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## Review of Bernhardt and Stemberger (1998) Handbook of Phonological Development

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**Barbara H. Bernhardt** and **Joseph P. Stemberger** (1998). *Handbook of Phonological Development From the Perspective of Constraint-Based Nonlinear Phonology*. San Diego: Academic Press. Pp. xiii + 793.

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The goals that Bernhardt and Stemberger set for themselves in this book\* are extremely ambitious. Assuming only a very basic knowledge of phonological theory on the part of the reader, they aim to provide an introduction to nonlinear phonology and to its constraint-based implementation in Optimality Theory, and to show how this framework can describe and illuminate a wide range of data on phonological development, as well as how the child data can inform theory construction. In doing this, they also present what they claim is a comprehensive inventory of the attested phenomena of child phonology, as well as a new proposal about the nature and range of possible constraints in Optimality Theory. The scope of the book is widened even further by the authors' use of data from children with both normal and delayed phonological development, and by their use of theoretical constructs drawn from literature on processing and connectionism. These ambitious and wide-ranging goals match the relatively large and diverse audience that Bernhardt and Stemberger hope to reach with this book: theoretical phonologists, researchers examining phonological development from various linguistic and psychological perspectives, and speech-language pathologists.

For its depth and breadth of theoretical and empirical coverage, this book will be of considerable value to anyone involved in phonological theory that has an interest in child phonology (although depending on one's circumstances, this value may or may not match the publisher's asking price of \$149.95 U.S.). As a phonologist working in Optimality Theory and acquisition, I was impressed with the extent to which the ideas, data, and references to earlier work were new to me. I now turn to this book regularly to help answer questions about

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phonological development, both those that come up in my own research and those raised by colleagues and students.

Whether this book will succeed in meeting the needs of the larger target group of relative newcomers to Optimality Theory is harder for me to determine, but there do seem to be some potential problems in this regard. Bernhardt and Stemberger adopt the basic premises of Optimality Theory (i.e. the postulation of ranked and violable markedness and faithfulness constraints), but their positions on the details diverge considerably from other theoretical and developmental research in the framework. These alterations to the theory are motivated partly by the laudable desire to make Optimality Theory accessible to psychologists and speech-language pathologists, who they believe will be put off by earlier versions of the theory. However, in attempting to build bridges between two or more disciplines, there is much to be gained by taking standard positions whenever possible. Not only does this allow the reader to move between the resultant work and other literature with relative ease, but the bridges end up being founded on a large and relatively robust body of results in each domain. The uniqueness of Bernhardt and Stemberger's proposals with respect to phonological theory would make me wary of recommending this book to those without a solid background in phonology, and of using it as textbook for a course on phonological development.

It is often difficult to decide whether it is worth trading conformity and compatibility for innovation and idiosyncrasy, and others may well find that the benefits of Bernhardt and Stemberger's modifications to Optimality Theory outweigh their cost. In the following survey of the book's contents, I will focus on the novel stances taken concerning both phonological theory and its relation to child phonology, with the hope of clarifying what one would be buying into with the adoption of Bernhardt and Stemberger's framework.

### **Chapters 1-3: Preliminaries**

The first chapter lays out the rationale for the methodological approach taken in the rest of the book. The application of phonological theory to child data is justified through the usual invocation of continuity and parsimony (Pinker 1984); child-specific mechanisms should only be posited when necessary. The argument for the use of child data in the evaluation of phonological theories, however, is quite unique. While a number of authors cite disparities between the set of phenomena found in child phonology and those of the languages of the world as problematic for

an account of the child data based on typologically derived phonological principles (see e.g. Drachman 1976, Kiparsky and Menn 1977, Vihman 1980), Bernhardt and Stemberger consider child-specific data to provide an indication of capacities of phonological systems that may be accidentally unattested in mature languages for historical reasons. Whether diachronic factors can in fact explain typological gaps like the absence of long-distance assimilation of primary consonantal place features is certainly worthy of further research, as it would have quite a bearing on the shape of phonological theories (cf. Gafos 1998a). However, one would equally want to search for explanations of the existence of child consonant harmony (e.g. /dɔg/ -> [gɔg]) in the cognitive and physical makeup of young speakers; if child data are granted the same status as typological facts in the construction of phonological theory, it is hard to know what could ever force the abandonment of continuity.

In their discussion of issues of methodology in the collection of the child data, Bernhardt and Stemberger acknowledge that sampling and transcription errors are difficult to avoid when one follows the common practice, as they often do, of relying on transcribed diary-style data in the study of phonological acquisition. To minimize the effects of these errors, they emphasize the importance of widening the empirical base of the field, in support of which they introduce a significant amount of previously unpublished data from their own studies. As the data are only presented in sufficient detail to support the analytic claims, we can only hope that they will eventually be made publicly available in their unabridged form, like the corpus from Fikkert (1994) and Levelt (1994) that is now in CHILDES (MacWhinney 1995). Wider availability of databases such as these would reduce duplication of research efforts, allow independent verification of analytic claims, broaden the community of researchers, and facilitate the development of hypotheses for controlled experimental investigation (which is ultimately the best way to avoid the pitfalls of the diary method). For the study of morphological and syntactic acquisition, all of these benefits have already been accrued from the existence of CHILDES.

The second chapter presents an overview of fundamental conceptual issues: the role of rules and constraints in phonology, the status of features, segments, and syllables as representational primitives, single versus dual lexicon models of child phonology (see e.g. Menn and Matthei 1992), and the innateness of phonological constraints. In this, Bernhardt and Stemberger argue for and adopt what seems to have emerged as a standard approach to child phonology: a purely constraint-based single lexicon model that makes no claim about the

primacy of any particular level of representation. The discussion of innateness reveals a refreshing agnosticism about the ontogenesis of constraints. A basic tenet of Optimality Theory is that constraints are universal, and that typological variation is due to differences in constraint ranking. While it is sometimes supposed that universality entails innateness, in the following comment to the Optimal list, Smolensky (1995) points out that it does not:

UNIV [i.e. universality - *JP*] says that constraints are universal, not that they are innate. I do believe, with Joe Stemberger, I think, that how the universality of constraints is in turn explained is to some degree a separable issue. Whether universality is explained by innateness, or by learning from some extra-mental source (the mouth, linguistic environment), or whatever -- this seems in principle decoupled from OT.

Since there seem to be few, if any, empirical consequences of either an innatist or emergentist stance in the child phonology data examined here, it is easy to be sympathetic with Bernhardt and Stemberger's view that one can afford to sit on the fence.

Chapter 3 consists of a relatively clear introduction to the representational assumptions of nonlinear phonology, of which little will be new to most phonologists. The main point of innovation is Bernhardt and Stemberger's model of consonant/vowel planar segregation. In brief, they adopt McCarthy's (1989) position that interaction between non-adjacent consonants is to be captured by placing them on a separate plane from vowels, so that they become adjacent, and the strict locality of phonological processes can be maintained. Where they depart from McCarthy's views though, is in assuming that consonants and vowels remain on separate planes throughout the derivation, and throughout all languages; consonant/vowel interaction is achieved through a mechanism of trans-planar spreading (cf. Clements 1989). It is important to note that the position of planar segregation in phonological theory has been made somewhat tenuous by the appearance of several cogent analyses of long-distance effects that appear to assume just the opposite position from Bernhardt and Stemberger – that planar segregation is universally unavailable (on non-local consonant dissimilations see Itô and Mester 1996, Alderete 1997, Frisch, Broe and Pierrehumbert 1997, MacEachern 1998, and Suzuki 1998; on apparently non-local consonant assimilations see Flemming 1995, and Gafos 1998b, on apparently non-local vowel assimilations see McCarthy 1994, and Ni Chiosain and Padgett 1997). Of course, these

analyses are dealing with typological data only, not with child consonant harmony, which Bernhardt and Stemberger take to require segregation (see further below).

#### **Chapter 4: Revised Optimality Theory**

In chapter 4, Bernhardt and Stemberger introduce their version of Optimality Theory. One is first struck by the notational idiosyncrasies. All of the constraints, whether innovated or adopted from earlier work, have been renamed, which is intended as an aid to learning and remembering their meanings (a helpful Appendix is provided that lists all of the constraints used in the book, along with their predecessors in other studies). The layouts of the tableaux and ranking diagrams have also been rearranged, to fit the length of the unabbreviated constraint names. While mildly distracting at first, these changes seem well motivated, insofar as they enhance the accessibility of the theory. However, underlying these cosmetic alterations is a fairly substantial reworking of the formulation of the constraint set, whose motivation is sometimes less clear.

The faithfulness constraints that Bernhardt and Stemberger make use of are a blend of those of Prince and Smolensky (1993) and McCarthy and Prince (1995), with a few new twists. The 'Survived' family is their version of McCarthy and Prince's 'Max' constraints, which penalize the loss of Input elements in the Output, that is, deletion. An interesting innovation is in the absence of 'Dep'-like anti-epenthesis constraints, whose effects are ascribed to more general constraints against the presence of Output structure (the 'Not' family, AKA \*Structure). This is justified purely as a reduction of the number of constraints, and Bernhardt and Stemberger do not investigate in any detail whether the elimination of Dep constraints has any empirical consequences in typology or development, surely a topic for further research (cf. p. 431). Relatedly, their example of epenthesis as a means of avoiding voiced codas (p. 148 ff.) is one that Lombardi (1995) has claimed not to exist cross-linguistically. Unfortunately, the only child language evidence of this process that Bernhardt and Stemberger provide seems to implicate a more general application of epenthesis that eliminates all codas (Carolyn, p. 427).

From Prince and Smolensky (1993), Bernhardt and Stemberger adopt 'Parse' and 'Fill' constraints, revised and renamed as 'LinkedUpwards' and 'LinkedDownwards'. The main argument for the use of an extra set of constraints to block deletion is that 'LinkedUpwards' has the added effect of allowing for nonminimal repairs, where, for example, a constraint that could be satisfied through the loss of a feature instead forces the deletion of an entire segment (p. 167).

Though this could equally be obtained through the use of featural identity or 'Ident' constraints (McCarthy and Prince 1995, Alderete, Beckman, Benua, Gnanadesikan, McCarthy, and Urbanczyk 1997), Bernhardt and Stemberger view the use of Ident along with Survived constraints as introducing too much redundancy to the theory (p. 169). However, this application of a redundancy metric seems somewhat arbitrary, since there is considerable overlap between LinkedUpwards and Survived. Again, the empirical consequences of these revisions to the theory are extremely subtle, and mostly unexplored (though see p. 400).

Bernhardt and Stemberger draw on psycholinguistic evidence and constructs for two more additions to their model of faithfulness. Unlike most practitioners of Optimality Theory, they see a continued role for underspecification, even though they recognize that it is rendered largely superfluous by the elaboration of constraints (see e.g. Smolensky 1993, Steriade 1995). In defence of underspecification, they point to the anomalous behaviour of coronal consonants and the vowel /ɛ/ in English slips of the tongue, where they are relatively likely to be replaced by other sounds, counter to the tendency for high frequency phones to resist substitution (p. 134). Putting aside the controversy over coronal underspecification (Paradis and Prunet 1991, McCarthy and Taub 1992), the use of these antifrequency effects as a diagnostic for underspecification seems to be belied by the lack of any independent phonological evidence for the status of /ɛ/ as a default vowel in English (see Yip 1987, though cf. Stemberger 1992). Underspecification, then, would seem to have to stand on its analytic merits alone, and Bernhardt and Stemberger do get a lot of mileage out of their theory of 'default underspecification' in their analyses of child phonology.

The second import from the psycholinguistic domain seems somewhat more likely to bear fruit, if it can be fleshed out. In what they term the sliding scale of faithfulness, Bernhardt and Stemberger suggest that the ranking of faithfulness constraints, and perhaps structural constraints, can be indexed to activation levels; elements in salient processing positions are highly activated, and trigger a higher rank of the faithfulness constraints (p. 223). As they note, this proposal has the potential to make concrete the connections between aspects of the positional faithfulness theory of Beckman (1997) and strikingly similar notions from processing theories (see also Beckman 1997: 5). However, for this promise to be borne out, and for the proposal to be properly assessed, one would need an algorithm for the mapping of activation levels to ranking positions, as well as a method of determining how the faithfulness constraints are to be

shifted as a block relative to the structural constraints; in Optimality Theory one cannot simply add numerical weight to the faithfulness constraints (cf. Prince and Smolensky 1993: 200). Without any explicitness on these counts, it is hard to see the advantage over Beckman's formalism. A similar issue arises when Bernhardt and Stemberger dismiss the problem of incomplete neutralization by invoking activation levels (p. 671). While one might be able to model partial realization of a feature through partial activation, it is unclear how this fits in with a theory of phonology that uses categorical representational primitives, and categorical constraints, to achieve categorical outputs, as Optimality Theory typically does (in this particular case, Bernhardt and Stemberger's 'Not(+voice)' allows no measure of gradience).

Bernhardt and Stemberger also ground many of their structural constraints in cognitive/processing terms. The justification for the 'Not(X)' family, for instance, is that the production of phonological elements consumes cognitive resources, and is avoided as far as possible (p. 154). On the whole, the structural constraints are more typical of those found elsewhere in the literature than are the faithfulness constraints, the main exception being Bernhardt and Stemberger's reluctance to employ Alignment constraints (McCarthy and Prince 1993), which they fear are too powerful (p. 199 ff., p. 249 ff.).

### **Chapters 5-9 Analyses of child phonology**

The bulk of the book is devoted to presenting and analyzing a wide variety of the phonological processes seen in child language. Chapter 5 deals with the development of segmental inventories. It begins with a discussion of some general trends in inventory development, and an overview of research in the Jakobsonian tradition on universal orders of acquisition, including recent work that derives predictions from feature geometric structure. Bernhardt and Stemberger conclude that these universalist predictions are on the whole only weakly supported, and focus in the rest of the chapter on presenting and accounting for attested substitution processes. The range of developmental patterns covered here is especially impressive. Segmental development is the best studied aspect of child phonology, and Bernhardt and Stemberger cover studies from a number of research traditions, clearly pointing out where further data are needed. Relatively minor quibbles are that the source of data is sometimes not cited (e.g. p. 293) and that children's ages are sometimes not provided for previously unpublished data (e.g. p. 329). This is more than compensated for, though, by the general thoroughness of the references.



The analyses are generally characterized by the innovative use of underspecification to derive patterns that might otherwise be problematic. For instance, a chain shift of /s/ -> [θ], and /θ/ -> [f] is accounted for by underspecifying /θ/ for coronal (and its dependent features), so that /s/ can be blocked from going all the way to [f] by a Survived(Coronal) constraint (cf. Dinnsen and Barlow 1998 for another approach). Having /θ/ as the default fricative might seem unusual, but it is argued that there is indeterminacy in the default value of the coronal dependent [grooved], an articulatory substitute for [strident] (p. 297). A large project for future work would be to investigate the typological implications of this approach to the child data, as opposed to alternatives that do not invoke this sort of underspecification. This task will be facilitated by the fact that Bernhardt and Stemberger do not skimp on the analytic details, though more extensive use of illustrative tableaux would have made them somewhat easier to follow (there are none in chapter 5, and less than 20 in nearly 400 pages of analysis).

In chapter 6, Bernhardt and Stemberger move up the prosodic hierarchy, examining in turn the development of syllables, feet, and prosodic words, as well as prosodically motivated segmental restrictions. Though prosodic reductions in child speech have long been noted, it is only relatively recently that they have become the subject of systematic investigation and theoretically motivated analysis. Here Bernhardt and Stemberger largely agree with other researchers (e.g. Gnanadesikan 1995, Demuth 1996, Barlow 1997, Pater 1997) that these reductions can be straightforwardly characterized through the dominance of structural over faithfulness constraints, and provide analyses of the phenomena along these lines. They do provide one putative example of a higher ranked faithfulness constraint in child than adult language (p. 382), which actually seems to be due to changes in ranking between structural constraints, with coda nasals preferred over syllabic ones in child language, but the reverse in adult Sesotho. Again, the empirical and theoretical coverage is exemplary in its thoroughness.

Chapter 7 turns to processes affecting consonant clusters in onset, coda, and medial position, as well as those affecting non-adjacent consonants. Given the model of planar segregation that they adopt, Bernhardt and Stemberger apply a single set of 'NoSequence' constraints to both adjacent and non-adjacent consonants to derive both local and non-local effects. For instance, 'NoSequence(Coronal..Dorsal)' is violated by [tejk] as well as [ejtk], so that child consonant harmony yielding [kejk] from /tejk/ would be a response to the same constraint that rules out \*[ejtk] in adult English (p. 558). One problem with ascribing harmony to such

parochial sequence constraints is that this would seem to subvert any account of the generalization that if noncoronals undergo harmony, so do coronals (Stemberger and Stoel-Gammon 1991, Pater 1997:242; cf. Dinnsen, Barlow, and Morrisette 1997); there seems to be nothing to prevent a ranking with NoSequence(Labial..Dorsal) above NoSequence(Coronal..Dorsal), with Faithfulness in between.

Bernhardt and Stemberger also suggest that harmony can result from lexical underspecification of a default such as Coronal, along with a constraint requiring surface specification (LinkedDownwards) that is fulfilled through spreading of a non-default like Dorsal (cf. Beckman 1994 for a similar approach to adult vowel harmony). Since LinkedDownwards is satisfied by spreading, and the statement of NoSequence requires adjacency, Bernhardt and Stemberger conclude that C/V tier segregation is required. However, there also accounts of child consonant harmony in Optimality Theory that make no appeal to segregation: Levelt (1996) and Goad (1997) invoke Alignment, while Pater (1997) and Dinnsen, McGarrity, O'Connor and Swanson (1998) use constraints against divergent place specification between consonants. Hopefully in the near future a sufficient supply of mutually accessible child language data will become available, against which these and other analyses can be tested.

Chapter 8 focuses on the application of nonlinear phonological theory to the treatment of developmental delays. It begins with comparison between normal and protracted phonological development, which concludes that "similarities outweigh differences" (p. 587). This chapter is particularly interesting for the detailed case studies that follow, which illustrate the changes that children's phonological systems undergo during treatment. Bernhardt and Stemberger make a strong case for the usefulness of constructs from nonlinear phonology in the description and treatment of protracted development. This chapter also serves to tie together the analyses introduced in the preceding chapter, as it examines the interaction of phenomena at various segmental and prosodic levels.

Chapter 9 discusses an often neglected area of phonological development: the acquisition of morphophonology. Data on English are largely drawn from Stemberger's diary studies, and there is also a survey of the small amount of literature on this subject available on other languages. The main theoretical point made here is that it is insufficient to characterize child phonology as having a lower rank of faithfulness than structural constraints; some phenomena point to higher faithfulness in child language. Bernhardt and Stemberger claim that this casts

doubt on Smolensky's (1996) proposal that learnability requires an initial structural >> faithfulness ranking, and suggest instead a "semirandom" initial ranking that "leads to some faithfulness constraints being ranked higher than in the target adult language, for some children" (p. 636). However, the clear examples of higher child faithfulness (e.g. English children whose flapping is blocked in derived words that have corresponding non-flapped coronals in their stems) involve a closer match between morphologically related forms in child than in adult phonology. These can be handled by the (apparently independent) proposals of Hayes (1998) and McCarthy (1998), which claim that just the faithfulness constraints that apply between base and derivative (AKA Paradigm Uniformity or Output-Output Faithfulness) are initially ranked high. McCarthy (1998) in fact demonstrates that an initial ranking of OUTPUT-OUTPUT FAITH >> INPUT-OUTPUT FAITH can be derived from the same learnability considerations that Smolensky invokes to derive STRUC >> FAITH.

## **Conclusions**

In chapter 10, Bernhardt and Stemberger conclude by discussing the relationship between phonological theory and phonological acquisition. They provide a list of factors that affect child pronunciations, but that fall outside the domain of phonology (e.g. perception, resource limitations, and personality factors), and review some of the phonological phenomena that proved difficult for their theory (e.g. chain shifts, nonminimal repairs). They then draw conclusions for phonological theory based on the child data, including the claims that: (1) the representation for similar segments can differ between children and between languages (e.g. affricates as [+strident, -continuant] or [-continuant][+continuant]); (2) the default values for features, and the underlying presence of redundant features, can also differ between children and between languages; (3) consonants and vowels are on separate planes; (4) faithfulness constraints are indexed to activation levels. These positions may be at odds with received wisdom, but one gets the impression that the authors would not have it any other way. Bernhardt and Stemberger are to be congratulated for taking on the important and often difficult task of integrating research in phonology and child phonology, speech-language pathology, and psycholinguistics, and for taking so few assumptions for granted in doing so. Whether or not one agrees with the details of the resulting framework, or even with the basic premises of the undertaking (cf. Hale and Reiss 1998), a phonologist of any bent should find something of interest in this book.

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