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Phonetics, Phonology, and Cognition. Ed. by JACQUES DURAND and BERNARD LAKS. (Oxford Studies in Theoretical Linguistics, 3). New York & Oxford: Oxford University Press, 2002. Pp. xiii, 338. ISBN: 0-19-829983-4. $45 US.

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Considerable recent work in phonology has sought connections and explanations for abstract sound patterning in two domains on 'either side' of traditional phonological representations: the physical realization and perception of sound that underlie most phonological patterns, and more general cognitive principles that might constrain or even determine the possible encoding of these patterns. As indicated by the title, this book fits squarely in the trend; it collects eleven papers (including an overview by the editors) that emphasize interdisciplinary approaches to the analysis of linguistic sound structure. Most of the papers originate in the conference *Current Trends in Phonology II*, held in June 1998 at the abbey of Royaumont; the majority of the contributors (17 of 23) are affiliated with French institutions.

After a brief survey of the chapters ('Introduction', 1–9), Durand and Laks present a substantial overview chapter ('Phonetics, phonology, and cognition', 10–50). They discuss trends, primarily in Europe and the United States over the last century, regarding the relationship between linguistic research on phonetics and phonology. This ranges

from the development of narrow and broad transcriptions to more formalist models in which phonetic substance is downplayed but more general cognitive principles might come to the fore.

JOAQUIM BRANDÃO DE CARVALHO ('What are phonological syllables made of? The voice/length symmetry', 51–79) proposes to treat voicing and aspiration — the phonological features responsible for voice onset time (VOT) — as a suprasegmental property like length, rather than as primitive distinctive features. This approach assumes two parallel tiers of sonority (well known as a property of the syllable nucleus) and tension (as found in the greater constriction of consonants). Just as a long segment results from linking a feature set to more than one timing element, so VOT might be represented by multiple linkings between timing elements and the sonority and tension tiers. The details are complex, incorporating diacritics that mark the tier elements as 'cold', 'positive', and 'negative' (cf. Kaye, Lowenstamm, and Vergnaud 1990), so it is difficult to assess the specific typological predictions. At a broader conceptual level, more evidence is necessary to motivate the suprasegmental analogy. Thus, while in lenition processes the relation of /tt/ and /t/ is similar to that between /t/ and /d/, it is not clear how the account would handle other instances of lenition, as when /d/ becomes /ð/ or /ɾ/ (cf. Kirchner 1998). Similarly, Carvalho alludes to evidence from word games for the suprasegmental status of length, but does VOT ever pattern in the same way? To take one example, the foot exchange in the Japanese argot *zuuja-go* changes *ja:zu* 'jazz' to *zu:ja*, but the name *daisuke* becomes *sukedai*, not **zuketai* with preservation of voicing in situ (Itô, Kitagawa, and Mester 1996). Carvalho's proposal is interesting for its potential

connections to non-linguistic cognitive notions, but its linguistic implications remain unclear.

JOHN GOLDSMITH ('Tone in Mituku: How a floating tone nailed down an intermediate level', 80–95) presents a rather straightforward example of opacity to argue for a level of representation between input and output. The case involves contour tones in the Bantu language Mituku that surface only when a underlying vowel has been deleted, as in the prefixes /tù-á-/ realized as [tă-]. The need for two vowels cannot be expressed on the underlying form, because a floating L tone (present before every H-toned verb root) will enter into a contour only if it first is able to link to a toneless vowel, and some toneless vowels arise only after the application of a rule. For example, in /bá-á-L-/ the HH sequence is simplified to H in [bá-a-L], and the ultimate result is [bâ-]; but in /tù-á-bá-L-/, while tone absorption changes [tă-bá-L] to [tà-bá-L], we find downstep of the following H rather than a contour, because the floating L was never exposed to a toneless vowel. As in similar situations, the opacity is easily analyzed by means of an intermediate representation, but this option is not available in a strict one- or two-level interpretation of Optimality Theory (Prince and Smolensky 2002, McCarthy and Prince 1995). Of course, the problem of opacity has figured prominently in criticisms of OT, and various responses have been proposed; the Sympathy Theory of McCarthy (2000) is one approach that would handle Mituku. The fact remains that a third representation — whether intermediate or occupying some other relation to the output — is necessary to capture the desired generalization. Only at the end of the paper does Goldsmith venture into the broader theme of the book; he suggests that constraints such as 'one tone per

vowel', as well as other aspects of phonological timing and rhythm, derive from a 'phase-locking' of neural oscillations. In the case at hand, the oscillations for vowels are in phase with those for tones, leading to the one-to-one correspondence.

JOHN COLEMAN ('Phonetic representations in the mental lexicon', 96–130) provides a critical overview of evidence for abstract phonological units in lexical representations, and advocates a phonetic approach that embraces redundant specification of information. He finds that syllables and feet have motivation, as do onsets and rhymes, but that moras are dubious constituents, and the phoneme may arise in monitoring tasks without playing a role in lexical representations. He advocates continuous representations with rich detail in phonetics and frequencies. Given that parsimony has reduced emphasis, however, it is not clear that more abstract phonological constructs must be shunned; something corresponding to a phoneme, or discrete segment, might very well be co-present representationally, as indeed Coleman seems to suggest in the final paragraph.

MICHAEL INGLEBY and WIEBKE BROCKHAUS ('Phonological primes: Cues and acoustic signatures', 131–150) discuss possible connections between the sort of phonological primitives generally assumed in linguistics and practical solutions to problems of automated speech recognition. Just as theoreticians seek to extract from the gradient phonetic stream the crucial distinctive properties, so a machine approach must determine which cues in the acoustic signal will assist in recognition; closer collaboration could lead to 'a physics contribution to the cognitive science of the speech channel'. Their criteria for effective cues are the use of relative rather than absolute quantities,

good clustering across speakers, and accurate identification of phonological heads and operators.

JUAN SEGUI and LUDOVIC FERRAND ('The role of the syllable in speech perception and production', 151–167) provide a very useful summary of experimental work on how syllable structure affects the processing of words. For example, in Romance languages such as French, traditionally called syllable-timed, one word better primes another when they begin with the same syllable, not just the same few segments. This effect is less in stress-timed Germanic languages such as English, suggesting that syllable structure is introduced later, or otherwise has lesser importance. Thus the rhythm of the languages appears to play a significant role in whether the category of syllable is prominent in processing. Other interesting results show that the CV or CVC structure of the syllable enhances the priming effect independently of the segmental content, indicating the psychological reality of syllable structure.

EMMANUEL DUPOUX and SHARON PEPERKAMP ('Fossil markers of language development: Phonological 'deafness' in adult speech processing', 168–190) outline a research program for studying the nature of language acquisition by reference to the inability of adult speakers to distinguish non-native contrasts. The authors assume a universal phonetic representation of an utterance, innate in all infants; a prelexical representation, containing only the language-specific contrastive features (a set that becomes more restricted as the infant acquires the language); and a lexicon, which depends on knowledge of word boundaries. Non-contrastive information will be excluded from the prelexical representation; if this representation, developed during the

acquisition process, is also used by adults in perceiving words in a new language, then the 'deafness' of adults to a feature that is non-contrastive in the native language, such as stress for speakers of French, reveals something about acquisition. The acquisition question is whether knowledge of the contrasts to be included in the prelexical representation is learned in bottom-up fashion, by reference only to the universal phonetics and the existing prelexical generalizations; or interactively, with information about function vs. content words, and boundaries between content words, also playing a role. In particular, the interactive model predicts that if the primary stress rule in a language depends on the second kind of information, then adult speakers should be stress deaf, because the prelexical representation can exclude stress. The bottom-up model predicts stress deafness only where the stress generalization can be stated in terms of the edge of an utterance, without knowing anything about the status of the final word. Experiments were ongoing at the time the article was written, but some results can be found in Peperkamp 2004.

CAROLE PARADIS and RENÉE BÉLAND ('Syllabic constraints and constraint conflicts in loanword adaptations, aphasic speech, and children's errors', 191–225) embrace an interdisciplinary approach to phonological questions by comparing evidence from the three sources in their title. The focus is on repairs made to marked syllable structure in borrowings, by two aphasic patients, and by children with normal speech and with a phonological deficit. Specifically, the authors discuss the preservation of underlying segments in the face of limits on the number of repairs to an input and constraints on the (metrical) size of the output. The paper is valuable for its examination of diverse types of

data, though I have doubts about the theoretical assumptions. To see an aphasic as possessing a grammar that favors certain unmarked structures, as a matter of teleology, seems less plausible than to treat the deficit as somehow impeding the implementation of the grammatical intention. Similar objections could be made with regard to acquisition (cf. Hale and Reiss 2001), but the authors' approach does have the virtue of permitting precise comparisons across the various domains.

Two papers are focused on language localization in the brain, from different perspectives. CHRISTIAN ABRY, MURIEL STEFANUTO, ANNE VILAIN, and RAFAEL LABOISSIÈRE ('What can the utterance 'tan, tan' of Broca's patient Leborgne tell us about the hypothesis of an emergent 'babble-syllable' downloaded by SMA?', 226–243) have the laudable goal of bringing together work in various labs on a particular sort of global aphasia, characterized by recurring meaningless CV syllables such as the [tã tã] of Broca's patient. Different researchers have claimed that such babbling is controlled by the Supplementary Motor Area, rather than the more specifically linguistic Broca's area. Surveying a wide range of results, and with reference to MacNeilage's (1998) notion of frame and content, the authors conclude that the SMA is likely responsible for the initiation of the utterance, but not its control. JEAN-FRANÇOIS DÉMONET, GUILLAUME THIERRY, and JEAN-LUC NESPOULOUS ('Towards imaging the neural correlates of language functions', 244–253) advocate a two-pronged approach to neural imaging that combines the temporal resolution of ERP with the spatial resolution of PET. Two sets of subjects were asked to perform the same tasks, but differed in which imaging technique was used; the results are presented together to give a fuller picture of the neural activity.

In a lexical task that relied on word understanding, the ERP showed faster and more automatic processing than in a phoneme task with pseudo-words, which forced a deliberate procedure. In complementary fashion, the PET analysis showed use of phonological working memory (left perisylvian) for the pseudo-word task, and more general activation for the lexical task, with evidence for lexical short-term storage in the left angular gyrus.

In the final article, JEAN-LUC SCHWARTZ, CHRISTIAN ABRY, LOUIS-JEAN BOË, and MARIE CATHIARD ('Phonology in a theory of perception-for-action-control', 254–280) propose to integrate speech perception into our understanding how language is produced. In their view, sounds are perceived correctly to the extent that the listener can integrate the percept into articulations mastered by the listener. The acoustic approximations of a bird mimicking human language are understood in terms of what the human listener would have to do to make similar sounds, while sounds such as clicks that the listener cannot produce may be perceived as lying outside the basic stream of consonants and vowels. The authors' discussion includes a particular emphasis on the degree to which the language learner perceives the articulation of sounds visually and thereby gains information about how to articulate the sound in turn. While some facts of this nature are undeniable, such as the famous McGurk effect (McGurk & MacDonald 1976), the suggested extension of integrated visual perception in the formal phonological system is not persuasive. Possible biases in segment inventories are easily attributed to enhanced success in language transmission — where the visual stimulus may play a role — but no attested phonological process depends on a visual feature.

The eleven contributions to this volume are wide-ranging indeed. The reader will find a valuable introduction to many interdisciplinary possibilities. As is typical in work across fields, the challenge often lies in taking into account the complexities and difficulties of each discipline. We can hope that this book will encourage deeper development of these connections, to the benefit of all the fields involved.

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