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processing' (140), but he argues that this does not imply morphemic decomposition of words, since the effects can be obtained by a network of connections among words. There appears to be conflicting experimental evidence for some of the notions tested in this section. E's decision to present the state of the question even when there is no definitive answer at present is probably correct, since it shows the reality of scientific investigation.

The book contains a very useful appendix on experimental design and basic statistical methods. This appendix also includes a section on available tools for conducting research on Spanish phonology and morphology. There is, however, no discussion of acoustic or other phonetic analysis.

E positions himself in the 'left field' of linguistics, that is, as someone espousing 'heterodox, unconventional, nontraditional ideas located far from the mainstream infield and distant from the more publicized players' (xiii). Whether or not the specific proposals he makes in this book are widely accepted, his insistence that claims be supported by replicable evidence ought to become a mainstream position. E observes that one is not likely to find such words as experiment and statistical significance in the work of authors who employ notions such as constraint ranking, c-command, and universal grammar (xiii). There is, however, no intrinsic incompatibility, as some recent work demonstrates (including the research on Spanish diphthongs in Albright et al. 2001 reviewed on pp. 101–6 and other work within the framework of stochastic optimality theory).

This important contribution to Spanish phonology and morphology is likely to have a profound impact on the field.

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**Phonetic interpretation:** Papers in laboratory phonology 6. Ed. by JOHN LOCAL, RICHARD OGDEN, and ROSALIND TEMPLE. Cambridge: Cambridge University Press, 2004. Pp. xiv, 402. ISBN 0521824028. \$85 (Hb).

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This new volume of the 'Papers in laboratory phonology' series features a collection of papers presented at the sixth Laboratory Phonology meeting in York in 1998, and published in 2004, five years later. This volume focuses on phonetic interpretation. The term PHONETIC INTERPRETATION has traditionally assumed the conversion of abstract, discrete, and invariant phonological representations to continuous and varying speech signals. A number of papers in the volume furnish evidence that forces us to reassess the nature of phonological representations, as JOHN COLEMAN rightly points out. The papers show that fine phonetic detail—which traditionally has played no role in phonological distinctions—is used by listeners to identify words (SARAH HAWK-

INS and NOËL NGUYEN), is used differently in dialects to indicate segmental contrasts (PAUL CARTER), and is exploited by speakers to identify themselves with a particular social group (GERALD J. DOCHERTY). Consequently, fine-grained phonetic detail must be part of the lexical representation and under the control of the speaker. Other papers in the volume provide evidence on the role of frequency of occurrence (token frequency) on the pronunciation of segments (RICHARD WRIGHT), and the role of frequency of the pattern in the lexicon (type frequency) on speech perception and on well-formedness judgments (JENNIFER HAY, JANET PIERREHUMBERT, and MARY E. BECKMAN). These findings on the role of phonetic detail and frequency in speech processing and speech production cannot be accounted for by abstract phonological representations stripped of phonetic detail and suggest probabilistic models of representation of phonological categories such as those put forward by exemplar models or usage-based models (e.g. Johnson 1997, Bybee 2001, Pierrehumbert 2002). If this is so and phonetic variability itself is part of the make-up of the category, the focus of the book should not be on the phonetic interpretation of phonological representations, but rather on how speakers form phonological categories and how phonological categories structure phonetic variation.

The sixteen papers are organized in four thematic sections each followed by a rigorous and comprehensive commentary by a renowned expert. The 'Introduction' written by the editors is an excellent review of the aims, practices, and research agenda of laboratory phonology, providing a common conceptual framework for the diverse papers in the volume.

Beckman and Pierrehumbert's paper provides a background to the first section, 'Phonological representation and the lexicon'. They review key issues in category formation, the arbitrariness of the linguistic sign, duality of patterning, the organization of the lexicon, and lexical retrieval. They couch these issues in terms of connectionist models (Dell 1988) and usage-based models (Bybee 2000). It is surprising though that they revisit long-standing notions without acknowledging the original authors.

Hawkins and Nguyen present perceptual evidence that phonetic properties of onset /l/ (consonant duration, F0 but not F2 frequency) can be used by speakers to predict the voicing of the coda obstruent in the same syllable (e.g. *led* vs. *let*). The two main findings of their study, that phonetic exponents of segmental contrasts can be present in nonadjacent segments and that the listeners show sensitivity to fine-grained acoustic information, lead them to suggest a word-based model of lexical access and that lexical representations must include fine-phonetic detail.

Wright's paper demonstrates that the pronunciation of individual lexical items is affected by the number and lexical frequency of the word's lexical neighbors. Thus, words from high-density neighborhoods and with low relative frequency use a more expanded vowel space. The expansion of the vowel space is such that only peripheral vowels—which can move to more extreme positions without diminishing the vowel contrasts—become more dispersed whereas the others remain fairly unchanged. This result is an interesting addition to the literature on the phonetic dimensions that increase (or decrease) perceptual contrast among words in hyperarticulated (or reduced) speech.

Hay, Pierrehumbert, and Beckman's contribution provides further support to the claim that native speakers' ratings of the relative acceptability of attested and unattested phonotactic patterns are based on type frequency (as calculated from the CELEX database) rather than on independent morpheme structure constraints. Thus, patterns with a higher lexical frequency tend to be rated as well-formed. In addition, their results show that type frequency biases speakers' perception, favoring the identification of more frequent clusters.

In the second section, 'Phonetic interpretation and phrasal structure', a number of the papers analyze how prosodic boundaries affect the realization of segments. Further, some of the papers attempt to determine levels of prosodic phrasing (e.g. utterance, intonational phrase, accentual phrase, word) from phonetic correlates, and whether these levels hold across languages. MARIA D'IMPERIO and BARBARA GILI FIVELA show that in Italian the boundary imposed by narrow focus is not an intonational boundary (I-boundary) since it does not trigger effects on vowel lengthening and consonant lengthening comparable to those of a regular I-boundary. An intriguing result of this study is that, except for fairly clear differences for consonant lengthening in syntactically

induced I-boundaries, the other boundaries show small and unreliable statistical differences in the two dependent variables, which challenges the authors' attempt to determine different levels of phrasal structure from the grouping of the data.

PATRICIA KEATING, TAEHONG CHO, CÉCILE FOUGERON, and CHAI-SHUNE HSU's study seeks evidence from four languages that the nature of the phrasal boundary affects the phonetic properties of segments, specifically, the extent of linguopalatal contact and constriction duration in domain-initial consonants. Their results show that the only distinction reliably made by all speakers is that between utterance/intonational-phrase boundary and all other boundaries, interestingly the very and only significant distinction found by D'Imperio and Gili Fivela in other phonetic exponents. In his commentary on these two papers, JONATHAN HARRINGTON suggests that domain-initial strengthening and phrase-final vowel lengthening may not be primary articulatory effects as suggested but rather an enhancement of the acoustic and perceptual effects to mark prosodic boundaries, that is, listener-oriented. But an increase in duration and articulatory activity in these positions is most likely associated with gestural expansion beyond the segmental acoustic onset and offset simply because there is no other segment next to it. This interpretation does not exclude that articulatory and temporal cues that consistently occur in certain positions may be used by the listener in parsing, as Quené (1992) shows for initial consonant length in Dutch.

D. ROBERT LADD and JAMES SCOBIE report that assimilation and gemination across words in Sardinian is categorical, thus challenging the view that assimilation across words is predominantly a gradient process. A major problem with this paper is whether one can claim that postlexical assimilation and postlexical gemination are categorical processes by exclusively measuring consonant duration, as the authors do. One would need to analyze articulatory and spectral data of the segments involved and of neighboring segments before ruling out the possibility that there may be residual gestures for the supposedly deleted segment in geminates or for the original segment in cases of assimilation. Harrington's commentary presents an interesting unified account of two seemingly disparate phenomena, postlexical geminates in Sardinian and *raddoppiamento sintattico* in Italian, invoking the listeners' misidentification of the trigger for consonant gemination (in the sense of Ohala 1981, 1990). Alternatively, categorical assimilation and gemination in Sardinian could be an indigenous process of isolated linguistic settings, comparable to the extensive place assimilation in consonant clusters in Majorcan Catalan and Occitan domains (Daniel Recasens, p.c.).

JOHN HARRIS argues for the foot as a prosodic domain of segmental interpretation. He proposes specifying the phonetic properties of ambisyllabic consonants by reference to their location within the foot, and abandoning the concept of ambisyllabicity. He also reanalyzes Danish vocalization of voiced stops and stop lenition in *Ibibio* in terms of their non-foot-initial position.

Three of the papers in the third section, 'Phonetic interpretation and syllable structure', are concerned with finding general phonetic properties of syllable onsets and syllable codas. BRYAN GICK explores how the gestures for /l/, /j/, and /w/ differ with position in the syllable. His results suggest that ambisyllabic sonorants are articulatorily closer to syllable-final than syllable-initial consonants, which questions the notion of resyllabification. In addition, Gick's results indicate that /l/ and /w/ are complex segments, with the tongue dorsum gesture leading the tongue-tip gesture for /l/, and the lip gesture for /w/, in syllable-final and ambisyllabic allophones but not syllable-initially.

PAUL CARTER provides evidence that in nonrhotic (with an /l/:r/ contrast only syllable-initially) and rhotic varieties of English (with a contrast both syllable-initially and syllable-finally), speakers use the F2 dimension (low vs. high F2 resonances) to keep laterals and rhotics distinct in positions of contrast.

KENNETH DE JONG replicates Stetson's (1951) experiment examining variations in the gestural timing of sequences of CV and VC syllables (*pealeep*; *beeleebe*) spoken at different rates. De Jong proposes that onsets involve coordination across different articulatory structures (e.g. supra-glottal and glottal articulators), as suggested by stable VOT durations across rates, whereas codas involve coordination between sequential gestures by the same articulatory structures. I have two main reservations with this interpretation. First, previous studies on the duration of VOT in

English CV syllables across different speaking rates (Summerfield 1981, Miller et al. 1986, Kessinger & Blumstein 1997, Solé & Estebas 2000) found that the timing of glottal and oral gestures is NOT stable (i.e. in slower speaking rates, the aspiration period is longer than in faster rates—as shown also in de Jong's data in Figure 14.2, bottom right panel). These results, therefore, are at odds with his conclusion. The second reservation is that de Jong's claim that there are no stable interarticulatory timing relationships in coda consonants involving different articulatory structures (e.g. nasals, palatalized, velarized, or pharyngealized consonants) may need further incontrovertible evidence. In fact, the available evidence (Krakow 1999) shows stable, though not necessarily synchronous, coordination patterns between different articulatory structures for coda consonants, and that the patterns of coordination differ across languages.

TERRANCE M. NEAREY addresses the question of the size of the phonological units in speech perception. He suggests that segment-sized units are the basic elements of speech perception since the rate of correct identification of syllables/words can be predicted from that of their constituent phonemes (i.e. factorability).

PETER LADEFOGED's final commentary reexamines some of the issues in the papers using traditional descriptive terms. Ladefoged's gift of stating the most complex facts and concepts using clear and plain language reminds us that some theoretical terminology and mechanisms may be like the emperor's new clothes.

The last section includes a variety of papers that have been grouped under the heading 'Phonology and natural speech production: Tasks, contrasts and explanations'. Two of the papers focus on the interaction between tone and phonation type. In a pitch discrimination experiment, DANIEL SILVERMAN shows that differences in pitch are more poorly perceived in breathy as opposed to modal phonation, thus providing a perceptual basis for the rarity of the simultaneous implementation of contrasting tone and contrastive nonmodal phonation in the same vowel. Silverman attributes the decreased perceptibility of pitch differences in breathy (nonmodal) voice to increased noise and pitch perturbation.

KATRINA HAYWARD, JUSTIN WATKINS, and AKIN OYÉTÁDÈ analyze tone and phonation in Yorùbá—a language with three tonal contrasts, high, mid, and low. The results show that low tones are associated with creaky voice while high and mid tones are not. Interestingly, the authors' results indicate that the contrast between Yorùbá tones is signaled not only by differences in F0 but also by a multiplicity of cues. Such concomitant cues in signaling contrasts ensure the maintenance and enhancement of tonal contrasts in a variety of contextual, rate, and noise conditions, and challenge the notion of a primary cue.

BUSHRA ZAWAYDEH looks for an articulatory or acoustic basis for the natural grouping of guttural sounds (pharyngeals, uvulars, and emphatics) as a phonological class. In addition, she addresses the question of why laryngeals pattern like gutturals in Arabic but not in Salish. Her endoscopic results show that Arabic laryngeals do not involve a pharyngeal constriction which reasonably leads her to reject an articulatory basis for grouping gutturals and laryngeals in Arabic. But surprisingly, because there is no direct evidence from Salish, the author concludes that the feature [pharyngeal diameter] may be the defining feature of gutturals as a class in Salish as opposed to laryngeals. The acoustic results show a raised F1 on neighboring vowels for laryngeals and gutturals in Arabic, which is taken as evidence for a grouping based on the auditory feature [high F1]. The higher F1 would result from a pharyngeal constriction for gutturals and an aryepiglottic constriction for Arabic glottals, such that 'Arabic glottals . . . [and pharyngeals] would involve constrictions in the pharynx' (Nolan 1995:366). If this is so, one wonders why the articulatory explanation for uniting these segments under a single class is thrown away.

KEIICHI TAJIMA and ROBERT PORT use the speech-cycling technique (where speakers produce a short phase repeatedly in time with metronome-like stimuli) to explore prominence structure in English and Japanese. Their main findings are that the prominent syllables phased with the imposed beats were lexically stressed syllables in English and mostly initial syllables in bimoraic feet in Japanese. Also, when the regular rhythm was perturbed by adding an extra syllable, the temporal stability of English stressed syllables was maintained (as predicted for stress-timed rhythm), while Japanese speakers showed longer interstress intervals, tending toward equal time intervals of moras (as predicted for mora-timed rhythm).

This section features a brilliant, critical, and amply substantiated commentary by Docherty. He addresses the issue of whether speech production is driven by the need to maintain phonological contrasts exclusively. He presents data on vowel and consonant variation in Tyneside English and convincingly argues that speakers make use of the variation in production as a social marker. This argument connects with the issue of the nature of phonological representations, and suggests that phonological categories structure phonetic content, and that certain regions in the range of variation within each phonological category may be used for social and dialectal indices.

In summary, *Phonetic interpretation* raises the question of what it is that we are interpreting, furthers our understanding of the nature and the size of phonological representations, provides empirical evidence for phonological claims, and presents experimental data on a variety of languages contextualized in the most current models of phonology and lexical access. My main reservation about the book is the time gap between the papers' presentation in York in 1998 and their publication in 2004 and the poor editing. The lengthy editing process has not been compensated for by updating the references accordingly, and the book has an unforgivable number of typos, mostly in the introduction. The volume would have benefited from more rigorous reviewing and editing procedures, which would have made the reading and interpretation of the data easier. But these editing flaws do not detract from the solid scientific contributions of the volume.

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