MOTOR CONTROL OF SPEECH GESTURES
Summary of Moderator's Introduction

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Speech production theory is currently faced with several closely related and quite crucial issues which are well illustrated by the papers in this Symposium on Motor Control of Speech Gestures.

Perhaps central to these issues is the growing impatience among many phoneticians with what they see as a constraint to bend or adapt physiological/mechanical "fact" from motor control research to fit abstract linguistic constructs. This issue has been discussed in detail by a number of authors (e.g., Moll, et al., 1977; Fowler, et al., in press) and its general importance is reflected by the fact that it is taken up not only at this motor control symposium but in other papers (see MacNeilage's Status Report on Speech Production) and symposia at this IXth International Congress of Phonetic Sciences. Very briefly, the issue may be summarized as follows. Many investigators today contend that concepts which are relevant to the motor control of coordinated movements in general, whether from the walking movements of the hind leg of a cat or from arm movements about the elbow of a human being, are relevant also to the understanding of the motor control of the articulators for speech. It is argued that concepts related to the fine motor control of non-speech behaviors can and should be incorporated into speech production/motor control theory. In fact, I suspect that most investigators would accept such an argument, at least up to some specific point. That is, while many would agree that much fine motor control data from non-speech and from non-human research is of importance to speech production theory, they would also argue that in the end speech and language are distinctly human behaviors (although see MacNeilage's Status Report at this congress) and that the motor control of those behaviors is therefore unique, at least in some respects. For example, Bladon in his paper in this symposium, takes the view that "the physical facts of phonetics are at their most interesting when they serve to explain some aspect of phonology, to answer the question of why the sound systems of languages are the way they are." It is at this point that the impatience of many phoneticians becomes most evident, when they

note that in virtually all physiological/mechanical experiments on motor control mechanisms, correlates of abstract linguistic segmental units are conspicuous via their absence. Such units have proven extremely difficult to quantify. Thus, the question arises: should production theorists develop their own units and concepts which are based on actual experimental observations of motor control mechanisms in general and which are unbiased by notions and abstract concepts borrowed from linguistic theory? In the consideration of this question, either explicitly or implicitly, related questions and issues quickly arise. For example, Turvey and his associates (see, e.g. Fowler, et al., in press, for a review) describe much of modern phonetics research in production theory as consisting of "translation theories" designed to discover or elucidate the rules which could serve to translate from abstract linguistic units to the more concrete neurophysiological/mechanical data of speech motor control research. Turvey's use of Action Theory (Bernstein, 1967; Turvey, et al., 1978) and his development of the concept of "Coordinative Structures" represents an attempt to avoid such translation theories while at the same time not reject out of hand the use of all traditional linguistic concepts. The paper by Gay and Turvey in the present symposium provides some experimental consideration and discussion of the coordinative structures concept in speech motor control.

By its very nature, research in speech motor control, as exemplified by the reports in this symposium, is integral to issues such as these. Sussman, for example, discusses single motor unit behaviors and the insights they provide to temporal reorganization in coarticulation and to such prosodic events as stress, thus suggesting a means to provide "sensitive indicants of higher level linguistic conditions". Hirose provides data relevant to relationships between electromyographic activity and subsequent articulator movement. As MacNeilage points out in his status report paper at this congress, issues such as these cause questions concerning the role of feedback or closed loop control to become crucial. Indeed, the majority of the papers in this symposium at least refer to problems of feedback mechanisms while several specifically address themselves to such problems. Bladon proposes a "coarticulation resistance compiler" which is "linked

ambidirectionally" to satellite units in the motor control system. Abbs suggests a preliminary "multi-level control model" to account for observations of speech motor equivalence and compensatory articulation behaviors. Folkins also addresses the problem of motor equivalence, "functional interchangeability of activity level in different muscles", and compensations for mechanical modifications of articulator positioning. Perkell provides a discussion of recent compensatory articulation, or "bite-block", experimentation and thus the role of various sorts of feedback in speech motor control. He presents an example of the use of data from non-speech behaviors and in addition concludes that ideas such as those raised in motor control research are "closely related to questions about the nature of fundamental units which underlie the programming of speech production."

Thus, these papers on the Motor Control of Speech Gestures can be seen to confront some basic and crucial issues in phonetic theory. Further discussion of these and related issues is certain to bring us closer to an understanding of how it is that speech is generated and controlled.

References

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