

The asymmetries between prevocalic and postvocalic positions that this study focuses on are twofold: (1) languages are attested that disallow codas (e.g. Fijian), only allows released (e.g. Arabic, Hindi, and Russian) or unreleased codas (e.g. Korean), or allow optionally released coda (e.g. English) in the postvocalic position whereas no languages are known as onsetless and prevocalic stops are always released; (2) postvocalic stops are likely to be a target of various phonological processes (deletion, assimilation, and epenthesis). Nevertheless, unlike unreleased stops, it has been documented that released stops are rarely targeted for deletion and assimilation in pre-consonantal context.

Perceptual approaches [1, 4, 7] have provided a possible analysis on such positional asymmetries by ranking a faithfulness constraint for a perceptually prominent position (e.g. when syllable initial or released) over a general faithfulness constraint within the optimality theory framework. However, they have rarely provided a principled analysis on such typology of syllable-final patterns in their framework. In addition, the ‘optionally released’ case could not be triggered by markedness constraints such as *RELEASE* and **RELEASE* without co-ranking them (See [4]). Also, for a language exhibiting syllable-final release (e.g. Zoque), this analysis could not predict an optimal output in that a faithfulness constraint for a specific condition (e.g. *MAX_{REL}(place)*) would not apply for a deleted output candidate (See [4, 7]).

Recently, nonlinear dynamic studies showed that intergestural coordination of multiple articulatory actions, each of which can be viewed as an individual oscillator, can be interpreted in terms of interaction of multiple oscillatory systems. Further, it is argued that a coupled oscillator model [3, 6, 8], in which intergestural coordination is controlled by coupling the dynamical systems (oscillators), can demonstrate the observed patterns of articulatory actions when coupling is positionally asymmetrical: onset gestures are all coordinated (synchronously) to the vowel gesture, as well (sequentially) as to each other, while only the first of the coda gestures is coordinated to syllable’s vowel gesture. Now this idea can be extended to a single consonant case by proposing splitting a consonant gesture into two gestures (closure (CLO) and release (REL)), which need to be specifically coordinated with respect to one another [2]. I.e., in onset, both CLO and REL are coordinated to vowel (and to each other) whereas in coda only CLO is coordinated to the vowel (CLO and REL coordinated with each other). The multiple (syllable-initial) and simply serial (syllable-final) coordinative structures are governed by two coordination principles:

SYN: “Maximize synchronous or in-phase relative phasing (zero-coordination)”

**SEQ*: “Minimize asynchronous relative phasing (non-zero coordination)”

The validity of the proposed structures has been demonstrated by (1) single-consonant c-center

effect: emergence of CLO V REL order in onset, (2) planning time: shorter stabilization time in dynamic simulations for onsets is accompanied by shorter behavioral reaction time to begin to produce a syllable with only onset Cs than only coda Cs, (3) noise-sensitivity and gestural stability: greater stability in onsets than in codas is shown in both simulations and behavioral data [5].

We propose here that the coordination principles (SYN: “maximize zero coordination” and *SEQ: “minimize non-zero coordination”) can be crucial markedness constraints to trigger alternations in languages with four types of codas. Released case (V-CLO-REL) violates *SEQ twice because both V-to-CLO and CLO-to-REL coordinations are sequential as non-zero coordination. Unreleased case (V-CLO) violates *SEQ once and codaless case satisfies *SEQ. Faithfulness constraints, MAX (C) is employed to block the deletion of a whole consonant, which can be triggered by *SEQ. Also, CLO-REL (‘A closure gesture should be coupled to a following release in the same organ.’) is a constraint to ensure prominent acoustics of a consonant through completion of production. Factorial typology of syllable-final consonant pattern by CLO-REL, MAX (C) and *SEQ is as follows.

CLO-REL, MAX (C) >> *SEQ: released final consonant

*SEQ >> MAX (C): codaless final consonant

MAX (C) >> *SEQ >> CLO-REL: unreleased final consonant

MAX (C) >> *SEQ = CLO-REL: optionally-released final consonant

Unlike the released case, the unreleased case, which usually allows a significant gestural overlap in pre-consonantal context, can be repaired through consonant deletion (Diola-Fogny), vowel epenthesis (Ponapean) or assimilation (Korean) by high-ranking *OVERLAP (‘an articulatory closure in the presence of closure in another organ (tract variable) should be prohibited’). For onset vs. coda asymmetry, it can be argued that onset consonants are rarely targeted due to the synchronous nature in syllable-initial position exhibiting greater bonding strength and more stable mode compared to syllable-final position that the sequential nature governs.

Finally, it is argued that evolution, integrity, and syllable-initial degemination of a geminate can also be accounted for by distinct structures predictable by dynamic constraints for gestural coordination in the optimality theory framework.

Implication: this study shows how constraints based on independently motivated dynamic gestural principles can be employed to account for cross-linguistic postvocalic patterns (released, unreleased, optionally released and codaless) and some asymmetrical behaviors (onset vs. coda and released vs. unreleased final) by proposing a split consonant gesture and a postvocalic coordinative structure distinct from the prevocalic one.

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