PROSODY AND ART ICULATORY DYNAMICS IN SPOKEN LANGUAGE

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Spoken language relies on an elegant and complex acoustic structure that supports communication between speakers and listeners. Considering the orchestration of articulatory activity that produces this acoustic signal is a necessary element in understanding the human communication process. The complex messages and emotions of spoken language must be communicated by the precise choreography of the jaw, tongue, lips, larynx, and respiratory system.

The long term objective of the proposed research program is to understand how linguistic structure conditions the spatiotemporal realization of articulatory movement during speaking. As research in speech production becomes more integrated with linguistic theory, it has become increasingly clear that segmental articulation cannot be understood independently of prosodic structure. Such structure includes, but is not limited to, prominence and phrasal organization, and effects of these high-level prosodic aspects of linguistic structure pervade low-level articulatory behavior. However, despite the pervasiveness of these effects, only a very few prosodic .signatures. have been identified at the level of articulatory patterning.

This competing continuation proposal outlines a research program that investigates the relation between one aspect of prosodic structure. Phrasal structure.and the control and coordination of articulation within a dynamical systems model of speech production. The specific aim of this proposal is to understand how speakers modulate the spatiotemporal organization of oral articulatory gestures1 as a function of their phrasal positions. A series of studies are described that fall into three areas: the kinematic characteristics of speech gestures in the vicinity of phrasal junctures, the categorical versus gradient nature of those junctures as manifested in articulation, and computational modeling of the systematic variability in articulation that occurs at phrase edges. The specific aims will be pursued using articulatory movement data collected with a magnetometer system and by elaboration of the well-known Task Dynamic computational model of speech production.

Specifically, the following questions are addressed:

The realization of phrasal structure in gestural patterning.

- *Locality:* Are the articulatory slowing effects that have been observed at phrase edges limited to that position, or can the phonological structure (e.g. stress) or semantic structure (e.g. informational content) of the phrase attract the slowing effect away from the very edge of the phrase earlier or later? That is, is phrase-final lengthening. necessarily final?
- *Extent:* Over what interval does phrase-edge slowing obtain? How remote from a phrase boundary is slowing observed to initiate and end?
- *Type:* Do the same types of articulatory effects occur at phrase onsets and phrase endings?
- *Phonological categories vs. gradient disjuncture:* Do the articulatory patterns at phrase boundaries suggest the existence of small set of categorically distinct boundary types or do they support an analysis in which the strength of disjuncture between phrases can be understood as gradient in degree?

Computational modeling of phrasal effects.

- *Simulation of phrase effects:* How can the kinematic effects we observe in experiments investigating articulation be simulated within a dynamical systems model of speech production? In particular, what is the role of *parameter dynamics* whereby the parameter values of gestures are subject to time-varying modulation at prosodic boundaries?

These experiments and the concomitant computational modeling of their results will provide a profile of the manner in which multi-gesture articulatory patterning is shaped by prosodic context. Understanding the organization of units of speech production as a function of the informational composition of utterances is critical to developing a unified account of how abstract linguistic structure is communicated in spoken language.