

Statistical co-occurrence restrictions in Oromo consonants

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In this work, I examine a novel case of laryngeal co-occurrence restrictions in Oromo, a Cushitic language spoken in Ethiopia. This study reveals that Oromo has both ejective harmony and voicing harmony on a statistical level. This case of laryngeal harmony has never before been described in Oromo, nor in other Cushitic languages. Since laryngeal harmony is so rare cross-linguistically, this research adds an important new case to the literature. Moreover, due to the statistical nature of the harmony, and in particular the statistical directionality patterns, Oromo raises crucial questions about the place of non-categorical patterns in phonology.

Oromo has laryngeal contrasts in stops/affricates that vary from a two-way contrast for bilabials (/p', b/), to a three-way contrast for post-alveolars (/tʃ, tʃ̣, dʒ/) and velars (/k, k', g/), to a four-way contrast for dentals (/t, t', d, d'/) (Gamta 1989). The purpose of this research was to determine whether there are harmonic restrictions on the distribution of these consonants.

Laryngeal harmony systems are rare, but common in other languages of Ethiopia, such as Chaha (Gallagher 2010). Since laryngeal harmony tends to involve only morpheme-internal restrictions (Hansson 2001, 2010; Rose and Walker 2004), it is easy for it to be missed, particularly when it is statistical. In this work, I look for these restrictions in Oromo words of shape CV(C)CV.

Specifically, my research tested whether Oromo voiceless stops (plain and ejective) are required to agree in [constricted glottis], as well as whether all Oromo stops are required to agree in voicing. Results show that these different categories of Oromo stops are not randomly distributed; chi-square statistics on laryngeal categories of first and second consonants show a very high level of significance ($p < 0.00001$ in both cases). Observed over expected (O/E) values given below show that agreement is highly over-represented, while disagreement is under-represented. Thus, Oromo has statistical laryngeal harmony. However, it is not categorical, since the disagreeing cases do not have O/E values of 0, and there are many examples of disagreement.

	<i>Ejective harmony</i>			<i>Voicing harmony</i>	
	<i>C2 Ejective</i>	<i>C2 Plain</i>		<i>C2 Voiced</i>	<i>C2 Voiceless</i>
<i>C1 Ejective</i>	1.53	0.35	<i>C1 Voiced</i>	1.46	0.57
<i>C1 Plain</i>	0.22	2.00	<i>C1 Voiceless</i>	0.38	1.58

This statistical harmony in Oromo has several major implications. In addition to a statistical tendency towards agreement, there are further statistical asymmetries in Oromo that mirror patterns that are categorical in other languages. In particular, the O/E values above show that within the disagreeing cases, there is greater under-representation when C2 is ejective for ejective harmony and when C2 is voiced for voicing harmony. For the voicing case, there is a notable trend towards significance ($p < 0.08$). This result mirrors a categorical regressive effect in languages such as Ngizim, where sequences of voiceless stops followed by voiced stops are forbidden but the opposite order is allowed (Hansson 2001, 2010). Thus, in addition to the overall trend towards harmony, there is a statistical directionality effect that requires explanation.

With such results, I consider the larger question of what implications these effects have for phonology, which is often considered categorical in nature. If we want to understand how cross-linguistic regressive directionality arises, it is crucial to look at statistical cases like Oromo, since they suggest that such biases may go much deeper than accounts of categorical harmony would suggest. While implications of statistical consonant harmony to phonological theory have been considered previously (e.g. Brown 2008), the present research is novel in that it looks at asymmetries like directionality within a statistical pattern. Thus, by examining this novel case of laryngeal harmony, I conclude that Oromo suggests a need to understand statistical consonant co-occurrences in order to fully understand the categorical patterns usually treated by phonology.

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