**Morphological and phonetic locality domains in Cochabamba Quechua phonotactics**

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Cochabamba Quechua (CQ) exhibits a cooccurrence restriction on ejectives, disallowing roots with multiple ejectives, *[k'ap'i], and also an ordering restriction on ejectives, disallowing roots with an initial plain stop and medial ejective, *[kap'i]. The results of a repetition task support native speaker knowledge of both of these restrictions and, further, are consistent with a representation of the ordering restriction that is sensitive to phonetic distance, and a more abstract cooccurrence restriction that applies within the morphological domain of the root.

***The question:*** Among other restrictions, roots in CQ may not contain pairs of ejectives (1c), or a plain stop followed by an ejective (1d). Ejectives may occur in medial position if the initial consonant is a non-stop (1b), and in initial position (1a).

(1) a. k'api 'to squeeze' t'uʌu 'skinny' b. satʃ'a 'tree' ʌant'a 'wood' c. *k'ap'i d. *kap'i

Both restrictions hold categorically of roots, which are overwhelmingly disyllabic, and thus the interacting consonants are separated by at most a single vowel and consonant. The current experiment compares CQ speakers' treatment of phonotactic violations in $C_1$-$C_2$ of a $C_1VC_2V$ nonce root with their treatment of the same violations in $C_1$-$C_3$ of a $C_1VC_2VC_3$ nonce root. CQ speakers' performance is relevant to understanding the degree to which learners form abstract generalizations beyond what is directly supported by the statistical patterns in their language (Becker et al. 2011; Hayes et al. 2009), and the extent to which typological patterns are reflected in synchronic grammars (Berent et al. 2007; Moreton 2008).

The lexical patterns are compatible with a narrow generalization that references the segmental string, e.g., "two consonants separated by a V (and C) are not both ejective", which predicts that violations in $C_1$-$C_2$ will be strongly disprefered to violations in $C_1$-$C_3$, or a broader generalization that references the morphological domain, e.g., "two consonants within a root are not both ejective", which predicts that violations in $C_1$-$C_2$ and $C_1$-$C_3$ will be comparable. Comparison of the cooccurrence and ordering restrictions is of interest because of the typological differences between these two restrictions. Cooccurrence restrictions on ejectives and other features are typologically common, while ordering restrictions are not (Gallagher 2013).

***Methods:*** 19 native CQ speakers listened to nonce words, and were instructed to repeat what they heard as precisely as possible. There were 90 target items, divided into two conditions, local and non-local, and three categories, control, ordering and cooccurrence. In the local condition, items were $C_1VC_2V$ where $C_2$ was always ejective and $C_1$ was (i) a fricative or sonorant (control, e.g., [lap'a]), (ii) a plain stop (ordering, e.g., [kip'u]), or (iii) an ejective (cooccurrence, e.g., [k'ip'a]). In the non-local condition, items were $C_1VC_2VC_3$, where $C_3$ was always ejective, $C_2$ was always a fricative or sonorant, and $C_1$ was (i) a fricative or sonorant (control, e.g., [nusap'i]), (ii) a plain stop (ordering, e.g., [kuwip'a]), or (iii) an ejective (cooccurrence, e.g., [k'imap'i]).

***Results:*** Responses were coded as 'correct' or 'incorrect' and analyzed in a Mixed Logit Model with predictors of locality and stimulus category and maximal random effects structure. Overall accuracy shows a strong effect of grammaticality, with participants repeating control items more accurately than either ordering or cooccurrence items ($p < .0001$). While there is no difference in accuracy between the ordering and cooccurrence categories overall ( $p > .1$), there is a significant interaction with locality ($p < .03$). Post-hoc tests show that accuracy on the ordering category is higher in the non-local than in the local condition, while accuracy on the cooccurrence category stays the same in the two conditions. Results are shown in Figure 1.

Responses were also coded for type of error. Errors on the cooccurrence category overwhelmingly repaired the phonotactic violation by de-ejectivizing the second of two ejectives ([k'it'a] produced as [k'ita]), though a few non-repairs existed with de-ejectivization of the first ejective ([k'it'a] produced as [kit'a]). In contrast, repairs and non-repairs were both frequent in errors on the ordering category; repairs either de-ejectivized ([kup'a] produced as [kupa]) or moved ejection ([kup'a] produced as [k'upa]), non-repairs doubled ejection ([kup'a] produced as [k'up'a]). The proportions of repairs and non-repairs are shown in Table 1.

***Discussion:*** The results show an effect of grammaticality, in both locality conditions, echoing results of previous work showing that speakers are sensitive to phonotactic restrictions between non-adjacent segments (Frisch & Zawaydeh 2001; Berent & Shimron 1997; Rose & King 2007; Gallagher 2013). There is also evidence of differences between the two restrictions.

First, performance on the cooccurrence category is unaffected by locality, while performance on the ordering category is sensitive to locality, improving in the non-local condition. Accuracy on the cooccurrence category is entirely consistent with an abstract, morphologically defined restriction that does not reference phonetic difficulty. If phonetic effort were at play, an effect of phonetic distance would be expected. Accuracy on the ordering category, however, suggests a role for phonetic difficulty in driving errors, and also that the representation of this restriction references phonetic detail and distance, as opposed to the morphological domain.

Second, errors on the cooccurrence category are overwhelmingly repairs, consistent with errors on this category being primarily driven by a grammatical restriction. In contrast, errors on the ordering category are evenly split between repairs and non-repairs. The prevalence of non-repair errors suggests that phonetic factors are relevant to this restriction, as the phonotactic grammar should not drive non-repair errors. The details of the articulatory and perceptual content of the ordering restriction are currently being explored in follow-up experiments.

***Conclusion:*** The cooccurrence restriction appears to abstract over phonetic detail and reference morphological locality, while the ordering restriction is sensitive to phonetic detail and distance. A more abstract representation of the cooccurrence restriction is consistent with a bias towards postulating this type of generalization, which is also typologically more common.

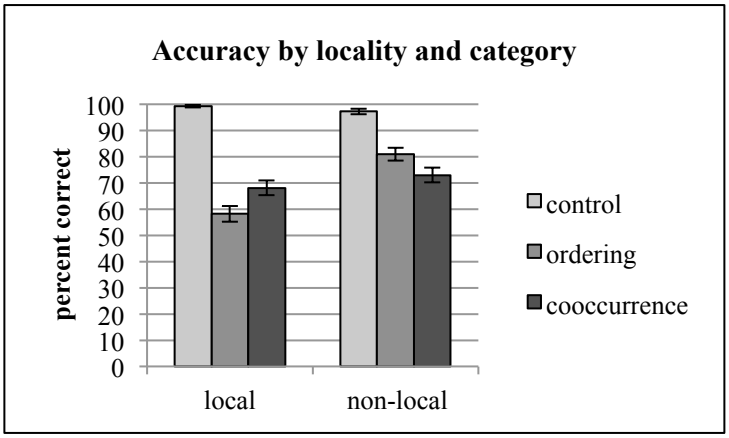


**Figure 1: Accuracy by condition and category, with SE.**

| | local | |
|---|---|---|
| | repair | non-repair |
| cooccurrence | 29.4 % | 2.2 % |
| ordering | 23.9% | 17.9 % |
| | **non-local** | |
| | repair | non-repair |
| cooccurrence | 19.9% | 7.1 % |
| ordering | 9 % | 10 % |

**Table 1: percentage of (non)repair errors**

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