A COMPUTER-DRIVEN PROGRAM TO IMPROVE SPEECH PERCEPTION AND SPEECH PRODUCTION SKILLS

Susan Rvachew
Alberta Children's Hospital

Introduction

Several studies have shown that a subgroup of misarticulating children has significant difficulties with the phonemic perception of speech sounds (Broen, Strange, Doyle, & Heller, 1983; Rvachew & Jamieson, 1989). It has been suggested that some of these children employ subperceptual category boundaries in both the perception and production of their error sound contrasts (Hoffman, Daniloff, Bengoa, & Schuckers, 1985). Subsequently, Chaney (1988) has recommended the use of perceptual training that focuses on the child's own misarticulations and teaches these children to identify standard phonemic categories. The purpose of this study is to evaluate the effectiveness of sound identification training in facilitating correct production of "sh" by phonologically delayed preschoolers.

Description of the Training Programs

Three groups of auditory stimuli were recorded from adults and children. Group 1 consists of correct productions of the word "shoe" and incorrect productions of the word "shoe" (e.g. /tu/, /tsu/, /su/ etc.). Group 2 stimuli are one correct version each of "shoe" and "moo" while Group 3 stimuli are one correct version each of "cat" and "Pete". All words were digitized (sf=20 kHz) using the Canadian Speech Research Environment (CSRE; Jamieson, Nearey, & Ramji, 1989). In addition, 9 sets of graphic feedback stimuli were developed. For example, one set depicts a duck pond in which birds appear one at a time. An AST 386C computer equipped with signal processing hardware and CSRE were used to present the words to the children over headphones. The child's task was to listen to each word and then indicate whether the word was correct or incorrect by pointing to the appropriate symbol on the monitor. Children assigned to the Group 3 stimili listened for the word "cat" while the remaining children listened for the word "shoe". Correct responses were rewarded by presentation of the graphic feedback pictures described above.

Subjects

The subjects were 14 boys and 5 girls ranging in age from 3 years - 8 months to 5 years - 5 months. All children were awaiting treatment for phonological delay. Every child was unstimulable for the "sh" sound during pretesting. Where possible, the children were matched according to chronological age, receptive language age, expressive language age, presence of a significant history of otitis media, and severity of phonological impairment. Children were randomly assigned to 1 of the 3 groups within their respective pairs or triads. Unmatched children were independently assigned to groups at random. The group sizes are 6, 8, and 5 children for Group 1, 2, and 3 respectively. There were no significant differences between groups with respect to any of the subject variables noted above.

Procedure

All children attended 6 weekly treatment sessions. Each session consisted of 60 perception training trials, with the stimuli determined by group assignment, and 60 production training trials. Production training followed a traditional sequence of steps from isolation (level 1) through (potentially) conversational speech (level 9). Following completion of the treatment program, a digitized recording of "sh" produced in isolation was obtained from each child. CSRE was used to determine the centroid for each "sh" production.

Results

Statistical analysis of the data will not be possible until at least 5 triads of matched subjects are completed. The raw data to date is revealing clear trends however. The mean centroids (in Hz) are as follows: Group 1 = 4202, Group 2 = 3654, Group 3 = 4906. All of the children who listened to "shoe" and "moo" produced perceptually correct "sh" sounds following therapy, and all but 2 of their "sh" samples yielded centroids below 4000 Hz. One Group 3 subject and four Group 1 subjects produced correct "sh" sounds. The centroids of the "sh" sounds produced by these groups were higher than 4000 Hz, with 2 exceptions in Group 1. For each matched pair or triad, the Group 2 centroid was the lowest.

Discussion

This study is revealing that identification training for correct "sh" sounds facilitates production learning by phonologically delayed preschoolers. In particular, children who identified the words "shoe" and "moo" were most likely to learn to produce "sh" sounds which were perceptually correct, and which had centroids appropriately below 4000 Hz. This result is consistent with Grieser & Kuhl's (1989) finding that infants' learning of equivalence classification of vowel categories is enhanced when the training stimuli are prototypical exemplars of the vowel classes being taught. The superiority of the "shoe-moo" treatment is also consistent with Gierut's (1990) maximal opposition approach to phoneme learning, in which sound contrasts that involve a major class distinction are taught.

This study also has implications for the use of acoustic analysis to document clinical outcomes and to guide the therapeutic process. With the ready availability of personal computers and software such as CSRE this is increasingly practical. As Huer (1989) has noted, however, more rigorous study of the acoustic characteristics of children's misarticulations is required. The standard acoustic cues for identifying /r/ and /S/ do correspond to clinician's perceptual judgements on the average, but a disturbing number of exceptions do occur. For example, in this study two children produced perceptually correct "sh" sounds that had centroids above 5000 Hz. One distorted "sh" sound had a centroid below 4000 Hz.

Acknowlegdement

This research funded by the M.S.I. Foundation (Edmonton, Alberta).

References

Broen, P. Strange, W., Doyle, S. & Heller, J.H. (1983). Perception and production of approximant consonants by normal and articulation delayed preschoolers. Journal of Speech and Hearing Research, 26, 601-608.

Chaney, C. (1988). Identification of correct and misarticulated semivowels. Journal of Speech and Hearing Disorders, 53, 252-261.

Gierut, J.A. (1990). Differential learning of phonological opposition. Journal of Speech and Hearing Research, 33, 540-549.

Grieser, D. & Kuhl, P.K. (1989). Categorization of speech by infants: support for speech-sound prototypes. Developmental Psychology, 1989, 577-588.

Hoffman, P.R., Daniloff, R.G., Bengoa, D., & Schuckers, G.H. (1985). Misarticulating and normally articulating children's identification and discrimination of synthetic [r] and [w]. Journal of Speech and Hearing Disorders, 50, 46-53.

Huer, M.B. (1989). Acoustic tracking of articulation errors: [r]. Journal of Speech and Hearing Disorders, 54, 530-534.

Jamieson, D.G., Nearey, T.M., & Ramji, K. (1989). CSRE: A speech research environment. Canadian Acoustics, 17, 23-35.

Rvachew, S. & Jamieson, D.G. (1989). Perception of voiceless fricatives by children with a functional articulation disorder. Journal of Speech and Hearing Disorders, 54, 193-208.