Optimal Sonority Order of Onset Consonant Clusters in Pashto Language

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Abstract

Pashto spoken by the majority of people in Afghanistan and Khyber Pakhtun khwa province of Pakistan. It is also spoken as the first language by the minority group of people in Kashmir. This paper aims to examine the consonant clustering of Pashto language spoken in Kashmir in the context of sonority hierarchy. Languages of the world exhibit different sequencing of consonants allowed by the sonority sequencing constraint. The linear order of segments in a language is usually influenced by different phonotactic restrictions which only allows the optimal order of consonant sequences. These arrangements of consonant clusters within syllables are subjected to occur in sequences adjacent to each-other by their sonority value. The sounds which are most sonorous occur at the peaks while as the less sonorous sounds occur at the edges within the syllables (Clements, 1990, Hooper, 1976, Kiparsky, 1979). This pattern is generally followed by most of the languages of the world. The sonority order of segments is constrained in languages, what are the different constraints which put these restrictions on Pashto consonant clusters? The phonotactic constraints of these clusters are subjected to manner, place and voice features of the sound segments in Pashto language which determines the order of consonant sequences in the language. This paper reveals different clustering order of consonants at the initial position of Pashto syllables constrained by the sonority value and how the sonority of different segments effect the linear order of sound sequencing in Pashto language.

Key words: Pashto, Phonotactics, Syllable, Sonority, Constraint.

Introduction

Pashto language also called Pakhto is the member of Indo-Iranian group of indo European languages. It is largely spoken in Afghanistan as the official language and Khyber Pakhtunkhwa province of Pakistan. It is spoken by an estimated 60 million people spread all over the world through Pashtun diaspora (Ethnologue). A small fraction of Pashto speaking people resides in Kashmir who migrated from Afghanistan and Pakistan and became permanent members of Kashmir after the partition of India. Being a minority group and alienated from their majority community Pashto speakers in Kashmir still maintained their culture and identity. This paper focuses on the analysis of consonant cluster sequences at the initial position of the syllables of Pashto language which is determined by the

sonority hierarchy of these consonants. This will include the identification of various phonotactic constraints which are responsible for the type of sequences allowed in Pashto language. The constraints which are responsible for the type of sequences are both articulatory and perceptual. This paper is an attempt to illustrate some of these constraints of Pashto language in the light of Optimality Theoretic framework.

Sonority theory

Sonority is a phonological non-binary feature that categorizes sounds into relative scales. There are many variants of the hierarchy of sonority; a common one is vowels > glides > liquids > nasals > obstructions (Parker, 2016). In other studies the obstruents are further categorized as fricatives > stops according to the sonority order. It is an established fact that syllables allows the sequencing of clusters from less sonorous to more sonorous at the initial positions. This pattern is followed by the majority of the languages of the world. In syllables, a primary sonority function is to linearize segments: more sonorous sounds tend to occur closer to the peak. The theory of sonority says that different segment types have different inherent sonority levels (linked to acoustic energy or vocal-tract stricture, though somewhat obscurely), and that the compatibility of a segment with a given environment depends on the permissible sonority contours within and between syllables (Clements, 1990).

Sonority Constraints and Theoretical background

The consonant clustering are constrained in languages and these clusters are subjected to the sonority order of the segments. The general patterning of these segments into sequences is from less sonorous to more sonorous at the onset positions of syllable. Low-sonority onsets are preferred cross-linguistically. When a choice between two different available onsets must be made, this preference can be most clearly seen. For example, it is the lowest sonority member of an onset cluster that is reduced in Sanskrit reduplication (Steriade 1982, 1988; McCarthy and Prince 1986). In child language phonology, another example can be found; different children have shown a preference for low sonority in phenomena such as cluster simplification (blue > [bu], sky > [a], snow > [so] and truncation (balloon > [bu:n]) (Gnanadesikanikan, 1995; 1997 at Barlow). A low sonority onset is preferred because it is more distinct than a high-sonority onset from the syllable nucleus (Delgutte 1997). This implies that the cross-linguistic preference for low-sonority beginnings is functionally grounded, but it must be modelled within a specific phonological framework.

The preference for low-sonority onsets can be formalized within Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1995) as a family of constraints of the general type *ONSET/X, where X is a variable that ranges over each step of the segmental sonority scale. Since preferred codas are often those that are high in sonority [Hooper 1976; Zec 1988; Clements 1990], it is preferable to separately treat

limitations of onset and coda sonority. The individual *ONSET/X constraints are in a universally fixed ranking determined by the sonority scale, with the highest rank given to the most sonorous onset constraint. The *ONSET/X constraints must be given a constraint formulation that the (leftmost) onset segment in a syllable is correctly identified and the level of its sonority inspected (L. Smith, 2002).

***ONSET/X.** It says that the left most segment in the syllable doesn't have the sonority level X.

This constraint assumes the sonority order of segments at the onset position for the languages given as below:

*ONS/GLIDE>> *ONS/RHOTIC>> *ONS/LATERAL>> *ONS/NASAL>> *ONS/VOICEDOBS>> *ONS/VOICELESSOBS

Prototypically, onsets contain an obstructive plus an approximant. In addition, the propensity to pattern a segment as a moraic is proportional to its sonority. These observations led to implications such as lower nuclei of sonority involving the existence of nuclei in a specific language from all higher classes of sonority. While such generalisations are strong, however, some have counterexamples, raising questions about the adequacy of sonority and how to grammatically encode it. A debate about its innateness has been revived by recent research on sonority. Experiments that ask speakers of different languages to rate the naturalness of or pronounce forms containing non-native clusters, for instance, demonstrate that universal limitations of markedness involving sonority predict accuracy on such tasks. Various studies, however, contradict the fact that this knowledge can be acquired by extrapolating statistical generalisations from the lexicons of those languages without prior bias with respect to preferred differentials in sonority. Computational algorithms that can calculate the relative sonority of acoustic samples directly and potentially segment them based on different phonetic parameters are an exciting development; these algorithms have contributed to automatic speech recognition. Connectionist networks have also been used to syllabify random strings of segments in Berber automatically. Sonority is a function of bidirectional excitation of competing segments over time in this approach, driven by global maximization of harmony using exponentially weighted constraints. The functional explanation of sequencing tendencies is another important issue. Some scholars have rejected the analysis of clusters in terms of well-configured sonority slopes in favour of an optimal ordering of segments to improve their auditory cue robustness. By their probability of helping the listener to recover critical aspects of the speech signal, this approach replaces sonority with perceptual constraints ranking phonological environments. In other related areas, cutting-edge technology has made a significant contribution, too. An Italian study with electromagnetic articulography, for example, shows a difference in gestural target coordination patterns for initial clusters such as /pr/ versus

/sp/ (a sonority reversal). This finding indicates that the two sequences have distinct prosodic structures, a crucial detail that is often downplayed- if "exceptional" clusters such as /sp/ are not actually tautosyllabic, then they actually confirm rather than violate the principle of sonority.

Onset Phonotactic Constraints in Pashto language

This paper illustrates the sonority order of onset consonant clusters which are responsible for the optimal output in the Pashto language. The phonological analysis of sonority constraints which is established on the basis of manner of articulation, place of articulation and voice features describes different allowed sequences of segments in Pashto onset clusters. On the basis of available data following initial consonant clusters were established in Pashto language.

Onset CC	**examples**	**gloss**
/pr/	/proːt/	horizontal
/pɽ/	/pɽaq/	twinkling
/pl/	/plaːr/	father
/pj/	/pjaːz/	onion
/tr/	/trix/	bitter
/tɽ/	/tɽap/	falling sound
/tl/	/tləl/	going
/tj/	/tjarə/	dark
/kr/	/krəka/	hate
/kɽ/	/kɽap/	Walking sound
/kl/	/klak/	hard
/br/	/brag/	multi colored
/bɽ/	/bɽastan/	mattress
/bj/	/bja/	again
/dr/	/drɛːm/	third
/gr/	/graːn/	costly
/gɽ/	/gɽaz/	Thundering sound
/ʈr/	/ʈrak/	truck
/ɖr/	/ɖrəm/	drum
/qɽ/	/qɽapu/	foodie
/mɽ/	/mɽa/	died
/ml/	/mla/	back
/mj/	/mjada/	stomach
/nj/	/njaː/	grandmother
/fl/	/flankai/	someone
/sp/	/spei/	dog
/st/	/stən/	needle
/sk/	/skor/	charcoal
/sx/	/sxaː/	rotten

/sq/	/sqər/	Father in law
/zb/	/zbərg/	saint
/zm/	/zməka/	land
/zɽ/	/zɽə/	heart
/zj/	/zjaɽ/	yellow
/ʃp/	/ʃpa/	night
/ʃt/	/ʃta/	available
/ʃk/	/ʃkaɳu/	porcupine
/ʃm/	/ʃmaːr/	count
/ʃn/	/ʃna/	bluish
/ʃl/	/ʃlol/	To cut
/ʃr/	/ʃraŋ/	Instrumental sound
/ʃʈ/	/ʃʈap/	Water sound
/ʃx/	/ʃxuan/	rumination
/xp/	/xpəl/	Own
/xk/	/xkər/	horn
/xr/	/xreːl/	shave
/ɣr/	/ɣrə/	forest
/ɣl/	/ɣlaː/	theft
/ʧʃr/	/ʧʃraɽ/	Crying
/ʧʃʈ/	/ʧʃʈap/	Kissing sound
/ʤʒr/	/ʤʒranda/	lock

The type of onset consonant clusters which are allowed in Pashto is evident from the above table. The following types of combinations are found which are based on the manner of articulation:

1. Stop + trill, flap, approximant, lateral approximant

These clusters follow the sonority scale principle which is less sonorous to more sonorous. Stop consonants in this case are least sonorous followed by less sonorous segments of Pashto. This gives us an optimal form of structure which follows the sonority hierarchy scale by satisfying the constraint of sonority *ONSET/X. The value of X can be any onset segment cluster which satisfies sonority hierarchy:

*ONS/GLIDE>> *ONS/RHOTIC>> *ONS/LATERAL>> *ONS/NASAL>> *ONS/VOICEDOBS>> *ONS/VOICELESSOBS.

Assuming this sonority hierarchy for the Pashto onset clusters we get the ranking:

*ONS/GLIDE+STOP>> *ONS/RHOTIC+STOP>> *ONS/APPROXIMANT+STOP

This hierarchy of dominance can be evaluated with the help of OT tableau. A combined tableau has been taken for the evaluation process in which the violation marks of any constraint excludes the available candidates. Taking the input of segments with different sonority value, we get the following optimal sonority order of segments.

Input:stop+less sonorous segments	*ONS/GLIDE+STOP	*ONS/RHOTIC+STOP	*ONS/Approx.+STOP	optimality
a. Stop+ trill				☞
b. Trill+ stop		*!		
c. Stop+ flap				☞
d. Flap+ stop		*!		
e. Stop+ approx.				☞
f. Approx.+ stop			*!	
g. Stop+ lat. Aprx.				☞
h. Lat. Apprx+ stop			*!	

The possible candidates are demonstrated in one frame above where for each optimal candidate a possible counterpart is generated for the evaluation process. The hierarchy *ONSET/X is placed horizontally individually for each combination which stands for different types of consonant clusters constraint by their sonority value. Candidates a, c, e, f emerges as the optimal candidates in Pashto language by satisfying the sonority hierarchy constraint while candidates b, d, f and h are excluded by violating the hierarchy constraint *ONSET/X.

This type of pattern is followed by all the consonants of the Pashto language in the onset consonant clusters subjected to the exceptions, if found in these clusters.

On the basis of place of articulation the Pashto onset consonant clusters disagree in their place feature. This means the consonants with same place of articulation are not allowed to make sequences in the syllables. This constraint can be represented as:

2. ***Place.CC** (adjacent consonants must disagree in place of articulation).

This constraint is highly ranked in Pashto language and is dominant to any faithful output and therefore restrict them to appear as the surface form. During the evaluation process this constraint exclude any possible candidates with same place of articulation which in this case is consonant clusters of segments with same place of articulation. Some of these combinations which are restricted in onset clusters of Pashto language on the basis of *Place.CC are bilabial stops, velar fricatives, velar stops etc.

Therefore the sonority constraint *place.CC is higher ranked in Pashto language which dominates the faith constraint IDENT-IO (identical input-output). This domination of markedness constraint over faithfulness constraint can be hierarchically represented as *Place.CC >> IDENT-IO.

This hierarchy can be demonstrated in the OT tableau with the aid of examples from Pashto language. Taking the input with same place of articulation but with different sonority value such as /pb/, /td/, /sz/ for the evaluation process, we get the following results:

Input: /pb/, /td/, /sz/	***Place.CC**	**IDENT-IO**
a. /pb/	*!	
b. /td/	*!	
c. /sz/	*!	

All the candidates with same place of articulation and having different sonority value (voiceless obstruents are less sonorant than voiced obstruents) violates higher ranked constraint *Place.CC and satisfies lower ranked constraint IDENT-IO. The satisfaction of lower ranked constraint cannot be considered and there is fatal violation by all the possible candidates in the tableau. Therefore the onset clusters with different sonority value and same place of articulation are blocked in the Pashto syllables.

There are some sequences in onset cluster of Pashto language that agree in voice features. These segments with different sonority value show harmony in voice feature that is both the segments must possess same voice feature. This constraint of sonority can be represented as:

3. AGREE (VOICE). Two adjacent consonants must agree in voice.

This constraint is highly ranked in Pashto language and functions as wellformedess constraint which don't allow sound segments with different voice feature. For example a voiced segment must follow voiced segment and voiceless segment is followed by voiceless segment. In Pashto language this constraint is satisfied by clusters of fricatives and stops which occur in harmony of voicing, for example, fricative and plosive consonant sequences at onset clusters of syllable. The wellformedess constraint AGREE (voice) confronts the faithfulness constraint IDENT-IO (identical input-output) in the conflict to give an optimal output. Thus, it gives us the ranking AGREE (VOICE) >> IDENT-IO.

This ranking of constraint conflict can be illustrated in OT tableau with the help of examples from Pashto language. Taking the input /sp/ (fricative and plosive), the following optimal output can be evaluated.

Input: sp	**AGREE (VOICE)**	**IDENT-IO**
a. sp		
b. sb	*!	
c. zb		*
d. zp	*!	

Candidates 'a' and 'c' satisfies higher ranked constraint while as candidates 'b' and 'd' violates higher ranked constraint. Therefore candidates 'b' and 'd' gets excluded during the conflict and candidates 'a' and 'c' emerges as the optimal candidates of Pashto language.

However this pattern of clustering occur in reverse sonority order in Pashto language i.e. a higher sonority segment is followed by a lower sonority segment which violates the sonority sequencing constraint. The sonority sequencing constraint naturally allows the clustering from low sonority to high sonority of segments at initial position. Wright (2004, 51-52), says that the fricative-plosive and nasal-plosive may be reversed in some languages which is the case in Pashto language. Bell and saka (1983, 259-275) explained this feature in their study 'reversed sonority in Pashto initial clusters'. However the study was about the consonants which belong to different class of consonants according to manner of articulation. This study finds the reverse sonority order consonants within same class of consonants i.e. Obstruents.

During the description of *Place.CC, it was found that the onset consonant clusters with same place of articulation and different sonority order are blocked in Pashto language. While as the constraint AGREE (VOICE) give license to some of such clusters which are found in Pashto onset clusters such as:

Consonant cluster	**examples**	**gloss**	**Place**
xk	xkər	horn	velar
tl	tlə̀l	to go	Alveolar

These clusters in Pashto language are also supported by the manner of articulation constraint (difference in sonority value). The /xk/ is the combination of different types of manner such as fricative and plosive while as /tl/ is the combination of plosive and approximant.

The above argument between sonority constraint (2) and (3) gives us another constraint ranking in which AGREE (VOICE) is placed at higher rank than *Place.CC constraint. This ranking can be represented as AGREE (VOICE) >> *Place.CC.

Conclusion

This paper illustrated the optimal onset clusters of Pashto language spoken in Kashmir which are determined by the sonority value of each sound segment. The analysis was based on the different types of sonority constraints mainly place, manner and voice feature of sound segments to find the optimal onset clusters. This study finds that Pashto consonant clusters occur in increasing order of sonority at initial position of syllables. However the fricatives and plosives occur in reverse sonority order. The structures with reverse sonority order are optimized by the dominance AGREE (VOICE) which is higher ranked constraint in the conflict with *Place.CC. This paper evaluated the onset cluster of Pashto syllables while leaving the scope to evaluate the sonority order of Pashto syllable at different levels.

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