

SPEECH SCIENCES — ITS RELEVANCE AND APPLICATIONS

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Speech Sciences, dealing with aspects of production, transmission and perception of speech, is a new and developing field in India. This paper enumerated on the scope of the field and its relevance to other fields, particularly Speech — Language — Pathology. The last section of the paper deals with the application of speech science to the fields of communication engineering, neurology among others.

As the title suggests, the purpose of this article is to delineate the different aspects of speech sciences as well as to examine closely its relevance to, and relationship with other fields like Speech-Language Pathology, Musicology, Speech Recognition, Communication Engineering among others. An article of this nature, dealing with such fundamental aspects of definition and scope of a field, in a scientific journal has become a necessity as questions have frequently been raised regarding these aspects particularly by Speech - Language Pathologists working in the Indian context. The questions have been raised partly because the field of Speech Science is of recent origin, particularly in India and partly because of the ignorance of Speech-Language Pathologists as well as specialists in allied areas, regarding the existance of a field called Speech Sciences in India and its scope.

All scientific areas borrow knowledge from other disciplines for their growth. The field of Speech Sciences, being no exception, has heavily borrowed from and in fact, has grown out of such varied fields like Medicine, Linguistics, Acoustics, Electronics, Psychology, Phonetics, Cybernetics and not to mention speech-language pathology and Audiology. Though the field of Speech Sciences has heavily borrowed from these areas, yet it can be identified to have a core discipline. The field of speech sciences is concerned with communication through speech. In

otherwords, Speech Science is the study of the production of speech, the acoustics of the signal, and the perception of speech by a listener. Speech Scientists concern themselves with everything down stream of that stage. The transformations from an intended phrase to its acoustic realization by a speaker, and the transformations from acoustics of speech to the decoding of the intended phrase by a listener, are within the province of investigation by the Speech Scientist." (Borden & Harris, 1980). This hybrid field has sufficient vitality to survive and sufficient breadth to include areas which would otherwise be called experimental phonetics, communication science and voice science.

Speech sciences and Speech-Language Pathology :

The discipline of speech-language pathology is basically concerned with describing and identifying the underlying causative, precipitatory or maintaining factors of speech-language pathologies as well as their treatment. Peterson and Fairbanks (1963), two of the fields most distinguished scientists, opine that a clinical profession, speech-language pathology not excluded, not anchored in a scientific discipline is unlikely to achieve status. On what foundation has speech-language pathology been erected? The answer to this question has been as divergent as the number of speech-language pathologists existing. Some veer towards engineering, some towards education, some towards medicine, some towards linguistics and other towards dentistry. While granting that there may be some substance in all these view points, it is the belief of the present authors that a satisfactory answer to the above question can be got only by a detailed analysis of the functions of speech-language pathologist.

As said earlier, the speech-language pathologist is concerned with (i) assessment, (ii) diagnosis and (iii) treatment of individuals afflicted with speech-language pathologies. However, in actual clinical practice, how does a speech-language pathologist classify between speakers with stuttering and speakers with just normal non-fluencies? Or, for that matter, how will a speech-language pathologist proceed to classify speakers into normal and abnormal categories based on their voice characteristics. Again what guidelines of speech-language pathologists have to terminate the therapy being administered, or to assess the efficacy of their therapeutic device and procedures? Who provides a speech-language pathologist the required information on these parameters? In otherwords, would it be possible for a speech-language pathologist to distinguish the abnormal from the normal without the requisite information on what constitutes the normality? One's ability to effectively distinguish between normal and pathological speech depends on his knowledge in the basic areas of normal speech production and perception. In otherwords, the basic knowledge of normal speech production, transmission and

perception become the basis for the assessment, diagnosis and treatment of speech language pathologies.

The relationship between speech-sciences and speech-language pathology becomes clear if we recall the definition of speech sciences stated in an earlier section. Generally, academicians are sorted out from clinicians in all fields. With reference to Speech and language, those who prefer academic identify as distinct from clinical activities may label their areas of concern 'communication science {a term covering all aspects of communication, including speech}. Those interested in this area "are closest to being 'pure ' scientists of speech Pathology " (Perkins, 1971).

The relationship between speech sciences and speech language pathology is much more than the relationship between the study of normal and pathological aspects of speech, though it is a significant one. The way in which speech-language pathology currently handles the theories of speech production and perception, offers a clue to the nature of the relationship between speech sciences and speech pathology (Gilbert, 1982). Two questions point to the reciprocity of the relationships : firstly, did the theories of speech production and perception have had any influence on speech-language pathology in devising techniques of assessment, diagnosis and therapy ? secondly, whether the findings through assessment, diagnosis and therapy in speech-language pathology, in turn, affected the theories ? In other words, whether the relationship proved catalytic ? Gilbert (1982) is of the opinion that to use pathologies to adjust to normal theories would be frustrating. Understanding pathologies requires a knowledge of normative theories and models; yet, to have a comprehensive theory about the normal, constant adjustments, provided by pathological exceptions are a necessity. Therefore, we are of the opinion that speech language pathology must try to find basis, for its functioning, for its methods and for its validity, in the discipline of speech sciences and speech sciences, in turn, must make use of experiments in nature the speech language pathologies to validate their theories. The theories and models of speech science must accommodate the speech-language pathologies.

There appears to be an impression on the part of speech-language pathologists that a speech scientist is not really interested in clinical problems and that they simply ignore the enormity of the clinical problems faced by the speech-language pathologists. This remark, besides being an uncomplimentary reference to Speech Scientists, has no truth in it. But, the above belief of speech pathologists has had a negative influence on the field in the sense that the modelling which does take place in speech-language pathology tends to be atheoretical and thus less efficient (Gilbert, 1982). Ignorance of theory does not produce effective therapeutic

results. It is imperative that for effective therapeutic results the assessment, diagnosis and therapy methods be based on theories and models of speech processes which, in turn, can only be developed based on the study of normal process of speech production and perception. Therefore, a speech scientist develops theories or model of normal processes, puts his hypothesis of normals into test on clinical population and refines his theories and Models based on the feedback from clinical results. The speech-language pathologist, gets a theory/model on which to base his techniques of assesment as well as treatment and also, provides valuable data to the speech scientists on the validity of their theories of normal processes.

It was stated earlier, in the above paragraph that there is no truth in the statement that the speech scientists simply ignore the clinical problems. Even assuming for a moment that the above statement is true, it does not in any way, be little the relevance of speech science or the mutual relationship between the two fields. Speech science provides the models/theories of normal processes, and tests them on clinical population. The Speech-language pathologists would make use of these theories to devise effective techniques of management, apply them on clinical population and in the process give valuable informations to the speech: scientists on the validity of his model/theories. Thus, speech science plays an important role in providing a strong basis for speech language pathology in achieving its goal of rehabilitation.

Application of Speech Science to Allied Medical Specialities :

The contribution and the relevance of speech sciences in the diagnosis of speech language pathologies is not just restricted to speech pathology alone. The field of speech sciences can and does contribute to neurology, psychiatry and pediatrics. In disorders of neuropsychiatry, the speech and language may or may not be normal. However, it is possible, by applying the techniques developed in speech sciences, to analyze the speech and language of the pathological group and provide valuable clues to neurologists and psychiatrists for the diagnosis of the neurologic and psychiatric conditions. The research work of Aronson (1975), Darley, [Aronson & Brown (1969) Moses (1959) and Darby (1981) are the most pertinent examples of the application of the techniques of speech sciences to the diagnosis of neuropsychiatric conditions.

Similarly, the techniques of speech sciences can provide valuable data in the early indentification of the pathologic conditions. It is a fact that speech reflects both physiological and psychological conditions of the speaker. Speech being the most complex and sophisticated function of the human being, it can be expected that change in the physilogical and psychological conditions of the individual

would be reflected in his speech, however subtle they might be. From an analyses of these reflected changes in speech, the speech sciences provides data for the early identification of the pathological conditions. Similarly, infant cry research yield valuable data to the pediatricians for the early identifications of some of the neurological and many other conditions in new born babies (Indira 1982). However, it should not be construed that we have all the necessary techniques for the early identification of the physiological and psychological conditions. Rather, the purpose of the preceding paragraphs was only to highlight the potentials of the field of speech sciences.

Relationship of Speech Sciences to other Areas :

Speech is not just limited to linguistic purpose. In addition to the comfort and assurance that a listener receives when the talkers voice seems natural to him, part of speech communication consists of receiving rhythms, accents, changes in pitch etc. (Hawley, 1977). Only a small portion of the information conveyed by speech, less than 10 percent, is used for linguistic purposes and the rest provides other kinds of information. For example- speech gives information about the specific character of the vocal tract of the speaker which in turn gives information pertinent to recognition of voice, recognition of the speakers physical well being, emotional state of the speaker and to gauge the speakers attitude towards the entire context in which communication takes place. Besides, speech also conveys information about the speakers with reference to conventions of social class, communication occasion and style. The information thus obtained on the identity of speakers by voice would be of immense value in computer technology (development of machines that will respond to spoken commands), forensic medicine (identification of the speaker by his voice and lie detection) and in defence (availability of classified information). Will a speech-language pathologist be interested in, and concerned about the non-linguistic purposes of speech ? The purpose served by speech, be it linguistic or non-linguistic, is a part of and" in fact determined by the overall processes of production, transmission and perception of speech. Therefore, the study of the non-linguistic aspects of speech falls under the domain of speech science.

The importance and application of the field of speech science is much more than serving as a foundation of speech-language pathology. Any theory or model developed based on normal aspects of speech will have validity only when they can explain speech not only in normal or sub-conditions but also in supra-normal conditions. Thus, speech science also depends on, and contributes to all those disciplines which make use of speech.

One such supranormal act of speaking is singing. Singing requires all that speaking does, but far greater skills in all spheres (Greene, 1972). Singing would require greater and more: precise control of the speech mechanism, since variations in pitch, loudness,; quality and rhythm are far more rapid and more precise in singing. Since singing makes use of the speech mechanism, the study of the use of speech mechanism in singing falls under the purview of speech sciences. The advantages occurring from such an enquiry are two-fold : first, the study of the speech mechanism during the act of singing would., tell us about the act of singing ; and second, study of singing would provide valuable data to verify the theories developed to explain speech behaviour of normals and abnormals. Further, speech sciences can also contribute information on more effective and more efficient methods of teaching singing, that is, it provides information on *how* :bcst the speech machanism can be used in singing.

The use of speech for public speaking and theatrical performance can also be considered to be supra normal use of speech. Speech Sciences has a role to play in educating and providing training regarding the appropriate way of using the speech mechnism and in suggesting measures for preventing and abuse of the mechnism. For example, informations on the factors necessary for 'projecting the voice' would be highly useful for both public speaking and theatrical performance.

Development of machines that speak and recognise human speech has long been a dream of communication engineers. Greater capabilities in voice communication between man and machine will open a new visit of computer technology. With the development of a system of voice communication between man and machine, the entire system of feeding information to the computers would be revolutionalised. Three other modes of interaction are of interest ; Computer voice read out of stored information, automatic verification of caller's identity by means of his voice and automatic recognition of spoken commands. Applications extend to : voice directed installation of telephone epuipment, authentication by voice of a credit customer etc. (Flanagan 1979). Speech Sciences can contribute at all stages in the process of machine recognition of speech : in analysing the speech fed into the microphone, in converting the out put of microphone into a syllable code, transmitting it and reconverting the code into speech ('Olson et al 1962).

Concluding Remarks :

Speech science is an hybrid discipline (Perkins 1972) and forms the foundation for speech pathology (Peterson & Fairbanks 1963). Speech Science, which is concerned with the study of production, transmission and perception of speech.,

is contributing to, and borrowing information from such varied fields as computer science, Audiology, Acoustics, Experimental Phonetics and most importantly Speech-Language Pathology. The relationship between speech sciences and speech language pathology, which was one of the concern of this paper, is reciprocal one : speech sciences, in providing models/theories of speech and providing normative data on speech to the speech-language pathologists, forms the foundation of the later ; speech language pathology on the other hand, applies these models and theories on clinical population and in the process contributes significant information on the validity of the theories of speech sciences. The relationship is one between theory and practice. Further, the relevance of speech sciences extends beyond speech-language pathology. The techniques developed in speech sciences can and are being applied to neurology, Psychiatry, Pediatrics, Communication Engineering and Defence.

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