

Autosegmental and metrical phonology

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Colchester, VT: Basil Blackwell, 199X

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Received

Both phonetics and phonology deal with the sound structure of human language. Phonetics deals with the physical reality of speech and phonology, with the apparently categorical representation of sound structure which is manipulated in the mind in constructing words and sentences. The two fields are profoundly interrelated. Phonetics concentrates on those aspects of speech which function contrastively in language; for this reason, resonances of the vocal tract are taken to be more important than mucuous viscosity in the vocal tract. In almost any phonetics experiment, phonological assumptions have explicitly or implicitly guided the construction of the stimuli or tasks, the decision of what to measure, and the analysis of the data. Similarly, phonologists understand that phonological categories are founded in our articulatory and psychoacoustic capabilities, and that their phonological behaviour deeply reflects their phonetic nature. In view of the theoretical ties between phonetics and phonology, many researchers feel that the academic disciplines of phonetic and phonology should be closer than they now are, and they may even undertake to read up in their sister discipline.

Autosegmental and Metrical Phonology represents the effort of one of the founders of autosegmental theory to integrate the different strands of phonological research which arose in the wake of Chomsky & Halle (1968). This effort is extremely welcome. Autosegmental Phonology, Metrical Phonology, and Lexical Phonology all addressed different deficiencies of *The Sound Pattern of English*, and in their early years concentrated on different types of phenomena, often in different language groups. As a result, through most of the 1980s, it was unclear to what extent they conflicted with each other and to what extent they complemented each other. It is time for the field to integrate the insights of a now large and wide-ranging body of research.

The book's greatest success is as an essay on the present state of phonology, directed towards active researchers in this field. Goldsmith is a highly original phonologist, with broad interests, and many thought provoking insights. I found the discussions of syllable structure and of Lexical Phonology particularly refreshing. The references are also very valuable. The book is particularly strong in providing references for descriptive studies of various languages, and in identifying the antecedents of present theory in the works of the American and British structuralists.

However, several characteristics of the book limit its usefulness to a larger audience that includes the readers of *Journal of Phonetics*. First, taking advantage of the book's billing as a textbook, Goldsmith often presents a consensus view of main ideas of current theory, without identifying where they first appeared or bringing out the points of disagreement amongst other major authors. Thus, for example, someone reading the discussion of metrical trees and grids might not be aware of the extent to which the same issues were raised in Liberman & Prince (1977), nor of their subsequent fate in work such as Hayes (1982), Prince (1983), Selkirk (1984) and Halle & Vergnaud (1986). For less central issues, the consideration of alternates is often on the contrary distracting thorough. This uneven level of detail may make it difficult for the outsider to identify the main issues in the field.

Second, Goldsmith presupposes more background in phonology than most phoneticians have. In a telling passage in the introduction, he says

From readers, whichever group they may come from, I expect some familiarity with generative phonology [...]. I might go far as to say that I expect some sympathy with it as well [...]. The ideal reader will have spent a semester or so working through the substance of a rigorous textbook such as, for example, Kenstowicz and Kisseberth's (1979) *Generative Phonology*.

It must be confessed that less than half of the editorial board of this journal meets this description, with many of the editors lacking not merely the knowledge that Goldsmith describes, but also the sympathy. In fact the description would apply to only the small minority of speech researchers in departments of electrical engineering, psychology, or speech and hearing, and it also fails to apply to many linguistic phoneticians working within linguistics departments. This fact might be viewed as an indictment of the training and research methodology in these areas. On the other hand, it might equally be viewed as a comment on the rather indifferent job generative phonology has done in obtaining the attention, respect, and support of scientists in related disciplines. Among speech scientists working outside of generative phonology, there are widespread complaints about its methodology, its inexactness and its faddishness. Claims of the theory which are neither applicable in technology nor amenable to experimental evaluation have had a particularly poor reception.

Persons with complaints about generative phonology may none the less wish to learn about Autosegmental and Metrical theory. This wish is not based so much on sympathy with generative phonology, as on the hope that it has improved. Specifically, the development of hierarchical representations and the current emphasis on representations over rules carries the promise of psychological interest and verifiability, as can be seen by comparing to the treatments of rhythm in Martin (1972) and Liberman & Prince (1977). Insofar as feature changing rules can be dispensed with entirely, the resulting phonological grammars are computationally tractable and can support speech technology, as shown e.g. by Coleman (1992a, b). Furthermore, the growing body of work on the phonetic and psychological manifestations of various phonological constructs brings home the relevance of phonology to the study of speech production and perception.

Unfortunately, Goldsmith's book does not put Autosegmental and Metrical theory in its best light for the group of outsiders and skeptics just described. One reason is that the book really deals entirely with morphophonemics (or phonological

processes involved in word formation), not covering the major points of contact between phonology and either phonetics or psycholinguistics. Let me mention some of these points of contact. I include references subsequent to Goldsmith's book to assist the reader in locating the current literature; readers should also refer to papers cited in these works.

The discussion on distinctive feature theory (left to the end of the book in "Further Issues", pp. 272-309) focuses on the overall organization of the features and their relationship to the autosegmental tier structure as exhibited in morphemic rules. There is no coverage of research on the relationship of distinctive feature theory to acoustics and articulation (probably the single largest body of work on the relationship of phonology to phonetics). The bibliography does not include Jakobson, Fant & Halle (1952) nor any subsequent work on this topic. The few remarks which are made on the phonetic content of phonological categories will strike phoneticians as uninformed. Readers with interests in this area are urged to refer to Stevens (1981), Stevens & Keyser (1989), and to special issues of *Phonetica* (1991) and the *Journal of Phonetics* (1989, 1990).

Similarly, the book does not discuss experimental work on morphological relatedness. (See papers in *Phonology Yearbook 3* (Ohala, 1986a), especially those by Ohala (1986b) and McCawley (1986)). The treatment of syllable structure covers only phonotactics and the consequences of syllable structure for stress assignment and for the theory of rule interaction. It does not deal with allophony related to syllabic position, nor with work on the psychological status of syllable structure (see e.g. Lehiste, 1960; Selkirk, 1982; Fujimura & Lovins, 1982; Treiman, 1983, 1984; Shattuck-Huhtagel, 1987; Derwing, Dow & Neary, 1988; Dell, 1986). The treatment of metrical structure deals with stress assignment in words, but not with the prosody of phrases or sentences. The treatment of tone deals with lexical tone patterns in words but not with intonation or with phrase-level phenomena in tone languages. The extensive experimental literature on the relationship of tone to fundamental frequency contours is not mentioned. References in the area of phrasal prosody, tone and intonation, include Bruce (1976), Pierrehumbert (1980), Selkirk (1984), Neespor & Vogel (1986), Pierrehumbert & Beckman (1988), Inkelas & Lebein (1990), Cutler (1991) and various papers in Cutler & Ladd (1983), Kingston & Beckman (1989) and Docherty & Ladd (1992).

Because it does not cover such topics, the book presents as primary data, or unsupported assertions, representations which would for an experimentalist be the result of detailed investigation and analysis. In cases where supporting experimental results actually exist, this represents a missed opportunity to defend generative theory against the accusation that it lacks an empirical foundation. In particular, broad aspects of the theories of syllable structure and stress have much better experimental support than one would guess from reading this book. However, experimental results have, of course, not always supported phonological theory. For example, Bruce's (1976) investigation led to a complete reanalysis of the Swedish accent system. Pierrehumbert (1980) identified phonetic principles which reduced the English intonation system from four contrastive levels to two, and Pierrehumbert & Beckman (1988) shows that Japanese lacks the tone spreading rule posited by previous authors. In view of such results, people who do instrumental work on tone are skeptical of the transcriptions made by people who do not, and will accordingly be skeptical of the transcriptions in this book. The foundation of distinctive feature

theory is another area of conflict between experimental results and generative theory. According to the standard model applied in Goldsmith's book, features represent articulatory actions and are furthermore organized in a tree structure according to active articulators. However, a growing body of work indicates that acoustic and aerodynamic factors influence phonological category systems in a way which can cross-cut the articulatory organization. Readers are referred to Stevens & Keyser (1989) and to the exchange amongst Beddor, Diehl, Kingston, Ohala and Ohala and Pierrehumbert in *Phonetica* (1991). Possibly a more sophisticated phonetic view of feature systems would lead to the discovery of morphophonemic processes which do not fit the articulatory mold.

The skeptical consumer of Autosegmental and Metrical theory may also be troubled by the poor formalization of the theory as presented in Goldsmith's book. The book abounds with technical terminology and specialized notation, but also in notational inconsistencies and in discrepancies between definitions and their application. For example, p. 14 provides the following definition for the Association Convention:

When unassociated vowels and tones appear on the same side of an association line, they will be automatically associated in a one-to-one fashion, radiating outward from the association line.

A later discussion of lengthening and nasality in Luganda asks (p. 56).

One might wonder [...] whether the association lines were not predictable (by the Association Convention, for example) and therefore unnecessary in the underlying representations.

Well, the Association Convention as defined is obviously inapplicable to the Luganda problem since it deals only with associations of tones to vowels, not with nasality. Goldsmith of course means something like "the obvious generalization of the Association Convention", however what may be obvious to Goldsmith himself is often not obvious to outsiders or students.

The formal inconsistencies in the book are discussed at some length in the review by Bird & Ladd (1991) and I will not repeat their discussion here. They lay part of the blame on the overall state of the field. It is certainly the case that no subsequent work in phonology has met the standards of formalization of Chomsky & Halle (1968), and some central formal problems of the present theory are going unsolved, particularly in the area of rule interaction. For example, some phonological principles are taken to block particular rules, while others trigger repairs; there is no consensus about what kind of principles will show which behaviour. There is no adequate definition of the Strict Cycle, a centerpiece of phonological theory which causes rules to apply differently in morphologically simple and complex forms. (Definitions in Kiparsky (1982, 1985) both suffer from technical problems.) However, the theory of representation and rule application is in somewhat better shape than one might guess from Goldsmith's presentation. Previous works which have a stronger formal treatment include Liberman & Prince (1977), Prince (1983), Halle & Vergnaud (1986) and Pierrehumbert & Beckman (1988).

Autosegmental and Metrical Phonology was used at Northwestern University in a third quarter graduate phonology course. Some of its drawbacks as an introduction to current theory for outsiders are also apparent when it is being used as an introduction for newcomers.

Specifically, as a textbook it presupposes that phonology is being taught in historical order, since all rigorous introductions to the field now available, such as Kenstowicz & Kisseberth (1979), represent the state of understanding at a previous time when it was quite different. Teaching phonology in this way is in fact quite unsatisfactory. The instructor cannot present the material with conviction, but must on the contrary continually point out what is no longer believed. Many aspects of Chomsky & Halle (1968) are unintuitive; it is unfortunate to begin with a forbidding and unintuitive treatment of phenomena for which a more intuitive treatment is now available. The shrewd insights of students often merely repeat past history; students miss the thrill that students of the 1960s and 1970s had if their best efforts contributed to current knowledge. As a result, the sympathy for generative phonology which Goldsmith presupposes is not necessarily found even in linguistics graduate students.

Students using Goldsmith's book also experience great difficulties due to the formal inconsistencies and vagueness. For example, they are unable to work out cyclic derivations because it is unclear when the cycle is invoked and what aspects of the representation carry over from one cycle to the next. They cannot derive the stress patterns for morphologically complex English words, due to lack of detail in the presentation of metrical rules; working from Hayes's original paper proves far easier. The discussions of tier conflation and of harmonic phonology are incomprehensible to people who have not read the original papers on these topics.

To summarize, then, *Autosegmental and Metrical Phonology* is a major contribution to the field of phonology. It is not an introductory nor even an intermediate level textbook, and in many ways does not live up to the promise that it is suitable for a broad audience. Phoneticians who have no background in generative phonology or have not kept up with the field will probably want to learn about Autosegmental and Metrical Phonology from other more accessible sources. The field still lacks a truly introductory and up-to-date textbook, and anyone who writes such a book will make an important contribution, both to graduate education in linguistics and to the reputation of generative phonology in related fields such as phonetics.

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