

Quantal Theory, Enhancement and Overlap

Kenneth N. Stevens (in collaboration with Samuel J. Keyser)

Department of Electrical Engineering and Computer Science and Department of Linguistics and Philosophy
Massachusetts Institute of Technology

Abstract

We review a number of examples in which there appear to be “quantal” attributes in functions that relate positions or states of articulators and the acoustic and perceptual consequences of these actions. As a consequence of this review, we have attempted to specify more clearly what defines a quantal relation: the speech production system can assume a set of discrete states such that there are minimum acoustic and perceptual consequences when the articulators are in such a state. A corollary is that as an articulator is manipulated to move from one state to another, the acoustic consequence in the vicinity of this boundary is sensitive to small movements, and is therefore somewhat unstable. These quantal states can arise from various properties of the physics of the articulatory/acoustics system: properties of coupled acoustic resonators; interaction of sound with dynamic properties of vocal-tract or laryngeal tissue; and the role of pressures, flows, and boundaries in shaping the acoustic pattern. While these quantal relations define acoustic cues associated with particular distinctive features or contrasts, the implementation of a feature in a given language can be supplemented by gestures that introduce additional acoustic cues that enhance the perceptual saliency of the features. These enhancing gestures have particular attributes that distinguish them from the defining gestures for features. In running speech the implementation of some features may be weakened or obliterated due to gestural overlap, but the presence of enhancing cues provides some redundancy that helps to preserve the perceptual saliency of these features.