Table 2
Comparison of Performance of All Ss on Each Night With That of the Succeeding Night and the Instruction Night Compared to the Extinction Night

Instruction	Compared to Avoidance 1	$\chi^2 = .66$
Avoidance 1	Compared to Avoidance 2	$\chi^2 = 12.08^a$
Avoidance 2	Compared to Avoidance 3	$\chi^2 = 9.91^b$
Avoidance 3	Compared to Extinction	$\chi^2 = 2.05$
Instruction	Compared to Extinction	$\chi^2 = 4.07^c$

^a $\chi^2 \geq 10.83$, 1 df, $p < .001$; ^b $\chi^2 \geq 6.64$, 1 df, $p < .01$; ^c $\chi^2 \geq 3.84$, 1 df, $p < .05$

DISCUSSION

The results of this experiment are consistent with the findings of other investigators. A few responses were obtained under instructions alone, i.e., without external cues or reinforcement, as was found by Antrobus et al (1965). However, contingent reinforcement resulted in marked improvement in performance, as was found by Williams et al (1963). The present study differed from that of Williams et al in that no tones were presented, and the punishment was merely an interruption of the state; no shock or threat of it was used. Thus, performance of the avoidance response permitted the REM state to continue. The following interpretation is suggested as a possible means of accounting for the data.

The greatest amount of responding occurred on the second avoidance night (Night 3). This effect was felt to be due to a substantial degree of REM deprivation produced on the first avoidance night and continued on the second. This REM deprivation resulted from awakenings for response failure. Possibly, this increased a drive for REM sleep and made internal signals associated with REM sleep more salient. This allowed REM sleep after a correct response to serve as an adequate reinforcer. That is, the Ss were motivated to perform the avoidance response in order to obtain REM sleep and curtail further deprivation. The precipitous decline in performance on Night 4 (Avoidance Night 3) can be interpreted as due to satisfaction of the drive, i.e., a partial-satiation effect, resulting from increased responding and, therefore, increased REM time on the previous night.

In only one case did an S provide a correct response on Night 4 in the early part of the night before several awakenings occurred. While the effect of the avoidance treatment did promote improved performance during the extinction night compared to that of the instruction night, only one response occurred within the first 3 min of a REMP.

The motivational interpretation stated above is highly speculative, and the data do not warrant a conclusion with respect to it. However, the findings indicate that sleeping Ss can discriminate and respond to internal cues associated with the ongoing REM state.

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NOTES

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2. Presently, an ITP fellow at the Langley Porter Neuropsychiatric Institute, University of California San Francisco Medical Center.

Vibrotactile code learning by young adolescent girls

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Three groups of young adolescent girls were trained to learn a nine-element vibrotactile code (one vibrator, three intensities, three durations of signal). Two of the groups consisted of deaf Ss, and the third group of girls had normal hearing. There was no significant difference

between the groups. Although there was a significant learning effect over 10 trials, the obtained *F* ratio only just reached significance. Most of the errors made on the last trial were combined errors of intensity-duration.

Recent research has indicated that blind adults can learn 26-element vibrotactile

codes with considerable accuracy, and also that young children are capable of learning a simple six-element vibrotactile code (Diespecker, 1967; Furner & Diespecker, 1969). Vibrotactile learning experiments of this type with handicapped children do not appear to have been reported in the literature. The present investigation was made in an attempt to determine if young adolescent girls might be capable of learning a simple nine-element vibrotactile code.

Experimental studies of nine-element code learning have been made with university students of both sexes. In studying the effect of noise on the learning of such a code, Diespecker & Davenport (1967) found that all 40 Ss were able to learn the code to criterion, i.e., one correct training trial. In a more recent experiment (Diespecker, in press), it was found that four groups of Ss (university students) were able to learn a nine-element code, although the durations of signals were varied over groups to determine whether or not at least one of the groups would be unable to learn the code due to the brevity of signals. There were no significant differences between these groups, but a highly significant learning effect was obtained.

In the present study, it was hypothesized that deaf girls would learn a nine-element vibrotactile code significantly better than would girls with normal hearing. This prediction was made since it seemed probable that deaf Ss would not have to contend with either sensory or physical noise and that they would therefore be able to pay more attention to such novel stimuli than would girls having normal hearing.

SUBJECTS

The Ss were two groups each of eight girls from the School for Deaf Girls at Waratah, N.S.W., and one group (eight) of girls with normal hearing. The third group of Ss attended schools in the Newcastle, N.S.W., district. Commonwealth Acoustics Laboratory average hearing loss (dB) measurements for each deaf girl were made available to E. The values (American Standards Association) ranged from 54 to 114+, i.e., some of the children were profoundly deaf. Although very few IQ values were available, most of the deaf girls were judged to be of average intelligence, and one of the groups (Group A) was rated by teachers to be the most proficient class in the school. Group B Ss were rated as slow learners and were slightly older. The 16 deaf girls all wore hearing aids and were competent lip-readers. The mean ages of the deaf girls were: Group A, 12.26 (SD = 1.06) and Group B, 14.11

Fig. 1. Learning curves for two groups of Ss showing increase in proficiency of reception as a function of practice.

(SD = 0.60). The mean age of the Group C Ss was 13.03 (SD = 0.98).

APPARATUS AND PROCEDURE

An electronic signaling unit was used to transmit pulses to a modified Sherrick-type vibrator (Sherrick, 1965). The 54-element signaling unit was designed to transmit pulses to as many as six vibrators. The intensities of signals, for each of the six channels, were equivalent to 10, 15, and 20 V, while the three durations were 0.1, 0.3, and 0.5 sec. The durations are the same as those used by Howell (1956), and the resultant nine-element code is given in Table 1.

The vibrator was taped to the volar surface of the left forearm midway between the wrist and elbow joints. Frequency of vibration was always that of the line current, i.e., 50 Hz. The vibrations could be neither seen nor heard. All Ss were tested individually. The deaf Ss sat in a chair with arm rests and in a position from which they could lip-read. A window near E had its blind partly drawn so that Ss were not compelled to lip-read against a strong light. The Ss with normal hearing sat in a similar arm chair in a laboratory that was equipped with an exhaust fan. This fan was always switched on to provide a masking noise.

Deaf Ss were given a simple instruction sheet to read, and a copy of the code was placed in front of them. Portions of the instructions were emphasized by E who read them aloud while pointing to either the code symbols or at the test apparatus. Instructions were read to the Group C girls. When Ss indicated that they understood the procedure, E gave two demonstrations of the code: Each signal was transmitted in serial order and named. Ten test trials were then given to each S. A trial consisted of the nine signals presented in random order. S was required to respond verbally with a number (a copy of the code was always available to Ss). She was immediately told whether or not her response was correct and the signal was always repeated and named after every response. Thus, Ss received immediate feedback and were able to "rehearse" each stimulus.

No fixed intertrial interval was used, but the interval was generally 4-5 sec except

when E had difficulty in interpreting the speech of a deaf S and asked her to indicate her response by pointing to the relevant symbol in the code table. Training schedules were always completed in one session. Ten trials were chosen because data from prior experiments have indicated that most learning occurs in the first 10 to 15 training trials.

RESULTS AND DISCUSSION

The mean numbers of correct responses for each group of Ss have been plotted against trials in Fig. 1. A repeated measures analysis of variance indicated no significant difference between the groups ($F = 2.79$; $df = 2/21$; $p > .05$). The same analysis showed that although there was a significant practice effect ($F = 1.93$; $df = 9/189$; $p < .05$), the obtained F ratio only just reached significance. There was no interaction between trials and groups ($F = 0.83$; $df = 18/189$; $p > .05$). When performance over the last five trials was analyzed, there were again no significant differences between the groups ($F = 2.03$; $df = 2/21$; $p > .05$). There was no significant learning effect ($F = 0.09$; $df = 4/84$; $p > .05$) and no interaction ($F = 1.05$; $df = 8/84$; $p > .05$).

Although the performances of the Group A (the brighter group of deaf girls) and the Group C Ss (girls with normal hearing) were similar, both sets of results differed from those of the second group of deaf Ss. No S was able to achieve nine correct responses in any one trial. All Ss appeared to be well motivated toward achieving as many correct responses as possible, but the curve (Fig. 1) for the Group B Ss, which initially represented a reasonable rate of acquisition, began to decline after the sixth trial. Inspection of Fig. 1 would seem to suggest that Group B Ss were capable of improving their

performances to approximately those of the Ss in Groups A and C, but that other factors prevented such improvement from occurring.

Four types of error were studied, using data from the last trial. These were errors of intensity (I), duration (D), combined intensity-duration (I-D), and adjacency (A). I errors, which resulted when intensity levels were confused, were the most frequent type of error for Group A Ss. For both Groups B and C, Ss' I-D errors predominated, and the total I, D, and I-D errors for the three groups of Ss on the last trial were 37, 31, and 54, respectively. I-D errors occur, generally, when Ss are guessing; they result when S confuses both the intensity and the duration of a signal. The 122 errors that were made on the last trial were also categorized as being signals that were either adjacent or not adjacent to the stimulus (e.g., neighboring or adjacent errors to the stimulus "9" would be "6" and "8"; the stimulus "5" would have, as errors of adjacency, "2," "4," "6," and "8"). Errors of this type accounted for 63% of the Group A confusions. The figures for Groups B and C were 42.30% and 45%, respectively.

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Table 1
Vibrotactile Code

	Short	Medium	Long
Strong	3	6	9
Medium	2	5	8
Weak	1	4	7