lexical tone contrasts (with ample minimal pairs) and very little GT compared to African languages. Where GT does exist, it does not form a central part of the inflectional system of nouns or verbs. Note that of the major Sinitic languages, the Shanghainese dialect of Wu Chinese [wuu], resembles the Ijoid languages described above in that the first morpheme~phonological word in a phonological phrase conditions tone changes on all subsequent units. Whether this is best characterized as Tone Sandhi or GT is often subject to the tradition of specific linguistic researcher communities.

South of the expansive Tibetan-Chinese area are several subgroups all of which contain languages with tone, but to various degrees: non-Tibetan/Chinese Tibeto-Burman (e.g. Lolo-Burmese, Karen families), Tai-Kadai, Austroasiatic, Hmong-Mien, and Chamic (in the Austronesian phylum). Compared to Africa, GT plays a much smaller role in tonal languages here, in line with the areal trend. GT is lacking for the most part in the major national languages Thai, Vietnamese, and Burmese (although for Burmese see Allot 1967). Even in those languages where something like GT occurs with more frequency (such as Hmong languages - Ratcliff 2010), it is much more limited than in the African context. I will not list here all of the languages for which it has been observed that GT is limited or lacking entirely, though the list is extensive.

One exception to the areal trend is Japanese and Japonic lects, which have prolific GT typically of the auxiliary prosodic exponence type. Kawahara (2015) lists the extensive ways in which tone (i.e. pitch accent) is manipulated in the context of various affixes, and a large literature exists by both theoreticians (Poser 1984) and Japanicists detailing GT across Japonic lects (Kubozono & Giriko 2018), although it is almost never described as 'grammatical tone'.

2.2.2.3 Other zones: North America, Mexico, the Amazon, Europe, Oceania/New Guinea

From the map in Figure 3 above, we can see additional tone areas in North America, Mexico, the Amazon, Europe, and Oceania/New Guinea. In North America, more simplex tone systems are found in northwest Canada consisting of Dene languages. This zone stretches southwardly into the US, with a large number of tonal languages in the south and southeast US. GT is much rarer here than in Africa (or at least described in different terms), but unlike Asian languages discussion of tone sandhi is virtually non-existent. GT plays a role in Karuk [kyh] (Sandy 2014, 2017), Hidatsa [hid] (Park 2012), Cherokee [chr] (Uchihara 2016, particularly discussion of floating Ⓗ tones), and Arapaho [arp] (Cowell & Moss 2008).

Moving south, tonal languages are abundant in Mexico, in northwest Mexico e.g. Choguita Rarámuri [tar] (Caballero 2018) and several other Uto-Aztecan languages, in several Mayan languages in the southeast, and most famously the Otomanguean family in the south. Of these, the last has the most robust GT and some of the most complex tone systems in the world, and are far too large to summarize here – for an overview see Palancar & Léonard (2016). As in Africa, GT plays a central role in all grammatical meaning in these languages, especially in the intersection of verb class membership and verbal inflection, and are frequently cited in exemplifying the outer limits of morphological exponence. For example, Baerman, Brown, & Corbett (2010:7-8) highlight what they refer to as 'distributed exponence' in Chiquihuitlán Mazatec [maq] (Jamieson 1982:152,166-167). They show that subject agreement is realized in three positions in the verbal word: in the final vowel, in the prefixed initial syllable, and in the tone. Importantly, they note the following (using the verb 'gather' as their point of reference):

> *"These three systems vary independently of each other, with each one falling into distinct inflectional classes in their own right… In terms of its final vowel inflection, 'gather' forms a class with 'return', but not with the others. Its prefixal inflection groups it with 'pull out', while its tonal inflection matches that of 'take out'. That is, the verb 'gather' simultaneously belongs to three inflectional classes, depending on which subsystem one is looking at. And the verbs*

'return', 'pull out' and 'take out' in turn pattern with still other verbs, forming a network of interlocking inflectional classes."

[Baerman, Brown, & Corbett 2010:7]

	'gather'		'return'	'pull out'	'take out'
1SG	čha^{3}ya^{1}		bu^{1}ya^{1}	čha^{3}nẽ^{1}	ba^{3}šæ^{1}
2SG	hba^{2}ye^{2}		bo^{3}ye^{2}	hba^{3}ye^{31}	nã^{2}še^{2}
3	čha^{3}ya^{2}		bu^{3}ya^{2}	čha^{3}nẽ^{1}	ba^{3}šæ^{2}
1INCL	hba^{2}yã^{2}		bu^{3}yã^{2}	hba^{3}nẽ^{31}	nã^{2}še^{2}
1PL	hba^{2}yĩ^{24}		bu^{3}yĩ^{24}	hba^{3}nĩ^{14}	ba^{3}šĩ^{24}
2PL	hba^{2}yũ^{2}		bu^{3}yũ^{2}	hba^{3}nũ^{1}	ba^{2}šũ^{2}

Table 8: Interlocking inflectional classes involving tone in Chiquihuitlán Mazatec

Because GT plays such a central role in these languages, they will be oversampled in the typological and theoretical discussion which follows, just as African languages are.

Within the Amazon, tone is an areal feature of the Vaupes Region (the red dots in NW South America on the map in Figure 3), and sporadically elsewhere. For GT, Barasana [bsn] (Gomez & Kenstowicz 2000) is often cited as having tonal changes present in noun compounds. Most languages in South America however have more limited GT compared to Africa and Mexico. Ticuna [tca] (Skilton 2017), one of the largest languages of the area, has a limited amount of grammatical tone, as does Maihiki [ore] (Skilton & Farmer 2015) where verb-verb compounds involve GT. A thorough examination of the grammar of Hup [jup] (Epps 2008) shows that GT plays only a small role:

"In addition to lexical tone, Hup also has two grammatical uses of tone. First, in the basic imperative mood…, the verb stem appears bare (i.e., without a Boundary Suffix) and its final syllable (which may belong either to a root or to an Inner Suffix) invariably receives a high (falling) tone. … Tone also plays a role in the derivation of nouns from verbs in Hup, although the productivity of this process is limited..."

[Epps 2008:97]

I am unaware of the extent that GT is used in other Amazonian tone languages outside this area, although GT in Urarina [ura] (Olawsky 2006) will be discussed below.

Finally, simplex tonal systems are found in parts of Europe (e.g. Swedish [swe], Lithuanian [lit], Limburgan [lim], Serbo-Croatian [hbs]), and are very well represented across New Guinea. There exists a small pocket of tonal languages in New Caledonia as well, clearly an innovation from non-tonal Oceanic languages. I have not thoroughly surveyed any of these regions for GT, which is important to admit as this constitutes dozens (perhaps hundreds) of additional tonal languages. It is quite clear that GT is employed in many New Guinean languages, e.g. in Gadsup [gaj] noun phrases (Pennington 2014) and Iau [tmu] tense/aspect/mood inflection (Bateman 1990a, 1990b, discussed in Hyman 2016). For an overview of the tonal diversity of languages in Papua New Guinea (including discussion of GT), see Cahill (2011).

2.2.3 Expressing meaning

Hyman (2011) states unequivocally that tone's ability to expone grammatical meaning is comparable to the more familiar case of exponence-as-segments. To conclude this chapter, I will discuss some of this ability. First, in those languages which use GT more sparingly (such as in Asia), there is a tendency to employ it to express derivational change, such as changes in part of

speech, or other similar meaning alterations. Those languages where GT is used heavily also employ it in their inflection system, an extremely common situation across Africa. Given our broad definition of GT as grammatical condition tonological operation, it would be both unfeasible and uninformative to catalogue all meanings associated with GT. This section will only examine common grammatical meaning realized via independent prosodic exponence and auxiliary prosodic exponence.

First, the bread-and-butter of GT is expressing derivation such as valency changes and category-changing. This is found in virtually every flavor, and is found even within Asian tonal languages which generally lack GT. For example, Kam (1980:218-224) summarizes five classes of 'semantic-tonal alternations' in Thai, which we might consider GT, but notes they are no longer productive. These mostly include derivational changes of part of speech, e.g. verbal denominalizations (N>V), nominal deverbalizations (V>N), adjectival denominalizations and deverbalizations (N>A, V>A), and adverbial deverbalizations (V>Adv). Similarly, Cantonese largely lacks GT, but has a set of derived nouns from verbs showing replacive tone, e.g. /ta:m^{53}/ 'to carry' > /ta:m^{44}/ 'a burden'; Yip (2002:107) points out that 'most of them are not productive these days'.

GT is used to express inflectional meaning and grammatical relationships as well. In the verbal sphere, tone can expone the full range of grammatical meaning including argument agreement (person/number/gender/animacy/etc.), tense, aspect, mood, and even polarity, such as in Aboh Igbo [ukw]:

(21) GT exponing negation

a.	*ò jè kò*	\ L L L \	's/he is going'
b.	*ó jé kò*	\ **H H** L \	's/he is not going'

[*Aboh Igbo* - Hyman et al. in press]

This is especially true across Africa, where it is extremely common to find that verb roots do not have underlying tone, or have a smaller set of contrasts than nouns (or other parts of speech). In many cases, tone has an exclusively grammatical function in the verbal domain. Examples cut across major families, languages including Kisi [kiz] (Atlantic - Childs 1995:55), Konni [kma] (Gut - Cahill 2000), Cishingini [asg] (Kainji - author field notes), the entire Edoid family (Elugbe 1989), Zande [zne] (Ubangian - Boyd 1995), and numerous Bantu languages (Odden & Bickmore 2014). It is my impression that imperatives are often expressed by independent prosodic exponence and that this is a trend even outside of Africa. For example, the Hup language of South America [jup] (Epps 2008:797) generally lacks GT although uses it in expressing imperatives.

The interaction of grammatical tone expressing derivational and inflectional meaning can be extremely rich and varied. One profitable way of illustrating such complex grammatical tone interaction is through **tonological paradigms**, such as in Table 9 below from Dinka [din] (Trommer 2011:133, interpreting Anderson 1995:52-53). Derivational categories are at the top, while inflectional categories are on the left side, all of which are expressed through GT and other segmental and suprasegmental stem changes. Derivational categories are expressed through GT in the context of inner inflection, evidenced by the consistent vertical tone marking in the top half of the table. Note that the lexical tones of the roots have an effect in a minority of cells where the two tables have different values, highlighted in light grey. In contrast, derivational GT generally loses to outer inflection GT, seen in the consistent horizontal tone marking in the bottom half of the table (with the exception of two cells with [H] tone, indicated in dark grey). Such tonological paradigms illustrate that GT expressing derivational and inflectional meaning can be as interwoven as in complex segmental morphology.

		Derivational						Derivational				
		Ø	CF/B	CP	BAP	AP		Ø	CF/B	CP	BAP	AP
Inner Infl	FIN	L	H	L	F	F	FIN	L	F	L	F	F
	1/3S	L	H	L	F	F	1/3S	L	F	L	F	F
	PL	H	H	L	F	F	PL	H	F	L	F	F
	NF	F	H	L	F	L	NF	L	F	L	F	F
Outer Infl	NTS	H	H	H	H	H	NTS	H	H	H	H	H
	PAS:CT	F	F	F	F	F	PAS:CT	F	F	F	F	F
	PAS	H	F	F	F	F	PAS	H	F	F	F	F
	2SG	L	L	H	L	L	2SG	L	L	H	L	L
	Root = CV́C (H)						Root = CV̀C (L)					

Table 9: Derivational, inflectional, and lexical tone interaction in Dinka (Glosses: FIN=finite, NF=non-finite, NTS=non-topic subject, PAS:CT=passive circumstantial, CF=centrifugal, B=benefactive, CP=centripetal, BAP=benefactive antipassive, AP=antipassive)

Like in the verbal domain, GT can express the full range of nominal inflectional found for segmental exponence. Nominal inflectional categories include definiteness, specificity, demonstratives, numerals, quantification, plurality~number, gender~classification, case, among others. Many of these cases involve auxiliary prosodic exponence. One common change involving independent prosodic exponence is exponing number and noun class membership, e.g. singular/plural pairs in Izere [izr] (Blench 2000), whereby LL singular becomes MH plural with no other changes, but the opposite is also attested, i.e. singular MH → plural LL. Within Bantu it is common for modifiers of nouns to co-occur with tonal manipulations of the noun, e.g. in Jita [jit] (Downing 2016) in which nominal modification can result in H tone placed on the final TBU of the noun. In Kalabari [ijn] (Ijoid – Harry & Hyman 2014), different modifiers co-vary with distinct grammatical tunes, e.g. HL (possessives nouns. numeral 1), HLH (possessive pronouns), LH (demonstratives, 'which'), and L ('some', numerals 4 and above).

One robust pattern found across Africa involves GT marking [N_1 N_2] constructions (expressing associative, genitive/possession, noun compounds, a.o.). This was shown above in (7) in Igboid involving a floating ⑭ between the two nouns. GT in this context is found widely cutting across stocks, e.g. in the Niger-Congo stock such as the Mande family (Green 2018) in the far west, the Afro-Asiatic phylum such as the Chadic family in the center (Schuh 2017:141), and even the Nubian family in the far east (compounds in Midob [mei] – Werner 1993:24). Marking a noun in this construction may constitute case marking, which GT marks in sometimes extreme ways. For instance, in Tugen [tuy] (Jerono 2013), there are at least 15 distinct input-output mappings involving the underlying tones of a noun (absolutive form) and its tone pattern in nominative (=subject) context. In these cases, it may be more profitable to analyze the nominative forms as distinct allomorphs, rather than try to derive them through tonological processes.

	Pattern #	Absolutive (=Elsewhere)	Tone	Nominative (=Subject)	Tone	Gloss
a.	1	kìbùkàndìì	L	kìbùkándíí	LH	guitar
	2	chèèp-ò	L	chéép-ò	HL	daughter of
b.	3	kwááríík	H	kwáárììk	HL	tendon
	4	móítá	H	mòìtà	L	calf
	5	káályááng'ík	H	kààlyááng'ík	LH	flies
c.	6	mùrsíík	LH	mùrsìik	L	sour milk
	7	chèèmòòsíí	LH	chéémóósíí	H	ogre
d.	8	káámèè	HL	kààmèè	L	mother
	9	cháálwòòk	HL	cháálwóók	H	wrongdoing
	10	séèsèè	HL	séèséé	HLH	dog
e.	11	láàkwéé	HLH	láákwéé	H	child
	12	óìnóósyék	HLH	óìnòòsyèk	HL	rivers
f.	13	ùsíì	LHL	úsíí	H	thread
g.	14	bèèlyóòndé	LHLH	béélyóóndé	H	elephant
	15	kìkóòmbéé	LHLH	kíkóòmbéé	HLH	cup

Table 10: GT patterns exponing nominative case in Tugen (Jerono 2013)

We saw an instance of marking case in Bantu above in Table 7 involving Giphende where floating tones with distinct tonological behavior corresponded to different abstract cases, e.g. $^{Ⓗ}_{2}$ ↔ [GEN] and $^{Ⓗ}_{3}$ ↔ [ACC].

The use of tone in expressing [N_1 N_2] constructions may be interpreted as GT marking a grammatical construction rather than a specific morpheme *per se*. One common instance of GT marking a construction is with [VERB OBJECT]~[OBJECT VERB] constructions. In these cases, the most straightforward analysis is that the verb and object form a constituent of some sort (often including other morphemes) over which a particular tonal pattern spreads. This is shown below in Izon [ijc] and Urarina [ura].

(22)

a. Noun tone class A: / bùrù$_A$ fẹ́ / → bùrù **fẹ̌** 'buy a yam'
b. Noun tone class B: / námá$_B$ fẹ́ / → námá **fẹ́** 'buy meat'
c. Noun tone class C: / òró$_C$ fẹ́ / → òró **fẹ̀** 'buy a mat'

[*Gbarain Izon* - author fieldnotes]

(23)

a. GT pattern A – initial H:
/ lureri $^{Ⓗ}_{A}$ + kwarakãu̶ / → lureri **kwá**rakãu̶ 'I have seen the house'
b. GT pattern C – final H:
/ komasaj $^{Ⓗ}_{C}$ + kwarakãu̶ / → komasaj kwarakã**ú̶** 'I have seen the wife'

[*Urarina* - Olawsky 2006:128]

In Izon in (22), nouns are split into three tone classes A, B, and C (idiosyncratically associated with lexical items), whose effects are seen on the following verb. Tone class A assigns a LH pattern, class B spreads the H tone from the noun, and class C assigns a L tone. This overwrites the underlying tone of the verb and is therefore replacive. In Urarina in (23), nouns also form lexically idiosyncratic tone classes depending on where they assign tone. For example, class A assigns a H to the initial TBU of the verb, while class C assigns a H to the final TBU.

GT can also play a role in signaling syntactic processes. For example in Asante Twi [aka], Korsah & Murphy (2017) show that verbs are marked with a replacive H tone if an object is

extracted over them to the left edge of the clause, e.g. as in (24). Note that the underlying tones of the verbs /kaé/ /LH/ 'remember' and /kita/ /LL/ 'hold' are both uniformly \H\ in the extracted context. These tonal changes do not take place if the object remains *in situ*.

(24) déén$_i$ na Kofi **káé** sɛ Ám^{+}má **kítá** t_i
what FOC Kofi remember that Ama hold
'What does Kofi remember that Ama is holding?'
[*Asante Twi* - Korsah & Murphy 2017:3]

Given the wide range of meanings GT can expone, I adopt the following null hypothesis following extensive work by Hyman (and others) on GT.

[Def 18] **Non-restrictive prosodic exponence**: all grammatical meaning can be expressed by segmental exponence, by prosodic exponence, or their combination

If this hypothesis is correct, there should be no grammatical meaning which *cannot* be exponed entirely or partially through prosodic units of contrast such as tonemes~GT, and equally there should be no grammatical meaning which can *only* be exponed via prosodic units of contrast.

I should mention, however, that there are several places where GT exponence is not common. Grammatical material which tends to be independent phonological words and not morphologically bound rarely (if ever) show independent prosodic exponence (although frequently show auxiliary prosodic exponence, of course). These include question *wh*-words, demonstratives, pronouns, quantifiers, auxiliaries, adverbs, and complementizers. Let us think of a hypothetical example. Spanish expresses proximate and distal meanings via pre-modifier morphemes exponed segmentally. We could easily imagine these meanings being exponed as three distinct floating toneme sequences which dock to a (toneless) noun, i.e. a hypothetical noun /mana/ 'man' surfacing as the following:

	Spanish		Hypothetical GT language		
	DEM	*hombre* 'man'	DEM	/ mana / 'man'	/ τ τ /
'this'	*este*	*este hombre* 'this man'	Ⓗ	\ máná \ 'this man'	Ⓗ τ τ
'that'	*ese*	*ese hombre* 'that man'	ⓂⒽ	\ māná \ 'that man'	Ⓜ Ⓗ τ τ
'that over there'	*aquel*	*aquel hombre* 'that man over there'	Ⓛ	\ mànà \ 'that man over there'	Ⓛ τ τ

Table 11: Hypothetical independent prosodic exponence of demonstrative values

More challenging is the following typological claim: it is uncommon for GT to expone clause-level grammatical meaning (that which is often associated in the CP field in generative linguistics). This includes complementation, evidentiality, adverbials of many types, and perhaps most surprisingly information structure such as types of topic and focus. If cases like this are truly rare or even non-existent cross-linguistically, it becomes a challenge to the typologist whether to interpret this as a systematic or accidental gap.

This may or may not be a quirk of African languages, where GT is overwhelmingly found. For example, in Kalinowski's (2015) survey of focus encoding in African languages,

grammatical tone plays a relatively small role across in the continent. Of the 135 languages surveyed in her study, only 12 were said to use prosody to encode focus. Of these, there is little to no indication by Kalinowski that these involve tone changes. One example is verbal focus involving verbal copying with a L tone in the Chadic language Ma'di [mhi] (Kalinowski 2015:377, citing Blackings & Fabb 2003:24). Kalinowski herself remarks on this:

> *"[W]hat is meant by focus constructions are those constructions which are used typically for encoding 'new' information, as can be identified by answers to wh-questions or in contrast to a given element. In African languages, this encoding is typically morphosyntactic in nature. While it is not unreasonable to expect some prosodic correlates of focus constructions, this is not the primary means of focus encoding in the languages studied here, and* ***most of the descriptions used in the creation of the database make little or no mention of the role of prosody in information structure****."*
>
> [Kalinowski 2015:34; bolding mine]

However, one place where tonal effects are associated with information structure is in Bantu languages, especially in the conjoint/disjoint distinction, e.g. Luganda [lug] (Hyman & Katamba 1993), Ekoti [eko] (Schadeberg & Mucanheia 2000), Makhuwa [vmw] (Van der Wal 2006), among others (for a cross-Bantu perspective, see Van der Wal & Hyman 2017). Refer also to the Bantu language Giphende discussed above in Table 7 where $^{\text{H}}{}_{1} \leftrightarrow$ [FOC].