HARMONY AND SONORITY IN GEORGIAN

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ABSTRACT

It has been claimed that in Georgian, harmonic consonant clusters have a single release, regardless of the number of consonants in the cluster [1]. Harmonic consonant clusters are those clusters that group together based on manner of articulation, e.g. voiced, aspirated, ejective, etc. [1,2,3, 4]. To examine this claim, harmonic and non-harmonic consonant clusters were recorded and analyzed in order to 1) assess the phonetic reality of the initial claim; and (2) to compare durations of cluster releases and whole cluster segments. Results of the distribution of release durations show a correlation to a sonority hierarchy [5]. This builds on previous work on Georgian, where it was found that while the use of a prefix {h} was decreasing [6], the pattern of its loss manifested a marked sonority hierarchy in two respects. I investigate here whether these hierarchies hold true across other phonological processes in Georgian.

1. INTRODUCTION

Languages of the Caucasus have long been know for their rich consonantal systems and complex consonant clusters. Georgian, a language in the Kartvelian or South Caucasian family of languages, not only follows this pattern, but differentiates between types of consonant clusters within its system. The clusters are divided into groups of harmonic consonant clusters and non-harmonic consonant clusters. In grammars of current usage (Aronson [1], Dirr [3], Marr and Briere [5], Rudenko [6], Tschenkeli [8], Vogt [9]) these clusters are described in detail. My purpose in this paper is to examine claims that harmonic clusters have a different release pattern than that of other consonant clusters -- that there is a single release at the end of the cluster rather than the expected release after each sound (more or less).

This paper will first present the rudiments of the Georgian consonantal system and then move on to explain the differences between the two consonant cluster types. This is followed by experimental concerns -- the parameters, the set-up, the results with discussion. After this I will look at issues of sonority manifested in Georgian from a previous work [10] and examine how these issues of sonority relate to harmonic consonant clusters.

2. GEORGIAN CONSONANTS

2.1 Georgian Consonant System

The Georgian consonant system, although not as complex as some languages in the North Caucasus, is fairly robust. Below is a table (adapted from Aronson [1]) that gives the consonant inventory of Georgian. Stops and affricates are grouped together as they have the three-way distinction - voiced, aspirated, glottalized. They are also the focus of this study. Although fricatives form harmonic clusters as well as the stop series, their lack of total closure makes them even less likely candidates for 'zero release'; they will not be considered here.

	Lab.	Dent.	Alv.	Palat-Alv.	Vel.	Post-Velar
Stops vcd.	b	d	dz	dʒ	g	
& asp.	p	t^h	ts^h	$tʃ^h$	k^h	
Affric.glot.	p’	t’	ts’	tʃ’	k’	q’
Fric. vcd.		z	ʒ			ɣ
vcls.		s	ʃ			χ
Nasals	m	n				
Liquids & Glides	v	l,r				

Table 1. Georgian Consonant System [1]

2.2 Non-Harmonic Cluster Types

Non-harmonic clusters may in principle be composed of a variety of consonant combinations, the restrictions of Georgian phonotactics notwithstanding. Clusters occur primarily in morpheme initial position. An example of a non-harmonic cluster is :

[t^h b i l i s i] 'Tbilisi', the capital city of Georgia.

The first element of the cluster is aspirated, and the second is voiced - a cluster differing by place and manner. Below (Figure 1.), the spectrogram illustrates a normative release pattern, closure and burst for the aspirated /t/, closure and burst for voiced /b/, i.e. two releases.

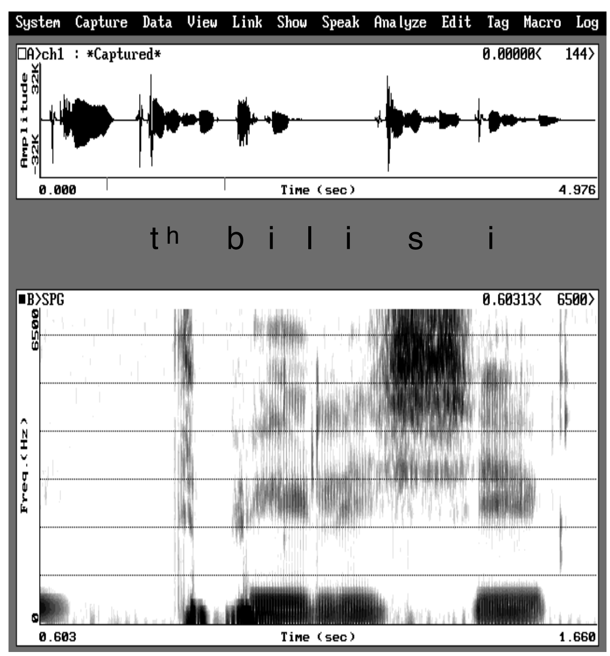

Figure 1. [t^h b i l i s i]

2.3 Harmonic Cluster Types

A view of harmonic cluster types is listed below. Although clusters can include more elements than those listed, the basic structure is grouped by manner, front of the oral cavity (labial, dental, alveolar, palato-alveolar) with a velar element, with a possible 2nd element post-velar as well.

Voiced:	bg, dg, dzg, dʒg
Voiced, 2nd element:	ɣ
Aspirated:	pk, tk, tsk, tʃk
Aspirated, 2nd element:	χ
Glottalized:	p'k', t'k', ts'k', tßk'
Glottalized, 2nd element:	q'

Table 2. Harmonic Consonant Cluster Groups

3. RESEARCH QUESTIONS

The experiment was designed with these specific research questions in mind:

1) Do harmonic consonant clusters have only one release?

2) Is it possible to differentiate consonants if there is no intervening release?

3) If there is a release, is it so much shorter than that of non-harmonic clusters that grammars have stated there is no release?

The first question is, to a certain extent, a straw dog in that it seems unlikely that the consonants can have zero release and still be identifiable. Although some cues may be had from the onset of a sound, the offset/release is a critical cue that given a series of no releases, as these clusters are described, there would be minimal chance of perceiving the intervening segments. This also addresses the second question, a follow-up to the first -- without an acoustic signal of any sort, it again seems dubious that a complex cluster could be perceived. It is then to the third question, that this paper is really addressed -- are the differences in the release durations between these two consonant cluster types so great as to engender a possible description of no release in harmonic clusters?

4. EXPERIMENT

4.1 Procedures

Six native speakers of Georgian were recorded on a DAT taperecorder using a Marantz Condenser microphone. Although a sound booth was unavailable in the field, very quiet conditions were achieved by using a central room, without windows to the outside. The speakers were natives of Tbilisi, the capital of Georgia, and considered to be fluent speakers of the standard literary language. The age of the speaker varied from 10 years old to 70 years old. The gender distribution was two females, four males. Although there is some variation to be found between males and females, this is not of the sort that should show a differences in consonant cluster production.

There were three repetitions of a total of 29 individual words. The first token was spoken in the frame sentence:

Tkvi ______ or dʒer.

'Say _______ two times.'

Immediately following this, each of the tokens was then pronounced twice in isolation for a total of three tokens per word.

The test clusters were of 4 types:

1) Non-harmonic initial clusters
2) Harmonic initial clusters - aspirated
3) Harmonic initial clusters - voiced
4) Harmonic initial clusters - glottalized

4.2. Acoustic Parameters Examined

The elements investigated in this study were various burst durations. First, burst durations of elements in each of the four cluster types were measured. Durations of whole clusters were also measured for comparison purposes. Comparison of durations of like elements in harmonic clusters and non-harmonic clusters were made to see whether there appreciable differences that regularly patterned with each cluster and element type.

4.3. Results

First and foremost it should be noted that all tokens of harmonic consonant clusters showed a release after each element in the cluster. There were no cases of a single release for a cluster sequence.

Across all 6 speakers (varying by both age and gender) the difference between the duration of the releases of elements within harmonic clusters and non-harmonic clusters was minimal. In some cases, the duration of a release of an element within a harmonic cluster was even greater than that of the same element in a non-harmonic cluster environment. The findings would indicate that definitive differences that could be attributed to an element's membership in one cluster type or another did not materialize.

The next spectrogram (Figure 2.) shows the token [tʃ' k' u a]. This is a two-member glottalized harmonic cluster. The first member a palato-alveolar, the second - velar. A careful inspection shows that there is considerable frication noise as part of the release of the first member of the cluster . In this case the initial member is an affricate, but again, in order to generate the noise seen on the spectrogram, there must be an egress of air .

A review of aspirated harmonic cluster sequences is similar to the previous paragraph about glottalized clusters. The word, [t^h k^h v a], across the 18 tokens shows the same results. The aspirated initial dental not only has a release, but the release does not differ appreciably from the release seen in the example above for /tbilisi/ (Figure 1.).

There were also cases where there was the addition of a vocalic element between consonants in the cluster, e.g. for example in the voiced harmonic token, /dgas/, its spectrogram shows a strong vowel-like segment between the /d/ and the /g/ that is clearly a schwa -- [d ə g a s] . Although it is possible in principle to produce the token with a dental onset and a velar offset for the cluster, this was not a course chosen by any of the six speakers, or 18 tokens of the same lexical item.

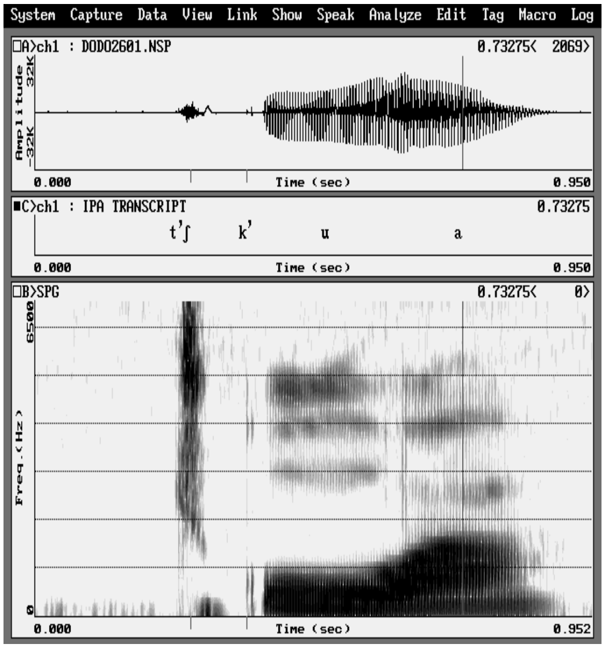

Figure 2. [tʃ' k' u a]

5. DISCUSSION

5.1 Experimental Results

Results from the experiment show that the statement found in grammars, 'harmonic clusters have one release,' [1], [3], [5], [6],[7], [8], [9] does not turn out to be true in its phonetic realization. There were also no differences that could be attributed to gender distinctions. Age as well did not seem to play a role. There is the possibility that there could be a style of speech (theatrical perhaps) that tries to follow this rule as closely as possible. Such a hypothesis would be interesting to pursue as the provenance of this dictum is opaque.

In a study [11], it has also been shown that harmonic consonant clusters in Georgian have more than one release and that further, their sequencing is a result of a complex set of parameters that include issues of sonority in their number.

5.2 Sonority in Georgian Phonological Processes

In a previous paper, the distribution of the morpheme {h} in Georgian (Old, Middle, and Modern) was defined in acoustic terms using the feature grave/acute [4]. This morpheme was gradually being lost from usage and followed a clear hierarchy of **+** sonority > **-** sonority . A brief look at the gradual loss of this prefix over time follows. The table below compares the differences between the Old Georgian rule vs. the Modern Georgian rule of the distribution of the morpheme {h}.

Old Georgian	*Modern Georgian*
h>0 / __V	h>0 / __V
h>h / __ L, N	h>0 / __ L, N
h>h / __ P, K	h>h / __ P, K
h>s / __ T, C	h > s / __ T, C
s>ʃ / __ C	

(C is used here as a cover term for palatals)

Table 3. Old Georgian vs. Modern Georgian {h} Distribution

Sonority hierarchies are usually set up by the degrees of sonority, that is resonance. For Georgian, sonority becomes relevant for both the h-series morpheme and that of the following consonant. Clements [2] proposes a sonority hierarchy set up in such a manner.

+Sonority -Sonority

V > G > L > N > O

(V-vowel, G-glide, L-liquid, N-nasal, O-obstruent)

We assume these principles of sonority operate in both the morpheme {h} and the followings consonant. The {h} becomes the target and the following consonant or vowel the trigger.

The sonority of [h] is closest to that of vowels, that is, it is next in the sonority hierarchy after vowels. The first environment to lose {h} is pre-vocalic, vowels being the most sonorous. We therefore have two sonority hierarchies operating simultaneously -- that of the {h} where /h/ is more sonorous than /s/ and that of the following element. The frication of the laryngeal spirant [h] is produced when the air passes through the half-closed glottis. The noise then receives coloring from surrounding vowels. This may account for its earlier disappearance before vowels.

Next is {h} before L,N (Liquids and Nasals), most likely in that order:

\+ *Sonority* -

L > N

We now come to the remaining environments of {h} -- obstruents. Because there has already been the change from h > s, we can hypothesize that the next environment is most likely to have been that of the feature grave and finally the feature acute, with /s/ as its marker.

Both of these hierarchies of sonority, working in parallel explain the loss of the {h} morpheme and the ordering of its loss. As an explanation of a phonological process, this hierarchy seems to work. However, does this hierarchy have any bearing on Georgian consonants and their synchronic inner workings -- and should it?

5.3 Sonority in Georgian

Returning to some of the examples in the harmonic consonant clusters, one sees that although consonant clusters may be long, i.e. there are no vowels in the consonant clusters, the longer consonant clusters are broken up with elements of greater sonority than that of obstruents.

The example above /dgas/ is a voiced harmonic consonant cluster. Its phonetic realization includes, in addition to the release of the first element [d], an intervening schwa-like element before continuing on to the [g] and the remainder of the word. This insertion of more sonorous elements, seen visibly in words by the interplay phonotactically of liquids, glides, nasals to offset obstruents, is a factor in the ability to permit what looks to be long and complex consonant clusters [11]. What occurs in addition to the actual representation of a given lexical item are the additional phonetic insertions, that provide even more sonority to a the production of a word.

How does this conform to principles of sonority that view consonant cluster sequencing as start to finish process? It doesn't. What it does do, however, is to adhere to principles of sonority sequencing in a wave across a word, that is adjacent elements will follow a trajectory though the sonority hierarchy within the production of the word. This may well be to say that sonority as a concept is as fluid as ever -- difficult to apply in rigid terms to the phonetic realization of Georgian.

6. CONCLUSION

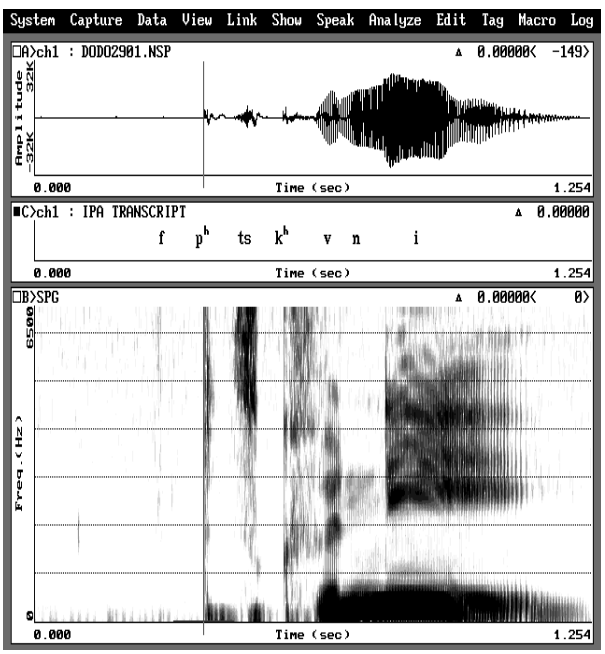

Figure 3. [f p^h ts^h k^h v n i]

The word in Figure 3., [f p^h ts^h k^h v n i], is often cited as an example of a long consonant cluster in Georgian. It is, but it is also a good example of the insertion of vocalizing elements in the production of such a cluster. The initial /v/ is devoiced to [f] by its proximity to [p^h] . A careful look a the next three segments shows them to be voiceless as well. However, a close look at the bottom of the spectrogram shows intermittent voicing throughout these segments. In addition, there are fairly strong formant lines crossing through these areas of frication. In fact, what one hears is vocalic elements at the offset of [p^h] and in the release of [k^h].

The most reasonable conclusion here is then, that although Georgian has seemingly impossible consonant clusters, most are in fact broken up in some way such that the actual consonantal length of any cluster phonetically is probably rarely more than 2 (maybe 3) together.

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