

*The Handbook of*  
**Phonological  
Theory**

*Second Edition*



*Edited by*

**John Goldsmith, Jason Riggle,  
and Alan C. L. Yu**

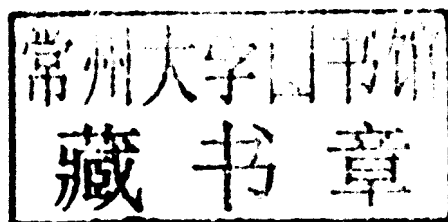
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The Handbook of  
Phonological Theory

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# Preface

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This new volume on phonological theory is in some respects a continuation of the *Handbook of Phonological Theory* published by Blackwell in 1995. The present book was several years in the making, and reflects both the changes that the field has gone through in the years since the first handbook was written, and a shift in the precise character of the questions we hope to see answered in a book such as this. As you will see in the chapters that follow, we have asked each author to take a step back from the research that has been published over the last decade in each subfield in phonology, and to ask what the broader questions are that have been the focus of investigators over a longer period of time. Having identified the long-standing questions, the authors were then asked to pass judgment – as best they could – on the degree to which the field had succeeded in providing answers to these questions.

In this way, our handbook takes on a perspective that is different from many others in linguistics. We have asked our authors to set as their primary goal to provide some grounds for determining the degree to which phonology – as a whole, and as a set of subdisciplines – displays a cumulative character, which is to say, succeeds in asking questions that are both interesting and useful in some respects, and then – just as importantly! – answering them. In particular, we asked our authors to avoid as much as possible adopting the stance of the scholar who predicts where the field will, or should, go in the next five to ten years, and what the important open questions are. While there certainly is a place for such gazing into a well-focused crystal ball, we felt that the present handbook was not that place.

Comparing the present handbook to the one that was produced in 1995, we seem to find, too, that the field has expanded: it now includes a good deal more content and emphasis on phonetics, on variation, and on computational approaches. In reality, the growth is more a matter of perspective than anything else: studies on phonetics, variation, and computation that were of interest to phonologists have existed for a long time, but the perception is now much stronger that this work is not outside the field of phonology (though of interest to some phonologists),



as it is a real and integral part of the field itself. The broader range of the questions covered by the authors in this volume is testament to that change.

If we were to point to the greatest single difference between the work in the two volumes, it would have to be the considerable replacement of the analytic tools of phonological derivations within a generative framework with those optimality theories, utilizing ranked constraints from a universal inventory of violable phonological constraints. The first chapter in this volume, by David Odden, provides an illuminating overview of the nature of the questions which have been explored, with the goal of understanding the essential difference between these two approaches.

In Chapter 2, Eric Baković revisits the topic of opacity and examines its role in distinguishing ordered versus parallel phonological derivations. He demonstrates that the range of opaque relations between underlying and surface forms does not partition neatly into “counterfeeding” and “counterbleeding” classes and moreover that there are cases which fit Kiparsky’s seminal definition of opacity that cannot be generated by ordered derivations.

Changes in analytic tools are often accompanied by shifts in perspectives. Age-old problems are given a fresh look while new puzzles come about, as novel theoretical tools are tested. In this respect, the emphasis on constraint interaction and monostratalism has certainly left an undeletable mark on how one thinks about the relationship between the morphological and phonological components of grammar. In Chapter 3, Sharon Inkelas surveys the pros and cons of a monostratal interpretation of the morphology-phonology interface, and details the many ways in which morphological processes can be sensitive to phonological information and vice versa, highlighting properties that any theory of the phonology-morphology interface must take into account.

In Chapter 4, Stuart Davis offers an overview of the development of moraic phonology and provides a survey of a wide range of linguistic phenomena where the mora plays an important role, including thorny issues such as the existence of moraic onsets and the replacement of moraic quantity with phonetically-defined weight sensitivity in language.

Matthew Gordon provides a broad overview of stress systems, including quantity insensitive systems and quantity sensitive systems, in Chapter 5. Gordon provides an account of what constitutes “weight” in various quantity-sensitive systems and discusses the relationship between word-level and phrase-level stress. The chapter also presents an in-depth comparison of foot-based and grid-based representations of stress and discusses their ramifications for models of stress.

John Goldsmith presents in Chapter 6 a synoptic overview of the ways of understanding the syllable that have played a role in phonological thinking over the last hundred years, emphasizing the ways – often complementary, and not always consistent – in which the different conceptions of the syllable have emerged and developed in discussions in the literature. The two most appealing approaches have based on waves of sonority, on the one hand, and constituent structure as developed by mid-century syntacticians, on the other. A few phonological theories

have tried to jettison the syllable, but rarely with any lasting success, and a successful synthesis of the best of what has been learned still awaits us.

Larry M. Hyman has studied tone languages – mostly, but not exclusively, African tone languages – in great depth since the 1960s, and in Chapter 7, he offers the reader a rich account of many of the properties of tone languages that have emerged in studies over the past several decades. He asks what we have learned about how tone is different from other aspects of spoken language, and how it can nonetheless shed a great deal of light on the way in which phonological information is organized in natural language.

Sharon Rose and Rachel Walker provide a thorough overview of harmony systems that includes vowel harmony, consonant harmony, and vowel-consonant harmony in Chapter 8. They provide an account of the triggers and targets of harmony in the case of continuous sequences and when harmony acts at a distance. For the latter, they provide an analysis of segments that block harmony when they intervene between trigger and target and those that are transparent to harmony. They identify a broad dichotomy between consonant harmony on one hand and vowel harmony – including vowel-consonant harmony – on the other that is framed in terms of blocking and transparent segments and the functional grounding that provides insight into why consonant harmony does not, in general, admit transparency, while harmony with vowels does. Finally, they discuss a range of fundamental issues, including the domain of harmony, directionality, and locality.

The notion of contrast reduction has been central to many major developments in phonological theories. Yu's chapter, which is an expanded version of an article titled "Mergers and Neutralization," that appeared in the *Companion to Phonology* (Wiley-Blackwell 2011), provides an overview of the range of contrast reduction phenomena in the world's languages and past theories that try to explain the typological tendencies. Yu places a particular focus on the problems raised by covert contrasts (i.e. incomplete neutralization and near mergers). He questions the reliability of the traditional methods of phonological investigation (see also Ladd's chapter) and argues for the need to evaluate the presence and absence of a phonological contrast at a more nuanced level.

While it is undeniable that languages are products of history, the issue of how phonological explanation should take into account historical factors remains a contentious one. Hansson's chapter, which originally appeared in the journal *Language and Linguistics Compass*, reviews an wide array of theoretical stances that phonologists have taken over the years, ranging from strictly modular approaches to the more integrationalist. Hansson shows that this controversy largely stems from questions about the nature of sound change and what models of sound change reveal about the nature of phonological knowledge.

D. Robert Ladd's chapter on the role of phonetics in phonology is a good example of how the thematic questions at the center of phonological discussions have evolved over the last 15 years. The time-depth of his discussion, involving scholars working over almost all of the twentieth century, is considerably deeper than that found in any of the chapters in the 1995 volume, and Ladd explicitly

draws together the views that Trubetzkoy developed in the 1930s with those at the heart of classical generative phonology and those that scholars today are developing, often under the influence of far richer computational resources than was imaginable even 25 years ago. The easy assumptions that phonetic reality can be modeled with a well-designed symbolic representation, such as that produced by the International Phonetic Association, have been widely challenged, and Ladd asks what alternative empirical accounts are available to us now for characterizing the nature of phonetic reality.

As noted earlier, a major change since the last edition of this handbook has been the rise in prominence of phonetic, variationist, and computational approaches in phonological investigation. A clear reflection of this is in the greater willingness on the part of many phonologists to engage data sources that have not played a large role in early theoretical developments. In their contribution, Ernestus and Baayen review findings of recent corpus-based studies of sound patterns and highlight important lessons to be learned from such studies. The appearance of what might in former times be thought of as “messy data” in the phonological discourse has invited renewed discussion on the abstractness of phonological knowledge, which the authors integrate by comparing the merits of abstraction-based vs. exemplar-based models of phonology.

In Chapter 13, Andries Coetzee and Joe Pater discuss several theoretical approaches to variation in phonology. It is fair to say that the emergence of widespread interest in variation among theoretical phonologists is one of the more significant changes in the field at large since the publication of the 1995 *Handbook of Phonology* (which did not contain a chapter on variation). Coetzee and Pater review a range of proposals in which variation is taken to illuminate the core phonological grammar rather than obscure it. Instead of regarding variation as a performance-related epiphenomenon that must be factored out in order to characterize the phonological grammar, they focus on understanding the locus (or loci) of variation in the grammar and the empirical consequences of various assumptions in this regard.

Lisa Selkirk has been doing influential work on the interface between phonology and other components of the grammar for over three decades. In Chapter 14, she discusses the interface between phonology and syntax in terms of the relationship between syntactic constituents and prosodic constituents. She presents a thorough account of the way that prosodic constituent domains for phonological and phonetic phenomena at the sentence level are related to syntactic constituency.

A domain where interests in phonetic and phonological investigations have converged in recent years is the area of intonational research. In their chapter on intonation, which is a slightly revised version of their contribution in the *Handbook of Phonetic Sciences* (edited by Hardcastle, Laver, and Gibbon, 2009), Beckman and Venditti review the development and advances of experimental intonational research and highlight their contributions to the understanding of intonational phonology and prosodic typology.

In Chapter 16, Harry van der Hulst presents an overview of work on government- and dependency-based phonology, which explores the consequences for phonological

theory of developing phonological representations that incorporate in an essential way formal asymmetrical relationships between abstract elements. "Asymmetrical" here refers to the important differences between what are called the head and the dependent, connected by a relation of dependency. Van der Hulst reviews recent work in this area, and notes respects in which government phonology has brought out parallels involving relations between elements in syntax and in phonology.

Katherine Demuth discusses in Chapter 17 the ways in which contemporary phonological theory has been reflected in the research concerns of a large part of the language acquisition community. Among the themes whose importance has grown over the last two decades are the relevance of surface-oriented phonological patterns, of prosodic patterns at both the syllable and foot level, of markedness and underspecification, and frequency. At the same time, conclusions can be drawn that are more robust in light of the wider range of languages that have been studied by acquisition researchers.

In Chapter 18, John Coleman guides the reader through the developments over the last 50 years which have influenced phonological modeling, bringing out the often only tacit connections between computational conceptions and phonological analyses, such as those employing finite-state methods, purely declarative formalisms, or techniques based on neural networks.

As phonologists rely more and more heavily on experimental methodologies, the question of the psychological status of phonological constructs becomes ever more important in the analyst's mind. Goldrick (Chapter 19) explores the notion of psychological realism in phonological inquiries, highlighting the need to differentiate at least three levels of analysis: functional, algorithmic, and neural. Using well-formedness judgments as a case study, he emphasizes the need to articulate in greater specificity the functional architecture of language processing in the context of interpreting experimental results.

Adam Albright and Bruce Hayes present an account of phonological learning in Chapter 20. They focus on formal systems designed to model the path by which children acquire the phonological grammar of their first language and evaluate the adequacy of the systems in terms of their ability to elucidate what is known about linguistic competence in three specific areas. The areas that they give special attention to are phonotactic knowledge, phonological alternations, and patterns of variation. They argue that any system capable of mimicking human performance in these areas – including the mistakes – will have reverse-engineered key aspects of the phonology of natural language in a way that enriches our understanding of both theoretical phonology and the broad character of observed phonological phenomena.

Diane Brentari's chapter on the phonological structure of sign languages extends her chapter on the subject in the 1995 edition of the handbook. In the current chapter, she reviews our better understanding of three important aspects of sign languages: their phonological structure, their iconicity (that is, the principles and patterns relating phonological structure to real or understood world structure), and the respects in which the phonologies of sign language are influenced by the

physical modality used, notably the structure of the signing hands and body, and vision, which is the perceptual system used for perception.

The last two chapters focus on linguistic evidence that has often been taken to be extralinguistic. Both sets of authors instead argue for the centrality of such evidence in testing and advancing phonological theories. In his chapter on language games (Chapter 22), Vaux provides an overview of the empirical and theoretical advances language games have contributed to phonological research. He argues that research on language games not only reveals subtleties of phonological representation, they also shed light on the cognitive limits of linguistic operations and language acquisition, as well as architectural issues such as opacity. In their chapter on loanword adaptation, the last chapter of this book, two veteran loanword phonologists offer a summary of major findings in loanword adaptation research, and reflect on major lessons learned from this line of inquiry. Echoing Ernestus and Baayen's call for more corpus studies in Chapter 12, Paradis and LaCharité illustrate in Chapter 23 the importance of corpus construction and the need to pay attention to statistical generalizations with their own Project CoPho loanword database.

We offer these chapters to both the reader who is relatively new to the field and to the expert knowing full well that no-one can keep fully up to date on all the fields that now comprise phonology. We thank our authors for their efforts, as well as for their patience and forbearance during the book's preparation, and we hope that our readers will profit from the chapters as much as we, the editors, have.

We would like to dedicate this book to the memory of G. N. Clements, who was planning to contribute a chapter to this handbook, and who left us too soon to able to do so. Like many others, we admired Nick's work and were influenced greatly by that work, and we will miss him.

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# 1 Rules v. Constraints

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DAVID ODDEN

## 1 Background

The goal of a theory of phonology is to elucidate the nature of “phonology” at a conceptual and predictive level. The title of this chapter refers to a comparative evaluation of rules and constraints as successful theories of phonology, which implies having a standard of evaluation, and adequate clarity as to what “rules” and “constraints” refer to. Neither prerequisite is trivial to satisfy.

### 1.1 *The Scope of Inquiry*

Certain assumptions about the nature of phonology must be considered, even lacking agreement on which assumptions to make. First and foremost, deciding whether phonology is based on rules or constraints, or a mix of the two, requires having objectively expressible statements of phonologies within different frameworks whose consequences can be compared. Therefore the theories must have a definite form, that is, they must be formalized. The entities which make up a phonological grammar should be expressions, which are finite sequences of elements taken from a specified set, and combined by rules of construction that define well-formed statements of rule or constraint. The value of formalism is its power to make objectively-interpretable statements about the phonology which can be checked against fact. To evaluate rules versus constraints as models, we should then consult the formalisms of the theories, to see whether one theory better passes the test of empirical and aesthetic adequacy.<sup>1</sup> Problems in this area are not trivial; certain theories of constraints or rules are severely under-formalized so that it is hard to know what predictions the theory makes; and a number of



theories are under-applied in the sense that it is impossible to determine from examples how particular phenomena would be analyzed.

Assuming that we are comparing formal theories, we must resolve questions about the scope of phonology, including how much of “phonetics” or “morphology” is phonology, and whether all facts bearing on phonology are the responsibility of the theory. Generative phonology traditionally encompasses a broad range of processes which might be considered phonetic (allophonic) or morphological (rules with lexical or morphological conditions), but the edges of phonology may also be contracted for theoretical purposes, viz. restrictiveness. Thus Webb (1974: 127) excludes metathesis from phonology, stating that “synchronic metathesis is not a phonological process. In the residual cases of metathesis, the rule is always morphologically restricted,” enabling the “Weak Metathesis Condition,” a restriction against reordering in phonology. If phonology is deemed to be concerned only with biuniquely recoverable surface-true relations between sounds (e.g. allophonic vowel nasalization in English), and abstract phonological alternations are to be described by the formal methods of morphology, a theory designed to account for just surface phonotactics cannot be meaningfully compared to one designed to account for both phonotactics and abstract morphophonemics.<sup>2</sup> A surface-phonotactic view of phonology thus must ignore a substantial portion of research into phonological grammars, on Bedouin Arabic (Al Mozainy 1981), Finnish (McCawley 1963; Harms 1964; Karttunen 1970; Keyser and Kiparsky 1984; Kiparsky 2003a), Chukchi (Krauss 1981), Kimatuumbi (Odden 1995), Klamath (Kisseberth 1973; White 1973), and Ojibwa (Piggott 1980), and numerous other languages.

There are also questions as to the level of explanation demanded of a theory – do we demand formal explanation, or formal and functional explanation? Much of the course of phonological theorizing has involved the increasing absorption of substantive factors into the theory, in an attempt to narrow the gap between prediction and observation. Comparative evaluation of theories implies determining which theory is better at making definite the notion “possible rule” or “possible constraint.” The notion “possible” is used in two ways. One sense is theoretical well-formedness, that is, a rule constructible by free combination of elements, according to a theory of the form of rules. In that sense, “ $A \rightarrow B/C\_D$ ” would be a possible rule, but “ $\rightarrow B\_/ACD$ ” would not. McCawley (1973: 53) points to a different sense, the metaphysically possible, claiming “One who takes ‘excessive power’ arguments seriously has as his goal characterizing ‘phonological rule’ so as to include all and only the phonological rules that the phenomena of a natural language could demand. . . .” This notion of “possible rule” seems to mean what does exist, so *is* attested, or that which we have solid scientific or philosophical reason to conclude *must exist* now or in the past or future, just waiting to be discovered. The latter kind of “possible” depends on metatheoretical expectations, so McCawley intuitively feels that assimilation of nasal to labials alone is not a possible rule (the present author does believe that such a rule is possible, if unlikely).

Whether such a rule is possible is not central to this discussion: what is essential, is distinguishing the undiscovered from that which is impossible by the nature