

# The Drawbacks of Optimality Theoretic Phonology: Objections and Refutations

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**Abstract:** Optimality theory was introduced in the early 1990s as an alternative model of the organization of natural human language sound systems. It suggests that the observed forms of language arise from the optimal satisfaction of conflicting constraints. Optimality theory differs from other approaches to phonology, like autosegmental phonology and linear phonology (The Sound Pattern of English), which are typically rule-based approaches rather than constraints (such as faithfulness and markedness operating between underlying forms, inputs, and surface representations, outputs). This study briefly reviews the rise of Optimality theory and its main tenets, teasing out a detailed study of the various critiques that have been addressed to the Optimality theory and its theoretical and applicable domains. It presents a critical appraisal of the role of Optimality theory in phonology to show its main shortcomings and defects. In addition to other criticisms directed to the theory that are triggered by different scholars, the study suggests some other weak points that may be added to those pointed out by such previous critiques. On the basis of what is revealed by the criticism, it is concluded that Optimality theory suffers from different shortcomings and problems. Six problems are identified: the ambiguity of generating process, not paying attention to the lexicon, the uselessness of creativity of mind, wrong ranking, diversity of the same sound in different languages, and focus on parallelism rather than serialism.

**Keywords:** Optimality Theory, Constraints, Generator, Evaluator, Ranking, Markedness, Faithfulness

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## 1. Introduction

Optimality Theory (henceforth OT), as suggested by McCarthy and Prince [22] and Prince and Smolensky [24], is a theory of constraint interaction. The central idea of OT is that surface forms of language reflect resolutions of conflicts between competing constraints. Such constraints, which are universal, interact according to their language-specific hierarchical priorities in which the higher-ranked constraint has priority regardless of the violations of the lower-ranked one. Given a hypothetically endless set of candidates, the constraint hierarchy determines the optimal candidate, which is the output.

OT is described as "The Linguistic Theory of the 1990s" [1], because it has clearly had many contributions to the fields of phonology and morphology, and later to syntax and pragmatics. This renders it to be widely

influential in the field of linguistics. For this reason, it has drawn the interest of many scholars. However, OT, like any other theory, has received essential amount of criticisms by many scholars for various deficiencies it suffers from. Nevertheless, those criticisms seem to have not covered many other gaps in the theory. Thus, this study sets itself the task of providing a complementary critique to the ones already existing. More specifically, it aims to show the shortcomings and defects of the architecture of the theory, focusing on its application to phonology. To achieve this aim, the current study gives an exhaustive overview of the OT architecture and its main tenets; and presents the main criticisms of the theory that are raised by different scholars. Then, it identifies some other weak points that may be added to those pointed out by those criticisms.

## 2. Architecture of Optimality Theory

In the early 1991, Alan Prince and Paul Smolensky developed a new linguistic model called 'Optimality Theory' which became known through their widely circulated manuscript '*Optimality Theory: Constraint Interaction in Generative Grammar*' [24]. Since 1993, the impact of this approach on the field of phonology has extended to include other studies within syntax, semantics, sociolinguistics, historical linguistics, and other areas [19]. OT is considered as a development of a trend in generative linguistics, which shares many assumptions of generative approach. In harmony with rule-based generative ancestors, OT states that lexicon, generator and constraints are said to be universal, given by Universal Grammar [18].

However, OT's viewpoint of Universal Grammar (UG) is fundamentally different from that of the classical rule based on generative theory, where UG is defined as a set of inviolable principles and parameters. OT defines UG as a set of universal constraints. Thus, OT radically differs from other traditional approaches, such as autosegmental phonology and linear phonology (sound pattern of English), because it replaces the notion of rule by 'constraint' [12]. Moreover, these constraints can be violable. Stemberger [25] distinguishes between two types of constraints: hard and soft constraints. The former cannot be violated in any language, whereas the latter may be violated in some languages. Soft constraints can also be differentiated depending on different levels of violability within a particular language:

High level: cannot be violated

Intermediate level: can be violated, but only in particular circumstances

Low level: can be freely violated in all circumstances [25]

Therefore, these constraints are hierarchically ranked, giving priorities to some constraints over others. "Such rankings are based on 'strict' domination: if one constraint outranks another, the higher-ranked constraint has priority, regardless of violations of the lower-ranked one" [15]. That is, the higher ranked constraints have total dominance over lower ranked constraints. Within the hierarchy, dominance relations are transitive in the sense that there is a Transitivity of Ranking [15], as in:

If Constraint 1 dominates Constraint 2 and Constraint 2 dominates Constraint 3, then Constraint 1 dominates Constraint 3.

Therefore, the main assumption of OT is that constraints are also said to be capable of clashing with each other, i.e., they are always in conflict [2]. In particular, there is a fundamental conflict between Markedness constraints and Faithfulness constraints.

In agreement with the classical rule based generative theory, OT distinguishes between inputs (underlying representations), and outputs (surface realizations), providing mappings from inputs to outputs. Unlike generative theory which focuses on the underlying representations, OT concentrates on outputs. That is, OT is surface-based in the sense that constraints are located in surface forms only, no

structural conditions are placed on underlying or lexical forms. According to OT, the input is much richer than the output, because there are no language-specific constraints on the input. Every grammar is able to deal with every input, i.e., "all inputs are possible in all languages" [24]. This is called 'richness of the base' which is sometimes referred to as 'Freedom of the Input' [11]. Within input, lexicon includes lexical representations of all contrastive properties of morphemes (roots, stems, and affixes) of a language, including phonological, morphological, syntactic, and semantic properties.

To achieve candidate processes, OT includes two main components: the Generator (GEN) and Evaluator (EVAL). These components constitute the whole architecture of OT. GEN produces a potentially infinite number of possible outputs, or candidates from the lexicon. It is maximally permissive which means that any output candidate is permitted for any input candidate within the limits of structural well-formedness [2]. The fundamental feature of the GEN is that it is free to generate any candidate for some input. This feature is called 'Freedom of Analysis' [15]. GEN in OT is equivalent to the transformational component in generative phonology in the sense that it generates a list of possible outputs for a given input. This is because both of them function as mediators between the underlying and the surface level [21]. However, GEN differs from transformation in which GEN cannot alter the morphological affiliation of segments [9]. This means that GEN needs no rewrite rules to map inputs onto outputs. All structural changes are applied in one-step, in parallel.

After selecting a number of candidates, GEN will pass them to the Evaluator (EVAL). Then, EVAL receives the candidate set from GEN to determine the winner or optimal candidate and the actual output by applying a language-particular constraint hierarchy to the set of candidates [15]. Although any candidate output can be posited by the GEN, the crucial role of EVAL is to assess the harmony of outputs with respect to a given ranking of constraints. The EVAL is the place of a set of universal constraints which are divided into two types: First, Faithfulness constraints assumes that the surface form (the output) has to correspond to the underlying phonemic representation (input) in the lexicon in some particular way. Second, Markedness constraints (also well-formedness or structural constraints), on the other hand, include the phonologically marked output and the variety of ways that language users can make their languages easier to pronounce [2]. Markedness constraints play a crucial role in determining the optimal candidates for various types of analyses. OT has at its disposal a wide selection of constraints and it is impossible to list all of them at a time. McCarthy and Prince [23] list some faithfulness and markedness constraints:

MAX: Maximize all input segments in the output: One violation for each segment in the input that does not appear in the output. This constraint prevents deletion. For instance, the output /kae/ for 'cat' would be in violation of the constraint MAX because /t/ of the input representation is not

parsed into the output representation.

**DEP:** Output segments are dependent on having an input correspondent: One violation for each segment in the output that does not appear in the input. This constraint prevents insertion. For instance, the output /kaetə/ would be in violation of the constraint DEP because /t/ of the output is not part of the input representation.

**IDENT:** Faithfulness constraint; the place, voice, and manner features of segments of the input must surface in the corresponding segments in the output. (Identically)

**COMPLEX:** Avoid consonant clusters. For instance, the candidate "play" violates COMPLEX constraint because it

includes the consonant cluster [pl-]. This means that [plei] is a marked output form in comparison to, for example, [pei], which contains a single consonant and therefore does not violate COMPLEX.

**Agree:** Agree in specification of [voi]: One violation for every pair of adjacent obstruents in the output which disagree in voicing.

**SS\*:** Sibilant-Sibilant clusters are ungrammatical: One violation for every pair of adjacent sibilants in the output.

The relationship among the input, GEN, and EVAL can be diagrammed as follows:

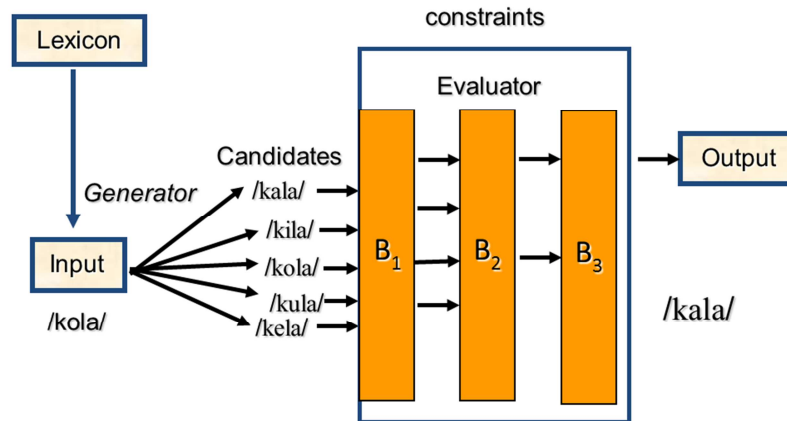


Figure 1. The Architecture of Optimality Theory.

Finally, OT also eliminates derivations, replacing these by parallelism. This shows an essential difference from earlier, rule-based generative theories where rules necessarily apply one after the other. The organization is not serial but parallel. For rules, that could be the end. Rules can only be serial, applying one after the other. In contrast, Constraints can perfectly well apply simultaneously, i.e. in parallel. For OT "all constraints pertaining to some type of structure interact in a single hierarchy" [15]. OT "eliminates the concept of serialism<sup>1</sup>. Instead, it assumes that the evaluation of all constraints (semantic, syntactic, morphological, phonological, etc.) happens in parallel" [26]. Baker supports parallelism for two reasons: the first is that maintaining parallel evaluation "produces interesting predictions and clear limitations on what human language can do"; the second reason is that OT is to be understood as having a high level at describing the actual grammar [4].

As mentioned earlier, OT has been widely influential in the field of linguistics, especially phonology and syntax, since its foundation. Thus, OT is of interest to many scholars so far. But this does not mean that it is perfect without shortcomings. OT, like any other theory in linguistics, has attracted substantial amounts of criticisms by many linguists for various deficiencies. It "has incurred a not insubstantial amount of criticism bearing on several of its fundamental

tenets as well as its practical implementation. This concerns the number and nature of its constraints, its psychological plausibility, its determinism, and the implications of the hierarchy of strict dominance" [26]. Therefore, the following section will introduce some criticisms that are raised against the OT, focusing on those related to phonology.

### 3. A Critique of Optimality Theory

As mentioned right from the beginning, this study concerns itself with a critical appraisal of OT in phonology. It is intended to make no claim about the contributions of OT to syntax. The study sheds light on the main criticisms that are triggered by different scholars, and also attempts to suggest some other weak points that have not been picked up by such other criticisms. In fact, many scholars have come up with different lists of problems. The most prominent critique directed to OT is by Chomsky's "The Minimalist Program". Chomsky has formulated his criticism saying: "In Prince and Smolensky 1993, there seems to be no barrier to the conclusion that all lexical inputs yield a single phonetic output, namely, whatever the optimal syllable might be (perhaps /ba/)" [8]. This is sometimes called as the 'ba argument' to OT.

Burzio also refers to this objection stating that the assumption that "the resulting word "ba" would be 80.000 ways ambiguous" is not very useful. He continues "representational optimization is not what is going on, but only that it cannot be the sole component of the system.

<sup>1</sup> Serialism recognizes intermediate outputs that may be distinct from the ultimate output. It shares this feature with serial rule-based phonology in the tradition of Chomsky and Halle (1968) as well as with derivationally-based syntactic theories like Government and Binding [7] or Minimalism [8].

There must be some other component as well, to insure diversity. That is obviously the lexicon, and then optimization must not be allowed to wipe out too many lexical distinctions, exactly as imposed by Prince and Smolensky's 'Containment' and 'Faithfulness' [5].

Chomsky further criticizes faithfulness constraints in which identity between input and output is virtually never satisfied, and this is also at the core of Chomsky's criticism of OT, as he [8] says:

[McCarthy & Prince (1994)] recognize the need to add input \_ output relations of some kind ("faithfulness"). Traditional approaches, dating back to Panini and revived in generative phonology from the late 1940s, spell out "faithfulness" in terms of the notion "possible phonological rule" (embodying assumptions about natural processes) and economy considerations on the system of rules (evaluation metrics, markedness considerations, etc.) McCarthy & Prince (1994) propose that "faithfulness" be restricted to input-output conditions, but what they suggest seems to have no relevance to the standard problem (e.g., "identity between input and output", a principle that is virtually never satisfied). The basic problem, long familiar, is the one mentioned earlier: crucial properties appear to hold not of input-output pairs but of intermediate stages, so that no input-output condition is formulable.

The main problem mentioned in this quote is that of 'Opacity' (see also [13]). It is claimed that OT cannot account for phonological opacity which means that we need intermediate stages between input and output. This is a problem specific to so-called parallel OT which has no intermediate levels for rules to operate on (see also criticism 6). For example, in Quebec French, the counter-bleeding rule that has effect is not visible at the surface level where high front vowels triggered affrication of /t/, as in /tipik/ → [t p k]. However, the loss of high vowels which is visible at the surface level leaves the affrication with no apparent source. Derivational phonology highlights for this through using the term of 'vowel syncope' which means the loss of the vowel "counterbled" affrication. That is, instead of vowel syncope occurring and preventing affrication, then it is obvious that affrication applies before vowel syncope, so that the high vowel is removed and the environment destroyed which had triggered affrication.

Therefore, such counterbleeding rule orderings are known 'opaque' features in phonology of OT (as opposed to transparent), because their effects are not visible at the surface level, and this opacity does not offer a very straightforward explanation in OT since intermediate levels are not accessible [3]. Different suggestions have been raised to account for this problem, but most of them tend to be highly controversial because they significantly change the basic architecture of OT, and such changes effect the universality of constraints by adding new types of constraints, or change the properties of GEN or EVAL. Such attempts have been done by John J. McCarthy's [16] sympathy theory and candidate chains theory [20], and many others.

Another point of criticism concerns the fact that the

number of universal constraints has to be controlled. Smith [27] states that the main problem in OT is formed by:

those constraints which are proposed as universal, but have no conceivable relationship with any kind of well-formedness principle — the modern equivalent of the crazy rule. As the functional basis for some probably genuine constraints is not entirely obvious, we cannot necessarily be sure of our ability to recognize such illegitimate constraints. The one case where this seems easy to do, however, is illustrated by the occasional proposals for pairs of constraints which are each other's exact opposites. Only one of the two constraints in such a situation can be functional, and therefore legitimate. The other "constraint" must be dysfunctional, and hence cannot be universal, and is therefore illegitimate.

OT has a challenge in determining what the phonological constraints are. Stemberger [25] refers to this problem stating "If a researcher is free to create new constraints at will, whenever the old constraints do not work, the theory is untestable and uninteresting". He believes that we have to deal with as few constraints as possible, and all constraints should be 'grounded': there should be an identifiable reason why any particular constraint should exist.

One of the common criticisms is that OT lacks psychological in most of its forms [14]. It claims that "standard considerations of theory construction dictate that the set of grammatical inputs be assumed universal, avoiding the need for further machinery to limit inputs. This is known as the principle of *Richness of the Base*" [24]. According to OT, GEN creates an infinite set of possible phonological candidates. Then, EVAL filters these infinite set of candidates to determine which candidate is optimal with respect to a finite set of phonological constraints [10].

The question is why should OT include an infinite set of candidates, if not for the sake of economy, simplicity and of mathematical beauty? It has argued that there is an absence of the firm criteria of mind. The notions of economy, simplicity and elegance, with the agreement of all linguists and psychologists, are the key criteria of mind. However, if all inputs are possible in all languages, as suggested by OT, this will rescind these criteria of mind. The powerful GEN also creates computational problems because the number of the selected candidates may also be infinite, i.e., the ability of GEN to collect material from the input is infinite. From the standpoint of psychological reality, it is clear that an individual cannot generate an infinite number of potential candidates because this would take an infinitely long time to process. In addition, the process of ranking the whole candidate set requires more computational power than finding the optimal element alone. Thus, it is impossible to find the optimal candidate in such an infinite search space, often not a trivial task in itself.

However, such points are not the only problems of OT. The current study suggests other shortcomings that can be valid in the same respect. These problems are summarized into the following points:

### 3.1. The Ambiguity of Generating Process

One other criticism that can be raised against OT might be the one which assumes that the relationship between the input and GEN is ambiguous. In standard optimality theory, GEN mediates between the input and the output. It permissibly produces a potentially an infinite number of candidates from the input, passing them to the EVAL (output) [24]. GEN is universal which means that the candidates emitted by GEN for a given input are the same in all languages. These candidates are also very diverse. This feature of GEN is called inclusivity or freedom of analysis. Accurately, because GEN is universal, "it must at a minimum supply candidates vary enough to fit all of the ways in which languages can differ" [17]. In addition, "GEN is also input dependent. The candidates emitted by GEN bear a determinate relation to some sort of input form, which might be a phonological underlying representation, a syntactic D-structure, or a morphosyntactic feature specification. The candidates record, by some means, how they differ from the input" [17].

The question is that on which basis these candidates are motivated or emitted? OT focuses on how GEN generates infinite candidates without giving attention to how they are collected. Therefore, there have to be rules or constraints, in terms of OT, governing such generating process. A function that relates the input to a set of candidate representations or the set potential outputs is opaque. Putting differently, the line between the GEN and candidate set is not clear (see Figure 1).

### 3.2. The Lexicon Is Not Under Its Attention

Another point of criticism that has not yet been mentioned concerns the fact that OT does not concern itself with the study of lexicon itself. According to OT, the lexicon includes all morphemic properties (roots, stems, and affixes) of a language, involving phonological, morphological, syntactic, and semantic properties. It "provides the input specifications which are to be submitted to the GEN. In this connection, perhaps the most striking property of the Lexicon, as conceived of in OT, is that no specific property can be stated at the level of underlying representations" [15]. Thus, the lexicon does not play any role in OT. It is just a lexical storage that contains all linguistic properties, phonological, morphological, syntactic, and semantic properties.

The question is how these properties are represented in the underlying form (lexicon)? This is one of the shortcomings of OT in which optimalization starts from GEN that produces unlimited set of candidates without giving any attention to the lexicon and its morphemic processes. For this reason, the lexical phonology (Approach in phonology developed by P. Kiparsky and others that divides the lexicon into levels, also known as strata, of word formation, with different phonological rules and/or constraints holding at those different levels) is suggested to study this insufficiency of OT in lexicon.

### 3.3. The Uselessness of Creativity of Mind

OT claims that lexicon contains morphemes or words and their linguistic properties, such as their morphological and syntactic categories, their phonological content, and their semantic content [9]. These properties are universal, that is, they are possible in all languages. But, here, lexicon is still restricted by specific processes regardless of the flexibility and creativity of the human mind. Chomsky, in his '*Aspects of the Theory of Syntax*', defines language in terms of creativity as the 'infinite' competence of ordinary language users to produce and understand language forms which they could not possibly have heard before [6]. Chomsky sees creativity as a fundamental species-specific capacity for generating an infinite number of rule-governed language choices which are new to both speaker and listener.

Thus, creativity is one of the main characteristic features of human language. This is the domain of lexical creativity which is not only restricted to create sentences and expressions, but the creative capacity will always involve the phonological and morphological levels of the language. This forms a problem to the notion of lexicon in OT, because GEN depends only on what is already found in the lexicon without allowing addition new phonological and morphological features to it. A major question also arises over the fact that most of the markedness constraints posited by optimality-theoretic phonologists have proved to be grounded in the lexicon. If the lexicon is only limited to all inherent phonological and morphological representations of all language, so how these new linguistic changes take place, since every language is unremittingly change?

### 3.4. Wrong Ranking

A further important problem with OT resides in the fact that ranking can miss the mark unintentionally or intentionally especially by first or second language learners. For OT, constraints are universal, but they can be violated, giving priorities to some constraints over others. Such violations must be minimal, depending on hierarchical ranking which is language specific. The ranking is based on 'strict' domination which means that the higher ranked constraints have total dominance over lower ranked constraints [15]. However, what happens if constraints are ranked erroneously? For example, the plural form in English can be regular, which is common as in cat \_\_\_ cats, or irregular like man \_\_\_ men. Children or second language learners may sometimes overgeneralize the apparent rule of adding -s to form plurals and will talk about mans. In this case, they have broken or violated the key notion of OT, which is ranking.

This violation of ranking can also be happened in sound change or in varieties within the same language, especially in diglossic societies. Phonological features can also be affected by extra factors such as style, register and addressee as well as gender, and age by which a speaker may differ from other members of the same language community. That is, a speaker

may use a specific constrain ranking which may be different from that is used by other members of the same language community. All of these variants may have different constraint rankings within an individual speaker or within a single language community. This leads us to another criticism which is the diversity of the features of the same sound in different languages.

### 3.5. Diversity of the Same Sound in Different Languages

Another criticism that may persuasively be acceptable is the sounds of all languages are not same. The /s/ sound in Arabic, for instance, is different from that in English or in any other language. This diversity is articulatory, acoustically and auditorily inherent in the sound itself. That is, the strength of the /s/ sound which is considered as voiceless may have different intensities in different languages. The air stream of the production of /s/ in Arabic is less intensity than that of English. The essential questions may also raise over the fact that are such sounds stored differently in the lexicon or as one entry forming a network of shared sounds? Or does this diversity takes place in the ranking of constrains? Such phenomena find no straightforward explanation in OT.

### 3.6. Parallelism Rather than Serialism

A potential criticism against OT might also be parallel in orientation without intermediate stages. Above and beyond all the problems enumerated in this critique, the key problem with OT is in its claims of Parallelism. OT assumes that "all constraints pertaining to some type of structure are evaluated within a single hierarchy" [15]. That is, all structural changes are applied in one step, in parallel. In other words, parallelism of derivation is a central part of OT, which means that sets of candidates are generated and evaluated simultaneously against the constraint ranking. However, the process of generating unlimited number of candidates and evaluating them to win the optimal one cannot simply happen simultaneously. The theory itself is recognized to be arranged in stages starting from GEN and arriving at EVAL. The number of universal constraints is also not limited and has to be controlled. Therefore, processing these constraints in one step is not recognized to be an easy task.

## 4. Conclusion

Although OT has extensively influential in the field of linguistics, especially phonology and grammar, since its inception, but it suffers from different shortcomings and problems. The numerous inadequacies of OT emerge mainly as a reaction to its central tenets. The study has arrived at conclusion that the main criticisms of OT that are triggered by different scholars are not the only criticisms. However, it is suggested that there are other shortcomings that may be acceptable. Six problems are identified, they are the ambiguousness of generating process, the lexicon is not under its attention, the uselessness of creativity of mind,

wrong ranking, diversity of the same sound in different languages, and parallelism rather than serialism.

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