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Erratum

The following Book Review was published with several typographical errors that altered the intended meaning. The entire review is reprinted here with those regrettable errors corrected.

Papers in laboratory phonology V: Acquisition and the lexicon. Michael B. Broe and Janet B. Pierrehumbert (Eds.). Cambridge: Cambridge University Press, 2000. Pp. 414.

This stimulating volume is the outcome of a 1996 conference, the first in the laboratory phonology series to incorporate psycholinguistic topics, including six chapters addressing acquisition. Here, as in the earlier conferences, the primary focus is on the relationship between phonetics and phonology. For example, in the first section, "Articulation and Mental Representation," Munhall, Kawato, and Vatikiotis-Bateson provide a lucid account of the state of the art in physical models of articulation; they conclude with a discussion of the difficulty of identifying the interface between phonology and speech production. In a related study, the relevance of overarching prosodic structure ("phrasal signatures") to low-level articulatory effects is illustrated in some detail by Byrd, Kaun, Narayanan, and Saltzman, who find that "prosodic structure is manifest in the details of articulation. . . . The abstract symbolic representation useful to linguistics [must be integrated] with a dynamical model of human movement useful to speech scientists" (p. 85).

As the term "laboratory phonology" implies, empirical work dominates here, but there is a strong theoretical orientation. Most striking is the approach to language acquisition and use embodied in many of these studies, which give a central, but not exclusive, role to frequency, sensitivity to distributional properties of language from early in life, and production experience and use. In several papers, phonological structure is seen as gradient and emergent, with reference to exemplar learning and storage as the source of structure. In keeping with the focus of this journal and my own area of competence, I will restrict this review largely to the third and longest section (11 out of 23 chapters, including two commentaries), which also provides the volume's title. I will discuss the chapters in the order in which they appear.

Werker and Stager present the experimental findings they reported earlier in *Nature* (Stager & Werker, 1997). They provide a thoughtful discussion of the possible reasons why 8-month-old infants showed longer looks in "switch trials" after habituation to a novel object and its associated nonsense label (/bê/ or /dê/), whereas 14-month-olds failed to distinguish the pair except in a condition that involved no word learning. The evidence leads to the conclusion that infants are

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more likely to focus on phonetic detail in discriminating word forms (speech perception task) than in learning form–referent associations (word learning task). The authors raise the question as to whether separate or common representations underlie these distinct tasks or whether representation ought to be assumed at all in the case of form discrimination. The question brings to mind the long and still unresolved debate in the phonological development field regarding the "dual lexicon." Do infants have separate or common word representations underlying comprehension and production? (cf. Jaeger, 1997; Menn & Matthei, 1992).

Taking their inspiration from the pioneering work of Macken and Barton (1980), Scobbie, Gibbon, Hardcastle, and Fletcher present a detailed acoustic study of a "covert contrast" between voiced and voiceless stops produced by a child with a phonological disorder. The child was found to produce a consistent voice contrast (although one not detectible by ear), not by timing voice onset differentially but by making differential use of glottal modes. Interestingly, the idea that a distinction may be obtained and function contrastively below the conscious auditory threshold is also the focus of one of the chapters in the second section, "Tone and Intonation." In that chapter, Peng uses production experiments in Mandarin to show that homophony resulting from tonal sandhi is not complete, and by manipulating attention and memory listeners can be trained to categorize the intended tones correctly.[1] Both of these studies remind us that the "all-or-nothing" model of phonemic categories is an oversimplification.

In an innovative experimental study, Beckman and Edwards ask whether "pattern frequency in the lexicon figure[s] . . . in the acquisition of 'lower-level' phonological patterns" (p. 208). These authors test the role of (productive) lexical experience on the imitation of nonwords, incorporating familiar versus novel consonant–vowel (CV), consonant–consonant, or vowel–consonant sequences by 3- to 4-year-olds (based on a corpus of first graders' spontaneous speech). An analysis of the accuracy of the children's imitations as transcribed revealed significant differences in favor of the lexically familiar sequences for CV (/´*gu*tən/ vs. /´*gau*tən/) and, to a lesser extent, the consonant clusters (/´mo*ft*in/ vs. /´mo*fk*ən/); rimes did not differ significantly. In a replication with six children with phonological disorders, all three two-segment structures showed the effect of lexical familiarity. The finding of a larger effect of lexical experience on the children with a phonological disorder supports the hypothesis that the production of a novel motor score is particularly challenging in the earlier stages of word-form learning (see Vihman & Velleman, 2000, for a demonstration of production experience on the acquisition of the geminate contrast in Finnish first-word production).

In a critical assessment of the "perceptual magnet" model, Lotto, Kluender, and Holt raise doubts about the stimuli and the methodology used in the studies on which Kuhl's theory is based. They argue that general learning processes are sufficient to explain perceptual category formation and the dispersion of vowels to extreme positions in linguistic systems; as they remind us, even starlings can be trained to peck differentially for [i] versus [ê].

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Goodman and Jusczyk extend to older infants (14 and 18 months) the experimental study of Jusczyk, Goodman, and Baumann (1999), in which infants looked longer at a list of nonwords that shared a common onset consonant or CV than at an otherwise comparable list that did not, but failed to look longer at common rimes. Interestingly, the extent of the infants' differential attention to the alliterating lists drops with age, although there is no concomitant increase in attention to rimes. Goodman and Jusczyk suggest that infants may begin to attend to the ends of words only with the discovery of morphological structure. However, there is evidence from production studies of individual children to suggest that a sensitivity to word-final consonants may precede an understanding of morphological function (Peters & Menn, 1993; Vihman, 1996, ch. 9). In cross-linguistic studies of final consonant production, only one or two out of five children were found to produce final consonants in the single-word period, even when exposed to languages like English, Swedish, or Welsh, which have high final-consonant occurrence (Vihman & Boysson-Bardies, 1994). This suggests that the absence of a group effect in perception may be related to a lack of production experience; such experience may be a prerequisite for the discovery of morphological structure.

In her commentary on the acquisition studies, Edwards highlights the multidimensionality of representations, as demonstrated by the studies of Stager and Werker (1997) and Jusczyk et al. (1999), both of which found a difference in "attentional mode" for younger versus older infants. Drawing on the notion of word templates, which have been shown to underlie "minispurts" in lexical acquisition in the single-word period, Edwards suggests that the role of lexical familiarity in acontextual nonword repetition in older children can simulate first-word learning, although here again a difference in attentional mode might be relevant.

Like Beckman and Edwards, Bybee believes that "use impacts representation" (p. 268). Drawing on evidence from sound changes in progress, Bybee develops an elaborate, but persuasive argument to support her view that sound change, far from reflecting the addition of rules to the grammar, results from incremental changes in word production with each use. Thus, sound change is highly sensitive to the effects of discourse (first uses are longer; later uses are more reduced) and lexical and grammatical frequency (each experience of a word is stored in memory). See Goldinger (1998) and other references for work supporting lexical access based on phonetic rather than phonological input in Coleman's commentary in the first section of this volume.

In a study somewhat similar to that of Beckman and Edwards, Treiman, Kessler, Knewasser, Tincoff, and Bowman examine the idea that phonotactic constraints may be probabilistic. They developed quadruplets of monosyllabic nonwords differing in frequency or wordlikeness of their rimes: for example, high frequency /up/ (*coop, loop, soup*) versus low frequency /uk/ (*kook, Luke, souk*). In one experiment adults and school-age children were asked to categorize pairs of nonwords differing only in their rimes as more or less like English words. Although less than half the children were able to perform this metalinguistic task, those who succeeded gave roughly the same (above chance) level

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of correct responses as the adults, showing a small, but reliable effect of sensitivity to rime frequency. Sensitivity to onset frequency was also observed in some of the experiments, but it was not systematically manipulated.

By demonstrating that "the beginning-to-end temporal order in which the segments in a word are processed is a functional influence on the phonology" (p. 283), Frisch supports his view that lexical processing cannot be excluded from competence. He provides two types of data analysis involving consonant dissimilarity constraints: Arabic triliteral roots and speech errors in the production of English tongue-twisters. In both cases, the constraints are gradient and affect word-initial position to a greater extent than they do consonants occurring later in the word. The findings point to a blurring of the performance/competence distinction, although Frisch sees a role for existing phonological formalism, as implemented in the framework of a connectionist-type model.

Starting from an earlier study in which the /t/–/d/ continuum proved to be immune to the effect of neighborhood density on listener identification of ambiguous phonemes, Newman, Sawush, and Luce tackle the status of /t/, which has been considered to be phonologically "underspecified." Creating a continuum from a nonword with a high-density lexical neighborhood (e.g., /ʃæv/: *shave, have, sham*) to a nonword with a low-density lexical neighborhood (/ʧæs/: *chase, pass, chassy*), they tested the hypothesis that all coronals might be immune to lexical effects (but /ʃ/, /ʧ/, /l/, and /r/ all showed those effects), that all alveolars might be immune (but both /d/ and /n/ showed the effects), and that /t/ might show immunity to the effect only when paired with /d/ (but nonword identification on the /t/–/s/ continuum was shown to not be affected by neighborhood density). Finally, because the most frequent English consonants are /t/ and /s/, the authors tested /s/–/ʃ/ and found immunity to the neighborhood density effect. Like Frisch, then, these authors were able to show a gradient effect of phoneme frequency on perception, such that for the most commonly occurring English consonants "frequency effects can overwhelm the relatively small effects of lexical neighborhood" (p. 310). Replication of the effect in another language would further strengthen the argument.

The last empirical study is that of Steriade, who argues strongly against the need for any distinction between phonetic and phonological features. In order to show that morphological invariance relates not only to phonological (contrastive) features, but also to phonetic variation, she identifies paradigm uniformity effects at the level of phonetic detail, both in American English, where post-stress tapping proves sensitive to paradigm membership, and in French, where the physical detail of consonant assimilation effects after optional schwa omission depend on "constraints requiring the invariance of morpheme edges" (p. 328). Steriade concludes that "the realization of phonetic detail properties is governed by some of the same principles that must be invoked in studying phonological or potentially contrastive features" (p. 331).

In the final chapter, Dell organizes his comments around three terms that received particular emphasis in the session on lexical representation (a subset of the papers reviewed here): (a) frequency, (b) similarity, and (c) sequence. The role of frequency demonstrated in several of the chapters – whether in experiments with nonwords, in precise accounts of sound change, or in the ob-

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servation of morphological leveling – constitutes evidence that phonological knowledge cannot be purely abstract and categorical. If that were the case, quantitative effects would not be found. Dell also points out that gradience – or tendencies for dissimilarity or neighborhood effects to obtain – is incompatible with the all-or-nothing structure of optimality constraints, as well as with the generative phonological rules of the past.

To Dell's assertion that lexical retrieval errors that are both semantically and phonologically similar are especially common, I would like to add a cross-linguistic illustration, taken from a child's bilingual production. When searching for the Estonian word *neerud* (kidneys), my daughter (age 6) inserted the English word *mushroom* into an otherwise all-Estonian discourse context. Her lexical search must have erroneously resulted in the English word through the joint activation of the phonologically similar *neerud* and *seened* (mushrooms) and the semantically related translation equivalents *seened* and *mushroom*(*-s*) (Vihman, 1981).

In his discussion of sequence effects, Dell provides reasons why beginnings of words might be better attended to than endings, but the effect – supported by the findings of several of the chapters here, although not all – remains surprising. Short-term memory supports endings as well as beginnings; the production of some sounds is learned word-finally before it is mastered in onsets (e.g., fricatives); suffixes are far more common in the world's languages than prefixes, suggesting some kind of processing advantage for word endings. Furthermore, it seems clear that positional effects cannot be usefully considered without including the accentual frame. For example, the failure of Spanish speakers to make word-onset errors as often as English speakers might reasonably be thought to relate to the characteristics of Spanish prosody.

Dell concludes his very useful commentary by outlining a "dream [connectionist] model," which would deal with both perception and production and with both segmental sequences and prosodic frameworks. One might add to this list of desiderata a suggestion that visual articulatory effects – the role of lip-reading in learning to speak, in particular – be incorporated as well. Fortunately, researchers in the related area of speech robotics have already begun work on such a model (Schwartz, Abry, Boë, & Cathiard, in press). Clearly this is an exciting time to be working on acquisition and the phonetics–phonology interface.

NOTE

1. The book is marred by a number of typographical errors, large and small. The most serious error affects this chapter. The legend to Figure 10.3 has the labels *Tone 2* and *Tone 3* reversed.

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