COMPUTER ASSISTED DIAGNOSIS OF PERCEPTUAL ERRORS

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ABSTRACT

A computer program has been developed for the scoring and analysis of perceptual errors in classifying German vowels. The program, written in "BASIC" for MS-DOS system computers, plots out specific errors and provides an accuracy index and length agreement correlate. A second part of the program provides the learner with a ranking list of specific vowel difficulty and an explanation of the likely nature of the perceptual error. The results may either be printed or viewed on the screen.

INTRODUCTION

The author has for some time been concerned with studies of perception, in particular its application to corrective procedures with the ultimate goal of correcting and improving pronunciation of learners of German. It has long been the author's belief that errors of pronunciation and errors of perception go hand in hand and that correction of both perception and production must be addressed. This has been the subject of several earlier papers ([1], [2]) and is the underlying premise of a book co-authored by H.-H. Wängler which has recently been published by Western Washington University Press [3] and is now used as a text by a number of German departments in the USA.

The contrastive phonetic approach used in the book is ideally suited for computer application. Each sound is treated individually with a number of pedagogically oriented steps provided to facilitate mastery of the sound in context based on potential perception and articulation difficulties. A perceptual or listening frame with accompanying listening tests in each case precedes actual production exercises. The listening exercises set a framework for contrastive problems both between potentially conflicting native (L1 = English) as well as target (L2 = German) sounds and contexts. The predetermining factors as the potential of likely problems for each sound are based upon contrastive phonetic principles and upon data gathered in the past administration of a perception test developed for native German speakers and then modified for non-native learners [4].

The test which has been modified numerous times has served in the past as an accurate indicator of degree of nativeness in perception. It is comprised of minimal pairs containing variations of German vowels which are then classified as one of fifteen phonemic categories in German. The test has in the past yielded valuable data about ranking order of vowel difficulty for students at various levels of study and has provided numerical indexes corresponding to performance standards for levels from first year college to advanced graduate student status [5]. However in its specific application here, the test is seen as an invaluable aid as part of a basic program aimed at improving individual language skills. This is done by administration of the test at varied intervals noting specific progress at elimination or improvement of certain perceptual errors. The computer program is designed to indicate specific perceptual errors, provide a priority listing of most frequently made errors and the likely nature of both errors affecting the general classification (or misperception) of vowel categories as well as specific vowel errors. As such the program has proved to be a valuable learning tool facilitating more automatic and accurate assessment of difficulties and has applications which greatly facilitate computer-dependent learner acquisition of sound perception/production.

EXPERIMENTAL PROCEDURES

The test was administered individually via a Tandberg Model 812 cassette recorder and headphones linked to an IBM-PC by a serial connection. The test material is displayed for the subject on a Teknika MJ-22 RGB Monitor or may be printed on an Epson LQ-1500 or FX-80 printer. The equipment is housed in the Foreign Language Learning Center at Western Washington University.

The student must classify each of 100 items on tape as one of fifteen phonemic choices. These choices appear as orthographic representations. The choices are indicated as letters A through O. At the conclusion of the test the student is provided with a display of all errors made along with a general assessment of major perceptual errors (6). The student may review the errors on the screen or receive a printed hard copy via printer as shown in Figures 1 and 2.
routine in the program classifies each vowel as a subset of either a short vowel group or long vowel group and calculates errors on the basis of whether they are in agreement with the length or in disagreement. The extent of this agreement is calculated as the LAF (length agreement factor). Further, the errors and create a hierarchical arrangement of the errors for individual vowels along with the percentage of the frequency of specific vowels. The display of errors as indicated in Figure 1 are it phonetic symbols and may be displayed either on the screen or printed. The screen program is accomplished through a screen were error routines and an IBM character generator. The printer routine utilizes graphics characters generated through Printworks [1] graphics program and downloaded to the main buffer of the printer. The basic display of errors and statistics analysis is followed by a second section which provides more directed diagnostic help to the learner based on further analysis of the errors. The results of the second phase of analysis are indicated as Figure 2. The types of errors are reclassified to provide more specific diagnostic help aimed at assisting the student to improve his/her perception. First a listing of vowels is provided, arranged in terms of perceptual difficulty for the student. The number of errors compared to the total number of that specific vowel contained on the test is indicated along with a percentage of misclassification of that vowel. This is followed by a section called "General Observations", and is again the number of a number of sub-routines comparing errors to specific array of character strings. The first statement provides an analysis of the LAF obtained previously. Since the test items were intended to exhibit deliberate differences in the number and length axis, the errors should have been roughly divided evenly between length and quality, an LAF of 50% - 60% would thus be considered the norm. If the LAF is less than 40%, the LAF percent factor is indicated along with the statement "Wrong length substitution—Not attentive enough to length differentiation among vowels." If on the other hand the LAF is greater than 60%, a statement such as that in Figure 2 appears indicating that too much emphasis was placed upon length in classifying the vowels and not enough upon qualitative distinctions. Further routines in the sub-routines section, the program compares errors as character strings to distinguish between un-rounded vs. non-rounded vowels and provides immediate feedback of errors. It is expected that this will be particularly useful for the beginner to assist in determining whether errors were caused by a short vowel (bitten) or long vowel (bitten); if [i] were perceived as [ɛ] a statement would thus be made noting that the perception was one of the wrong quality (efficient instead of efficient) and if [i] were perceived as [ɛ] a statement would follow indicating that a long vowel was perceived as a short vowel of lower quality (bitten instead of bitten). This fashion errors reflecting all commonly substituted vowel sounds are given brief explanations as to the nature of the error.

RESULTS

This analysis program has provided a useful tool in attempts to correct perception errors. It affords the possibility of self-administration of the test and repeated attempts at frequent intervals to monitor progress towards the elimination of errors. It furthermore allows the opportunity to concentrate efforts in goal-directed fashion on specific perceptual problem areas. Since the nature of the errors are by large predictable based on contrastive phonetic distinctions between English and German, this program could be further enhanced by providing moving graphic illustrations on the screen correlating to specific physiological activity produced in yielding the error. The program also has the potential to be adapted to a digitizing/synthesizing package to serve as a prerequisite to provide virtually automated recognition and correction of pronunciation errors. Together with an interactive video display the result ultimately could be a "teachable phonetician," at least within a limited context where errors are relatively predictable.

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