Constraints' Hierarchy of Syllable Structures in Maḥbashi Yemeni Arabic: A Violation Computing Method

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Abstract:

This paper is tackled to investigate how the constraints' hierarchy is formed in Maḥbashi Yemeni Arabic. This paper addressed the most difficult issue in Optimality theory (OT) account, constraints' ranking. This study with the help of OT constraints applied Violation Computing Method (VCM) (Nadeem, 2016). The analysis revealed the applicability and the simplicity of VCM in constraints' hierarchy ranking across languages. The study asserted that the use of the violation computing method is applicable to different languages. The study concluded that VCM is functional and operative in doing OT analysis. This paper has proved that syllable structures is couched in OT in the order: Ons > *i,u]σ> MaxSeg, DepSeg > NoComplCoda , NoComplOns > No Coda.

Keywords
Syllable, Maḥbashi Yemeni Arabic, Violation Computing Method, Constraints

Abstract

7

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تراتبية ضوابط تشكيل المقاطع الصوتية في لهجة المحابشة اليمنية العربية بطريقة التعارض المحوسبة

ملخص البحث:

تناولت هذه الورقة التحقيق في كيفية تشكيل تراتبية ضوابط المقاطع الصوتية في لهجة المحابشة اليمنية العربية. حيث تطرقت الورقة الى أصعب قضية في حساب نظرية الامثلية (OT)، تحديدا تراتبية القيود. طبقت هذه الدراسة بمساعدة قيود نظرية الامثلية OTطريقة حساب التعارض المحوسب (VCM) (Nadeem,2016) , حيث كشف التحليل قابلية وبساطة تطبيق VCMفي تراتبية ضوابط القيود عبر اللغات. وأكدت الدراسة أن استخدام أسلوب حساب التعارض المحوسب ينطبق على لغات مختلفة. خلصت الدراسة إلى أن VCMيعتبر وظيفية وفعاله في إجراء تحليل النظرية الأمثلية (OT). و أثبتت هذه الورقة أن هياكل المقطع تمت صياغتها في OTبالترتيب التالي: MaxSeg, Ons > *i,u]σ> DepSeg > NoComplCoda , NoComplOns > No Coda.

□

1. Introduction

Nowadays great attention is paid to the syllable in the theory of philology and practical application of theoretical knowledge. It is connected with the progress made in accounting for the problems of artificial intelligence. Syllable structure is defined as a sequence of segments which function as a unit (Reetz & Jongman, 2009). The syllable is formed differently from one language to another one. That is to say whereas some languages allow syllable structures with consonant clusters in both onset and coda positions, other languages do not. Different theories have been applied to study the syllable structures across languages; Autosegmental Phonology (Goldsmith, 1976), CV theory (McCarthy, 1981), Moriac theory (Hyman1985; Hayes,1989) and optimality theory (Prince and Smolensky 1993/2004; Kager, 1999). Optimality theory is considered one of the modern theories in generative phonology. It is a theory of constraints interaction in universal grammar (Legendre, 2001). Constraints ranking rises problems for some scholars. Ranking constraints requires an extensive learning. This paper tries to investigate the constraints ranking of the syllable structures in Maḥbashi Yemeni Arabic by applying a systematic method of Violation Computing Method.

2. Literature Review

The linguistic literature on syllable structures of Arabic dialects is full of discussions beginning with (Ali, 1996; Watson, 2002; Ben-Meir, 2015) and extending through rule-based studies, autosegmental studies and constraint-based studies (Watson, 2002; Alsharbi, 2010; Damom, 2013). Under the premise of constraint-based framework, Al-Hamzi (2019) conducted an extensive study on Maḥbashi Yemeni

Arabic (MYA, henceforth) which constituted the cornerstone in the analysis of the phonological patterns of this dialect of Yemeni Arabic. He adopted the framework of optimality theory (OT) to examine the syllable structures and its related processes such as epenthesis, syncope, and vowel shortening. The attested syllable structures in MYA are C[1]VC, CVV, CV, CCV, CVVC, CCVV, CCVC, CVCC, CCVCC and CCVVC (Alhamzi, 2019, p.134). Opting to OT constraints, Alhamzi (2019, p.233-234) come up with the following ranking of constraints which has been established for the syllable structures in MYA: -

1- **Onset> *i,u]σ >MAX-IO, DEP-IO >*CC] σ >*σ[CC>*CODA**

The following tableau illustrates a complete order of the above constraints where ONS is ranked high.

/ħuru:b/	ONS	*i,u]σ	MAX-IO	DEP-IO	* σ [CC	*CC] σ	*CODA
☞ b.[ħru:b]			*!				*
a.[ħu.ru:b]		*!					*
c.[u:b]	*!						*
/ kabʃ /	ONS	*i,u]σ	MAX-IO	DEP-IO	* σ [CC	*CC] σ	*CODA
☞a.[kabʃ]						*!	*

[1]- C stands for Consonant and V stands for a Vowel.

b.[ka.biʃ]				*!			
c.[kab.iʃ]	*!						

Tableau (2.1) words /kabʃ] /→[kabʃ] 'sheep' and /ħuru:b / →[ħuru:b] 'wars' (Al-Hamzi, 2019, p.234)

The first candidates (a) for both inputs are the winners because all of the rest candidates (b&c) violate constraints that are ranked higher.

To conclude, the objective of this study is to revisit the final hierarchy ranking of the syllable constraints by adopting a mathematical formula to see its applicability to different languages. This study is an attempt to:

1- Examine the applicability of Violation Computing Method (VCM) in the hierarchy ranking of the syllable constraints in MYA.
2- Check the simplicity of applying Violation Computing Method in selecting the constraints and their specific ranking in MYA.

3. Theoretical Framework

This paper used the Optimality Theory (OT) framework to account for the syllable structures in MYA. OT is a linguistic model developed by Prince and Smolensky (1993). OT is a constraint-based model which proposes that the observed forms of language arise from (or are a product of) optimal satisfaction of conflicting constraints (Kager, 1999). According to McCarthy (2002, p. 3), "OT is not operational, rule-based, or transformational; rather, it is comparative: it compares candidates in a set with respect to a given input by applying a hierarchy of violable constraints." This is done with the help of three crucial components: Constraint set (CON), Generator (GEN) and Evaluator (EVAL) (Prince & Smolensky, 1993; Kager, 1999; McCarthy 2002).

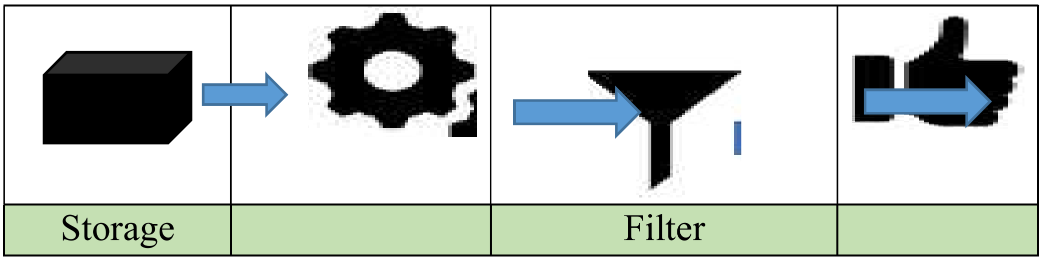
The CON component contains the entire repertoire of constraints that are linguistically universal. GEN then produces a candidate set from an input that is made available by the lexicon, and the candidate set is submitted to EVAL to determine the optimal candidate. Finally, EVAL chooses the optimal candidate by using a language-specific constraint hierarchy to the set of candidates (McCarthy, 2002). In OT parlance, the optimal candidate is the output form which incurs the least serious violations of the constraint hierarchy. In the context of a given language, the optimal candidate is termed as the "actual output of the grammar" (Kager, 1999, p. 21) or the "grammatically well-formed structure" (Prince & Smolensky, 2004, p. 3). The systemic relationship between the functions of GEN and EVAL abstracted from McCarthy (2002) is shown in (2):

2. /input/ → {cand1, cand2, …} → EVAL → [output]

The mechanism of OT is illustrated in the following table: -

(3.1) Elements of OT (modified from Kager, 1999, p. 19)

Lexicon	Generator	Evaluator	Output
Underlying Repersention (Input)	Generates Output Candidates A,B,C…..	The set of ranked Constraints. Evaluate Output Candidates.	The optimal Candiate



4. Methodology

This study adopted the quantitative approach. This section provides an overview of the method which has been used to account for the constraints' hierarchy of the syllable structures in MYA. Violation Computing Method (VCM, henceforth) is a newly-established method which has been proposed by Nadeem (2016) to account for constraints' ranking hierarchy for stress patterns in Pakistani Standard English. In this method, the right-hand column represents all the actual data (inputs) of any language variety whereas the left column represents the appropriate constraints. The bottom row shows the overall number of violations each input receives. This method is clarified in the following table: -

Table (4.1): Constraints ranking via VCM (Nadeem, 2016, p. 82-83).

Inputs	Constraint 1	Constraint 2	Constraint 3	Constraint 4	Constraint 5
1- Input A	✓	*	*	*	✓
2- Input B	✓	*	*	*	✓
3- Input C	✓	*	*	✓	✓

4- Input D	✓	✓	*	*	✓
5- Input E	✓	✓	✓	✓	✓
6- Input F	✓	✓	*	✓	✓
7- Input G	✓	*	✓	✓	✓
Overall No. of Violations	0	04	05	03	0

From the above table, starting from the left, the first column presents inputs in the form of real possible linguistic forms of any variety and five applicable constraints are shown in the top row. In the above table, satisfaction of the constraints at the connection of the syllable row are shown with a tick (✓) mark and instances of constraint' violation is marked by the asterisk symbol (*). The overall number of violations carried out by candidates with regard to every constraint is presented in the lowermost row. The following table illustrates the number of violations against each constraint.

S.no	Constraints	No. of Violations
1	Constraint 1	**0**
2	Constraint 5	**0**
3	Constraint 4	**03**
4	Constraint 2	**04**
5	Constraint 3	**05**

Table: (4.2) Summary of Constraints' violations (modified from Nadeem, 2016, p. 84).

Table (4.2) sums up the overall violations of the constraints. The increasing number of violations is shown in a top-bottom order. In order to show how the constraint ranking is built up, it has been stated that "the higher is the number of violations, the lower is the constraint in ranking" (Nadeem, 2016, p. 84). This is can be achieved by manipulating the formula of VCM:

3. **No. of V α** $\frac{1}{CR}$ (Nadeem, 2016, p. 84)

In the mentioned formula, V stands for violation, C for constraint and R for ranking. It states that "the number of violations is inversely proportional to the ranking of constraint" (Nadeem, 2016, p. 84). With the application of VCM the following constraint hierarchy is suggested:

4. **Constraint 1, Constraint 5 » (undominated) Constraint 4 » Constraint 2 » Constraint 3**

It can be noticed that constraint **1** and constraint **5** are ranked higher since they indicate zero violation (0). constraint **4** comes next since its number of violations is (03) which is greater number of violation than that of higher-ranked constraints but smaller than constraint **2** which displays (04) violations. Constraint **3** is the lowest-ranked constraint in this hierarchy since it gets the highest number of violations (05).

5. **Discussion & Analysis**

First, we have to look at the basic markedness and faithfulness constraints which are responsible for the erecting the syllable structures in MYA. To capture this, the following universal constraints are addressed:

a) Onset (Ons): Syllables must have onsets.
(Prince & Smolensky, 2004)
b) No Coda: Syllables may not have codas.
(Prince & Smolensky, 2004)
c) Dep^{Seg}: Assign a violation to any segment that is inserted. (No insertion).
d) Max^{Seg}: Assign a violation to any segment that is deleted. (No deletion).
(McCarthy & Prince ,1995)
e) No Complex Onset (NoComplOns): Onsets can't be complex.
(Kager 1999, p. 97)
f) No Complex Coda (NoComplCoda): Codas can't be complex.
(Kager 1999, p. 97)
g) *u,i]σ (Kenstowicz, 1996, p. 318)
High short unstressed vowels in open syllables are not allowed.

To determine the constraint hierarchy for the syllable structures in MYA, we have to recall the "Violation Computing Method" (VCM). This scheme is expressed as:

5. VCM = No. of V α $\frac{1}{CR}$ (Nadeem, 2016, p. 84)

In order to express the applicability of the formula used by (Nadeem, 2016), the following table unveils the core syllable structures in MYA with respect to their violations of the primary constraints.

Table (5.1): Syllable Constraints Ranking in MYA Using VCM

S. N	Syllable Type	List of Constraints						
		Ons	NoCompl Ons	NoCompl Coda	No Coda	Max Seg	Dep Seg	*i,u]σ
1-	CV	✓	✓	✓	✓	-	-	-
2-	CVV	✓	✓	✓	✓	-	-	-
3-	CVC	✓	✓	✓	*	-	-	-
4-	CVCC CVCG	✓	✓	*	*	-	-	-
5-	CVVC	✓	✓	✓	*	-	-	-
6-	CCV	✓	*	✓	✓	-	-	-
7-	CCVCC	✓	*	*	*	-	-	-
8-	CCVC	✓	*	✓	*	-	-	-
9-	CCVVC	✓	*	✓	*	-	-	-

10 -	CCVV	✓	*	✓	✓	-	-	-
Overall No. of Violations		0	05	02	06	-	-	-

Table (5.1) shows the individual values of constraints' violations for each syllable. Ons made up zero violation and No complex coda made up (02) violations. No complex onset constraint receives (05) violations whereas No Coda constraint obtains (06) violations. The last two faithfulness constraints $Max^{Seg\ and}$ Dep^{Seg} and the markedness constraint *i,u]σ are marked as (-) since their violations are computed via the inputs and outputs correspondence. VMC is mainly designed to calculate and compute the inputs' violations.

To further clarify the scenario of VCM, the number of constraints' violations obtained by the patterns of syllables in MYA is offered in the following table:

Table (5.2): Summary of Syllable Constraints Violations

Constraints	Ons	NoComplCoda	NoComplOns	No Coda	Max^{Seg}	Dep^{Seg}	*i,u]σ
No. of Violations	0	02	05	06	-	-	-

It can be observed that the violation of the constraints is arranged in a descending manner. Put it differently, Onset demonstrates (0) violation. Subsequently, the constraints NoComplCoda, NoComplOns and No Coda receive (02), (05) and (06) violations respectively. Pertaining to VCM mechanism, the constraint which gets the highest number of violations has to be ranked lower in the hierarchy. Therefore, the constraints' ranking for the MYA syllabification structures is given in (3).

6. **Ons > NoComplCoda > NoComplOns > No Coda**

MYA does not allow a syllable without an onset; therefore, Onset must be ranked high. It also encourages consonant clusters in both onset and coda. It has been observed that some syllable patterns end with/without coda. This means that the No Coda constraint must be ranked low. It has been stated that VCM is basically tended to compute and calculate the inputs' violations. Therefore, the faithfulness constraints Max^{Seg} ^{and} Dep^{Seg} and the markedness constraint *i,u]σ are not incorporated in the above hierarchy.

In the subsequent analysis, there is a need to include the faithfulness constraints to ensure that input segments are not deleted or inserted. Moreover, consonant clusters in the onset position is formed in MYA due to the deletion of the vowel of high unstressed syllable, consequently, the markedness constraint *i,u]σ serves this purpose and has to be ranked after the Onset. Therefore, the ultimate constraints ranking for MYA syllable structures is as follows.

7. **Ons > *i,u]σ> $Max^{Seg,}$ Dep^{Seg} > NoComplCoda , NoComplOns > No Coda**

With an additional piece of evidence to the above mentioned constraint hierarchy, the following tableau accounts for the interaction between the markedness and faithfulness constraints in opting for the optimal outputs for /zi.ra:r/ →[zra:r] 'A button' and / ħarb/→[ħarb] ' war':-

/zira:r/	Ons	*i,u]σ	Max^{Seg}	Dep^{Seg}	NoComplOns	NoComplCoda	NoCoda
☞[1]a.[zra:r]			*!		*		*
b.[zi.ra:r]		*!					*
c.[zi.a:r]	*!		*				*
/ħarb/	Ons	*i,u]σ	Max^{Seg}	Dep^{Seg}	NoComplOns	NoComplCoda	NoCoda
☞a.[ħarb]						*!	*
b.[ħa.rib]				*!			*
c.[ħar.ib]	*!						**

1- The pointing hand "☞" indicates optimal candidates."*!" fatal violations. In addition, cells which do not participate in the decision are shaded.: Dotted line shows no crucial ranking.

Tableau (5.3) OT Analysis of the Inputs/ zi.ra:r/ →[zra:r] 'A button' and / ħarb/→[ħarb] ' war'

Candidates (a) for both inputs emerge the optimal ones. In other words, any violation of ONS is costly and takes a candidate out of contention as candidates (c) are out done. The unacceptability of candidates (b) for both inputs is due to their breaching of the constraints *i,u]σ and DEP-IO.

6. Conclusion

This paper aimed to revisit the constraints' hierarchy of the syllable structure in Maḥbashi Yemeni Arabic. This paper has checked the validation of the constraints' hierarchy of the syllable structures in MYA by using a violation computing method (Nadeem, 2016). The study asserted that the use of the violation computing method is applicable to different languages. The study also proved that the VCM is effective and simple in doing OT analysis.

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