Phonetica
Editors: H. PILCH, Freiburg i. Br.; G. UNGEHEUER, Bonn
Publishers: S. KARGER, Basel
SEPARATUM (Printed in Switzerland)

Phonetica *34:* 304–306 (1977)

Factors in the Maintenance and Cessation of Voicing

LEIGH LISKER

University of Pennsylvania, Philadelphia, Pa., and Haskins Laboratories, New Haven, Conn.

In preparing a comment for this meeting, I found myself wondering just why the larynx seems to attract so much more attention than any of the other parts of the speech-producing apparatus. Not that we have no questions about the functioning of the velum, tongue, jaw, lips and respiratory musculature, but the larynx is especially provocative of question and debate. Of course, we are all in agreement about some things: the larynx is the source of the quasi-periodic signal which characterizes most speech that we call 'voiced', and a glottal airflow is a necessary though not sufficient condition for the oscillatory movement of the vocal folds that provides the modulation of this airflow. Moreover, if we limit our attention to voicing as a distinctive feature of the languages best known to Europeans, then we can believe, erroneously of course, that the larynx is a two-state device so far as its linguistic function is concerned: the folds either vibrate at an audible frequency or they do not. In this view, the different kinds of vibratory patterns which the folds can execute are equally [+voice]; indeed one of them may be called the 'normal' mode of vibration, all the others being relegated either to paralinguistic function or to certain exotic languages we are inclined to ignore, except as we are taught better by colleagues like EUGÉNIE HENDERSON. Can we similarly presume to suppose that there is a state of the larynx that is 'normal' for speech characterized by the absence of vocal-fold vibration? The answer seems to be 'no': the absence of modulation of a glottal airflow does not suffice as unambiguous evidence for the state of laryngeal adjustment. The folds may be approximated or tightly closed, or they may be widely separated. If we are certain that there *is* a glottal airflow and that it is not modulated by vocal-fold oscillation then we are somewhat surer that the folds are

well separated. Just how much they are separated is perhaps related, as KENNETH STEVENS suggests, to other factors that may be operating to prevent the passing air from setting up appreciable oscillation of the folds. But it must be noted that if the voicelessness of particular consonants is said to involve, necessarily or even optionally, some action to stiffen the folds, we are so far without observational data to support this view.

The straightforward picture of the larynx as an on-off tone generator gives way to a more complex situation when we consider a fact of language, namely, that voicing as a distinctive property of the speech signal most often occurs in conjunction with a severe constriction of the oral cavity. For the condition in which air flows through the glottis there may not be a unique state of the larynx for 'oscillator-on' and another for 'oscillator-off' operation, but we may be certain that in switching from one condition to the other, the larynx itself undergoes some adjustment. However, if there is blockage of the airflow somewhere above the larynx, an interruption of fold vibration need not, on the face of it, be ascribed to any particular laryngeal adjustment; it might be simply a consequence of oral occlusion maintained long enough to halt the glottal airflow needed to support oscillation. If voiceless stops tend to have closures of longer duration than voiced, this would be consistent with a view that articulatory closure is at the same time a devoicing gesture. Calculations reported by HALLE and STEVENS [1967] and by ROTHENBERG [1968] suggest, however, that the durations of even the voiced stops are greater than would seem needed to halt glottal airflow. This raises a question to which we are still without a sure answer: how is this airflow maintained during the oral closures of the order of 100 msec that are not unusual in speech? Observational data are reported that show enlargement of the supraglottal cavity during voiced-stop production: velar elevation, tongue advancement, larynx lowering – and each of these maneuvers should reduce the pressure-equalizing effect of the oral closure. But whether cavity-enlarging maneuvers and passive response of the cavity walls to air pressure change, assuming the cavity is tightly sealed, are sufficient to account for the durations of observed voiced-closure intervals is still not entirely clear. It is, in fact, not all that certain that the various cavity-enlarging maneuvers available to the speech mechanism are regularly performed during voiced-stop production; thus, for example, PERKELL's [1969, p. 42] well-known X-ray analysis reports that 'there is little observable effect of the

different consonants on the behavior of vertical movement of the hyoid bone and larynx'. In any case, however, the fact that voicing may persist unbroken through an interval of oral closure has elicited an explanatory literature. On the other hand, it has not been generally agreed that *voiceless* closure intervals require no devoicing maneuver other than the articulatory closure itself. Thus the voiceless stops (and fricatives also) have been on occasion described as involving a feature of general tenseness, a tensing of the supraglottal cavity walls, and/or a more specifically laryngeal tensing. Given then the extensive literature on stop voicing, one is entitled to ask whether it is the voicing or the devoicing of a closure interval that forces us to invoke a maneuver or maneuvers over and above the aerodynamic effect of the unaided closure. Of course, we might also suppose that the question is poorly posed in 'either-or' terms: to ensure voicing could require cavity enlargement or oral leakage, while reliable devoicing might necessarily involve positive prevention of any such enlargement, perhaps even a contraction of the supraglottal volume. If this were true in fact, then we should be greatly tempted to believe seriously that the stop voicing distinction need involve no specifically laryngeal adjustment. Whether or not such an adjustment is strictly necessary, however, it is an incontestible fact that in the production of voiceless stops there is clear electromyographic evidence of contraction of the posterior cricoarytenoid muscles. This action, if it is redundant, is evidence that the notion of economy of articulatory effort can be taken too seriously as an explanation of speech phenomena. But perhaps it is risky to write off the activity of the posterior cricoarytenoids as an instance of the 'unmotivated' expenditure of articulatory effort. What is most certain in all this is that stop voicing will continue to provide problems to exercise us, assuredly until the next international congress.

References

HALLE, M. and STEVENS, K. N.: On the mechanism of glottal vibration for vowels and consonants. Q. Prog. Rep. Res. Lab. Electron. MIT *85:* 267–271 (1967).

PERKELL, J. S.: Physiology of speech production: results and implications of a quantitative cineradiographic study (MIT Press, Cambridge 1969).

ROTHENBERG, M.: The breath-stream dynamics of simple-released-plosive production. Biblthca phonet., No. 6 (Karger, Basel 1968).

Prof. LEIGH LISKER, Department of Linguistics, University of Pennsylvania, *Philadelphia, PA 19104* (USA)