

# Historical Sound Change in Optimality Theory\*

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Oh, Young-Il. 2002. *Historical Sound Change in Optimality Theory*. *SNU Working Papers in English Language and Linguistics* 1, 127-141. This paper deals with how to represent historical sound change within the framework of Optimality Theory. It is generally accepted in Optimality Theory that language change is characterized by employing constraint reranking. In this paper, however, I argue that historical sound change must be decomposed into a series of unranking, reranking, and ranking process in order to accommodate the gradual aspect of historical sound change. Based on the new interpretation of the dotted line, I also argue that constraint reranking should be applied not across the solid line but across the dotted line in the domain of sound change. (Seoul National University)

**Keywords:** historical sound change, Optimality Theory, constraint reranking, dotted line

## 1. Introduction

All living languages change gradually with time. Diachronic changes can be witnessed in all components of grammar including phonology. As such, sound changes are inevitable and a more restrictive account of them has to be included in any phonological theory. In a rule-based theory, sound change is accounted for by means of rule addition, rule insertion, rule loss, and rule reordering (Halle 1962, Kiparsky 1968, King 1969). On the other hand, in Optimality Theory (OT, McCarthy and Prince 1993, Prince and Smolensky 1993), another method has to be sought in explaining sound change because OT, a constraint-based theory, does not employ the process of rule operation.

OT claims that "individual grammars are constructed by imposing a ranking on the Universal constraint set ... Interlinguistic variation is to be explained primarily as the result of differences in the ranking of

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constraints (McCarthy and Prince 1993: 5)." Just as cross-linguistic variation is accounted for by means of the reranking of constraints, we have good reason that diachronic sound changes are also due to different constraint rankings. Thus, constraint reranking is invoked in OT to account for sound change (Jacobs 1995, Bermúdez-Otero 1996, Cho 1998, Green 2001).

Even in the optimality-theoretic approaches, however, historical sound change was categorially, not gradiently, represented by appealing only to constraint reranking. In this paper, I propose that historical sound change can be naturally represented as a series of unranking, reranking, and ranking strategy within the optimality-theoretic framework. For this, I divide the whole procedure of historical development in four stages to represent the gradient nature of historical sound change. And I reinterpret the constraint reranking system and the implication of dotted line in OT. The data examined here are consonant cluster simplification (CC simplification) from Middle English (ME) to Modern English (ModE) and I focus on the word initial change from [kn] to [n].

This paper is organized as follows. Section 2 critically reviews two previous studies on sound change in OT: Cho (1998) and Green (2001). In section 3.1, a brief mention is made on the cause of sound change and the scenario of sound change. In section 3.2, based on the word initial [kn] to [n] simplification, I propose a new optimality-theoretic analysis of sound change. By means of a series of unranking, reranking, and ranking strategy, the gradual characterization of historical sound change is naturally represented within our approach. I also reinterpret the implication of the dotted line in order to show the shift of frequency in the diachronic variation. Section 3.3 deals with advantages of our analysis over the previous approaches. Section 4 concludes this paper with some remarks.

## 2. Previous studies on sound change in OT

### 2.1 $n \sim \emptyset$ alternation in Korean

As an optimality-theoretic account, Cho (1998) proposes an analysis of language change as reranking of constraints. Assuming that the reranking between Constraint 1 (Const1) and Constraint 2 (Const2) has to be mediated by two stages of undoing the ranking and creating the new ranking, she characterizes the permissible and impermissible constraint reranking respectively as in (1).

## (1) Reranking of Constraints

- a. Permissible: Const1  $\succ$   $\rightarrow$   $\rightarrow$   $\succ$  onst1  
 b. Impermissible: Const1  $\succ$   $\rightarrow$   $\succ$  onst1 in one step.

For a typical example, she takes the  $n \sim \emptyset$  alternation in Korean historical phonology. The brief description of the  $n \sim \emptyset$  alternation in Korean is as follows: in the 18th century the nasal  $n$  started to delete in word-initial position before the high front vowel /i/ and as a result, /ni/ has been completely neutralized to /i/ in the initial position in Modern Standard Korean (Cho 1998: 53-54). To be concrete, she explains the replacement of earlier /nip/ 'leaf' with the new form /ip/ by employing constraint reranking between Faithfulness and \*[ni constraint. The relevant constraints are defined as follows:

## (2) Faithfulness

The output is faithful to the input.

## (3) \*[ni

/ni/ is ill-formed in the initial position of a phonological word.

Before the 17th century, Faithfulness dominated \*[ni and only /nip/ form was used. After unranking stage in the 18th century when both /nip/ and /ip/ forms occurred side by side, \*[ni was finally ranked above Faithfulness in the 19th century and only /ip/ form was used in Modern Standard Korean. The historical development is presented in (4).

 (4)  $n \sim \emptyset$  alternation in Korean

## a. before the 17th century

/nip/ 'leaf'	Faithfulness	*[ni
☐ nip		*
☐ ip	* !	

## b. the 18th century

/nip/ 'leaf'	Faithfulness	*[ni
☐ nip		*
☐ ip	*	

## c. after the 19th century

/nip/ 'leaf'	*[ni	Faithfulness
☐ nip	* !	
☐ ip		*

Cho postulates an *unranking* stage (4b), which accommodates variation. She adopts a Free-variationist model sketched in (5).

(5) Free-Variationist Model of Sound Change (Bermúdez-Otero 1996: 5)

Stage 1 (no variation)

$C_1 \gg C_2$

↓

Stage 2 (free variation)

$C_1 \quad C_2$

↓

Stage 3 (no variation)

$C_2 \gg C_1$

According to the Free-Variationist model (5), it is implied that, at the intermediate stage, both variants (/nip/ and /ip/) are equally harmonic and thus simultaneously available to each speaker of the language at all time (Green 2001: 11). As Green points out, however, this is intuitively unlikely from the sociolinguistic viewpoint, because the variants are unlikely to surface simultaneously at the same frequency. Besides, though it may be right to introduce an unranking stage for modelling variation, I think the unranking process needs to be subdivided in order to capture the gradual nature of historical sound change.

## 2.2 Simplification of [kn] to [n] in English

Green(2001) also argues that constraint reranking is responsible for a large amount of diachronic variation. Besides, in response to the question "How do constraint rankings change?", he proposes 'the Promotion of the Unmarked' as an extension of the theory of the Emergence of the Unmarked (McCarthy & Prince 1994). The promotion of the unmarked means that a constraint against a marked pattern is promoted upwards in the constraint hierarchy, showing that sound change is the result of the promotion of a constraint against a marked phonological pattern. In other words, phonological change results when unmarked pattern comes to predominate in the phonology (Green 2001: 3).

As a piece of evidence for the Promotion of the Unmarked, he offers the simplification of the initial *kn-* clusters to *n-* occurring between ME and ModE. In ME, the *kn-* cluster was permitted as an onset while in ModE it was not: *kn-* was simplified into *n-*. Put in OT terms, in ME,

the Faithfulness constraints outranked  $*_0[\text{kn}]$ .<sup>1</sup> But at some point, speakers promoted the phonological constraint  $*_0[\text{kn}]$ , recognizing that *kn-* was an unacceptable onset cluster. Once  $*_0[\text{kn}]$  was promoted, one of the faithfulness constraints, MAX, was demoted in order for a candidate to be judged optimal (Green 2001: 8). The tableau representing this historical development is given in (6).

(6) a. Middle English

/knou/	DEP	MAX	IDENT(nasal)	I-CONTIG	$*_0[\text{kn}]$
kə ɔu	* !				
nou		* !			
krou			* !		
kou		* !		*	
☞ ɛnou					*

b. Modern English

/knou/	DEP	IDENT(nasal)	I-CONTIG	$*_0[\text{kn}]$	MAX
kə ɔu	* !				
☞ ɛnou					*
krou		* !			
kou			* !		*
knou				* !	

Concerning the intermediate stage which shows variation, Green postulates *free ranking* of adjacent constraints instead of *unranking* for the sociolinguistic reason. From the sociolinguistic viewpoint, he argues, it is far more plausible that there were geographic, stylistic, and/or generational implications to each form [knou] and [nou]. That is, it is unlikely that the variants surface simultaneously at the same frequency. So he presents Free Ranking model of sound change as in (7).<sup>2</sup>

<sup>1</sup> The constraint  $*_0[\text{kn}]$  prohibits the sequence in syllable-initial position (Green 2001: 8).

<sup>2</sup> free ranking: when two constraint  $C_1$  and  $C_2$  are freely ranked, two tableaux are constructed for each input, in one of which  $C_1 \succ C_2$  and in the other of which  $C_2 \succ C_1$ . The winning candidates in each tableau are retained as alternative output forms. (Clements 1997: 315)

- (7) Free Ranking and Reranking of MAX and \*<sub>o</sub>[kn] (Green 2001: 11)
- a. Middle English : MAX  $\gg$  \*<sub>o</sub>[kn]
  - b. Intermediate stage
    - Grammar A: MAX  $\gg$  \*<sub>o</sub>[kn]
    - Grammar B: \*<sub>o</sub>[kn]  $\gg$  MAX
  - c. Early Modern English: \*<sub>o</sub>[kn]  $\gg$  MAX

Under the free ranking system, however, we are forced to need two separate tableau representing each grammar at the intermediate stage. In case of more than two variants, this free ranking approach can impose a heavy burden on the grammar because it is forced to generate all the relevant grammars depending on external, sociolinguistic factors. Furthermore, in the free ranking model, the possibility cannot be excluded that the shift of frequency in variants is reversed at the intermediate stage.

To sum up, although Cho (1998) and Green (2001) introduce unranking process and free ranking respectively in order to explain variation, they both could not show the gradual nature of historical sound change properly, especially the shift of frequency in variants. Thus I will divide the whole procedure of historical development into four stages to represent the gradient nature of historical sound change, integrating and overcoming both approaches. In section 3, I will propose that historical sound change can be naturally represented as a series of unranking, reranking, and ranking strategy within the optimality-theoretic framework. In addition, I will reinterpret the constraint reranking system and the meaning of a dotted line in OT.

### 3. A new proposal to represent historical sound change in OT

#### 3.1 The cause and scenario of sound change

Before taking up the main subject, I will make a brief discussion on 'the cause of sound change' and 'the scenario of sound change'. Firstly, why does sound change occur? It can be said that language is in a state of constant tension between two driving forces: the easiness of the speaker's articulation and the clarity of the hearer's perception. Language is always affected, controlled, and balanced by these two forces. The conflict between these two forces is also reflected in sound change.

In the case of CC simplification, cluster simplification itself is the

result of facilitating the speaker's articulation because it is much easier to pronounce one segment than two. At the same time, in deciding which segment is deleted, listener's position is taken into account because the segment with the more perceptual salience can be better heard. As such, a tendency toward simplification is counteracted by the need to increase clarity, and much of language change is the result of a balance between the two forces.

In terms of OT, we can find that the markedness constraint \*COMPLEX and the faithfulness constraint MAX-IO play an important role in explaining CC simplification. Furthermore, MAX-IO constraint must be divided into MAX (More-Sal C) and MAX (Less-Sal C) in order to correctly select which segment of the cluster is deleted. The relevant constraints are as in (8).<sup>3</sup>

- (8) a. \*COMPLEX: Syllables have at most one consonant at an edge.
- b. MAX (More-Sal C):  
          The more salient consonant of the input has a correspondent in the output.
- c. MAX (Less-Sal C):  
          The less salient consonant of the input has a correspondent in the output.

As to the scenario of sound change, we have to make two assumptions. First, as Bermúdez-Otero (1996: 4) points out, one of the basic ideas that a theory of language change must encode is that change is *gradual*. Second, language change is unthinkable without structural *variation* (Haspelmath 1999: 8). Based on these assumptions, we can suggest the scenario of language change as in (9).

- (9) Scenario of language change
  - a. In an earlier time, there was only linguistic structure A.
  - b. In an intermediate time, there was structural variation: A and B.
    - i B began to appear and spread at some point, but A was still prevalently used.
    - ii B became more and more frequently used than A.
  - c. In a later time, after all, high-frequency structure B may become obligatory, and low-frequency item A may be lost.

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<sup>3</sup> Oh (in progress) is researching the factors consisting of salience. Transience, sonority, and place factors etc. can be included in determining salience.

This scenario shows the gradual nature of sound change properly. In the next section, with the example *know*, I will propose a new approach of representing historical sound change in OT.

### 3.2 Diachronic Reranking Hypothesis

According to the scenario of sound change (9), we can describe a historical development procedure of *know* as in (10).

- (10) CC simplification from ME to ModE
- a. In ME, *know* was pronounced [knou].
  - b. At intermediate stages between ME and ModE,
    - i [nou] began to appear and spread, but [knou] was still prevalently used.
    - ii [nou] became more and more frequently used than [knou].
  - c. In ModE, [knou] was finally simplified to [nou].

How can we represent this gradual aspect of historical CC simplification in OT tableau? How can we express the shift of frequency in variation with the grammaticality-selecting tableau?

First, I argue that historical sound change must be represented as a series of unranking, reranking, and ranking processes. Besides, contrary to the previous optimality-theoretic approaches, constraint reranking should be applied not across the solid line but across the vertical dotted line in case of sound change. This Diachronic Reranking Hypothesis is suggested in (11).

(11) Diachronic Reranking Hypothesis

Historical sound change must be represented as a series of unranking, reranking, and ranking processes. Furthermore, in the domain of sound change, there is no constraint reranking strategy which directly passes across the solid line.

Second, as a formalism to reflect the shift of frequency in variation in OT, I argue that the dotted line should be newly interpreted into two types and a different meaning be given depending on each type.

In OT, solid lines between constraints indicate crucial rankings while dotted lines indicate that the ranking is not (or not yet) crucial (Archangeli 1997: 12). However, in fact, the dotted line is used in two



cases: crucial and noncrucial nonranking.<sup>4</sup> Whereas noncrucial nonranking indicates the situation in which constraints cannot be ranked with respect to each other due to a lack of interaction, crucial nonranking is concerned with variation in which neither constraint can dominate the other. Thus I propose the dotted line be divided into two types. One is a vertical dotted line which is concerned with variation. The other is a horizontal dotted line indicating the case where constraints cannot be ranked with respect to each other due to a lack of interaction. This division fits in with the original conventions of constraint tableau in OT: left-to-right column order mirrors the domination order of the constraints (McCarthy and Prince 1993: 6-7).

Then, what is the implication of the vertical dotted line in OT tableau? I suggest that it does imply the difference of the frequency in variation. The more left positioned in crucial nonranking the constraint is, the more strongly it affects the frequency of variation.

Based on the assumptions above, I will introduce new terms and notations in the constraint tableau of OT. The definitions of them are as in (12).

(12) New terms and notations in OT constraint tableau

- a. Hard domination: domination in which two conflicting constraints  $C_1$  and  $C_2$  are ranked in either of two ways:  $C_1 \gg C_2$  or  $C_2 \gg C_1$ . Two constraints are strictly ranked. This domination is indicated by the solid line.
- b. Soft domination: domination in which two conflicting constraints  $C_1$  and  $C_2$  are ranked in either of two ways:  $C_1 \succ C_2$  or  $C_2 \succ C_1$ . Two constraints are not strictly ranked, but they affect frequency of occurrence in the output form. This domination is indicated by the vertical dotted line.
- c. Non domination: domination in which two constraints  $C_1$  and  $C_2$  are equally ranked in either of two ways:  $C_1, C_2$  or  $C_2, C_1$ . Two

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4 In Prince and Smolensky (1993: 51), the term *crucial nonranking* is first used: "... we assume that the basic ranking hypothesis is that there is some total ranking which works; there could be (and typically will be) several, because a total ranking will often impose noncrucial domination relations (noncrucial in that either order will work). It is entirely conceivable that the grammar should recognize nonranking of pairs of constraints, but this opens up the possibility of crucial nonranking (neither can dominate the other; both rankings are allowed), for which we have not yet found evidence. Given present understanding, we accept the hypothesis that there is a total order of domination on the constraint set; that is, that all nonrankings are noncrucial."

constraints cannot be ranked with respect to each other due to a lack of interaction. This domination is indicated by the horizontal dotted line.

- d.  $\rightarrow$  iore: the more frequent output form  
 $\rightarrow$  ss: the less frequent output form  
 $\rightarrow$  the optimal form

Let us now represent the gradual aspect of CC simplification from ME to ModE in a newly suggested constraint tableau of OT. As I mentioned before, historical sound change must be represented as a series of unranking, reranking, and ranking processes. The whole procedure of CC simplification from ME to ModE is as in (13).

(13) a. Middle English

/knou/	MAX(More-Sal-C)	MAX(Less-Sal-C)	*COMPLEX
nou		* !	
kou	* !		
$\rightarrow$ knou			*

↓ (unranking)

b. Intermediate Stage 1

/knou/	MAX(More-Sal-C)	MAX(Less-Sal-C)	*COMPLEX
$\rightarrow$ :ss nou		*	
kou	* !		
$\rightarrow$ iore knou			*

↓ (reranking)

c. Intermediate Stage 2

/knou/	MAX(More-Sal-C)	*COMPLEX	MAX(Less-Sal-C)
$\rightarrow$ iore nou			*
kou	* !		
$\rightarrow$ ss knou		*	

↓ (ranking)

d. Modern English

/knou/	MAX(More-Sal-C)	*COMPLEX	MAX(Less-Sal-C)
$\rightarrow$ nou			*
kou	* !		
knou		* !	

By the domination of MAX over \*COMPLEX of (13a), we can find that only [knou] was permitted in ME. Then, the variant [nou] began to appear and we can represent this variation through unranking process. But, because [knou] was still prevalently used, we display the difference of frequency between variants by soft domination of MAX(Less-Sal-C) over \*COMPLEX. At the later intermediate stage, [nou] became more and more frequently used than [knou], and this can be confirmed through reranking of MAX(Less-Sal-C) with \*COMPLEX and soft domination of \*COMPLEX over MAX(Less-Sal-C). In ModE, [knou] was finally simplified to [nou] and we can ascertain this simplification by ranking process or hard domination of \*COMPLEX over MAX(Less-Sal-C).

### 3.3 Advantages over the previous approaches

I have presented a new optimality-theoretic analysis of historical sound change focusing on the gradual aspect of change. Historical sound change must be represented by a series of unranking, reranking, and ranking processes. To display the frequency of variants in the course of change, I divided the dotted line into two types and newly interpreted the implication of the vertical dotted line. Then, what are the advantages of our proposal over the previous approaches?

First, our approach can show the gradual aspect of sound change more naturally than Cho (1998) and Green (2001). To explain variation at the intermediate stage, Cho and Green introduce unranking system and free ranking system, respectively. However, Cho (1998) and Green (2001) both do not show the gradient difference in frequency occurring during the whole process of sound change. According to Cho's unranking system, both variants ([knou] and [nou]) equally occur side by side. As Green points out, this is intuitively unlikely. On the other hand, Green suggests free ranking system to explain sociolinguistic differences in variation. But, even in the free ranking system, the possibility that the shift of frequency in variants is reversed in an intermediate stage cannot be excluded, and thus it may not show the gradient shift of frequency in variation properly. Contrary to the two approaches, our approach reflects the scenario of sound change in a natural way.

The second advantage of our approach is that it can incorporate both approaches. By separating the procedure of sound change into four stages, we can include the Free-variationist model (Cho 1998) and the Free Ranking model (Green 2001). I present the relevant stages of all

three models below.

(14) Diachronic Reranking Hypothesis Model

- a. ME : MAX(Less-Sal C)  $\gg$  \*COMPLEX  
 $\downarrow$   
 b. Intermediate 1: MAX(Less-Sal C)  $\succ$  \*COMPLEX  
 $\downarrow$   
 c. Intermediate 2: \*COMPLEX  $\succ$  IAX(Less-Sal C)  
 $\downarrow$   
 d. ModE : \*COMPLEX  $\gg$  IAX(Less-SalC)

(15) Free-Variationist Model (Cho 1998)

- a. ME (no variation) : MAX  $\gg$  COMPLEX  
 $\downarrow$   
 b. Intermediate (free variation): MAX, \*COMPLEX  
 $\downarrow$   
 c. ModE (no variation): \*COMPLEX  $\gg$  MAX

(16) Free Ranking Model (Green 2001)

- a. Middle English : MAX  $\gg$  'o[kn]  
 $\downarrow$   
 b. Intermediate stage  
   - Grammar A: MAX  $\gg$  'o[kn]  
   - Grammar B: \*o[kn]  $\gg$  MAX  
 $\downarrow$   
 c. Early Modern English: \*o[kn]  $\gg$  MAX

Though (14) does not cover all the relevant issues, it can be said that our approach contains the substantive arguments of each model.

Third, based on the scenario of sound change, our approach makes the OT formalism more enriched. On the basic convention of OT, we divided the dotted line into two types and interpreted the vertical dotted line in a novel way, which involves the meaning of soft domination. In addition, we argued that in case of sound change, constraint reranking should be applied across the vertical dotted line, but not across the solid line. With the example of (13b) and (13c), repeated in (17) and (18) again, we confirm again this new interpretation of the vertical dotted line and the enrichment of OT formalism.

(17) Intermediate Stage 1

/knou/	MAX(More-Sal-C)	MAX(Less-Sal-C)	*COMPLEX
☞ :ss nou		*	
kou	* !		
☞ iore knou			*

↓ (reranking)

(18) Intermediate Stage 2

/knou/	MAX(More-Sal-C)	*COMPLEX	MAX(Less-Sal-C)
☞ iore nou			*
kou	* !		
☞ ss knou		*	

In the above tableau (17) and (18), we can see that two variants [knou] and [nou] occur side by side. However, the implication of (17) and (18) is rather different. In (17) it can be interpreted that [knou] occurs more frequently, because MAX (Less-Sal C) is the more left-positioned in soft domination and affects more frequently on the grammar, whereas in (18) [nou] is interpreted as more frequently occurring for the similar reason.

#### 4. Conclusion

I have showed in this paper that we can represent historical sound change with the help of new interpretations of dotted lines in OT. In OT, language change is generally accounted for by employing constraint reranking. However, I argued that historical sound change must be represented as a series of unranking, reranking, and ranking stages in order to show the natural historical development of sound change. For this, I divided the dotted line into two types and reinterpreted the notion of the vertical dotted line. I also showed that constraint reranking should be applied not across the solid line but across the dotted line in the domain of sound change. With the example of consonant cluster simplification from Middle English to Modern English, especially [knou] to [nou], I have justified the proposal made in this paper.

However, I treated only historical sound change based on the scenario

of sound change. Further study on alliteration may give some empirical evidence of the sound change scenario. Besides, though both synchronic variation and diachronic change are based on the same phonological principles (Kiparsky 1995) and every historical change must at some point have been a synchronic change (Green 2001), I wonder why we should treat the synchronic variation and the diachronic sound change in the same way.<sup>5</sup> To the extent that both types of variation are solved by reranking of constraints, we can say both phenomena are similar. But, because the domain applied by constraint reranking is obviously distinct and because the synchronic variation does not contain the flow of time, we cannot simply say that the synchronic variation and the diachronic sound change should be treated in the same way. Further empirical and formal investigation will be needed to sharpen and settle this issue.

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