Timing, perceptual distinctiveness, and cluster phonotactics in Spanish and Italian

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This paper argues that phonotactic restrictions on complex onsets in Spanish and Italian are explained by the phonetic properties of the sounds involved. We propose that the relevant properties are the possibility of temporal compression - compensatory shortening - and the availability of perceptual cues to contrast. Compression is the tendency for segments to be shorter in syllables that contain more of them ([1], [2], [3]). An analysis that appeals to these properties allows a unified account of cluster phonotactics involving obstruents, /l/, and the problematic rhotic sounds in these languages.

Spanish allows word-initial consonant clusters consisting of an obstruent followed by a liquid (e.g. /baŋko/ ‘white’), but not word-initial obstruent-obstruent (OO) clusters (e.g. */bdaŋko/). The acoustic realization of /r/ in such clusters, however, normally described as a trill, has more in common acoustically with an obstruent like /d/ than a liquid like /l/. The availability of /Cr/ clusters, then, is something of a puzzle.

Previous analyses ([4], [5]) have attempted to relate the licensing of /Cr/ clusters to the appearance of an excrecent vowel (the acoustic reflex of an open transition) in between the obstruent and tap (Fig. 1), claiming it is realized to improve the recoverability of the obstruent and its features. This line of analysis raises the question of why OO clusters cannot undergo the same repair. While we agree that perceptibility plays a direct role in this domain, we argue that both the availability of /Cr/ clusters and the unavailability of OO clusters are crucially dependent on higher-level timing factors related to compression effects. Syllables are subject to conflicting pressures, on the one hand to be realized with relatively short durations, and on the other hand to preserve the perceptibility of segments. In /Cr/ sequences, this conflict is solved by simultaneously shortening the /r/ (G1), shortening the following vowel (G2), preserving the perceptibility of the following vowel (G3), and preserving the perceptibility of the preceding obstruent (G4). This solution involves producing the /r/ as a single-cycle trill (satisfying G1) with extensive overlap between this segment and the following vowel (satisfying G2) resulting in a so-called excrecent vowel between the two consonants (satisfying G3 and G4). Pilot data from a Spanish production study shows that the excrecent vocalic interval tracks the formant values of the following vowel, plausibly contributing to its perceptibility (Fig. 2). Furthermore, formant values within the vocalic interval show signs of the non-coronal tongue gestures ([6]) associated with the apical trill; this is consistent with the hypothesis of a reduced trill, but not expected from a ballistic tap. Finally, the vowel following a /Cr/ cluster is shorter than that following a singleton onset. In OO clusters, on the other hand, only a subset of the goals mentioned above can be achieved at once. For instance, shortening the vowel through extensive overlap with the preceding obstruent will decrease the vowel’s perceptibility more than in the /Cr/ case, due to the longer closure associated with an obstruent. Trying to avoid this outcome by producing an excrecent vowel between the two obstruents will involve substantial lengthening of the syllable.

In this account, the realization and availability of various clusters is affected by constraints on syllable duration. We predict that if a language licenses a particular realization of one cluster, it will also license realizations of other clusters with similar temporal properties, all else being equal. In Spanish, for instance, only an extremely compressed realization of /Cr/ clusters is licensed; because OO clusters have no equivalent realization, they are not licensed. A language that allows less compressed realizations of /Cr/ clusters, on the other hand, is expected to allow a greater variety of clusters.

We argue that this prediction is instantiated by Italian. Descriptive and experimental data from Italian shows that /r/ is realized as a full trill in onset clusters; correspondingly, Italian is more tolerant of a variety of OO clusters than Spanish is. We explore the implications of these facts for timing, compression, and their interaction with perceptual distinctiveness in Italian.
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**Fig. 1.** Utterance of nonce-word /tapro/ from a Venezuelan Spanish speaker. Clearly visible in the waveform and spectrogram is an excrescent vowel (labeled ‘e.v.’) separating [p] and [ɾ].

**Fig. 2.** Formant space for one Venezuelan speaker internal to stressed vowels (largest space), excrescent vowels in stop-tap sequences (intermediate space), and the open phases of trilled /r/ (smallest space). Data points within each space are respective average values for {u, i, e, a, o}, clockwise from top left. Y-axis is inverted to preserve height orientation of vowel chart.

**References:**