The Relationship Of Non-Linguistic Visual Perception To Lipreading Skill

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The importance of visual perception to lipreading is at once obvious. Visual evidence of the message must be identified by the lipreader with speed and accuracy if the lipreader is to attain proficiency in lipreading. Its importance is recognized and explicitly discussed by both classic and recent writings concerned with lipreading training (Nitchie, 1950, p. 41; O'Neill and Oyer, 1961, pp. 50-69; Bruhn, 1965, p. 8; Jeffers and Barley, 1971, pp. 142-149). Yet only a limited amount of research has been reported which even indirectly considers the relationship of speed and accuracy of visual perception to lipreading (Heider and Heider, 1940; Reid, 1947; Wong and Taaffe, 1958; Brannon and Kodman, 1959; Coscarelli and Sanders, 1968; and Hardick, Oyer, and Irion, 1968). Moreover, the research reported provides little clear direction regarding the best approach to the training of this important component of lipreading and provides little basis for confidence that the various approaches to lipreading training develop visual skill with maximum effectiveness. Furthermore, the research that has been done has not had a precise and exclusive focus on visual perception.

This study was undertaken to consider the question of whether a specific type of visual perception independent of learned linguistic elements such as phonemes, words, and sentences might relate to and assist the lipreading process. Furthermore, it seemed logical that, because lipreading depends fundamentally on the visual identification of sound configurations on the lips, an examination of visual perception and training might most appropriately involve differing lip postures.

Specifically two questions were examined in the study. *First*, is there a relationship between untrained identification of non-linguistic mouth postures and the lipreading of either speech sounds, words, or sentences? *Second*, is lipreading skill improved as the result of training in the identification of non-linguistic mouth postures?

METHOD

Subjects

Two groups of 16 subjects were involved in the study, an experimental group (8 males and 8 females) and a control group (9 males and 7 females). The subjects were randomly selected from a large class of 400 college students and were randomly assigned to the groups. Each of the subjects was determined to have normal vision and none of the subjects had received previous lipreading training. The mean ages of the two groups was 21 and 20 respectively.

Lipreading Pre-tests

Each of the groups was first presented a lipreading pre-test battery by means of video-tape with no sound. The battery consisted of the sentences from the Keaster-Tracy Clinic Film Test of Lipreading (Taaffe, 1957); 16 unvoiced consonants presented in nonsense syllables composed of /ʌ(c)ʌ/; 11 vowels presented in syllables composed of /m(v)m/; and 50 mono-syllabic words comprising List I of the Michigan CNC Discrimination Tests.

For the test presentations the subjects were seated in four rows 5, 8, 11, and 14 feet from the television set on which the tests were presented. The head size of the image projected on the 19-inch TV screen was approximately 10 x 12 inches, including the full face and hair of the speaker.

Stimuli and Training Procedure

The full face of a female subject was photographed with her lips and mouth forming 9 different postures consisting of 3 degrees of lip rounding, 3 degrees of vertical mouth opening, and 3 degrees of horizontal widening of the mouth. Color slide transparencies were produced for projection with a tachistoscope.

Following the lipreading pre-test tachistoscopic presentations were given to the subjects in groups of 3 to 6. The subjects were seated in one or two rows with the first row situated 5 feet and the second row 8 feet from a rear projection screen on which the life-size images were projected. The subjects were asked to identify the mouth postures by writing "H 1" for horizontal posture 1 or "V 2" for vertical posture 2, etc.

The subjects first received practice in identifying the mouth postures for each dimension (horizontal, vertical, and rounding) separately by viewing each posture with no timing until an identification was attempted. Immediate feedback regarding accuracy was provided in this practice session and throughout the program. Next, in the initial session, the postures in each dimension were presented at tachistoscopic exposures of 1/5 of a second, then at 1/10 of a second, and finally at 1/25 of a second. (The exposure times of 1/5 and 1/10 of a second were used for the purpose of introducing the tachistoscopic procedure and were not used after the first session.) The last portion of this session consisted of practice in the identification of all of the postures presented with equal frequency, and in random order with untimed exposure.

The second session involved review of the procedure and, for each dimension separately, identification practice with untimed exposure followed by presentations within each dimension at each of the experimental exposure times of 1/25, 1/50, and 1/100 of a second. (This order of exposure times was maintained for succeeding sessions.) Finally, the postures for all dimensions were combined and presented randomly at the three exposure times. The same procedure was followed for session 3. During the fourth session, lip postures for all dimensions were combined and presented twice in a random order at each of the exposure times. The sessions were approximately one hour in length.

The control group received no training.

Two days after the final training session post-tests of lipreading skills were given to both the experimental and control groups. The post-test consisted of an equivalent form of the Keaster-Tracy Clinic lipreading test sentences (Taaffe, 1957) and the same nonsense syllables and words used in the pre-test but presented in different randomized order.*

RESULTS AND DISCUSSION

Relation of Perceptual Speed to Lipreading

The first question concerning the relationship between untrained identification of non-linguistic lip configurations and lipreading skill was examined by calculating coefficients of correlation between error scores for the first randomized, timed exposures of the mouth postures across all dimensions and the pre-test lipreading scores. These correlations are shown in Table 1.

It will be noted that for the exposure duration of 1/25 of a second the coefficients of correlation for words and sentences were not statistically significant at the .05 level; and no correlation is shown for lipreading of speech sounds for any of the conditions. However, at higher exposure speeds the coefficients of -.50 and -.58 for the lip-

*Equivalence of the lipreading test sentences has been established by Taaffe (1957) and equivalence of the video-tape presentations of these sentences was assumed since the sentences were spoken by the same talker under the same circumstances and during the same recording session. This was also true of the video-tape presentations of the nonsense syllables and words.

reading of words and the coefficients of -.66 and -.62 for the lipreading of sentences were statistically significant at the .05 level or better, thus indicating that the greater the perceptual accuracy for the lip postures with shorter exposure times, the greater was the success in lipreading words and sentences.

Table 1. Correlation of Errors of Visual Perception and Lipreading Skills

Lipreading Test	Exposure of Stimuli in Seconds 1/25	1/50	1/100
Sentences	-0.25	-0.66**	-0.62**
Words	-0.42	-0.50*	-0.58**
Vowels	-0.16	-0.24	-0.14
Consonants	-0.05	-0.21	-0.27

*Significant at the .05 level
**Significant at the .01 level

Although the magnitude of the significant coefficients of correlation might be considered rather low, when comparison is made to coeffients obtained from other studies of factors related to lipreading ability, they appear somewhat stronger. A review of such studies (Jeffers and Barley, 1971) reveals that the highest coefficient of correlation reported was .68, in one instance, with most correlations below .55. Thus visual perception as examined here appears to be as worthy of attention as other factors considered to be important to lipreading.

The finding that significant correlations existed only at the most rapid exposure speeds and not at 1/25 second may be related to the fact that most consonant sounds and some vowel sounds have duration times of less than 1/25 second (Fletcher, 1961, pp. 61-67). Hence skill in perception at more rapid speeds logically might be expected to contribute to greater accuracy in identifying the visible components of speech, resulting in higher lipreading scores.

One might expect to find a close correlation between the lipreading of vowels and consonants in nonsense syllables and the identification of mouth postures, especially in the case of the vowels, since the experimental mouth postures might be seen as similar to the production of isolated phonemes, particularly vowels. A possible reason for this lack of relationship may be the extreme ambiguity associated with the visual identification of English phonemes in the absence of contextual clues (Woodward and Barber, 1960; Fisher, 1968; and Franks, 1972). The high degree of confusion involved in the visual identification of speech sounds may have placed correct identification of vowels and consonants on a chance basis where even a high degree of visual skill did not influence success in the task. This suggestion is supported by the fact the scores for the lipreading of phonemes were extremely low.

Although no statistically significant relationships are shown at the speed of 1/25 of a second nor for the lipreading of phonemes at any exposure speed, the statistically significant correlations at higher exposure speeds for words and sentences support visual perceptual skill as a variable in lipreading and seem to indicate that speed of perception is important.

Results of Perceptual Training

Skill in identifying the tachistoscopically presented mouth postures was found to improve with practice. Table 2 gives a comparison of the mean number of errors for the first and final randomized presentations of the postures. All of the differences were determined by *t*-tests to be significant at the .05 level.

Table 2. Means, standard deviations, and *t*-test probabilities for error scores in identifying mouth postures for the first and final randomized tachistoscopic presentations.

Exposure	First		Final		*t*-test
Times	M	SD	M	SD	probability
1/25 sec.	12.56	4.08	7.56	4.35	.02
1/50 sec.	10.25	4.23	6.31	3.09	.02
1/100 sec.	9.43	4.59	6.44	3.03	.05

However, only to a limited extent was this apparent improvement in perceptual skill reflected in improved lipreading test scores for the experimental group in comparison to the control group.

Table 3 shows the mean differences between the pre- and post-tests of lipreading skill for the two groups. For the lipreading of sentences the mean differences favor the experimental group to a slight degree; however, the differences between the mean gains of the experimental and control groups were not statistically significant at the .05 level.

In the final analysis, minimal evidence was derived from the data to support separate training of visual perception, *as used in this study*, as a method which can be expected to have significant impact on lipreading proficiency. However, several possibilities might be considered which would justify further investigation: 1) The period of training involved in this study may not have been sufficiently long to influence

Table 3. Means of lipreading scores before and after perceptual training, mean differences, standard deviations of differences and t-test results comparing the difference scores of the experimental and control groups.

	Experimental				Control				
Lipreading Tests	Pre-M	Post-M	M Diff.	SD	Pre-M	Post-M	M Diff.	SD	t-test probability
Sentences	65.81	72.44	6.63	14.18	60.18	61.53	1.44	17.84	.37
Words	9.63	8.81	-.81	3.53	9.00	7.24	-1.88	2.78	.35
Vowels	4.69	5.00	.31	2.24	4.12	4.29	.18	2.23	.87
Consonants	7.75	8.56	.81	2.26	6.71	8.35	1.75	2.49	.27

lipreading skill. 2) Separate visual training may be helpful to lipreading, but the influence of visual perception training may have been masked by more prominent factors involved in lipreading success. 3) The specific method used here may not have been a valid approach to improving lipreading skill, but another method of visual perception training might be found to influence lipreading skill. In this regard, we should not ignore the significant correlations shown between initial success with the visual perception task used and scores on the sentence and word portions of the lipreading pre-test. The type of visual skill utilized to identify the rapidly presented mouth postures appears, at least, to involve a factor or factors important to lipreading. If this is true, we should be concerned with further objective investigation to more specifically identify this component of the lipreading process and to continue to search for the best method to strengthen this and other elements of lipreading skill.

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