Training With A Vibrotactile Aid: A Case Report

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A twenty-nine year old woman, completely deafened, was fitted with a vibrotactile device as an adjunct sensory input. The device was a body hearing aid with a bone conduction receiver taped to the client's palm. After wearing the aid for two months, training in vibrotactile duration discrimination was undertaken, while speech-reading training was suspended. A speechreading test of four CID Everyday Sentences lists was administered before and after training. Improvement was noted on all lists, ranging from eight to twenty percent. Besides the overall advantage of vibrotactile input, improvement in perception of an isolated parameter appeared to transfer to speech perception generally. Implications for auditory/vibrotactile training are discussed.

This paper describes the use of vibrotactile stimulation as a sensory communication aid in the aural rehabilitation program for a deafened adult. Previous research with vibrotactile communication has been largely limited to normal-hearing adults or deaf children, with the exception of two other reports (Decker & Folsom, 1978; Kaplan, 1982). The subject in the present study became deaf in adulthood. It was felt that such input might prove especially beneficial for this type of client in light of the suggestion by Zeiser and Erber (1977) that previous linguistic experiences may play a beneficial role in receiving certain speech parameters vibrotactilely; their subjects counted numbers of syllables in words.

SUBJECT

The subject of this report was a twenty-nine year old woman who had become completely deaf as a sequel to surgery for bilateral acoustic neuromas. She had had a moderate hearing loss in the right ear with no measurable hearing in the left ear until July, 1978. At that time she suddenly and

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completely lost all measurable hearing in the right ear as well. During the time she had residual hearing, she wore a left-to-right Bi-CROS aid, and received aural rehabilitation services, including speechreading training from this investigator for about nine months. After a hiatus of about six months, she resumed audiologic rehabilitation when she became deaf. Although a good lipreader, it was decided to try vibrotaction as an adjunct sensory input.

APPARATUS

The unit used for transduction was a powerful, commercially available body hearing aid (Omnitron 12). The output transducer was a commercial hearing aid type bone conduction vibrator. At the volume setting worn by the subject (4), the unit had a gain of 30 dB, and a frequency range of 450 to 3000 Hz, both computed by ANSI specifications. The curves are pictured in Figure 1.

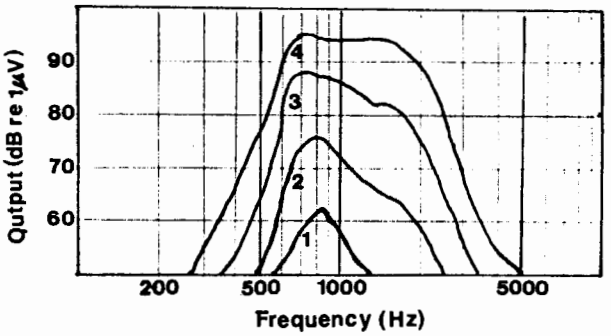

Figure 1. Frequency response curves for the vibrotactile aid with input of 60 dB SPL. The numbers refer to the volume control settings on the aid.

The subject wore the unit taped to her palm. This location seemed to her as sensitive as the fingertips, and did not interfere with normal hand function. Palmar placement has been reported to yield more sensitive speech thresholds than forehead or cleidosternal placement in deaf and hard-of-hearing children (Bender, 1973).

PROCEDURES

Initial Application of Vibrator

To estimate whether the application of such a device would be helpful at all, a speechreading test was given in an ABA design. That is, speechreading scores were obtained without the vibrator, then with it, and finally without it a week later. Materials used for the test were lists C and E of the

Table 1

Speechreading Scores (in percent) Obtained With Initial Application of Vibrotactile Aid

CID List	Visual Only	Visual Tactile	Repeat Visual	Max. Change
C	52	88	54	36
E	14	70	30	56

CID Everyday Sentences (Davis & Silverman, 1978). As may be seen in Table 1, application of the vibratory adjunct yielded improvement on both lists, and ranged from 36% on list C to 56% on list E.

Vibrotactile Training

Although the client improved initially by wearing the vibrator, it was felt that she might improve further with specific training of various acoustic parameters of speech. Training in isolated parameters was chosen for two reasons. First, Erber and Cramer (1974), after training with a small set of sentences, indicated that it would probably be more beneficial to learn to recognize characteristics which can be generalized, rather than specific words or sentences. Second, this client already possessed excellent language skills, and did not need training to learn words or sentences.

The feature chosen for training was duration, since this parameter seemed, from past research reports, to be the one which the vibrotactile signal transmits best (Geldard, 1961). Both Pickett (1963) and Oller, Payne, and Gavin (1980) have shown the ability of subjects to learn to discriminate duration. Such discrimination is important in determining voicing, and several suprasegmental aspects of speech.

At the time of the beginning of training, the subject had been wearing the aid for about two months. This allowed her time to develop skills spontaneously in using the vibrator prior to training. Once duration training began, speechreading training was suspended.

Sentence Recognition

The first experimental procedure was the administration of a speechreading test again, without and with the vibrator. The materials used were lists G, H, I, and J from the Everyday Sentences. These were chosen since they had not been used previously in therapy or assessment. To assess what changes in score were truly due to the use of the vibrator, a design was used in which a list of sentences was presented twice without it. This allowed for practice effects in the scores. Initially, third trials were included as well, but practice effects "peaked out" at the second presentation. After all lists were presented this way, each list was presented twice with the vibrator. Presen-

tation of lists was randomized within conditions, i.e. unaided and aided.

Duration Discrimination Training

Training was started for duration discrimination of one- versus two-syllable words. The words chosen for comparison were monosyllables, and trochees which contained the monosyllable as the stressed syllable, e.g. farm-farming or some-summer. Stimuli were presented live-voice, without visual assistance. Stimuli were first given in a same-different format with feedback after each trial. Criterion for completion was 90% correct in two consecutive blocks of twenty trials each.

Following the same-different procedure, the subject's next task was to judge which one of the two stimuli was the longer. The same materials were presented in a two-alternative forced choice (2-AFC) format, which is a more difficult task than the same-different judgment.

The same-different and 2-AFC procedures were repeated with CVC stimuli which varied in the duration of the medial nucleus, e.g. hit-hid or pick-pig, in which the cognate with the voiced final consonant would contain the longer vowel. Similar stimuli were used by Pickett (1963). The task became more difficult here due to the smaller differences in duration compared with the one- versus two-syllable stimuli.

Speechreading Retest

Following duration discrimination training, bisensory speechreading scores were re-established with the same Everyday Sentences lists used previously (G, H, I, J).

RESULTS

Sentence Recognition

Results of pre-training sentence recognition without and with the vibratory aid may be seen in Table 2. In all cases there was an improvement with the vibrator. Final improvements on the second presentation with the

Table 2

Scores on CID Everyday Sentences (in percent) After Wearing The Vibrotactile Aid for Two Months and Prior to Training in Duration Discrimination

CID List	Visual		Visual/Tactile		
	Trial 1	Trial 2	Trial 1	Trial 2	Change
G	22	40	52	56	16
H	42	52	56	72	20
I	30	58	72	80	22
J	32	50	58	66	16

vibrator ranged from sixteen percent on Lists G and J to twenty-two percent on List I.

Duration Discrimination Training

On the task using monosyllables versus trochees in the same-different format, the subject reached criterion performance in six trial blocks (recall that criterion performance was 90% correct in two consecutive twenty-trial blocks). With the same stimuli, and the task changed to the 2-AFC, criterion performance was reached in twelve trial blocks.

On the task using CVC words in the same-different format, the subject reached criterion performance in twenty-one trial blocks. When the task was changed to the 2-AFC, the subject did not reach criterion in forty trial blocks, and training was terminated.

Speechreading Retest

Results of the retest using the Everyday Sentences may be seen in Table 3. Improvement was noted on all test items, and ranged from eight percent on List H to twenty percent on List I.

Table 3

Test-retest Speechreading Scores (in percent) After Training in Duration Discrimination

CID List	Before	After	Change
G	56	72	16
H	72	80	8
I	80	100	20
J	66	78	12

DISCUSSION

In similar endeavors with deafened adults, both Decker and Folsom (1978) and Kaplan (1982) indicated improvement in speechreading scores after application of a bone vibrator. Kaplan did not report undertaking training with the vibrator alone. Decker and Folsom reported further improvement in speechreading scores after training with the vibrator only. Those authors acknowledge the possibility that their results were confounded by their subjects' possible spontaneous development of speechreading skills, apart from vibrotactile training. In the present case, the subject had had considerable training in speechreading before wearing the oscillator, so improvement was not likely due to that factor. Decker and Folsom's results may also have been due to an effect of practice with the vibrator apart from formal training. This subject had been using the vibrator for two months before training began, and furthermore, bisensory speechread-

ing scores were not better after those two months.

Aside from the indication of vibratory input as a valuable adjunct to speechreading, it seems that training in an isolated acoustic parameter transferred to aid in the overall speech recognition process. The ability to learn to discriminate words which differ primarily in duration substantiates Pickett's (1963) work in this regard. The finding of transfer learning lends credence to the suggestion of Erber and Cramer (1974) for training generalizable parameters. The present results also substantiate findings of transfer learning by vibrotaction by Kirman (1974). In many cases this may be the training method of choice, and should be seriously considered for some segments of the deaf population.

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