# Grammatical tone in Distributed Morphology*

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**Grammatical tone** (GT) is the realization of abstract morphosyntactic features (e.g. tense, number, etc.) through tone. Some examples:

(1) a. *number in Noni* (class 9/10) (Hyman & Leben 2008:590)
bw**ě** ~ bw**é** 'dog.SG/PL'
dʒɔ̌n ~ dʒɔ́n 'star.SG/PL'

b. *genitive in Uspanteko* (Bennett & Henderson 2013)
**a**qan ~ w-**á**qan 'leg/my leg'
**i**xk'eq ~ w-**í**xk'eq 'fingernail/my fingernail'

**Piece or process?** A very basic question—and a loaded one in the current climate of morphological theory—is whether GT involves *piece-based* or *process-based* morphology. At first sight, GT might seem to implicate process-based morphology simply because it is manifested suprasegmentally (rather than before or after a stem).

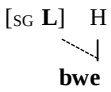
E.G. Nida (1946:vii), without comment, classifies GT as a kind of 'change,' alongside suppletion (e.g. *go-went*) and irregular vowel phonology (e.g. *sing-sang*), rather than as a kind of affixation.

GT might therefore seem to pose a problem for piece-based theories of morphology like Distributed Morphology (DM, Halle & Marantz 1993).

E.G. Boutin (2009:3): '[A piece-based theory like DM] treats morphemes as a linear string of phonemes which are attached to a base. However, morphosyntactic properties can be realized by suprasegmental features such as tone…' Boutin argues that such 'nonconcatenative phenomena' are better treated as the output of phonological processes, as in word-and-paradigm theories.

But as has long been recognized in the literature on tone, this tension is only apparent: the widespread adoption of **Autosegmental Phonology** following Goldsmith 1976 makes it straightforwardly possible to analyze suprasegmental morphology in a piece-based way. To illustrate, the Noni singular from (1)a could be treated as in either (2)a or (2)b:

(2) a. **piece-based**
[SG] is a L-tone prefix




b. **process-based**
[SG] triggers a phonological rule/process
**V́** → **V̌** / [N+SG __...]

Autosegments effectively 'make tone concatenative' (Trommer 2008)—and since they're independently motivated (§1), the existence of GT is not in itself a challenge for DM.

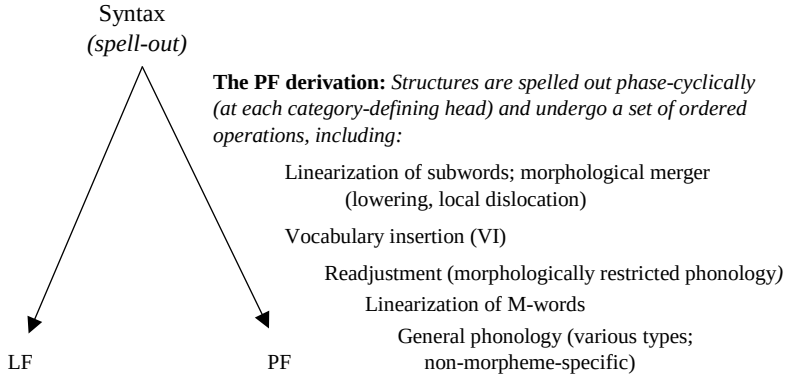
Nevertheless, GT has been largely overlooked in the DM literature. Those studies that have emerged recently—e.g. Rolle 2018, Sande 2016—have adopted hybrid DM-OT models with morpheme-triggered cophonologies to account for different types of GT. Whether GT can be handled in a traditional DM model has not yet been addressed to my knowledge.

**Proposal:** GT can be analyzed via the same PF operations (and associated locality constraints) as those proposed for segmental morphology in DM. These include:
- vocabulary insertion (exponence, the source of *tonal affixes*)
- readjustment (morphophonology, responsible for GT *deletion/replacement*)
- general phonology (responsible for tier-association, tone spread, etc.)

## 1. Background: DM and Autosegmental Phonology

In envisioning how Autosegmental Phonology might be integrated into a DM-based proposal, I adopt the spirit of Pulleyblank (1986:19): while DM provides an organization of the overall grammar, Autosegmental Phonology provides an organization of the phonological component proper. In the diagram in (3), autosegmental representations will play a prominent role in *vocabulary insertion*, *readjustment*, and *general phonology*.

(3) **DM architecture** (Halle & Marantz 1993, Embick & Noyer 2007)




In DM the syntax is the starting point for all complex linguistic structures. What makes words appear to be packaged differently from phrases is a series of later operations, including head-movement as well as post-syntactic (PF) merger and readjustment.

Relatively early in PF, after individual morphemes (subwords) have been linearized within a spell-out domain, Vocabulary Insertion (VI) applies, supplying phonological content to morphemes by rules like (4). Some vocabulary items (e.g. (4)b) supply several exponents that compete for insertion—a situation we recognize as **contextual allomorphy**.

(4) a. English definite article: D[+DEF] ↔ ðɪ
b. English past-tense suffix: T[PAST] ↔ -t/√MEAN, √FEEL …__
-Ø/√HIT, √PUT, √DIG, √READ …__
-(ə)d

Note that VI may insert nothing (e.g. the zero allomorph in (4)b). Crucially, VI still applies here, but the exponent it inserts happens to be null.

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The exponents added at VI may be further modified by subsequent PF operations.

- Some of the roots in (4)b undergo irregular vowel changes (e.g. i → ɛ in the past tense of *mean, feel, read*)—a type of **readjustment**, or morphophonological rule.
- Near the end of the PF derivation, the **general phonology** may make additional changes. The past tense of √MEAN is /mɛn-t/ after Readjustment, but this form may be further altered by general phonological rules like flapping or glottalization, depending on its phrasal context: e.g. *I* [mɛɾ̃] *it*; *That's what I* [mɛnˀ].

**With GT, the PF derivation proceeds in exactly the same way** as just sketched for English *meant*. The only difference is in the phonological representations that PF operations apply to—specifically, they have an additional tonal tier.

The core premise of **Autosegmental Phonology** (Goldsmith 1976) is that phonological representations are multi-tiered structures rather than 2D, 'uniformly sliceable' strings of segments. Tones, instead of being represented as features of vowels, exist on a separate tier. This allows for (2)a, where two tones are linked to a single TBU, as well as (5)a, where a single tone is linked to two TBUs (Kukuya, Hyman 2014).

(5) a. H
/ \
wata 'bell'

b. H H
| |
ma-ba 'They are oil palms'
CL6-oil.palm

c. H → M / __ //

d. i. wátá → wātā
ii. má-bá → má-bā

(5)a contrasts with bimorphemic (5)b, which has two underlying H's. When the prepausal tone-lowering rule in (5)c applies, *both* vowels in *wátá* get lowered because they are both linked to a single tone (5)d-i, while only the second H in *má-bá* lowers (5)d-ii. As Hyman (2014) points out, this contrast would be difficult to explain without autosegments.

Autosegmental theory also enables a principled account of **tone displacement**. In Igbo (Goldsmith 1976:78ff), the subordinate-clause marker [SUB] is a floating H that usually docks *leftward* onto the final syllable of the preceding noun (6)a. Only if there is no overt material before it does H dock rightward (6)b.

(6) a.


èŋwó Ø àtàà yá
[[monkey] [SUB [eat 3PL]]]
'lest a monkey eat them' (< èŋwò)

b.


Ø ô-gbùò éghú
[SUB [3SG-kill leopard]]
'lest he kill a leopard' (< ò-gbùò)

The fact that Igbo [SUB] H can 'see' its host across multiple syntactic boundaries in (6)a can be taken as a sign that **tier-association** rules apply late in this language—after the entire clause has been linearized. (See Kenstowicz 1994:317, Pulleyblank 1986: 11-12, Inkelas 2016:521, for comments on the language-variability of tier association.)

An analysis of Igbo [SUB] without autosegments—where tones were treated as features of vowels—would run afoul of serious problems. The tone alternations on *èŋwó* in (6)a and on *ô-gbùò* in (6)b would need to be attributed to phonological processes triggered by the feature [SUB]—see e.g. the hypothetical Paradigm Function Morphology-style rules of exponence in (7)a (cf. Stump 2016:135-139) and DM-style readjustment rules in (7)b:

(7) a. i. XV, Noun, {SUB} → XV́
ii. VX, Verb, {SUB} → V̌X

b. i. V → V́ / …_ T[SUB]
ii. V → V̌ / T[SUB] __...

Significant problems with these rules are readily apparent:

- In (7)a, the same [SUB] feature shows up both in a verb paradigm and a noun paradigm (where it is wholly unexpected, since noun don't normally host features like [SUB]).
- In (7)b-i, the target V is separated from its trigger T[SUB] by multiple phase boundaries, in violation of well-attested locality conditions on readjustment (Embick & Shwayder 2018) (§3). This would be akin to English T[+PAST] effecting an irregular vowel change on the preceding *subject*, e.g. i → ɛ in *The trees* [trɛz] *burned down)*.
- The fact the *last* syllable of the subject *èŋwó* gets H while the *first* syllable on the verb *ô-gbùò* gets H is an unexplained coincidence in (7). In the piece-based autosegmental analysis in (6), however, this distribution falls out naturally from the hypothesized syntactic locus of [SUB] between the subject and the verb.

Together with other arguments in the literature (see e.g. Kenstowicz 1994:ch7), these observations show that autosegments are independently motivated. The use of autosegments in e.g. (2)a thus cannot be viewed as an unnecessary complication unique to piece-based theories—and correspondingly, the existence of GT cannot be viewed as support for non-piece-based theories. The piece-or-process question plays an important role in GT, as we'll see, but the use (or not) of autosegments is largely orthogonal to it.

## 2. A model

In the descriptive literature on GT, a distinction is often drawn between **tonal affixation** (simple insertion of a floating tone) and **replacive tone** (deletion/suppletion of tones), with the suggestion that the latter involves a phonological process. Rolle (2018) makes a similar distinction between **non-dominant** and **dominant** GT, respectively, with the latter involving a special cophonology triggered by certain exponents.

In my proposal, this distinction is modeled as in (8). Again, the operations involved are the same as those involved in segmental morphology.

(8) a. *Tonal affixation involves two steps:* tone insertion (VI) and tier-association (general phonology).
b. *GT deletion/replacement involves three steps:* tone insertion (VI), morpho-phonological rules (readjustment), and tier-association (general phonology).

### 2.1 Tonal affixation

We'll assume that all tone languages have (at least) two active tiers: a tonal tier and a segmental tier. Not all vocabulary items insert material on both tiers, however. Just as it is possible in English to insert Ø as a [+PAST] suffix for *put* (4)b, it is possible for a tone language to insert Ø on either the tonal tier or the segmental tier, or both. Moreover, if an exponent has overt material on both tiers, the tiers may be either 'pre-linked' or linked by association rules. I'll provide sample vocabulary items for each of these types of exponents.

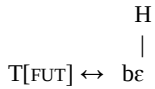
**Segment(s) + tone(s), pre-linked**. We'll start with a relatively simple example: the future prefix /bɛ́/ in Asante Twi (Paster 2010:88), which always surfaces with H:

(9)

| | | | |
|---|---|---|---|
| ési **bɛ́**-tɔ́ pɛ̀n | ‘Esi will buy a pen.’ | ési tɔ́ pɛ̀n | ‘Esi buys pens.’ |
| yàw **bɛ́**-tɔ́ pɛ̀n | ‘Yaw will buy a pen.’ | yàw tɔ́ pɛ̀n | ‘Yaw buys pens.’ |
| ési **bɛ́**-nôm ìnsyù | ‘Esi will drink water.’ | ési nôm ìnsyù | ‘Esi drinks water.’ |
| yàw **bɛ́**-nôm ìnsyù | ‘Yaw will drink water.’ | yàw nôm ìnsyù | ‘Yaw drinks water.’ |

Because the H tone on /bɛ́/ is constant (and because H and L are contrastive in Twi), we can assume that the vowel in /bɛ/ is underlyingly linked to its H tone—just as the lexical tone distinguishing e.g. *má* ‘mother’ and *mâ* ‘scold’ in Mandarin is underlyingly linked.

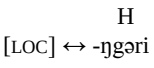
(10)




Such examples seem unremarkable, but they serve as a useful baseline—we will see that both subsequent types of exponents differ only minimally from (10).

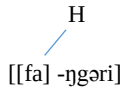
**Segment(s) + tone(s), unlinked**. It is possible for an exponent to contain material on two tiers that are linked later, by association rules. In Margi, the suffix *-ŋgəri* ‘onto’ is argued to contribute a H tone that it is not underlying linked to (i.e. a floating H):

(11)

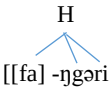



This floating H gets linked to the segmental tier later, by tier-association rules in the general phonology. In Margi, tier-association operates as follows: H docks first on the (toneless) root, then spreads rightward through the suffix (Pulleyblank 1986:71ff)—so that the tonal part of the exponent is realized earlier than its segments (another case of displacement).

(12) a. tone matching



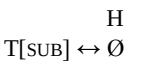

b. tone spreading




fá- ŋgɔ́rí ‘take many onto’
cf. fà ‘take many’ (default L)

**Tone-only** exponents contain material on the tonal tier only. As such, they necessarily show displacement effects: the tone(s) they introduce *must* ultimately dock on a segment belonging to some other morpheme. The Igbo subordinate marker from (6) is an example. First Vocabulary Insertion applies:

(13)



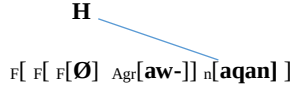

Later, in the general phonology, tier-association links this H to a TBU. As noted in §1, the fact that this H is allowed to ‘float through’ several spellout cycles and dock on the preceding subject suggests that tier-association applies late, at the clause or utterance level.

The genitive case marker in Uspanteko is another example of a tone-only exponent. Bennett & Henderson (2013) propose that the case morpheme ‘F’ (14) introduces an H-tone that docks on the penult of the M-word. The fact that H ‘skips over’ the possessor-agreement morpheme Agr and docks on the noun root in (15)a indicates that tier-association applies after the M-word has been spelled out (another case of displacement).

(14)


(15) a. aqan ‘leg’ w-áqan ‘my leg’, aw-áqan ‘your leg’
b. pix ‘tomato’ ín-pix ‘my tomato,’ qá-pix ‘our tomato’

(16)



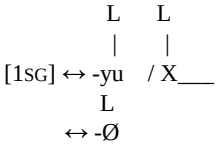

**Allomorphy.** Recall that some morphemes have multiple exponents (allomorphs) that compete for insertion, e.g. the English [+PAST] exponents *-t*, *-Ø* and *-(ə)d* (4)b. If my proposal is on the right track—i.e. if GT is derived by the same PF operations as segmental morphology, with no special additions or constraints—then we should expect to find allomorphy in GT as well. More specifically, *any* of the various types of exponents just reviewed should be able to compete allomorphically with any other type.

Paster & Beam de Azcona (2004) describe such a case in a dialect of Mixtepec Mixtec, where the [1SG] suffix is *-yù* iff the preceding root ends with L, otherwise a floating L. The vocabulary item in (18) accounts for this pattern. [1SG] has a segment+tone allomorph (*-yù*) alternating with a tone-only allomorph (floating L). The floating L is later assigned to a TBU by tier-association rules.

(17)

| | |
|---|---|
| chàî ~ chàî-**yù** | ‘chair/my chair’ |
| tutù ~ tutù-**yù** | ‘paper/my paper’ |
| nàmá ~ nàmá**à** | ‘soap/my soap’ |

(18)




### 2.2 Tone deletion/replacement

So far I have been focusing on a two-step analysis, VI + general phonology, to analyze GT. However, some cases of GT cannot be analyzed via these two steps alone because they involve tone deletion or replacement (recall (8)). These cases require an intermediate third step: **readjustment**, or morphologically restricted phonology.

For example, the Somali alternation in (19) likely involves deletion of lexical H in subject case (note that lexically toneless *gabhdo* ‘girls’ remains toneless) (Appleyard 1991:9):

(19)

| | |
|---|---|
| gabhdo ~ gabhdo | ‘girls.SUBJECT/NON-SUBJECT’ |
| n**i**n ~ n**í**n | ‘man.SUBJECT/NON-SUBJECT’ |
| **i**nan ~ **í**nan | ‘boy.SUBJECT/NON-SUBJECT’ |

DM traditionally allows for a class of **readjustment rules**, which render phonological changes in morphologically limited contexts. Examples from Embick & Shwayder 2018:

(20) a. English past-tense vowel changes (e.g. i → ɛ in *mean, feel, read, keep,* etc.)
b. German umlaut (e.g. f**u**s ~ f**y**s-e 'foot.SG/PL')
c. Spanish diphthongization (e.g. p**e**ns-ar ~ p**je**ns-o 'to think/I think')

A readjustment rule to account for the Somali data in (19) is given in (21). This rule applies just after VI in the cycle when Agr is spelled out. (The exponent for Agr itself is null (Ø).)

(21) H → Ø / __ Agr[SUBJECT]

The Logoori imperative (Odden 2018) is another case involving readjustment. Verb roots in Logoori either are underlyingly toneless or have H on the first vowel. In the imperative, toneless verbs remain toneless (22)a, while H verbs undergo a series of changes (22)b:

(22) a. ko-sooma ~ sooma 'to read / read!'
ku-vuruganya ~vuruganya 'to stir / stir!'
b. ko-r**é**eta ~ reet**á** 'to bring / bring!'
ku-z**áá**zama ~ z**aa**z**á**m**á** 'to taste / taste!'
ku-f**ú**nyiiriza ~ f**u**ny**íírízá** 'to smell / smell!'

Odden assumes that this pattern is derived in three steps, which I formalize as follows:

(23) a. STEP 1: *Vocabulary insertion*

Mood[IMPER] ↔ -Ø / X ___ (H H)
↔ -Ø

'Insert H if preceding root has H, otherwise nothing.'

H H
| |
funyiiriza **-Ø**

b. STEP 2: *Readjustment*
H → L / __ Mood[IMPER]

**L** H
| |
funyiiriza -Ø

c. STEP 3: *General phonology*
H spreads leftward until it hits another tone.
(Logoori has general leftward H-spread,
e.g. *kugura* 'buy' → *kúgúrá mácu̲nga* 'buy oranges.')

L H
| /
funyiiriza -Ø

Notably, the three steps in (23)—VI, readjustment, general phonology—are the same three steps used to derive the past-tense of English *mean* in §1.

(24) STEP 1: *Vocabulary insertion* (4)b T[+PAST] ↔ -t/√MEAN, √FEEL …__ [min] **-t**
STEP 2: *Readjustment* i → ɛ in [+PAST] of √MEAN, √FEEL, √READ, etc. [mɛn]-t
STEP 3: *General phonology* (flapping, glottalization, etc.) I [mɛɾ̃] it.

This parallelism is in line with the spirit of my proposal: GT is fully compatible with a traditional DM architecture, with no special additions or constraints.

## 3. Back to the piece-or-process question

Probably the main difference between my proposal and other recent accounts of GT—e.g. Rolle 2018, Sande 2016—is my use of **readjustment rules** to analyze replacive/dominant GT. (Rolle and Sande, in contrast, use morpheme-triggered cophonologies in a a hybrid DM-OT model.)

Readjustment rules represent a mechanism for process-based morphology in a primarily piece-based theory. They must be stored individually, separate from vocabulary items. As such, I have limited their use to cases that can't be analyzed with VI only (e.g. GT deletion).

A major question for future work is whether replacive/dominant GT generally holds to hypothesized **locality conditions** on readjustment.

- Readjustment rules apply early in PF, when sub-words are being processed (3). In §1 I argued for a VI-only (piece-based) analysis of Igbo [SUB], rather than invoking readjustment, because the GT docks onto the subject across several XP boundaries. This kind of nonlocal interaction is possible in the general phonology, but not with readjustment rules. A prediction of my model is that we should not find GT deletion/replacement applying across phrasal boundaries in this way. Cases that appear to involve such 'phrasal readjustment' (see e.g. Sande 2016 for one candidate) will potentially involve allomorphy or morphological merger instead.
- Embick & Shwayder (2018) propose that if a readjustment rule has a morphological trigger, its target must be spelled out in the same cycle or an earlier cycle. I suspect that this constraint is behind the **trigger-tone asymmetry** described by Rolle 2018: With dominant GT, affixes can trigger changes on roots but roots don't trigger changes on affixes. Future work will test the extent to which the locality conditions on readjustment make accurate predictions for dominant/replacive GT in my model.

**References**


Appleyard, David. 1991. The role of tone in some Cushitic languages. *York Papers in Linguistics*, 15, 5-32.
Bennett, Ryan & Robert Henderson. 2013. Accent in Uspanteko. *NLLT* 31, 589-645.
Embick, David & Rolf Noyer. 2007. Distributed Morphology and the syntax-phonology interface. *The Oxford Handbook of Linguistic Interfaces*, ed. G. Ramchand & C. Reiss.
Embick, David & Kobey Shwayder. 2018. Deriving morphophonological (mis)application. In R. Petrosino, P. Cerrone & H. Van Der Hulst (eds.) *From sounds to structures: Beyond the veil of Maya*. Mouton.
Goldsmith, John A. *Autosegmental phonology*. Ph.D. Dissertation, MIT.
Halle, Morris & Alec Marantz. 1993. Distributed Morphology and the pieces of inflection. In K. Hale, & S. J. Keyser (Eds.), *The view from building 20* (pp. 111-176). MIT Press.
Hyman, Larry M. 2014. How autosegmental is phonology? *The Linguistic Review 2014*, 363-400.
Hyman, Larry M. & William R. Leben. 2008. Suprasegmental processes. *Morphologie: Ein Internationales Handbuch zur Flexion und Wortbildung*, Vol. 1, 587-594. Mouton DeGruyter.
Inkelas, Sharon. 2016. The role of morphology in generative phonology, autosegmental phonology, and prosodic morphology. In Hippisley & Stump (eds), *Cambridge handbook of morphology*, 513-549.
Kenstowicz, Michael. 1994. *Phonology in generative grammar*. Wiley.
Odden, David. 2018. Tonal melodies in the Logoori verb. *Shaping phonology*, 70-95. U. Chicago.
Paster, Mary. 2010. The verbal morphology and phonology of Asante Twi. Studies in African Linguistics 39.
Paster, Mary & Beam de Azcona, Rosemary. 2004. A phonological sketch of the Yucunany dialect of Mixtepec Mixtec. Proceedings from the 7th Workshop on American Indigenous Languages, 61-75.
Pulleyblank, Douglas. 1986. *Tone in Lexical Phonology*. D. Reidel Publishing Company.
Rolle, Nicholas. 2018. *Grammatical tone: typology and theory*. PhD thesis, UC Berkeley.
Sande, Hannah. 2016. Scalar tone shift as evidence for morphology without morphemes. *UC Berkeley Phonetics and Phonology Lab Report*, 103-124.
Stump, Gregory. 2016. *Inflectional paradigms: content and form at the syntax-phonology interface*. Cambridge.
Trommer, Jochen. 2008. Autosegmental phonology: Tone. Course slides, Concatenative Approaches to Nonconcatenative Morphology, Universität Leipzig.