FINAL DEVOICING IN CENTRAL KURDISH: AN OT ANALYSIS

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Abstract

As Selkirk (1986) states, final devoicing is a pattern of phonological distribution in which both voiced and voiceless obstruents occur in a language, but at the end of a particular prosodic domain only voiceless obstruents occur. The Phonological process of final devoicing has been a well-studied topic dating back to Trubetzkoy in 1933 (translated published in English in 1969) and it has been cited by most phonologists as an example of neutralisation (Brockhaus 1991 inter alia). Many languages disfavour coda voiced phonemes; however, devoicing is subject to parametric variation (Myers 2012). Most languages resolve voiced coda in a similar fashion; by devoicing rather than nasalization, deletion, or epenthesis.

This paper argues that Central Kurdish (hence forth CK) is one of the languages that undergoes final devoicing; it also claims that Kurdish resolves coda voicing by devoicing the voiced coda rather than other means mentioned above. For example, underlying /bəɾd/ 'stone' can become [baɾ̪t] but not *[bəɾ], *[bəɾm], *[bəɾdə]. Further, my analysis makes two theoretical claims: First, the prosodic domain within which coda devoicing occurs in CK includes both syllable and Prosodic word. Second, coda devoicing in CK, like many other languages (Steriade 2001/2008), can pose a hitherto unsolved problem to Optimality Theory. With the total absence of literature on this topic, I will recourse to the intuition of native speakers' judgement to support the claim that final devoicing is occurring in CK.

1. Introduction

The Phonological process of final devoicing has been a well-studied topic dating back to Trubetzkoy in 1933 and it has been cited by most phonologists as an example of neutralisation (Brockhaus 1991). Selkirk (1986) states that final devoicing is a pattern of phonological distribution in which both voiced and voiceless obstruents occur in a language, but at the end of a particular prosodic domain only voiceless obstruents occur. Thus, final devoicing is meant to occur at the end of both syllables and words and it is also limited to obstruents which have voiceless counterparts in the phonemic inventory of the language.

Nevertheless, to the best of the author's knowledge, no research has ever tried to look into the existence of this phenomenon in CK and there is no CK corpus to be used in search for this phenomenon. I observed the occurrence of final devoicing both in syllable and word final positions and noticed that CK has no voicing contrast in final obstruents, neutralising it towards voicelessness. With the total absence of literature on this topic, I will recourse to native speakers' intuition judgement on the occurrence of final devoicing. Constraint-based analysis is used to examine the data. The present essay has two main goals: The first is to examine final devoicing in CK and look into its properties. The second is to use Optimality Theory for the analysis and see how it works. This paper falls into the following sections:

2. Discussion of the Data
3. Descriptive Generalisations
4. Constraint Interaction
5. Devoicing as a problem for OT
6. Conclusions

2. Discussion of the Data

There is no general consensus among phonologists concerning the causes of final devoicing which is quite common among the world's languages including German, Dutch, Polish, Turkish and Russian, among others (Brockhaus 1991). Earlier accounts of devoicing attributed it to fortition or strengthening, while most recent literature regard it as an instance of weakening (see Harris 2009; Crystal 2008). Iverson & Salmons (2007) use two reasons for regarding final devoicing as fortition: One is based on the observation that obstruent voicing commonly occurs inter-vocalically, is clearly a weakening process to assimilate the obstruent consonants with the surrounding vowels. The other argument takes the form of a claim that devoicing strengthens final obstruents in order to demarcate the right edge of words. Harris (2009) uses the same two reasons to argue against the claims that regard final devoicing as fortition in the sense that it becomes more consonantal and turns less sonorous than the underlying voiced consonants.

In the following list of words, the final voiced obstruent phoneme is devoiced (realised and heard by native speakers) as the voiceless counterpart of the same phoneme /b/ to [p], /d/ to [t] and so on (Note that the examples include all the obstruents: plosives and fricatives except [h] and affricates).

(1) Set of Data for CK Final Devoicing

1. a		1. b		1. c	
[*b*a*r*t]	'stone'	[*b*a*rd*a]	'it is stone.'	[*qɒ**p.**tʃa*]	'button'
[*kɨtep*]	'book'	[*kɨteb*a*k*a]	'the book'	[*ba**t.**ka:r*]	'evil doer'
[*sak*]	'dog'	[*sagakat*]	'your dog'	[*ʔa**k.**rin*]	'we cry'
[*ba:tʃ*]	'badge'	[*ba:dʒakam*]	'my badge'	*ʔa**ʃ.**di.ha*]	'python'
[*mɨrɒf*]	'human'	[*mɨrɒvi ʒir*]	'wise human'	[*las.ga*]	'sticker'
[*b*a*r*a*:s*]	'pig'	[*b*a*r*a*:z*a*k*a*n*]	'the pigs'		
[*gɨrʃ*]	'tension'	[*gɨrʒ i w ʔa:lɒzi*]	'tension and unstable'		
[*ʔa:.za:t*]	'free'	[ʔa:.za:.di:]	'freedom'		

In the examples of (1a) the devoicing includes word final devoicing as (either the words are mono-syllables or the non-final syllables do not give evidence for syllable final devoicing). (1b) shows that the obstruents regain their voicing when they are not final (either followed by another consonant or a vowel. In this case, as Wolf (2008) states, there is no reason to think that any language would only allow devoicing intervocalically (given that intervocalic voicing is a typologically common process). Examples of (1b) represent only syllable final (coda) devoicing. Following Kager (1999), I will use coda devoicing instead of word final devoicing as coda devoicing captures greater generalisation. Unlike Japanese, which only allows coda consonants if they share a place of articulation with the onset of the following syllable, consonantal place features of coda in CK can be different from the place of articulation of the following onset (see 1c). Thus, the Coda Condition Constraint is ranked low and violable in CK. Languages vary with regard to syllable final or word final devoicing. While in Slavic, Romance, Germanic, Basque and many others only word-final obstruents are voiceless, in Thai, Vietnamese, Turkish, Malay and many others the syllable coda is devoiced (Myers 2012).

Looking for counterevidence to our analysis, one may look at cross-linguistic data to be cautious of possible pitfalls. For instance, in Dutch, final devoicing only occur within individual words while when we look at phrases, the final obstruents are re-voiced through voicing assimilation of the neighbouring phonemes. In CK, however, the phonological difference between single words and phrases is often not visible for these two reasons: The first

one is that, CK is a morphologically rich language and the different suffixes are mostly null, that is, not affecting the structure of the root word. Owing to this factor, most morphological phrases are phonologically single words, for example, the phrase /*mɨrd*/ 'he died' undergoes devoicing [*mɨrt*] as any single word. The second factor seems to be that CK syllables are not complex and the syllables strongly abide by onset maximisation in a way that they turn the final obstruent into the onset of the next syllable as in *gir.ʒiw. ʔa:.lɒ. zi* 'tension and unstable' which comes from **girʃ iw ʔa:lɒzi* when the devoicing occurs before syllabification. Nevertheless, this does not mean voicing assimilation is totally absent in CK. The phoneme /k/ in the word *jak.dʒar* 'once' is assimilated to /g/ resulting in [jag.dʒar].

Coda devoicing should be kept apart from assimilation of final consonant. In a language like English, for example, certain sounds (voiced fricatives in this case) change into other sounds (voiceless fricatives) under the influence of adjacent sounds (Spencer 1996) as in (2):

(2) a. *five past* /faɪvpɑːst/ ⟶ [faɪf.pɑːst]
b. *love to go* /lʌvtəg/ ⟶ [lʌf.tə.gəʊ]
c. *breath slowly* /briːðslə ʊlɪ/ ⟶ [briːθ.sləʊ.lɪ]

In the above examples, the final obstruents undergo regressive assimilation: the final voiced obstruent is devoiced under the influence of the following voiceless phonemes. However, in coda devoicing, in contrast to assimilation, the voiced obstruent is devoiced without being affected by adjacent phonemes. It can be said that final devoicing is both context-free and context-sensitive: it is context free in the sense that the devoicing is not triggered by the adjacent sounds and it is context- sensitive in the sense that only in coda position the voicing is neutralised.

As mentioned in the introduction, no previous studies are available to support the occurrence of coda devoicing in CK. So, solid evidence is needed to prove this point. I will approach this issue using evidences from both native speakers' judgement and phonological argument. For speakers' judgement, 10 native central CK adult speakers (7 male) were consulted to decide on whether they perceive the final consonant in (1a) as devoiced and the ones in (1b) regain the voicing. The speakers' perceptions were also consulted about the devoicing of syllable final consonants. All the speakers acknowledged devoicing of the coda consonants in (1a) and (1c) and voice regaining for (1b). However, they also noticed that they perceive a devoiced coda as a different phoneme from an underlyingly voiceless consonant. This supports the fact that the voiced and voiceless consonants are underlyingly different and behave accordingly. Voiced consonants, for example, cannot shorten the preceding vowels in contrast to underlyingly voiceless phonemes which shorten the preceding vowels.

Sometimes speaker judgement is not categorical or even may be misleading. For instance in the examples given above, it can be argued that the underlying phonemes in the first place are actually voiceless. Hence, a competing analysis arises as a result of two competing rules: The first one, coda voiced obstruents undergo devoicing as this paper claims while according to the second analysis, underlying voiceless obstruents surface as its voiced counterpart before a vowel. As far as the list of words in (1) is concerned, both of them are possible. To solve this enigma, as Davenport & Hannahs (2010) state, when more than one analysis is possible for a set of data, it is one of the tasks of the phonologists to evaluate competing analysis and choose between them.

Looking a bit further for more evidence in CK, many words like [*tɒ**p**aka*] 'the ball', [*kil**k** i rewi*] 'tail of fox' [*da**s**im*] 'my hand', [*ka**f**a*] 'it is foam' can be found. Words like these and multiple other examples can be used as a counterargument for the second analysis and at the same time they can be used as an admissible evidence to support position one, i.e. an underlying voiced obstruent becomes voiceless at the end of a word. If position two were

correct, these words would have to appear as *[*tʊ**b**aka*], *[*kil**g** i rewi*], *[*da**z**i min*], *[*ka**v**a*], but voiceless consonants never surface as their voiced counterparts intervocalically as far as I am aware. So, underlying voiceless consonants tend not to undergo voicing assimilation. Rather, it is the underlying voiced consonants that undergo devoicing in coda position as in (1a and 1c). Examining the full set of CK data we never find words like *[bard], i.e. a word ends with and pronounced with a voiced stop, although there are CK words which have voiced coda obstruents in the spelling.

Thus far, perceptually and phonologically, it has been established that coda devoicing is really attested in CK. This achievement helps us to account for the correct input and output in the next section when through constraints different competing candidates are evaluated and the optimal output is chosen. In the next section, an OT analysis is developed to account for the set of data presented in this section to account for the coda devoicing of obstruents in CK.

3. Descriptive Generalisations

In rule-based phonology, there is no correlation between the rules as rules need only concern themselves with their immediate outputs; they are blind to the overall actions of other rules and to the ultimate outcome of their own application. Constraint-based analysis, on the other hand, considers the broader implications of any specific operation or the effects of any particular process (Davenport & Hannahs 2010).

In phonological alternations, it is inevitable that faithfulness constraints should conflict with markedness constraints. In our case, devoicing in CK seems to be clear that no phonemes are deleted or epenthesised, but rather, a feature is changed and thus IDENT (F) is violated. However, thinking in terms of markedness constraints, the task seems to be daunting and not as easy as it looks from the beginning. Any faithfulness constraint that is violated must be dominated at least by one markedness constraint.

Markedness constraints can only do one thing: prohibit certain output configurations. But this command is too general to be understood or applied easily on phonological alternations as *Gen* can produce any candidate. Chomsky (1995) criticises this aspect of OT stating that "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/)."

Chomsky was looking at one side of OT in his assessment. It is true that Richness of the base and Freedom of Analysis **(**two properties of OT) allow all lexical items to produce anything including /ba/, but he ignored two important points: the first one is that *Gen* can produce any item from the input before the *Eval* where through a set of ranked constraints, output candidates are evaluated to their harmonic values and the optimal one is selected. The second point, though more crucial, is that Chomsky does not take into consideration lexicon optimization which roughly states that underlying forms should always match surface forms in the absence of evidence to the contrary. However, lexicon optimization should not be understood in a way that all optimal candidates are faithful to input.

For the coda devoicing in CK, the following descriptive generalisations are proposed:

(3) a. No voiced obstruent in coda position. (If the syllable includes complex coda, final phoneme in the coda is devoiced).
b. (a) is enforced by devoicing.
c. (a) is not enforced by coda deletion.
d. (a) is not enforced by epenthesis.

The descriptive generalisations indicate that the CK words obey a markedness constraint that are violated by _____voiced obstruent≠ or ____ voiced obstruent**,** where **(**≠) indicates word boundary and (**.**) is used for syllable boundary.

4. Constraint Interaction

The decision of which constraints to be used and how they should be ranked in an analysis depends mostly on the input elicited from the data. Sometimes the given data is not sufficient for constructing a solid OT analysis that works beyond the given data. A major reason for that is probably the data set was constructed with a focus on forms that alternate , it may be biased toward input that map to unfaithful output forms. The list of words and phrases of (1b) is good evidence that the input should be of a voiced coda.
Based on the descriptive generalisations in the previous section, a marked constraint is needed for (3a) to disallow no voiced coda which is *VOICED-CODA.

(4) *****VOICED-CODA
Obstruents must not be voiced in coda position.

This constraint is well established in OT literature (see Kager 1999, Steriade 2001, Lombardi 2001, McCarthy 2008 inter alia).The basic tenets of OT requires another constraint for the first constraint to conflict with about output forms. The second constraint should be a typical faithfulness constraint requiring the input value of the feature voice to be preserved in the output which is IDENT_IO(voice).

(5) IDENT_IO(voice)
The specification of the feature [voice] of an input segment must be preserved in its output correspondent.

The constraints including the above constraints are supposed to be universal but it is the rankings that are subject to language particulars. For example, in English, the faithful constraint IDENT_IO(voice) outranks *VOICED-CODA resulting in a word in which final voicing is pronounced.

IDENT_IO(voice) »*VOICED-CODA

While in CK, the constraints are ranked in a reversed order; resulting in voice neutralisation in coda.
*VOICED-CODA » IDENT_IO(voice)

To draw a tableau for this ranking, two candidates are needed and since ranking arguments are based on comparing candidates, we need a winner and a loser. The winner is already chosen [*ʔa:.za:t*] 'free' which satisfies *VOICED-CODA and derived from the input /*ʔa:.za:d*/. The loser, on the other hand, should do better than the winner on the IDENT_IO(voice) and worse than the winner on *VOICED-CODA. A loser that meets both these criteria is *[*ʔa:.za:d*].

Following Brasoveanu and Prince's (2005) comparison between ranking tableau and violation tableau, I use the ranking tableau as in the ranking tableau the winner is already known and we are trying to figure out which ranking will produce that winner. Now after the winner, the loser and the input are known; the ranking argument can be easily drawn as illustrated in tableau (6).

(6) Ranking argument: *VOICED-CODA » IDENT_IO(voice)

/ʔa:.za:d/	*VOICED-CODA	IDENT_IO(voice)
a. ☞ ʔa:.za:t		*
b. ʔa:.za:d	*W	L

A careful look at the markedness constraint *VOICED-CODA reminds us that this constraint can be satisfied in different ways. Lombardi (2001) assumes that *VOICED-CODA can be permuted in final devoicing languages with respect to other faithfulness constraints. She states that different permutations of the constraints either reveal different grammars or explore gaps in the typology of the languages as shown in (7-9). The resulting typology has two significant gaps: languages that avoid voiced codas by deletion as shown in the tableau (7), and languages that avoid voiced codas by vowel epenthesis (8).

(7) Max at bottom (Not attested yet)

/bad/	*VOICED-CODA	IDENT_IO(voice)	DEP	MAX
a.☞ ba				*
b. bad	*W			L
c. bat		*W		L
d. badə			*W	L

(8) DEP at bottom (unattested though Kwakwala may be an example of this ranking)

/bad/	*VOICED-CODA	IDENT_IO(voice)	MAX	DEP
a.☞ badə				*
b. bad	*W			L
c. bat		*W		L
d. ba			*W	L

(9) IDENT (voice) at bottom (German)

/bad/	*VOICED-CODA	MAX	DEP	IDENT_IO(voice)
a. ☞ bat				*
b. bad	*W			L
c. ba		*W		L
d. badə			*W	L

The inevitable question arises here is that why certain constraint ranking seems to be unattested or even impossible? Lombardi (2001) approaches this question by revising the theory of faithfulness suggesting that deleting a voiced consonant is basically less faithful than devoicing it. When a voiced consonant is deleted, IDENT_IO(voice) is vacuously satisfied as the optimal candidate in [ba] in (7) shows. This analysis is parallel with the well-established view in OT which states that violation to input is always minimal and always happens with a good reason. Steriade (2001) takes a similar approach but with a different reasoning. She argues

that relative unfaithfulness is determined by perceptual similarity. Speakers choose [bat] over [ba] because [bat] is more similar perceptually to [bad].

The example from CK supports the view that the candidate that incurs the minimum violation to the input will be the optimal candidate. That is, *VOICED-CODA is satisfied through the violation of IDENT_IO(voice) rather than violating MAX or DEP. However, this analysis is far from convincing (for more discussion, see section (4) of this essay).

(10) IDENT (Voice) at bottom as in CK

/ʔa:.za:d/	*VOICED-CODA	MAX	DEP	IDENT_IO(voice)
a. ☞ ʔa:.za:t				*
b. ʔa:.za:d	*W			L
c. ʔa:.za:		*W		L
d. ʔa:.za:da			*W	L

One essential factor for valid ranking that can be used as a test for supporting an analysis is to look for constraints that may do the same job as the dominating constraint. A constraint that seems to do the similar job is the one which states that no obstruent should be voiced; these kinds of constraints are called context-free constraint. This constraint is already available in OT literature under the name VOICED OBSTRUENT PROHIBITION VOP (Kager 1999).

However, CK final devoicing is an example of positional neutralisation: obstruents are devoiced in certain contexts of the syllable coda, while their voicing features are retained elsewhere. This means, devoicing is context sensitive in CK. The three constraints involved in the final obstruent devoicing are ranked in the following way: (these constraints are also used by Kager 1999).

(11) Markedness Constraint-sensitive » Faithfulness » Markedness Constraint –free
*VOICED-CODA » IDENT_IO(voice) » VOP

The rankings in (11) states that a voiceless realisation of obstruents in coda position outranks voice preservation in coda obstruents. While faithfulness on input feature [voice] outranks the complete devoicing of obstruents. The word /bard/ [bart] ‘stone’ can be a concrete example for the ranking in (11) as the final obstruent in [bart] is unfaithful to the input while the onset /b/ retains its voicing feature required by the context free markedness constraint VOP. The tableau (12) shows the interaction between the constraints.

(12) Tableau format for *VOICED-CODA» IDENT_IO(voice) » VOP

/*bard*/	*VOICED-CODA	IDENT_IO(voice)	VOP
a. ☞ *bart*		*	*
b. *part*		**W	L
c. *bard*	*W	L	**W
d. *pard*	*W	*	*

The candidates (12c, d) are eliminated by the highest ranking constraint *VOICED-CODA, as each contains a voiced obstruent in coda position. The other two remaining candidates (12a-b) satisfy *VOICED-CODA and they are passed to the lower ranking constraints for evaluation. Both (12a and b) violate IDENT_IO(voice) , but (12a) is chosen on the basis that its violation to IDENT_IO(voice) is minimal compared to (12 b).

A striking property of constraint ranking in (12) is the candidate (12d). This losing candidate [pard] is harmonically bound which means that cannot win no matter how the constraints are ranked. [pard] preserves the input value for [voice] in its coda consonant, but is unfaithful to [voice] in its onset consonant. This incurs violations for each of the three constraints in the tableau: it violates *VOICED-CODA as it has a voiced coda obstruent[d]. It also violates IDENT-IO(voice) as it is unfaithful to the input value of [voice] in one of its consonants (the onset [p]). In addition, it violates VOP because it contains a voiced obstruent [d]. Kager (1999) gives a similar account for devoicing in Dutch.

5. Is Coda Devoicing a problem for OT?

In rule based phonology, the grammar is an input –output relation as in OT. An element (A) changes to an element (B) in the context of (X) and (Y) as shown here:

$A \longrightarrow B / X \_\_\_\_ Y$

Each rule makes only one structural change ($A \longrightarrow B$) to the input. For every rule to apply, a certain context is needed known as structural description (XAY). Both aspects of rule-based phonology (structural change and structural description) have counterparts in OT. The trigger of the negative constraint (*XAY), can simply be regarded as the structural change and there is an anti-change constraint in the same time represented by faithfulness constraints ($*A \longrightarrow B$).

However, a basic difference between Rule based theory and OT is that in OT different phonological processes may have a unitary function while rule based theory cannot relate different rules as it has no means of expressing output goal. This functional unity which is known as conspiracy was signalled as early as Kisseberth (1970) who observed that in Yawelmani, (syncope, epenthesis, allomorphy) all act to create or preserve well-formed structure. Before OT, phonologists noticed the role of output in grammatical theory. Hence, mixed models were invented which led to complicated interaction of rules and constraints (Kager 1999).

On the other hand, OT avoids such interactional complexity by limiting grammatical interactions to constraints. It can also account for conspiracy in which different means are used to achieve the same goal. In Welsh, for example, Epenthesis, deletion and metathesis all serve to resolve potential sonority sequencing violations (see Hannahs 2011). While in rule-based theory, the structure is blind to the output and therefore cannot find the coherence relation between the processes.

Moreover, it is assumed that different ranking of phonological processes yield different grammars. For example, *VOICED-CODA dominates IDENT-IO(voice) in German, Polish, Russian, CK and other languages, In languages like Arabic and English, the reverse ranking is seen. Nevertheless, Factorial typology reveals gaps in the ranking, that is, languages which are unattested but might be expected to exist. This means, certain markedness constraints can only be satisfied in only one way and final devoicing seems to be a good example in this respect as tableaux (7) and (8) show.

OT suggests that in any phonological analysis two types of language should be attested: the ones which satisfy the constraint by changing the marked element and the ones where position of a marked element is modified. Yet for most such constraints, the languages which modify the marked element are attested but the ones modifying the position are not (Staroverov 2010). McCarthy (2008) uses the term *too- many-solutions problem* for this phenomenon which has too many solutions and only one of them is applied cross-linguistically. For example, in the case of coda devoicing, the problem of no voiced coda can be solved in several ways as shown in (13) for *bard* ‘stone’ but only (13a) is attested in all the languages that devoice coda. Namely, constraint ranking, as expected, is not attested.

(13) a. devoicing: /*bard*/ → [*bart*]
b. nasalization: /*bard*/ → [*barm*]
c. lenition: /*bard*/ → [*barz*]
d. deletion: /*bard*/ → [*bar*]
e. feature reversal: /*bard*/ → [*part*]
f. metathesis: /*bard*/ → [*darb*] or [*rabd*], etc.
g. epenthesis: /*bard*/ → [*bardə*]

Thus, it seems, the predictions of the theory do not match up with the attested typology of languages which claims that OT is inherently typological (McCarthy 2002). This problem has been approached in different ways. First, Steriade (2001) proposes a move towards abandoning the original OT assumption that every constraint may trigger multiple repairs. Second, Lombardi (2001) adopts a modified theory of faithfulness to features which allows them to account for the unavailability of repairs in (13b-d) as well as (13 e-f). Finally, Staroverov (2010) uses Serial OT to tackle this problem by replacing relevant OT constraints with constraints that specify position in the output of the previous derivational step. However, this problem, which is the subject of on-going debate in the literature, is beyond the scope of this essay.

6. Conclusions

CK undergoes coda devoicing; the devoicing includes plosives, fricatives and affricates. This devoicing is neither assimilation nor Coda Condition similar to what happens in Japanese. It is similar to coda devoicing in Dutch and German. Constraint-based analysis can be used to explain devoicing. The constraints used for evaluating the candidates produced by *Gen* are established in the OT literature.

However, coda devoicing poses a problem for the basic principles of OT in the sense that it does not allow different ranking of the faithfulness constraints. Namely, what is expected by factorial typology (all the possible orders for a given set of constraints) to be attested cross-linguistically has not been met. This problem is approached but has not received a solution with convincing evidence yet.

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