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# Prosodic Theory and Practice

**Edited by: Jonathan Barnes, Stefanie Shattuck-Hufnagel**

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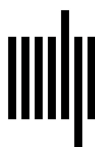
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# Commentary on Chapter 1: Introducing Flexibility into Autosegmental-Metrical Phonology

Martine Grice

## Introduction

In this chapter, Amalia Arvaniti provides a comprehensive overview of the autosegmental-metrical (AM) approach to intonational phonology, tracing its development over the last three decades. Although there is some diversity among models that come under the AM umbrella, not least for the analysis of the intonation of English, this is currently the most widespread approach to the study of intonation, and it continues to be employed for analyzing a broad range of well-researched and lesser-known languages (Jun 2005, 2014).

## Main Advantage of AM: Separation of Tune and Text

The main advantage of the AM approach over previous and competing ones is that the *tune*, in the form of H and L tones, is represented on a tier that is autonomous with respect to the *text*. This autonomy allows for generalizations to be made about tunes that occur across different words and phrases. Because the H and L tones need only to be specified for certain privileged syllables in an utterance, the generalization of patterns to new examples of different lengths is relatively straightforward. Thus the texts in (1) and (2) can be produced with what is essentially the same intonation pattern, represented on the tone tier by an identical sequence of tones, a sequence of L, H, and L, representing the rise to a pitch peak followed by a fall to low pitch.

(1) LHL

Right

(2) L H L

I agree with you

Both the tune and the text tiers have some form of structure, which plays a role in determining how they are synchronized. We turn to the structuring of the two tiers.

## Structure of Tiers and Complex Intonational Primitives

### Text

On the text tier, words are analyzed into smaller constituents, such as syllables and feet, and at the same time, they are grouped together into larger constituents, reflecting phonological phrasing. These constituents are organized hierarchically, with designated heads. The general mechanism for synchronizing the two tiers is clear: tones are associated with tone-bearing units (TBUs) via association lines, and because tones are relatively

sparsely distributed, reference has to be made to the structure of the text tier to determine the TBUs, in particular stressed syllables (Goldsmith 1979; Liberman 1979; Leben 1976). Taking the structure of the text into account, association to a stressed syllable implies association to a foot or prosodic word of which this syllable is the head (Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988). There can also be association to the edges of constituents, and in some languages (Korean, Turkish and Hindi, for example), this is the only association possible (Jun 2005, 2014; Féry 2017). Association to edges often means that the tone is placed at or near a particular edge, but it can also have a secondary association with a TBU close to the edge (Pierrehumbert and Beckman 1988; Grice, Ladd, and Arvaniti 2000; *inter alia*). This means that the tone is anchored to a designated syllable, for example, the final or penultimate syllable in the phrase, or in some cases even a lexically stressed syllable. Not all languages appear to have such secondary associations, and not all models in the AM framework allow for this possibility.

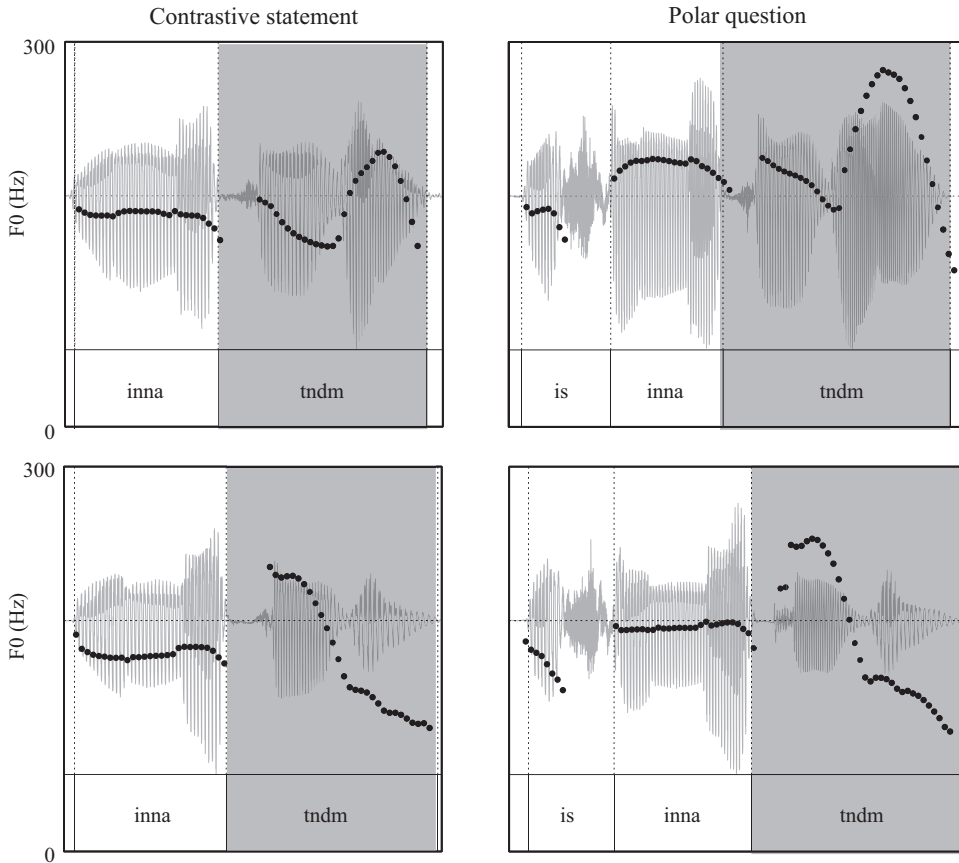
### Tune

The structure of the tone tier, representing the tune, consists of H and L tones, which are generally agreed to be intonational primitives. These tones can be combined in different ways to form more complex structures: either they are grouped together within the tone tier, with a structure permitting one tone to be strong (represented using the star notation), or they are multiply associated with a TBU without a strength relation. They form two types of structures, which are generally taken to be building blocks of intonational tunes, which Arvaniti refers to as complex primitives: pitch accents and boundary tones. These are usually defined according to not only (i) their association properties, that is, whether they associate with heads or edges of constituents, but also (ii) their function within the system, that is, whether they are prominence-cueing or demarcative.

Cross-linguistic preferences for relating association properties of tones to their function have led to overoptimization in AM models toward the typical case. This can be a straitjacket for the analysis of new languages and even for the analysis of new phenomena within languages already under investigation. Allowing for tones to have associations to a constituent in the prosodic structure, without necessarily further specifying head or edge association, in addition to separating the association properties from the function, provides a more powerful and flexible tool for the analysis of a wider set of phenomena. This is especially important, given that we still know little about the prosodic systems of the majority of the world's languages.

Two examples illustrate the need for flexibility in AM models of intonation: Tashlhiyt Berber has prominence-cueing tones in the absence of a stable metrical structure and hence the absence of a clearly defined head, and Maltese has tones that appear to function similarly to the regular pitch accents in the language, but these tones are at a word edge rather than its head.

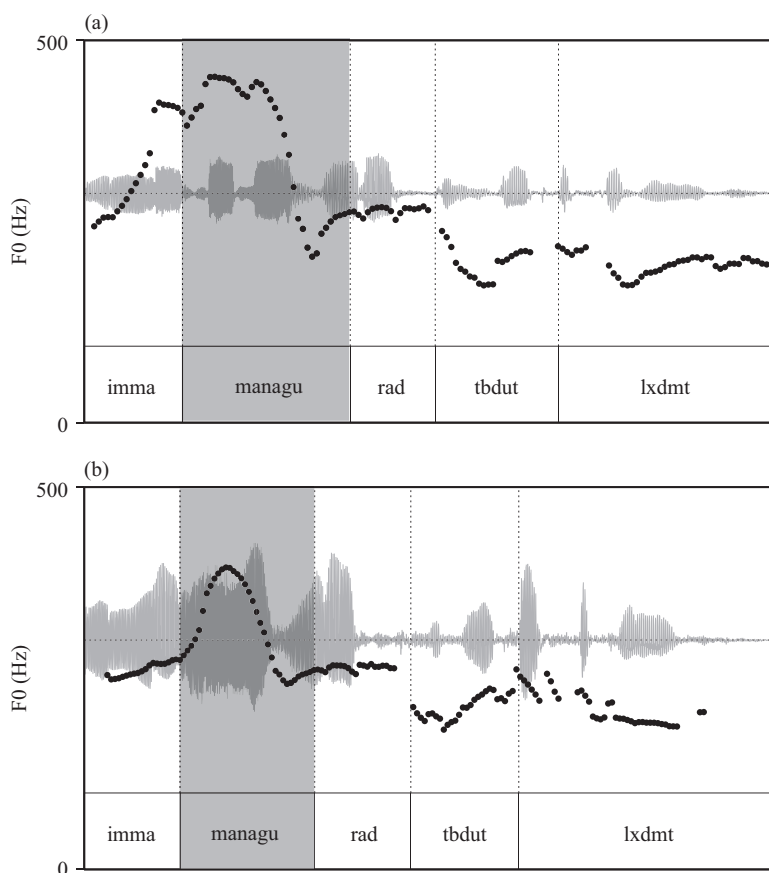
In Tashlhiyt Berber, prominence-cueing tones are highly variable in their position, reflected in F0 peak alignment (Grice, Ridouane, and Roettger 2015; Roettger and Grice 2015; Roettger 2017). In addition to variability in identical pragmatic contexts (see figure 1c.1), some of the variability has been shown to be affected by factors such as sonority, syllable weight, and sentence modality, as well as speaker-specific tendencies. Such variability precludes an analysis whereby tones are associated to specific syllables. Rather, the general picture indicates the possibility of an association to a larger constituent, with probabilistic distributions reflecting their exact placement. Sentence modality plays a role insofar as a greater number of peaks are found on the final syllable in polar questions than in contrastive statements.



**Figure 1c.1** Tashlhiyt Berber. Examples of final peaks (top) and penultimate peaks (bottom) in statements with contrastive focus (left)—*inna tndm* (He said: “She regretted”)—and questions (right)—*is inna tndm* (Did he say “she regretted?”). Shaded area indicates the word on which the peak occurs. *Source*: Adapted from Grice, Ridouane, and Roettger (2015).

In phrase-initial position, an H tone can be realized as a peak with variable alignment within a constituent or optionally as a plateau extending over the whole constituent (Bruggeman, Roettger, and Grice 2017; Bruggeman 2018; see figure 1c.2). This further supports an analysis of tones having an association to a constituent without this being reflected in alignment with either a head or an edge. Thus, although the tone serves the function of cueing prominence (e.g., by virtue of occurring on the focused constituent, or being used in explicit contrast), it does not have the association properties of a regular pitch accent, that is, association to a head. Allowing for association of tones to a constituent without them percolating to the head or edge of this constituent may be a way forward for analyzing further languages that—like Tashlhiyt—lack lexical stress.

Maltese poses a further challenge to the current understanding of tune-text association in the form of an H tone that occurs at the beginning of words in certain pragmatic contexts, such as in questions, imperatives, and vocatives (Vella 2007). The complex question word in *ma’ min minnhom* (With which one of them?) in figure 1c.3 has lexical stress on the penultimate syllable, following the stress rules of Maltese. In direct

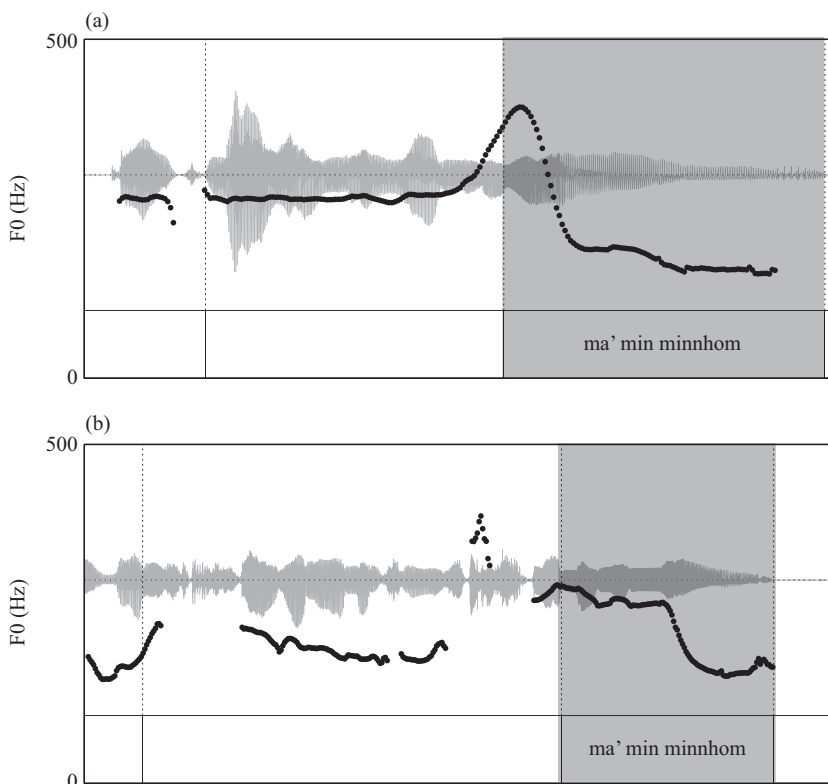


**Figure 1c.2**

Tashlhiyt Berber. Example of (a) plateau and (b) peak on question word constituent *managu* (when) in *Imma managu rad tbdut lxdmt?* (So when will you start work?). Source: Adapted from Bruggeman, Roettger, and Grice (2017).

questions (the top panel of figure 1c.3), there is a fall in pitch on the first syllable, *ma'* (note that the apostrophe is part of the orthography and does not reflect stress). In indirect questions (the bottom panel of figure 1c.3), by contrast, the fall occurs on the stressed syllable. This pattern, in which the fall in pitch is on the first syllable in direct questions and on the stressed syllable in indirect questions, was found to be stable across speakers in a production study involving scripted dialogues (Grice, Vella, and Bruggeman 2019).

Thus Maltese employs a word-initial tone in direct questions and a tone associating with the lexical stress—in line with other pitch accents in the language—in indirect questions. The word-initial tone cannot be analyzed as marking the edge of a larger prosodic constituent (intermediate phrase/intonational phrase), because question words can occur in medial and final positions in the phrase and have word-initial tones in these cases too. Neither is there evidence of a smaller, phrase-internal boundary before the question word. The language thus appears to make use of both edges and heads of words for the association of tones, although there is no evidence for one association leading to a demarcative function and the other to a prominence-cueing one.



**Figure 1c.3**

Maltese. F0 contours for a direct question (top) *Mar jgħum ir-Ramla ma' min minnhom?* (With which one of them did he go swimming at Ramla?) and for an indirect question (bottom) *Il-mistoqsija li għandna bżonn insaqsu hija: ma' min minnhom* (The question we need to ask is: With which one of them?). Shaded area indicates the complex question word, *ma' min minnhom* (With which one of them?). *Source:* Adapted from Grice, Vella, and Bruggeman (2019).

The reported research on both Tashlhiyt Berber and Maltese clearly calls for a separation of association properties (head, edge, higher-level constituent without percolation) and their function (prominence-cueing, demarcative) when determining the intonational inventory of a language.

### Making Generalizations in AM: Beyond Pitch Accents and Edge Tones

As pointed out by Arvaniti, a successful model of intonation should provide a principled way of accounting for differences among the contours of a language and be able to make generalizations, such that it can capture instantiations of the “same” melody across different segmental strings, that is, the same tune on different texts. Although there is evidence for the compositionality of *tunes* (e.g., Pierrehumbert and Hirschberg 1990), meanings being assigned to particular pitch accents or edge tones separately, the general practice is to take into account particular combinations of pitch accents and edge tones. For English and other West Germanic languages, this is often the nuclear tune—the nuclear pitch accent (often equated with the final pitch accent in the phrase) and the following edge tones. For instance, the intonation of examples (1) and (2) are

both analyzable as L+H\* L-L%. A longer phrase such as in example (3) can be considered to be “the same,” even if there are two accents, because it is the final accent that is generally considered to bear the main pragmatic meaning of a phrase-length tune, although there is a growing interest within the AM framework in the meaning of initial (secondary) accents (Braun 2006; Féry and Kügler 2008; Petrone and Niebuhr 2014; Bishop 2013, 2017) and phrase-length patterns (Welby 2003; Baumann and Rathcke 2013; Baumann, Mertens, and Kalbertodt 2017).

H\*            L+H\* L-L%

(3) I **think** you’re **right**.

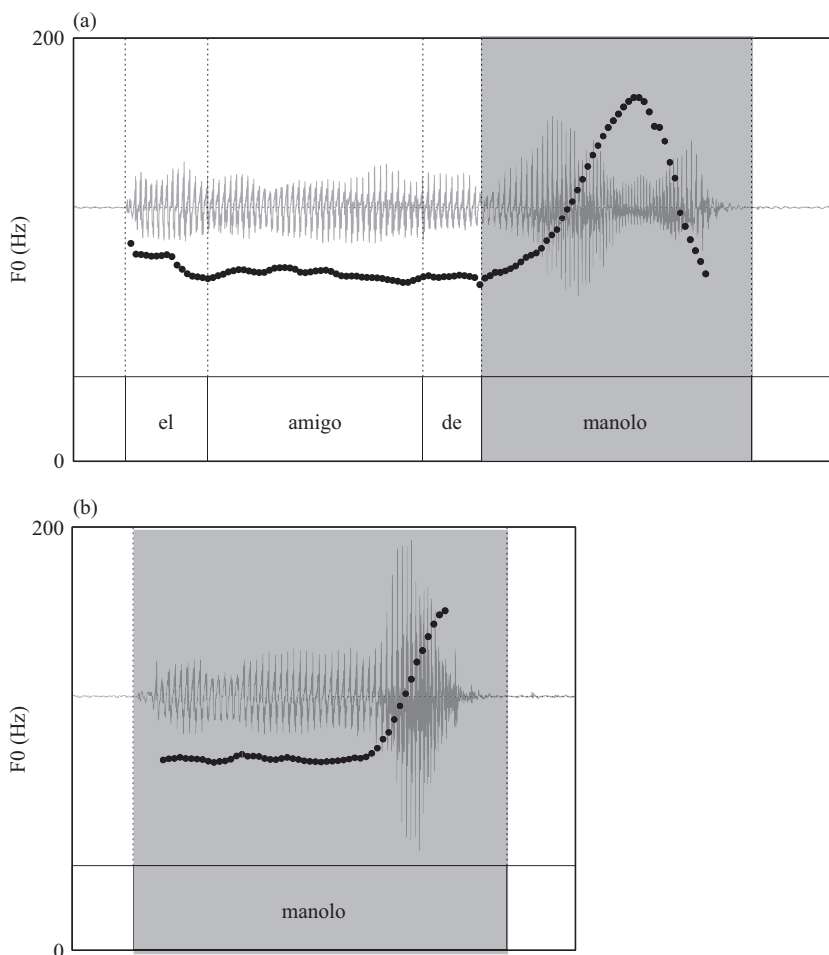
The concept of nuclear accent was developed with West Germanic in mind—languages that are flexible in their placement of accents. In these languages, the nuclear accent on a focused constituent can be followed by a number of words that are deaccented (they are not accented even if they are in principle accentable, e.g., nouns). In languages that do not make such widespread use of deaccenting after a focal accent, the primacy of the final pitch accent has long been called into question. Languages that tend to accent more densely may not assign any special status to the final accent in a phrase. This is the case for varieties of Arabic (Hellmuth 2014, forthcoming) and for many Romance languages (Swerts, Krahmer, and Avesani 2002; Frota and Prieto 2015), as well as for Greek (as discussed by Arvaniti).

Torreira and Grice (2018) discuss a number of tunes in Spanish that not only call into question the importance of final pitch accents but also call for a different way to describe the similarity of tunes across utterances of different lengths. They show that the tunes they investigate are better conceived of as tones that are associated differently depending on the metrical structure of the phrase. They argue that the association properties of these tones depend on the availability of suitable heads in the metrical structure. The evidence put forward stems from two sources: conversational data in which the focus structure and pragmatic meaning can be inferred from the context and experimental data in an imitation and completion task. In the Spanish low-rise-fall contour, as shown in figure 1c.4, they provide evidence for differential association of the H tone, depending on whether the utterance consists of two or more prosodic words or only one. In the former case, H has a head association, in the latter case it has an edge association. By contrast, the first L always has a head association, as shown in (4), where it is associated with the stressed syllable of *amigo* in (4a) and with the stressed syllable of *Manolo* in (4b).

L            H L            L H (L)

(4) a. El **amigo** de **Manolo**            b. **Manolo**

The common practice of describing tunes as consisting of nuclear pitch accents and edge tones misses this generalization, as does an analysis of tones with a fixed association type (e.g., a tune containing H\*). Torreira and Grice propose a clearer separation between tones and metrical structure, in which association can result from melody-specific principles of tune-text association. They thus propose a more abstract notion of tune, for example, representing both (4a) and (4b) as LHL, with a priority association of the first L to the first stressed syllable in the phrase, ensuring the presence of L\* and variable association of the following H and L tones. Other tunes in other languages may have different priority associations. Again, allowing for this flexibility would make it easier to capture similarities in other languages that may be lost if considering tunes as strictly composed of (nuclear) pitch accents and edge tones.



**Figure 1c.4**

Spanish. F0 contours and speech waveforms with intonation contours that are “the same” on (a) two prosodic words, *el amigo de Manolo* (the friend of Manolo), and (b) one prosodic word, *Manolo* (Manolo). *Source*: Adapted from Torreira and Grice (2018).

One aspect of this Spanish contour needs clarification: the final pitch does not fall when there is only one prosodic word, indicated informally in (4b) by parentheses around L, but it does fall when there are two or more prosodic words in the phrase. The former case is interpreted as truncation, as discussed at length for other languages by Arvaniti, and put into a larger context of tune-text adjustments.

### Tune-Text Adjustments

Truncation of pitch contours involves adjustments to the tune when more than one tone is crowded onto a TBU. Another possible adjustment in the case of tonal crowding is to make room for the realization of a particular tune by extending the text. This can entail lengthening of vowels (Grice, Savino, and Refice 1997), the addition of vowels



(Grice, Savino, and Roettger 2018), or blocking of vowel devoicing (Kilbourn-Ceron and Sonderegger 2017), all serving to facilitate the full realization of a complex contour.

Both types of adjustment—to the *tune*, involving tonal identity, and to the *text*, involving segmental properties of the TBUs—may be characterized by continuous parameters, lending themselves to a phonetic implementation account, as discussed by Arvaniti. However, not all adjustments to the tune can be accounted for as phonetic. The case of *Manolo* in Spanish in figure 1.c4a is a case in point. There is in fact ample time for a rise-fall in pitch to occur on the final open syllable, there being, for example, no final voiceless consonant to shorten the voiced portion in the syllable. Typical cases of truncation attributed to phonetic implementation have such a voiceless coda (see, e.g., Grabe 1998 for German and Grabe, Post, Nolan, and Farrar 2000 for varieties of English). However, Rathcke (2016) has shown that patterns of truncation are language-specific, as well as dependent on the association properties of a particular tone. Furthermore, she discusses the truncation of the fall in Russian rise-falls as “a categorical abandonment of an underlying boundary tone” (223). This is clearly a phonological analysis, similar to Grice’s (1995) analysis of a similar fall in Palermo Italian in which truncation is treated in terms of the lack of association to a TBU.

Adjustments to the text are not always attributable to phonetic implementation either. Vowels that are inserted are sometimes as long as or even longer and more sonorous than lexical vowels (for Tashlhiyt, see Roettger 2017; for Italian, see Grice, Savino, and Roettger 2018). Moreover, durational adjustments are sometimes attributed to phonological lengthening, represented as an extra metrical beat (Selkirk 1984) or an extra mora (see for instance Strunk 1983 on vowels with an added mora in Sanskrit).

Any phonological account of these adjustments compromises the independence of tune and text, one of the basic tenets of AM theory (see Roettger and Grice 2019 for further discussion).

### Problems with Categorization in AM

Although AM models are widely used as a standard for the transcription of intonation (Beckmann, Hirschberg, and Shattuck-Hufnagel 2005), there are still considerable problems of intertranscriber consistency (Pitrelli, Beckman, and Hirschberg 1994; Grice et al. 1996; Mayo, Aylett, and Ladd 1997; Jun et al. 2000; and Escudero et al. 2012, *inter alia*). An AM analysis of an utterance not only determines the association properties and functions of tones; it also determines the tonal makeup of the tune, that is, which tones and sequences of tones are present. For example, in (3) the prenuclear pitch accent is H\* rather than L+H\*, and the nuclear pitch accent is L+H\* rather than H\* or L\*+H. Such paradigmatic aspects of the analysis are particularly prone to intertranscriber inconsistencies.

This is in part because of the complex relationship between phonetic parameters and abstract AM categories, involving multiple dimensions. Thus, as Arvaniti points out, peak alignment and scaling are not sufficient for capturing distinctions between these categories. In fact, even within one language community, individual speakers and listeners use these dimensions in different ways and to varying degrees to produce and perceive one and the same category (Grice et al. 2017; Cangemi, Krüger, and Grice 2015 for German; see similar results for English in Burdin, Holliday, and Reed 2018). Thus, where one speaker or listener will pay more attention to one dimension, for example, the alignment of F0 peaks, another will focus on a different one, for example, F0 scaling. These differences might be captured by a different weighting of cues or, at least

partially, by measures that collapse various dimensions over a longer stretch than a simple peak position, such as the tonal center of gravity (Barnes et al. 2012).

Concentrating on one parameter only, for example, alignment of peaks, can lead to the conclusion that a language has no pitch-accent distinction, such as in the case of Egyptian Arabic, because it has been shown that different speakers make use of different phonetic parameters to express the same contrast (Cangemi et al. 2016). Bruggeman et al. (2018) showed that a measure of the tonal center of gravity was able to capture important distinctions across different speakers that would otherwise be lost if relying on individual F0 peak properties as a single cue.

The nature of intonational meaning—with functions ranging from marking information structure, managing discourse, and encoding attitudinal and indexical aspects of communication—makes it difficult to establish how far the parameter manipulations discussed here are equivalent in their function. Despite problems in pinning down the relative importance of different parameters, the necessity to have labels for abstract entities has meant that the AM models are still prevalent and are still the models of choice for embarking on an analysis of a new language. Allowing for flexibility in these models will ensure that the model will be able to accommodate and account for the considerable range of variation within and across languages that we are beginning to discover.

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