Phonological Structure and Phonetic Form: Papers in Laboratory Phonology III by Patricia A. Keating
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As the third in the series, this volume continues the LabPhon tradition of bringing together a diverse group of researchers with interests in linguistic sound systems. Most contributions to the present volume are oriented towards investigating the phonology—phonetics interface. However, this volume also includes papers that extend the domain of laboratory phonology to computational phonotactics, speech-synthesis strategies and language variation and change. The original papers and accompanying commentaries are revisions of oral presentations given at the 3rd Conference in Laboratory Phonology (LabPhon3) at UCLA in June 1991. Appropriately, the volume is dedicated to Peter Ladefoged, whose retirement from teaching at UCLA coincided with the conference. The volume begins with a brief introduction by the editor, Patricia Keating. The eleven original papers are then grouped into four sections, namely *Intonation, Syllables, Feature theory* and *Phonetic output*. All but two of the papers have an accompanying commentary.

The section on *Intonation* contains three papers and commentaries that are connected by a quest for phonetic correlates of the perceived prosodic hierarchy. The section begins with a paper by Mary E. Beckman & Jan Edwards, ‘Articulatory evidence for differentiating stress categories’. Beckman & Edwards provide empirical support, in the form of lip open–close cycle durations, for a theory of English stress that supposes different primary phonetic correlates for the content-feature 'stress' at different levels of the prosodic hierarchy. The commentary by Stefanie Shattuck-Hufnagel, “Stress shift” as early placement of pitch accents: comment on Beckman and Edwards’, expands on the general theoretical stance presented by Beckman & Edwards by discussing some of the available evidence for perceived stress shift as early pitch accent placement for the purpose of signalling a prosodic constituent boundary.

The next contribution to this section is 'Constraints on the gradient variability of pitch range, or, Pitch level 4 lives!' by D. Robert Ladd. In this paper Ladd arrives at an argument for a distinction between normal High and Overhigh tones in English intonational phonology by way of an experimental investigation of Free Gradient Variability in accent pitch-range setting. The crux of his argument is that relative heights of accents within a phrase are set in categorical, relational ways, and that the distinction between normal High and Overhigh tones is part of the grammar that determines the categorical relations between two accent peaks within an utterance. The commentary by Bruce Hayes, ‘‘Gesture’’ in prosody: comments on the paper by Ladd’, takes issue with Ladd’s proposal that the High–Overhigh distinction is a categorical, phonological distinction. Hayes suggests an alternative interpretation of the experimental evidence against Free Gradient Variability. He proposes that
linguistic and paralinguistic factors combine to yield a phonetic contrast between 'gesturally emphasised' and normal High tones.

The final contribution to the section on Intonation is 'What is the smallest prosodic domain?' by Vincent J. van Heuven, with an accompanying commentary by Allard Jongman entitled 'The segment as smallest prosodic element: a curious hypothesis'. Van Heuven presents preliminary data on listeners' abilities to identify narrow focus on segment-sized units, and on possible acoustic correlates of these prosodic contrasts. Jongman points out that the results are somewhat weak, and thus it is premature to conclude that the segment (or by extension, the feature) is actually a prosodic domain. Nevertheless, Jongman notes that van Heuven's experimental approach represents a promising paradigm for investigating the effects of focus placement on speech perception and spoken word recognition.

Section II, *Syllables*, presents a collection of papers that clearly demonstrates the breadth and depth of the laboratory phonology approach. The section begins with a paper by Alice Turk entitled 'Articulatory phonetic clues to syllable affiliation: gestural characteristics of bilabial stops'. Turk presents x-ray microbeam data on opening and closing upper-lip gestures of bilabial stops in an attempt to provide a phonetically motivated account of consonantal syllable affiliation in American English. She uses discriminant analysis to compare opening and closing gestures of bilabial stops with unknown syllable affiliations to those of known syllable-initial and syllable-final bilabial stops. Turk shows that both opening and closing components of bilabial stops that follow stressed vowels and precede unstressed vowels pattern with syllable-final bilabials.

The second paper in this section, 'The phonology and phonetics of extrasyllabic word-initial and word-final consonants in French', by Annie Rialland, presents an analysis of extrasyllabic word-initial and word-final consonants in French. The proposed analysis is shown to provide a unified account of various phonological phenomena in French. Rialland also presents preliminary data on acoustic correlates of extrasyllabic vs. core-onset consonants in French. The papers by Turk and Rialland are followed by a commentary by Francis Nolan entitled 'Phonetic correlates of syllable affiliation'. By providing preliminary articulatory (electro-palatographic) and acoustic data on medial voiceless English velars, this commentary provides a very clear and convincing demonstration of the insights that can be gained by concurrent study of various forms of phonetic data. The main point of this commentary is well taken: phonetic data is complex and operates in various domains (articulatory, acoustic and perceptual); therefore, it is important to take into account a broad range of phonetic facts before concluding that direct phonetic correlates of phonological structures have been revealed.

The final paper in the section on syllables is 'Syllable structure and word structure: a study of triconsonantal clusters in English', by Janet Pierrehumbert. This contribution stands out as an excellent example of how keen observation and experimentation, in conjunction with formal phonological theory, can lead to novel insights regarding linguistic sound patterns. The overall goal of this study was to investigate the extent to which phonotactic constraints on syllable onsets and codas account for the inventory of long medial clusters in English. Based on discrepancies between the observed and expected frequencies of occurrences of these medial clusters, and on results of an
experiment that revealed listeners' tacit knowledge of triconsonantal medial cluster phontactics, Pierrehumbert shows that phontactic constraints are not fully accounted for by a stochastic syllable grammar. Instead, gaps in the distribution of medial clusters might arise from cooccurrence constraints due to an interaction of syllable and word position, or from a general constraint against total identity even across intervening material.

Section III, on Feature theory, consists of two original papers, 'The phonetics and phonology of Semitic pharyngeals' by John J. McCarthy, and 'Phonetic evidence for hierarchies of features' by Kenneth N. Stevens, each with an accompanying commentary by Louis Goldstein. Taken together, these four essays provide an excellent exposition of the various approaches and kinds of evidence, both phonetic and phonological, that address the representation of phonological features. The paper by McCarthy presents a survey of the phonetic and phonological evidence for the proposal that pharyngeal consonants form a natural class. The major innovation of this approach is that it characterises natural classes on the basis of place of articulation, expressed in terms of 'orosensory goals' (Perkell 1980), as well as on the basis of major articulator. In this view, the phonological features [labial], [coronal], [dorsal] and [pharyngeal] reflect a division of the vocal tract into four subjectively equivalent 'orosensory' units. Goldstein's commentary proposes an alternative articulator-based property to distinguish guttural from non-guttural consonants, namely contact along the upper vocal tract surface. Such a feature is lacking for guttural, but present for non-guttural consonants. From Goldstein's point of view, the major advantage of defining place features in terms of active articulators, rather than in terms of articulatory regions corresponding to orosensory patterns, is that it is compatible with the view that speech is composed of gestures (Browman & Goldstein 1989), which involve the co-ordinated activity of independent articulators.

The paper by Stevens draws on two basic proposals to present articulatory and acoustic evidence for a hierarchical organisation of features. First, building on earlier work (Halle & Stevens 1991), Stevens proposes that the various acoustic and articulatory correlates of abstract features be organised into a hierarchical structure that parallels the feature geometries that have been proposed in the phonological literature (e.g. Clements 1985; Sagey 1986; McCarthy 1988). Second, Stevens develops the notion of landmarks as the acoustic manifestations of features, which serve to assist speakers and listeners by placing constraints on the coordination of articulator movements. Goldstein's commentary, entitled 'Do acoustic landmarks constrain the coordination of articulatory events?' focuses exclusively on the second proposal of Stevens. Goldstein points out several specific cases where gestural coordination may not be constrained by acoustic landmarks alone, or where the expected acoustic landmark for a particular primary feature is apparently 'missing'.

As an ensemble of papers dealing with the phonetics and phonology of feature theory, the contributions of McCarthy, Stevens and Goldstein are particularly stimulating, and exemplify the value of cooperation between phonetics and phonology. As is brought out so clearly in these papers, our understanding of distinctive feature theory crucially depends on careful study of the patterning of sounds in language, as well as on knowledge of the acoustic and articulatory manifestations of speech sounds.

Section IV, Phonetic output, begins with a paper by Malcah Yaeger-Dror,
entitled 'Phonetic evidence for sound change in Quebec French'. This paper is an important contribution to the current collection of laboratory phonology papers, because it provides an excellent demonstration of how studies of language variation and change can provide important information about general linguistic competence. It is not new for modern sociolinguistic studies to depend on modern linguistic theory and careful phonetic analysis of real-world speech data (e.g. Labov et al. 1972); however, it is still somewhat unusual to find a paper with a clear sociolinguistic orientation included in a collection of phonology papers. This paper thus represents an important (and very welcome) broadening of the laboratory phonology scope. A major finding of Yaeger-Dror's study of changes in the Montreal French realisation of mid-low lengthened vowels is that this 'change from below' continues to occur in real time for individual speakers. Furthermore, Yaeger-Dror shows that this change in vowel production is subject to a lexical split, such that some lexical items, marked [+ conservative], will not show the change, whereas others will. Since such changes can advance continuously in all speakers, linguistic forms should be seen as dynamic, rather than fixed in speakers' brains, and thus subject to both linguistic and paralinguistic influences.

In the next paper, 'Polysyllabic words in the YorkTalk synthesis system', John Coleman provides a sketch of the YorkTalk approach to the relationship between phonetics and phonology. Coleman then demonstrates how the basic YorkTalk principles would model the phonological representation and phonetic implementation of polysyllabic forms, which incorporate phonetic variability due to foot structure and position of syllables in feet. The accompanying commentary by Keith Johnson, 'Phonetic arbitrariness and the input problem: comments on Coleman's paper', provides a useful clarification of some of the broader consequences of the YorkTalk approach for our understanding of the relationship between phonetics and phonology. With respect to the issues of phonetic arbitrariness in the implementation of phonological representations and the nature of the input to the phonology, Johnson suggests that hyper-articulated, clear-speech forms might play an important role.

The final paper in this section, 'Lip aperture and consonant releases', by Catherine P. Browman, is an important step in the general Articulatory Phonology research programme (Browman & Goldstein 1986, 1989, 1990). This paper presents an x-ray microbeam study of jaw and lip movement in CV sequences. By examining lip aperture in the consonantal portion of CVs with various labial or non-labial consonants and rounded or unrounded vowels, Browman shows that lip movements can be decomposed into separate consonantal and vocalic portions. Additionally, Browman provides evidence for active stop consonant releases for a sufficiently open vocal tract for the following vowel, rather than simply viewing the mouth opening gesture as a passive consequence of the return to the articulator-neutral position. John Kingston's commentary on this paper, 'Change and stability in the contrasts conveyed by consonant releases', provides valuable complementary phonological and phonetic data regarding the two main findings of Browman's articulatory study. Together, Browman's phonologically motivated articulatory study and Kingston's subsequent insights into related linguistic phenomena provide yet another example of the value of the cooperative spirit encouraged by the laboratory phonology approach.

In sum, this volume lives up to the high standard of research we have come
to expect from the *Papers in laboratory phonology* series. I welcome the broadening of the scope of laboratory phonology, and end this review with a word on other areas of linguistic sound-structure inquiry that might be good candidates for inclusion in future LabPhon volumes. Specifically, studies of the phonology of special populations, such as second-language learners and normal or developmentally delayed children, have well-established traditions of merging experimental phonetic methods with phonological theory (e.g. Yavas 1994; Archibald 1995), and may have much to offer to the general laboratory phonology enterprise.

**References**


