John A. Goldsmith, Elizabeth Hume,
W. Leo Wetzels (Eds.)

TONES AND FEATURES

PHONETIC AND PHONOLOGICAL PERSPECTIVES

Tones and Features
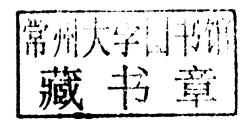
Phonetic and Phonological Perspectives

edited by

John A. Goldsmith, Elizabeth Hume,
and W. Leo Wetzels

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Preface

The papers in this volume are all concerned with two current topics in phonology: the treatment of features, and the treatment of tone. Most of them grew out of a conference at the University of Chicago's Paris Center in June of 2009 which was organized by friends and colleagues of Nick Clements in tribute to decades of contributions that he had made to the field of phonology, both in the United States and in France. Nick's work served as a natural focus for the discussions and interactions that resulted in the papers that the reader will find in this book. We, the editors, would like to say a bit about Nick's career and his work in order to set the context.

1. G. N. Clements

Nick was an undergraduate at Yale University, and received his PhD from the School of Oriental and African Studies, University of London, for a dissertation on the verbal syntax of Ewe in 1973, based on work that he did in the field. In the 1970s, he spent time as a post-doctoral scholar at MIT and then as a faculty member in the Department of Linguistics at Harvard University. Throughout this period he published a series of very influential articles and books on areas in phonological theory, a large portion of which involved linguistic problems arising out of the study of African languages. His work in this period played an essential role in the development of autosegmental phonology, and his work in the 1980s, when he was a professor of linguistics at Cornell University, was crucial in the development of many of the current views on features, feature geometry, sonority, and syllabification. He worked closely with students throughout this time—including one of us, Elizabeth Hume—at Cornell. He also co-wrote books with several phonologists (Morris Halle, Jay Keyser, John Goldsmith) and collaborated on many research projects.

In 1991, Nick moved to Paris, where he and his wife, Annie Rialland, worked together on projects in phonetics, phonology, and many other things, both linguistic and not. Visiting Nick in Paris became an important thing for phonologists to do when they had the opportunity to come to Paris. Over the next twenty years or so Nick continued to work selflessly and generously

with students and more junior scholars, and was widely sought as an invited speaker at conferences.

Nick passed away a few months after the conference, late in the summer of 2009. Many of his friends (and admirers) in the discipline of phonology had been able to express their admiration for his contributions through their papers and their kind words at the time of the conference in June. This book is offered as a more permanent but equally heartfelt statement of our affection and respect for Nick's work in phonology and in linguistics more broadly.

2.   Tone

The proper treatment of tonal systems has long been an area of great activity and curiosity for phonologists, and for several reasons. Tonal systems appear exotic at first blush to Western European linguists, and yet are common among languages of the world. The phonology of tone is rich and complex, in ways that other subdomains of phonology do not illustrate, and yet each step in our understanding of tonal systems has shed revelatory light on the proper treatment of other phonological systems. At every turn, tonal systems stretch our understanding of fundamental linguistic concepts: many languages exhibit tonal contrasts, in the sense that there are lexical contrasts that are physically realized as different patterns of fundamental frequency distributed globally over a word. But from a phonological point of view, words are not unanalyzable: far from it—they are composed in an organized fashion from smaller pieces, some mixture of feet, syllables, and segments. Breaking a pitch pattern (when considering an entire word) into pieces that are logically related to phonological or morphological subpieces (which is ultimately ninety percent of a phonologist's synchronic responsibility) has proven time and time again to be an enormous challenge in the arena of tone. One of the classic examples of this challenge can be found in Clements and Ford's paper (1979) on Kikuyu tone. In Kikuyu, the surface tone of each syllable is essentially the expression of the previous syllable's tonal specification. Each syllable (often, though not always, a distinct morpheme) thus has an underlying – we are tempted to say, a logical—tone specification, but that specification is realized just slightly later in the word than the syllable that comprises the other part of the underlying form. Morphemes in such a system show utter disregard for any tendency to try to be realized in a uniform way across all occurrences; tones seem to assert their autonomy and the privileges that come with that, and use it to produce a sort of constant syncopation in the beat of syllable against tone.

Is tone, then, different from other phonological features? This question is directly posed by three papers in this volume, that by Nick Clements and colleagues, that by Larry Hyman, and that by David Odden. Each is written with the rich background of several decades of research on languages – largely African tone languages, at least as far as primary research is concerned, but also including the fruits of research done on Asian languages over decades as well. In the end, Clements, Michaud, and Patin conclude that tonal features may well be motivated in our studies of tonal systems, but the type of motivation is different in kind from that which is familiar from the study of other aspects of phonology. Hyman, for his part, is of a similar conviction: if tones are analyzed featurally in the ultimate model of phonology, it is not a step towards discovering ultimate similarity between tone and every other phonological thing: tone's diversity in its range of behavior keeps it distinct from other parts of phonology. David Odden's chapter also focuses on the motivation for tonal features. However, his focus is on the types of evidence used to motivate a given feature. Along these lines, he argues that tonal features, like other phonological features, are learned on the basis of phonological patterning rather than on the basis of the physical properties of the sounds (for related discussion, see Mielke 2008).

Goldsmith and Mpiranya's contribution addresses not features for tone, but rather one particular characteristic of tone that keeps it distinct from other aspects of phonology: tone's tendency to shift its point of realization (among a word's syllables) based on a global metrical structure which is erected on the entire word. This is similar to the pattern we alluded to just above in Kikuyu, but in Kinyarwanda, certain High tones shift their autosegmental association in order to appear in weak or strong rhythmic positions: a bit of evidence that rhythmicity is an important organization principle of tonal assignment, in at least some languages, much like that seen in accent assignment and rarely, if ever, seen in other aspects of a phonological system.

The theme of rhythmicity is continued in the paper by Annie Rialland and Penou-Achille Somé. They hypothesize that there is a relationship between the linguistic scaling in Dagara-Wulé, as manifested in downstep sequences, and the musical scaling in the same culture, as found in an eighteen key xylophone. They suggest that downstep scaling and xylophone scaling may share the property of being comprised of relatively equal steps, defined in terms of semitones.

3. Features

The hypothesis that the speech chain can be analyzed as a sequence of discrete segments or phonemes, themselves decomposable into a set of

phonological features, has been at the core of almost a century of research in the sound structure of human language. By virtue of their contrastive nature, phonological features function as the ultimate constitutive elements of the sound component in the sound-to-meaning mapping, while, being both restricted in number at the individual language level and recurrent across languages, their intrinsic characteristics are often associated with general properties of human anatomy and physiology. Apart from being distinctive, phonological features appear to be economical in the way they combine to construct phoneme systems and to express, individually or in combination, the regularity of alternating sound patterns, both historically and synchronically.

It was discovered by Stevens (1972) that small articulator movements in specific areas of the articulatory space may lead to large acoustic changes, whereas, in other regions, relatively large movements lead to only minor acoustic variations. Stevens' quantal model of distinctive features forms the theoretical background of the study by Dogil and his colleagues, who discuss the function of subglottal resonances in the production and perception of diphthongs in a Swabian dialect of German. It is observed that Swabian speakers arrange their formant movements in such a way that the subglottal resonance region is crossed in the case of one diphthong and not the other.

In Stevens' model, the defining acoustic attributes of a feature are a direct consequence of its articulatory definition. The relation between articulation and acoustics is considered to be language-independent, although a feature may be enhanced language-specifically to produce additional cues that aid in its identification. As required by the naturalness condition, phonological features relate to measurable physical properties. Therefore, to the extent that features can be shown to be universal, it is logical to ask what the defining categories of a given feature are that account for the full range of speech sounds characterized by it. This problem is explicitly addressed in the chapter by Ridouane, Clements, and Khatiwada, who posit the question of how [spread glottis] segments are phonetically implemented, and propose a language-independent articulatory and acoustic definition of this feature. Also following the insights of Stevens' quantal theory, Vaissière elaborates a phonetic notation system based on the combination of acoustic and perceptual properties for five 'reference' vowels and discusses its advantages over Jones' articulation-based referential system of cardinal vowels. Kim and Park address the issue of how the opposition between the Korean fricatives /s, s'/ is best characterized in phonetic terms. From their acoustic data they conclude that the most important parameter that distinguishes these sounds is frication duration, which is significantly longer in /s'/ than in /s/. They

propose that this difference is best expressed by reference to the feature [tense].

Discovering the smallest set of features able to describe the world's sound patterns has been a central goal of phonological theory for close to a century, leading to the development of several different feature theories. The chapter by Mielke, Magloughlin, and Hume compares the effectiveness of six theories to classify actually occurring natural and unnatural classes of sounds. They show that a version of Unified Feature Theory (Clements and Hume 1995) with binary place features, as suggested by Nick Clements in 2009, performs better than other proposed theories.

Another important topic in feature research concerns the relation between the feature structure of phonological representations and phonological processes or constraints. How are segments, morphemes or words represented in terms of their feature composition, and which features pattern together in phonological processes and bear witness to their functional unity? Hallé and Adda-Decker study the latter question by examining whether voice assimilation in French consonant clusters is complete or partial. They show that, of the acoustic parameters involved in the assimilation process, voicing ratios change categorically, whereas secondary voicing cues remain totally or partially unaffected. They propose to describe voicing assimilation in French as a single-feature operation affecting the [voice] feature. Rubach addresses the question whether palatalized and velarized consonants should be treated as complex or as simplex segments in terms of their geometrical representation. Looking at Bulgarian data, he concludes that palatalization as well as velarization on coronals and labials are represented as separate secondary articulations. In his study on mid-vowel neutralizations in Brazilian Portuguese, Wetzels argues for a gradient four-height vowel system for this language. The interaction between vowel neutralization and independent phonotactic generalizations suggests that vowel neutralization cannot be represented as the simple dissociation from the relevant contrastive aperture tier, but is best expressed by a mechanism of marked-to-unmarked feature substitution. McCarthy's paper provides a detailed discussion of how vowel harmony should be accounted for in Optimality Theory. Since proposals for dealing with vowel harmony as embedded in parallel OT make implausible typological predictions, he proposes a theory of Serial Harmony that contains a specific proposal about the constraint that favors autosegmental spreading within a derivational 'harmonic serialism' approach to phonological processes.

In addition to the authors noted above and the participants at the 2009 Paris symposium, we would like to acknowledge others who contributed

to this tribute to our friend and colleague, Nick Clements. The University of Chicago generously provided its Paris Center where the symposium was held, and we would like to thank Françoise Meltzer and Sebastien Greppo, Director and Administrative Director of the Paris Center, respectively, for their invaluable assistance in organizing the event. We are also grateful to Deborah Morton of The Ohio State University Department of Linguistics for editorial help in preparing the manuscripts for publication, and to Julia Goldsmith for her assistance in creating the index. Likewise, our appreciation extends to the editorial staff at Mouton de Gruyter, including Julie Miess, and the late Ursula Kleinhenz for her enthusiastic support of this project.

<div align="right">John A. Goldsmith, Elizabeth Hume, W. Leo Wetzels</div>

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Contents

1. The representation and nature of tone

Do we need tone features?

G.N. Clements, Alexis Michaud, and Cédric Patin

Abstract. In the earliest work on tone languages, tones were treated as atomic units: High, Mid, Low, High Rising, etc. Universal tone features were introduced into phonological theory by Wang 1967 by analogy to the universal features commonly used in segmental phonology. The implicit claim was that features served the same functions in tonal phonology as in segmental phonology. However, with the advent of autosegmental phonology (Goldsmith 1976), much of the original motivation for tone features disappeared. Contour tones in many languages were reanalyzed as sequences of simple level tones, calling into question the need for tonal features such as [±falling]. Processes of tone copy such as L(ow) > H(igh) / __ H(igh) were reinterpreted as tone spreading instead of feature assimilation. At about the same time, a better understanding of downstep emerged which allowed many spurious tone levels to be eliminated. As a result, in spite of the vast amount of work on tone languages over the past thirty years, the number of phenomena that appear to require tone features has become significantly reduced, raising the issue whether the notion of tone features is at all useful. This paper first reviews the basic functions for which segmental features have been proposed, and then examines the evidence that tone features are needed to serve these or other functions in tone languages. The discussion focuses successively on level tones, contour tones, and register, building on examples from Africa and Asia. Our current evaluation of the evidence is that tone features, to the extent that they appear motivated at all, do not serve the same functions as segmental features.

1.   Introduction

In this introduction, we review criteria that are commonly used in feature analysis in segmental phonology, and suggest that these criteria have not, in general, been successfully extended to tonal phonology.

Some important functions of features in segmental phonology are summarized in Table 1.[1]

Table 1. Some common functions of features in segmental phonology

Function		example (segments)
distinctive	distinguish phonemes/ tonemes	/p/ and /b/ are distinguished by [±voice]
componential	define correlations (sets distinguished by one feature)	[–voiced] p t c k [+voiced] b d ɟ g
classificatory	define natural classes (rule targets, rule contexts)	[–sonorant] sounds are devoiced word-finally
dynamic	define natural changes (such as assimilation)	obstruents become [+voiced] before [+voiced] consonants

It is usually held, since the work of Jakobson, Fant and Halle (1952), that one small set of features largely satisfies all functions. We have illustrated this point by using the feature [±voiced] in the examples above. It is also usually believed that each feature has a distinct phonetic definition at the articulatory or acoustic/auditory level, specific enough to distinguish it from all other features, but broad enough to accommodate observed variation within and across languages. In this sense, features are both "concrete" and "abstract".

With very few exceptions, linguists have also maintained that features are universal, in the sense that the same features tend to recur across languages. Thus the feature [labial] is used distinctively to distinguish sounds like /p/ and /t/ in nearly all languages of the world. Such recurrence is explained by common characteristics of human physiology and audition.[2]

Although all the functions in Table 1 have been used in feature analysis at one time or another, the trend in more recent phonology has been to give priority to the last two functions: classificatory and dynamic. We will accordingly give these functions special consideration here.

Feature theory as we understand it is concerned with the level of (categorical) phonology, in which feature contrasts are all-or-nothing, rather than gradient. Languages also have patterns of subphonemic assimilation or coarticulation which adjust values *within* given phonological categories. Such subphonemic variation does not fall within the classical functions of features as summarized in Table 1, and it should be obvious that any attempt to extend features into gradient phenomena runs a high risk of undermining other, more basic functions, such as distinctiveness.

Traditionally, rather high standards have been set for confirming proposed features or justifying new ones. The most widely-accepted features have been founded on careful study of evidence across many languages. Usual requirements on what counts as evidence for any proposed feature analysis include those in (1).

(1) a. *phonetic motivation*: processes cited in evidence for a feature are phonetically motivated.
   b. *recurrence across languages*: crucial evidence for a feature must be found in several unrelated languages.
   c. *formal simplicity*: the analyses supporting a given feature are formally and conceptually simple, avoiding multiple rules, brackets and braces, Greek letter variables, and the like.
   d. *comprehensiveness*: analyses supporting a given feature cover all the data, not just an arbitrary subset.

Proposed segmental features that did not receive support from analyses meeting these standards have not generally survived (many examples can be cited from the literature).

The case for tone features, in general, has been much less convincing than for segmental features. One reason is that much earlier discussion was vitiated by an insufficient understanding of:

- "autosegmental" properties of tone: floating tones, compositional contour tones, toneless syllables, etc.
- downstep: for example, ¹H tones (downstepped High tones) being misinterpreted as M(id) tones
- intonational factors: downdrift, final lowering, overall "declination"
- contextual variation, e.g. H(igh) tones are often noncontrastively lower after M(id) or L(ow) tones

As a result, earlier analyses proposing assimilation rules must be reexamined with care. Our experience in the African domain is that most, if not all, do not involve formal assimilation processes at all.

A second reason, bearing on more recent analysis, is that the best arguments for tone features have often not satisfied the requirements shown in (1). Feature analyses of tonal phenomena, on close examination, very often prove to be phonetically arbitrary; idiosyncratic to one language; complex (involving several rules, Greek-letter variables, abbreviatory devices, etc.);

and/or noncomprehensive (i.e. based on an arbitrary selection of "cherry-picked" data).

A classic example in the early literature is Wang's celebrated analysis of the Xiamen tone circle (Wang 1967; see critiques by Stahlke 1977, Chen 2000, among others). Wang devised an extremely clever feature system which allowed the essentially idiosyncratic tone sandhi system of Xiamen to be described in a single (but highly contrived) rule in the style of Chomsky & Halle 1968, involving angled braces, Greek letter variables, etc. Unfortunately, the analysis violated criteria (1a–c), viz. phonetic motivation, recurrence across languages, and formal simplicity. As it had no solid crosslinguistic basis, it was quickly and widely abandoned.

The following question can and should be raised: when analyses not satisfying the criteria in (1) are eliminated, do there remain any convincing arguments for tone features?

2.   The two-feature model

Though there have been many proposals for tone feature sets since Wang's pioneering proposal (see Hyman 1973, Anderson 1978), recent work on this topic has converged on a model which we will term the Two-Feature Model.

In its essentials, and abstracting from differences in notation and terminology from one writer to another, the Two-Feature Model posits two tone features, one dividing the tone space into two primary registers (upper and lower, or high and low), and the other dividing each primary register into secondary registers. The common core of many proposals since Yip [1980] 1990 and Clements 1983[3] is shown in (2). This model applies straightforwardly to languages that contrast four level tones.

(2)		top	high	mid	low
	register	H	H	L	L
	subregister	h	l	h	l

We use the conventional terms "top", "high", "mid", and "low" for the four tones of the Two-Feature Model in order to facilitate comparison among languages in this paper. The model outlined in (2) analyzes these four tones into two H-register tones, top and high, and two L-register tones, mid and low. Within each of these registers, the subregister features, as we will call them, divide tone into subregisters; thus the top and high tone levels are