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Reviews

Joan Bybee (2001). *Phonology and language use*. (Cambridge Studies in Linguistics 94.) Cambridge: Cambridge University Press. Pp. xviii + 238.

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The functionalist viewpoint in linguistics can take different forms. A caricature of functionalist thinking is the notion that the structure of language is optimised, or nearly so, for its function as a means of human communication. This notion has met with widespread scepticism because of its lack of predictiveness in the face of typological variation. Either it leads to the prediction that all languages are en route to some single ‘Utopian’ (even if they have not quite achieved it) or it leads one to posit so many contradictory functional goods that the nature of possible languages is not effectively restricted. A second, and far more sophisticated, understanding of functionalism is the claim that there are regular relations between the way language is represented in the mind and the way that it is processed during speech production and perception. These relations arise because language is acquired from experiences of use, and because even in adults patterns of use affect cognitive representations. The effects of individual instances of language use are local, incremental and context-dependent. Language use and competence in a language are thus two aspects of a single system. Multiple system configurations are possible for the same reason that multiple ecosystems are possible; like the products of biological evolution, human languages are merely good enough, and not globally or absolutely optimised. This understanding of linguistic functionalism has proved fruitful for at least two decades and is now coming into its own. Its rise constitutes part of the rise of scientific research on complex systems and emergent structures generally, in areas ranging from geophysics and granular media to population biology. Bybee is a major figure in this development as it has taken place in linguistics, and this book is a landmark for its line of research.

Phonology and language use synthesises more than thirty years of research on the relationship between phonological forms and their use. It discusses many different sound alternations, ranging from gradient and variable phonetic processes, such as schwa reduction, through alternations with significant lexical and morphosyntactic conditioning, such as French liaison. Most examples are taken from English, Romance and Germanic; out of 114 references to languages in the index, 33 are to English, 38 to Romance languages and 8 to Germanic languages. 26 of the additional languages mentioned figure only in the survey of syllable structure, and there is no in-depth discussion of an alternation in a non-Indo-European language. The phenomena discussed are covered in a degree of detail which vastly exceeds what would normally appear in a phonological description. For example, the results on the /s/–/h/ alternation in Latin American

Spanish are based on corpus studies involving almost 15,000 relevant tokens in Argentine Spanish and more than 8,000 relevant tokens in Cuban Spanish. Such large data sets make it possible to distinguish rates of occurrence for different contexts and for different stages of historical evolution. They permit detailed comparisons between empirically established frequencies and outcomes in psycholinguistic experiments. As a result, Bybee is able to identify deep generalisations about statistical variability which have eluded more qualitatively oriented researchers.

The mental lexicon plays a central role in the theory developed by Bybee. The lexicon includes not only words (defined by Bybee as entities which could be produced in isolation, on which more below), but also frequent phrases and collocations. Lexical entries are categorisations of the speech signal, and as such they show the main hallmarks of categorisation in other domains, such as statistical variability and prototypicality effects. Informational minimisation, or elimination of non-contrastive features, is not characteristic of categorisation systems in general, and considerable evidence is presented that it is not characteristic of lexical entries either. The items in the lexicon, and generalisations over items in the lexicon (or 'schemas'), provide the locus for frequency effects.

Some of the most ubiquitous frequency effects documented in this book provide major challenges for standard generative models of phonology. Many cases are presented of incremental phonetic reduction of word forms as a function of word frequency. In standard phonological models, word-frequency information is not available. If it were made available (probably by importing from psycholinguistics the notion of baseline activation levels for different lexical items) it might affect the speed or reliability with which words were accessed. However, it would not affect details of pronunciation, because the modularity of the standard architecture allows the phonetic implementation system to access only the phonological analysis and position of a word. This issue is discussed at more length in Pierrehumbert (2002), which shows how frequency-related reduction of word forms can be handled in a model with incrementally updated word-specific phonetic representations.

Bybee also reviews experiments showing that many regular (as well as irregular) morphologically complex forms are mentally stored. Although Pinker (1991) claimed that regular forms are generated by a separate rule-based process, and would accordingly be exempt from frequency effects, more recent experimental results indicate that reasonably frequent regular forms also display frequency effects. Such results point to a model in which the productivity of morphological patterns arises from a single uniform process. The productivity of patterns is shown to be sensitive to type frequency (the number of different forms in the lexicon displaying the relevant pattern), providing strong evidence for an architecture with more than one level of representation. However, the dependence takes an unexpected form. The strongest productivity is found for patterns which are exemplified in numerous mid-frequency forms; high-frequency forms matter even less than their small numbers would predict, leading to Bybee's suggestion that they develop autonomy in the system. This claim has been replicated in the area of phonotactics by Bailey & Hahn (2001). It provides a major challenge both to those generative models that do incorporate frequency effects and to connectionist models of morphophonology. In both classes of models, effects of frequency are generally monotonically increasing (though not

necessarily linear). Thus no mechanism is provided by which high-frequency forms could matter less than mid-frequency forms.

A last important finding is that purely phonological processes are generally unstable towards processes which are lexically or morphosyntactically conditioned. For example, the alternation found in *wife/wives* and in *leave/left* arose as the phonologisation of a uniform phonetic process voicing fricatives in intervocalic position. However, it then split apart historically into a voicing rule (restricted to nouns) and a devoicing rule (restricted to verbs); both are now also restricted to particular lexical gangs. Bybee shows that this line of development is typical. In both classical generative models and in Optimality Theory it is difficult to explain why processes which can be stated straightforwardly using core formal mechanisms should evolve towards ones which require parochial constraints or rules. This line of development is unsurprising, however, in a theory in which the lexical representations form the core of the system.

The degree of convergence between functionalist and generative perspectives on phonology which can be observed in this book is noteworthy. Specifically, Optimality Theory in its original conception built heavily on the treatment of syllable structure and phonetic naturalness in works such as Hooper (1976) and Stampe (1973). Subsequent research in Optimality Theory (such as Flemming 1995 and Kirchner 1997) undertook to incorporate observations by Ohala (1981) and Lindblom *et al.* (1984) about the role of perceptual discriminability in shaping phonological inventories. The systematicity of probabilistic effects and the need for an architecture permitting incremental updating based on language experience is reflected in Boersma (1998) and Boersma & Hayes (2000). Specific analyses of Bybee's that rely strongly on detailed lexical representations and output-oriented templates are highly complementary to some of the most thorough studies in prosodic phonology and OT, such as Burzio's (1994, 1996) analysis of the English stress system.

Perhaps the most important distinction between Bybee's proposals and those current in Optimality Theory relate to the role of the lexicon. Optimality Theory draws a strong distinction between the grammar and the lexicon. Phonetic pressures appear directly in the grammar, and phonological constraints which pertain to only a small subset of the lexical items are handled with varying degrees of success by positing parochial constraints. In contrast, Bybee views the phonological grammar as projected, almost epiphenomenally, from the structure of the lexicon. This architecture makes it possible for small phonetic pressures to have large cumulative effects over time, which in turn translate into large effects in the grammars of particular languages. This is probably the key to understanding the relationship between markedness in individual languages and statistics across languages. This relationship was advanced in Greenberg (1966), and it has never been really explained, providing one of the major unsolved problems of phonological theory.

Among works in functionalist linguistics, this book exhibits a high degree of deductive structure, leading to clear predictions and obvious questions for further research. Incisive pursuit of many of these questions will require further formal development of the approach. Though individual phonological alternations are analysed in depth, there is relatively little consideration of the issues which arise when an individual form exhibits the effects of several different processes or constraints. The phonological theory of the future will probably

bring together the probabilistic schemata proposed in the present book with a richer theory of schema interaction, building on the successes of Lexical Phonology and Optimality Theory while avoiding their failures. The word and phrase-based approach yields deep results for the Indo-European data on which the book is primarily based. However, the extension to languages with more complex morphological structure is far from clear. Although Bybee makes a strong case that the mental lexicon does not include morphemes at the expense of words, the case for excluding morphemes in addition to words is less firm. Even in English, and even for infants, words are normally extracted from running speech rather than learned in isolation; positing a mental lexicon of any and all effectively extractable chunks might provide a better basis for the analysis of more complex morphological systems. Lastly, the central role of the schema for Bybee brings to the fore an issue which is equally critical to other theories. A schema is a phonological template expressing dimensions of similarity amongst words by virtue of which they function as groups in the morphophonology. By the end of the book, one is impatient to understand more about which schemas emerge (out of all the extremely many schemas that the formal apparatus might provide) and which ones do not. This impatience draws attention to the fact that the structural descriptions of rules (in derivational theories) and the specifics of constraints (in constraint-based theories) have often been taken too much for granted. Previous suggestions about how they are restricted have related mainly to formal complexity. In the light of *Phonology and language use* we should be looking for a solution in terms of the relationship of formal complexity to statistical behaviour.

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