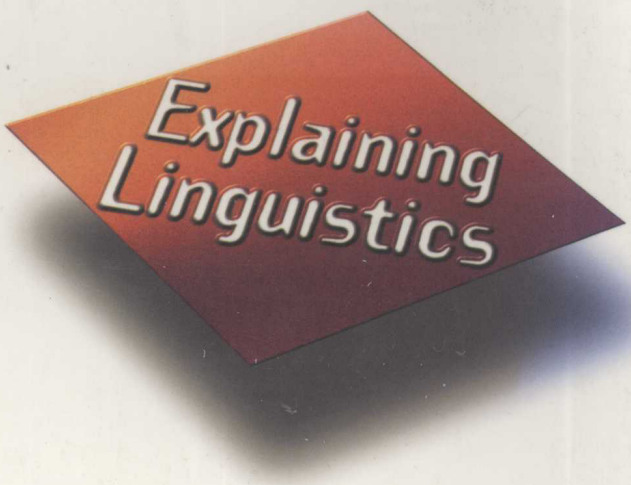

OPTIMALITY THEORY

An Overview

Edited by **Diana Archangeli**
and **D. Terence Langendoen**

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Optimality Theory
An Overview

Explaining Linguistics

D. Terence Langendoen, *Series Editor*

This is the first in a series of volumes of essays designed to introduce and explain major research areas in linguistic theory and practice. It is intended for researchers, scholars and students who have a need or a desire to learn more about these areas. Future volumes in the series will be incorporated as special issues of the journal *Linguistics Abstracts*.

Notes on Contributors

Diana Archangeli (MA, University of Texas; PhD, MIT) is Professor of Linguistics at the University of Arizona. She taught previously at the University of Illinois, Champaign–Urbana. She is the coauthor with Douglas Pulleyblank of *Grounded Phonology* and is now engaged in a number of projects involving Optimality Theory.

Michael Hammond (PhD, UCLA) is Associate Professor of Linguistics at the University of Arizona. He has also taught at the University of Minnesota and at the University of Wisconsin, Milwaukee. He has published extensively on phonological theory and metrical analysis.

D. Terence Langendoen (PhD, MIT) is Professor and Head of the Department of Linguistics at the University of Arizona. He taught previously at Ohio State University, Brooklyn College, and the Graduate Center of the City University of New York. He has published on a wide variety of linguistics topics.

David Pesetsky (PhD, MIT) is Professor of Linguistics at the MIT. He taught previously at the University of Massachusetts at Amherst, and is well known for his wide–ranging research in syntax.

Douglas Pulleyblank (PhD, MIT) is Associate Professor of Linguistics at the University of British Columbia. He taught previously at the University of Southern California and the University of Ottawa. He is known particularly for research on the phonology of African languages.

Kevin Russell (PhD, University of Southern California) is Assistant Professor of Linguistics at the University of Manitoba. He is currently working on the phonology and morphology of Arabic and Cree.

Margaret Speas (MA, University of Arizona; PhD, MIT) is Associate Professor of Linguistics at the University of Massachusetts, Amherst. She has written extensively on problems of phrase–structure analysis and the analysis of pronominals.

Foreword

The goal in creating this volume has been to offer an accessible introduction to Optimality Theory, a powerful new model of grammar. Our intended audience is anyone with a serious interest in language who desires to understand this model, regardless of their background in formal linguistic theory itself.

What is a grammar and how does it work?

People who know a language are able to produce and recognize a huge number of intricately structured expressions (words, phrases, sentences, etc.). Moreover, they are able to distinguish those expressions which belong to a particular language from possibly very similar expressions which do not. Linguists, the scientists who study language, have assumed that these abilities are accounted for by a mechanism, called a **grammar**, which relates the expressions of a language to the elementary parts of which they are made.

Linguists are thus faced with two related problems. One is to ensure that the grammar of a particular language is able to encompass all of the expressions that can reasonably be supposed to belong to that language. The other is to ensure that the grammar is able to distinguish those expressions which belong to the language from those which do not.

The problem can be compared to that of a fisherman trying to catch in a net all the fish of certain types in a certain area, but nothing else (no other types of fish, no other creatures, etc.). The ideal net would be large and fine enough to gather all the desired fish (the desirables), and be designed to allow the undesired fish and other creatures (the undesirables) to escape. But it may not be possible to construct such a net. Any net which is large and fine enough to catch all the desirables may of necessity also catch some undesirables.

If that is the case, one would need a device (a separator) to remove the undesirables once the catch has been taken, no matter how effective the net is in allowing the undesirables to escape. One might therefore decide to put one's energies more into designing an effective separator than into refining the capabilities of the net to allow the undesirables to escape. The ideal separator is one which always succeeds in removing the undesirables, no matter how many the net retains. If one could design an ideal separator,

then one might be content with a net which catches everything in the area, allowing nothing to escape, leaving the job of removing the undesirables entirely to the separator.

The ideal net corresponds to the original idea of a generative grammar (as in Chomsky 1957) that accounts directly for (i.e. generates) *all and only all* the expressions of a given language with no auxiliary devices to remove ungrammatical expressions. Because of the enormous complexity of the grammar which results from trying to put that idea into practice, many linguists chose to drop the *only all* proviso for the generative mechanism (the technical description of this state of affairs is that the grammar **overgenerates**), and to add devices, called **filters**, to eliminate the ungrammatical expressions that the generative mechanism allows; see Chomsky and Lasnik (1977) for a proposal along these lines.

The resulting theory divides the task of separating the grammatical from the ungrammatical sentences to two parts of the grammar: the generative component, which accounts for all the grammatical expressions, allows some ungrammatical expressions, and rejects others (i.e. the net); and the filtering component, which removes all the ungrammatical expressions let in by the generative component (i.e. the separator).

This situation, in turn, has been viewed as unsatisfactory: why have two components of the grammar responsible for separating out the expressions which are ungrammatical in a particular language? Chomsky (1995b:223) states this view as follows:

> The worst possible case is that devices of both types are required: both computational [generative] processes that map symbolic representations to others and output conditions [filters].

In phonological research in the late 1980s and early 1990s, analyses including both generative processes and filters were prevalent. Moreover, in many cases, the same facts might be covered by process or by filter, with no empirical consequences. Optimality Theory was introduced in response to this situation. Optimality Theory opts for the 'ideal separator': a very simple generative mechanism (GEN; see Chapter 1) that allows ungrammatical expressions to be created essentially without restriction, leaving all the work of separating out the ungrammatical ones to filtering devices (EVAL; also see Chapter 1). Because the need was so apparent in phonology, the Optimality Theoretic model has rapidly gained the attention of phonologists worldwide.

In syntactic research, Optimality Theory again is the ideal separator. But the research climate is less receptive to such a model: in general, syntactic analyses have not made rampant use of both processes and filters. For example, Chomsky's Minimalist Program (see Chapter 6) represents a return to the idea of the 'ideal net': a generative mechanism that allows the ungrammatical expressions to escape, permitting only the grammatical ones to be accounted for. Consequently, the Minimalist Program and Optimality Theory can be seen as attempts to avoid the worst-case scenario in opposite ways.

An overview of the book

This book is organized to present an introduction to Optimality Theory, and to demonstrate its workings in phonology, morphology, and syntax. Chapter 1, by Diana Archangeli, first summarizes the goals of formal linguistic research, then introduces

Optimality Theory, showing how it addresses these goals. The reader who has little or no understanding of Optimality Theory would do well to start with this chapter. It serves as a preface to the remaining chapters, since the concepts it introduces are assumed in each of the other chapters. The reader who is already familiar with the basics of Optimality Theory might prefer to go directly to one of the following specialized chapters: Chapters 2 and 3 on phonology, Chapter 4 on morphological issues, and Chapters 5 and 6 on syntax. The book concludes with an Afterword, concerning the nature of the input. A summary of Chapters 2 through 6 follows, including comments on which chapters serve as background for subsequent chapters.

Chapter 2, by Michael Hammond, provides an introduction to syllables and feet, the two central constituents in discussions of prosody. The chapter illustrates how Optimality Theory accounts for a variety of prosodic phenomena. It also provides an excursus into psycholinguistics, with a discussion of how some surprising patterns of speech perception are explained under Optimality Theory, patterns which constitute a serious challenge to derivational models of language. This chapter is particularly useful for the non–phonologist because virtually all of the examples are from English. This chapter relies heavily on the analysis provided in Chapter 1, as well as making use of the theoretical points introduced there; it is also useful to the understanding of Chapter 4, which is about morphology.

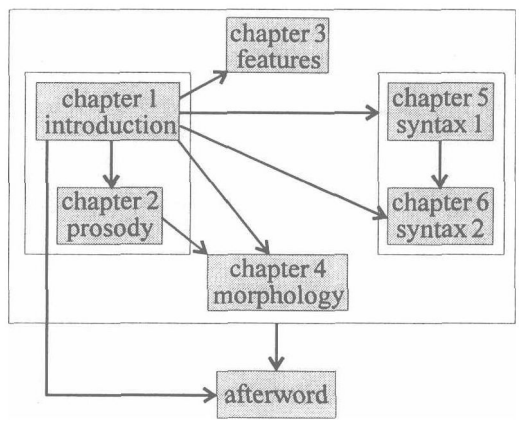
Chapter 3, Douglas Pulleyblank's chapter on phonological features, explains the concept of phonological features and illustrates a variety of feature patterns found in different languages. The cross-linguistic sketch of how different languages resolve nasal-obstruent sequences (e.g. *nt*, *ms*, *nb*, etc.) illuminates one of the main advantages of Optimality Theory, its ability to precisely characterize formal differences between languages. The chapter also addresses the issue of how a "segmental inventory" is expressed within a model which allows for no restrictions on the inventory of segments in underlying representation.

Kevin Russell introduces key questions in the study of word formation, or morphology, in Chapter 4. This chapter focuses primarily on the phonological, or pronunciation, aspects of morphology: it does not address the syntactic and semantic reasons why certain morphemes may combine with each other while others may not. Chapters 1 and 2 form a useful introduction to Section 3 in particular, which explores reduplication and infixation phenomena. In Section 4, he turns to English, providing an account of the "multiple use" of the suffix *s* in English. In English, both the possessive and the plural forms of most nouns sound alike: *book's/books*, *tool's/tools*, *judge's/judges*. Interestingly, a possessive plural is formed exactly the same way: *books'*, *tools'*, *judges'*, not **books's* ([bookss] or [booksəs]), etc.

The remaining two chapters explore syntactic problems in terms of Optimality Theory. David Pesetsky begins Chapter 5 with a beautifully clear introduction to the essence of current syntactic theory, elucidating both the phenomena and the formal explanations. This part of the chapter is an excellent introduction for Chapter 6 as well as for the rest of Chapter 5, while the reader who is already familiar with current syntactic theory might wish to skip the introductory section and begin directly with Section 2, comparing standard theory and Optimality Theory in syntax, or Section 3, an exploration of the distribution of *that* and of relative pronouns. In English, we can say *the man **who** I saw*, *the man **that** I saw*, and even *the man I saw*, but we don't say **the man **who that** I saw*.

Pesetsky shows that the facts for the comparable sentences in French are subtly and interestingly different, and provides an Optimality Theoretic account of each pattern.

In Chapter 6, Margaret Speas first evaluates the standard "principles and parameters" theory of syntax, and shows that the inviolable principles of this theory are inviolable simply because each such principle includes an "escape hatch" for when it does not hold. She then shows that by adopting Optimality Theory, the principles can be expressed more generally, the escape hatches being eliminated in favor of constraint ranking. The discussion centers on the analysis of "null pronouns", occurring in the position of the underscore in sentences like *Mary expects __ to promote Bill* and *__ To behave in public would enhance Bill's reputation.* In the first, it can only be Mary who will do the promoting, whereas in the second, the one being admonished to behave might be Bill, but might also be some other person. After formulating constraints and constraint rankings to explain these facts, she analyzes the properties of null pronouns in a number of other languages to show that OT also insightfully accounts for the cross-linguistic patterns these pronouns display.



Kudos

A number of people worked very hard to bring this volume to publication. Several of these individuals are identified in the chapters for their contributions to the development of their respective content. We were ably assisted in the formatting, editing, and indexing of this book by Laura Moll–Collopy, Keiichiro Suzuki, and Dirk Elzinga. We are very proud of the results they achieved.

Funding for this book came in part from National Science Foundation grant BNS–9023323 to Diana Archangeli, for which we are grateful.

Finally, for their patience and moral support throughout the duration of this project we thank Dante Archangeli and Nancy Kelly. Special thanks go to Marina and Amico Archangeli for always being there.

Electronic Access to Optimality Theory

Readers who are interested in accessing more material on Optimality Theory have three options. The first is to look to the published literature. A good start is this book. However, at the time this book is going to press, there is very little published work available on Optimality Theory. By contrast, electronic access to a wide variety of works is possible. The Rutgers Optimality Archive (ROA) is a well–maintained electronic repository of unpublished works in OT, which is accessible through the World Wide Web. The ROA includes abstracts of most entries.

URL of the Rutgers Optimality Archive on the WEB
`http://ruccs.rutgers.edu/roa.html`

The third option is to join the optimality net. This is an electronic bulletin board which posts information about additions to the archive and archive maintenance. It also occasionally serves as a forum for discussion of issues in OT. The instructions for joining this discussion group are available in the ROA homepage.

Tucson, Arizona, USA
October 1996

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Optimality Theory: An Introduction to Linguistics in the 1990s*

Diana Archangeli

Optimality Theory (henceforth "OT") is THE Linguistic Theory of the 1990s. It made its public debut at the University of Arizona Phonology Conference in Tucson in April 1991, when Alan Prince and Paul Smolensky presented a paper entitled simply 'Optimality'. In the spring of 1993, linguists around the world found in their mailboxes a pair of hefty and convincing manuscripts: *Optimality Theory: Constraint Interaction in Generative Grammar* by Alan Prince and Paul Smolensky and *Prosodic Morphology I: Constraint Interaction and Satisfaction* by John McCarthy and Alan Prince. Research in Optimality Theory, especially in the area of linguistics known as phonology (see Section 2), has grown tremendously ever since, and is coming to dominate the world of linguistic research as presented at conferences, workshops, seminars, and colloquia; and the Rutgers Optimality Archive is perhaps the most active and extensive of the various electronic publication outlets in linguistics (see Foreword). The impact of OT in the areas of linguistics outside of phonology has not been as dramatic, but it has been significant, and is likely to rival its impact in phonology before long.

Since OT is a theory of generative linguistics and has had its greatest impact so far in phonology, the next two sections present brief summaries of the goals of generative linguistic theory, and more specifically of the goals of phonological theory. Readers who are familiar with this material can skip directly to Section 3, where discussion of OT begins.

*Special thanks to Michael Hammond, D. Terence Langendoen, Dirk Elzinga, Keiichiro Suzuki, and Margaret Speas for their careful reading and suggestions which led to improvements in this chapter. Work on this chapter was supported in part by NSF grant BNS–9023323 to the author.

1 What is Linguistics?

There are two central research objectives in linguistics. The first is to determine and characterize **universal properties of language**, the properties that are shared by all languages. Although the manifestation of a specific universal in a particular language may not be the same as it is in the language next door, such universals are thought to be present in some regard in every language. This leads to the second research objective in linguistics, to determine and characterize the range of **possible language variation**.

Linguistics is the study of...

1. **language universals**: the range and type of properties shared in some way by all languages.
2. **language variation**: the range and type of variation possible between languages.

By the definitions of language–universal and language–specific properties given above, one might imagine that there is a continuum between the two. The term **markedness** is used to refer to this continuum, with completely unmarked properties being those found in virtually all languages and extremely marked properties being found quite rarely. Language universals must be formulated in a way that is able to characterize this distribution.

The central hypothesis driving generative linguistic research today, due to Noam Chomsky (Chomsky 1965, 1975, 1986; see also Pinker 1994), is that these universals are part of the genetic inheritance of every normal human being. Thus, not only do human beings have an innate ability to learn language, but this innate ability is limited, so that not all strings of sounds can be learned as a language, just as not all strings of words can be put together as a sentence of a language. Universal properties of the world's languages result from inflexibility in this innate language capacity; language variation arises from its flexibility. Linguists use the term **universal grammar** to refer to the innate language knowledge that humans have, including both the flexibility and the inflexibility. In our discussion of Optimality Theory, we will see how the model encompasses both universal and language–specific properties, and how markedness is expressed.

Universal Grammar...

is the innate knowledge of language that is shared by normal humans — it characterizes both the universal properties of language and the variation tolerated among specific languages

In studying a language, the linguist finds evidence to show that there is a pattern to study, then figures out what the nature of the pattern is, and, finally, determines a formal characterization of the pattern. In each of these efforts, linguists maintain a fairly broad approach. When finding a pattern, the concern is not simply "does this pattern exist?" but also "how does this pattern interact with other patterns in the language?" and "how does this pattern compare to similar patterns in other languages?"

For example, in English there are adjectives like *active*, *tangible*, and *possible*. A negative form of each adjective can be created by adding a prefix, resulting in *inactive*, *intangible*, and *impossible*. The linguist notes that the negative prefix takes the form *im-*; which ends with a labial nasal (m), whenever it precedes an adjective which begins with a labial stop (*p*, *b*), otherwise it takes the form *in–*: *imbalance*, *impolite*, but *inoperative*, *intangible*, *infallible*, *inviolable*. The prefix, then, is analyzed as having an input form, *in–*, which relates to two different output forms, *in–* and *im–*, depending on the context in which the prefix is placed. (See also Chapter 3 for more about this sort of sound change and Chapter 4 on the standard generative phonology relation between a single input and a variety of output forms.) In characterizing patterns, whether phonological, morphological, or syntactic, linguists try to determine the input form, the output form(s), and the nature of the relation between input and output. Optimality Theory offers a specific view of the nature of that relation.

Studies that focus on a single language explore the patterns that exist within that language. Studies that focus on comparable phenomena across languages examine the range of variation possible within natural human language. By understanding the variation that does occur, we are also able to determine those areas where there is no variation. The more common properties or patterns are thought to be universal, part of our innate language endowment. Not all universals are manifested in the same way in all languages however, due to variation. The more robust a universal is in a particular language, the less marked the language is in that respect. A highly marked property is one which has minimal (or no) claims to universality.

Linguists look for...		**to determine...**
a.	**patterns**	their existence and characteristics
b.	**variation**	differences among the patterns of different languages
c.	**universals**	the properties that are part of our innate language endowment
d.	**markedness**	the robustness of a given property within a language

These methods and goals can be more concretely understood by working through particular language data. For example, consider the phonological universal that words start with a consonant–vowel ("CV") sequence. (Ultimately, we refine this notion in terms of syllables and onsets; for the moment "words start with a CV sequences" is adequate.) In English *sing*, *like*, *wish* all start with a "CV" sequence. Languages share this property to different degrees. For instance, in Yawelmani (a language we examine in some detail below) *every* word starts with such a sequence. By contrast, the English pattern shows variation in two ways: on one hand, it allows words to start with more than one consonant, e.g. *stripe*, *gleam*, *smooth*, while on the other hand, some words start with a vowel (and no consonant): *apple*, *important*, *up*. In this regard, the syllables of Yawelmani are less marked than are those of English.

Within linguistics there are four major subdisciplines: phonology, morphology, syntax, and semantics, defined in (1.1). The first three are topics of chapters in this book. There are other subdisciplines as well, including psycholinguistics, sociolinguistics, and

phonetics. However, the four areas mentioned here are the core disciplines within formal linguistics.

Each chapter discusses the application of Optimality Theory in a specific subdiscipline in linguistics; in each, we explore the way in which OT characterizes the universals, variation, and markedness in that subdiscipline. OT began its life as a theory of phonology; this introductory chapter follows suit to a large extent. However, the points made extend to other subdisciplines, as is demonstrated in Chapter 4 for morphology and Chapters 5 and 6 for syntax. In this chapter, sound patterns are used simply as a vehicle for better understanding how the model works.

(1.1) The four major subdisciplines in linguistics

a.	**phonology**	The study of how sounds combine to make morphemes and words, e.g. *in–active*, but *im–polite*, not *in–polite*
b.	**morphology**	The study of how morphemes combine to make words, e.g. *act–ing, in–act–ive*, but not *in–act–ing* 'not acting'
c.	**syntax**	The study of how words combine to make sentences, e.g. *I saw the dog* is good English, *I saw dog the* is not.
d.	**semantics**	The study of how meanings of subparts combine to make meaning of the whole.

2 An Extended Example: Syllable Structure

To make our discussion of patterns, variation, universals, and markedness concrete, some properties of the cross–linguistic distribution of consonants and vowels of words are illustrated in (1.2), with examples from Hawaiian, English, Berber, and Yawelmani.

A simple pattern of consonants and vowels is found in Hawaiian (1.2a). Hawaiian allows no more than one consonant in a row so we find words like *kanaka* 'man' with three singleton consonants: *kanaka*. However, Hawaiian has no sequences of consonants. In fact, when borrowing words from another language, any consonant sequences are altered to fit the Hawaiian pattern: English *flour* becomes *palaoa*; English *velvet* becomes *welewека*, etc.

English illustrates the opposite extreme, for it allows long strings of consonants in the middle and at the edges of words, as in *construct* and *sprig*, illustrated in (1.2b). An even more extreme case is illustrated by Berber, a language spoken in Morocco, which does not require vowels at all in its words, *txdmt* 'gather wood' along side *ildi* 'pull'.

Finally, a middle ground is struck in Yawelmani, a Native American language that was once spoken in California (Newman 1944). This language allows at most two consonants in a sequence within a word, as in *xa[th]in,* where the sequence *th* represents two consonants, *t* and *h*. Additionally, Yawelmani tolerates at most one consonant at the beginning and one at the end of a word: *xathin* starts with a single *x* and ends with a single *n*.[1]

[1]Since phonology studies the sounds of words, it is important not to get confused by the orthographic conventions of a particular language. For example, the symbol [θ] is used to represent the sound spelled *th* in an English word like *sixth* or *ether*. The symbol sequence [th] as in *xathin*

(1.2) Example: cross–linguistic distribution of consonants and vowels in words

a.	Hawaiian	allows no more than one consonant in a row	*wa**h**ine* 'woman' *a**l**a**p**ine* 'often'
b.	English	allows long strings of consonants...	construct; sprig sɪ*ks*θ*s* (si*xths*)
		but doesn't require them.	*mave**n***
c.	Berber	allows words to consist solely of consonants...	*trglt* 'lock' *txdmt* 'gather wood'
		but also allows vowels in words.	*ildi* 'pull'
d.	Yawelmani	allows up to two consonants in the middle of words...	xa*th*in 'ate'
		but allows at most one consonant at word edges.	*x*athi*n* 'ate'

The four languages illustrated here demonstrate that there is a wide range of ways in which consonants and vowels distribute themselves within words in the world's languages. Significantly, there are also many patterns of consonants and vowels that you can think of that simply do not occur in natural languages. One such imaginable but non–occurring language would stack up all the consonants at the beginning of the word and all the vowels at the end of the word (1.3a). Words like *mrnaia* would exist, but no words like *marina*. A more "language–like" example would be comparable to English except that it *requires* all words to start with two or more consonants (1.3b). Words like *sprig* would be well–formed in this language, but not a word like *construct*, for *construct* begins with a single consonant.

(1.3) Some imaginable but non–occurring languages

a.	All consonants are in a sequence at the left edge of the word, followed by all vowels.	OK: not OK:	*spree, blue, mrnaia* *sprig, lube, marina*
b.	Every word begins with a string of consonants, otherwise like English.	OK: not OK:	*string, sprig, blue* *ring, pig, every*

There are no languages like those sketched in (1.3) and yet *it is not hard to describe such patterns*. In fact, many of the nonexistent patterns are *easier* to describe than some of the patterns found in natural languages, such as those in (1.2).

Through this extended discussion of consonant and vowel distribution, we have arrived at the central issues facing students of language. Although our example has been in terms of the sound systems of languages, the questions themselves are general and extend to all domains of language study.

(1.2d) is two sounds, as in *hot headed*; not one, as in *ether*. Finally, the sound symbolized by [x] in (1.2c, d) is a voiceless velar fricative, the final sound in the German pronunciation of a name like *Bach*. Following conventions of the field, square brackets are used to enclose symbols which represent sounds directly, such as [θ], [th], and [x] above.