

THE EFFECT OF AUDITORY STIMULI PRESENTED
DURING THE SLEEP OF CHILDREN
WITH DELAYED SPEECH

THAYNE A. HEDGES

THE UNIVERSITY OF WICHITA

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DURING THE SLEEP OF CHILDREN
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THAYNE A. HEDGES

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CHAPTER I

THE PROBLEM AND ITS SIGNIFICANCE

The acquisition of communication skills by children in a logopedic clinic is a fascinating and extremely interesting process. However, for the child who is handicapped by mental deficiency or childhood aphasia, this is many times a slow process.

One of the main objectives of a professionally oriented speech clinic is the search for new and improved methods of training.

Martin F. Palmer has stated that since speech clinicians are relatively few, one of the most pressing needs in the logopedic clinic today is the reduction of time necessary for corrective training. Thus it follows that more children can be helped to live a useful and independent life.¹

Interest in this particular experiment was stimulated by Palmer and members of the staff of the Institute of Logopedics at the University of Wichita. This was especially true with the reported success of a similar experiment by Charles Elliott in 1948 on normal college students which will be noted later in this study.

¹ Martin F. Palmer, Lecture delivered to class at Institute of Logopedics, Inc., in 1948.

It is the purpose of this study to determine the effect of auditory stimuli during the sleep of children with delayed speech who show evidence of mental deficiency or childhood aphasia with special regard to the subsequent improvement in speech or comprehension regarding speech.

The importance of this study is revealed by the progress of such children in the speech clinic. In reviewing the case histories of several retarded children it was found that the general picture of progress was the acquisition of several new sounds, increase in babbling, and comprehension of speech over a period of several years.² Of course the above refers to the more severely retarded children with which this experiment is concerned.

Stinchfield and Young believe there is no doubt that there are cases in institutions for the deaf and in schools for the feeble minded who have not been recognized as children who are backward or slow in development and whose essential need is special educational and speech training.³

Thus we see that any new or added technique which will increase the speed of training of such children should certainly be attempted; not only for improving the welfare of the child but also to stimulate further research into the problem.

2 From the Case History Files of the Institute of Logopedics, Inc., Wichita, Kansas.

3 Sara M. Stinchfield and Edna Hill Young, Children with Delayed or Defective Speech (Stanford: Stanford University Press, 1932), pp. 24-25.

DEFINITION OF DELAYED SPEECH

The term "delayed speech" is a general one and the words themselves are vague. Stinchfield and Young describe children with delayed speech as those who do not readily acquire speech, or who perhaps entirely fail to develop speech responses at the age when most children have become fairly fluent in self-expression through speech.⁴

However, this experiment deals with children whose speech is severely delayed due to mental deficiency or childhood aphasia; the classification being made by experienced staff members of the Institute of Logopedics, Inc. at Wichita, Kansas. Thus we have an additional two terms to be defined.

Aphasia of childhood is a condition where some portion of the communicative process is disturbed by specific lesions in the upper regions of the cerebral hemisphere.⁵ For further understanding of the problem it is necessary to note what Best and Taylor say about the normal development of speech:

"The first state . . . is the association of certain sounds . . . words . . . with visual, tactile and other sensations aroused by objects in the external world . . . after definite meanings have been attached to certain words, pathways between the auditory area of the cortex and the motor area for the muscles of articulation become established, and the child attempts to formulate and pronounce the words he has heard . . . Later, as the child

4 Stinchfield and Young, op. cit., pp. 3.

5 Palmer, loc. cit.

is taught to read, auditory speech is associated with the visual symbols of speech and finally, through an association between these and the motor area for the hand, the child learns to express his auditory and visual impressions by the written word."⁶

The child with aphasia therefore, does not follow the normal pattern because "injured" brains have differing cortical energy patterns.

Mental deficiency corresponds with the term Amentia (a, without: mens, mind), and in the main it corresponds also with the term oligophrenia (oligos, small: phren, mind). Mental deficiency or Amentia, then, is a condition in which the mind has failed to reach complete or normal development.⁷

⁶ Charles H. Best and Norman B. Taylor, The Physiological Basis of Medical Practice (Baltimore: Williams and Wilkins Co., 1943), pp. 1511-12.

⁷ A. F. Tredgold, Mental Deficiency (Amentia) (Baltimore: William Wood and Company, 1947), pp. 1-2.

CHAPTER II

REVIEW OF THE LITERATURE

I. LITERATURE CONCERNING LEARNING DURING SLEEP

The literature is very scanty in regard to learning during sleep. There have been several studies but most of these have been concerned with the measurement and depth of sleep.

The Jenkins and Dallenbach experiment was one of the earliest studies and is quoted in most of the literature on sleep. From their experiment in 1924 they report:

"Our results indicate that a similar condition of retention and forgetting exists in the hypnotic and in normal sleep . . . The results of our study as a whole indicate that forgetting is not so much a matter of the decay of old impressions and associations as it is a matter of the interference, inhibition, or obliteration of the old by the new."¹

It showed that distraction and other disturbing influences were reduced during sleep.

A similar experiment by Van Ormer in 1933 reported by Guthrie resulted in no difference in effect on amount retained between one hour periods of sleep or waking, a slight difference in favor of sleep for eight hour periods. Then quoting Van Ormer: "It is suggested that our results

¹ J. G. Jenkins and K. M. Dallenbach, "Obliviscence During Sleep," American Journal Psychology, 35:605-612, 1924.

in favor of sleep are brought about by the absence of the inhibition of obliteration of the learned material by the waking activity."²

Elliott reports an early attempt in 1916 by Thurstone to teach the Morse Code during sleep to a group of sixteen naval students in Washington D.C. Thurstone reported that this study gave very encouraging results but this data still has not as yet been published.³

Further studies in this problem of learning during sleep have been made in the last decade. Leshan, in 1942, experimented on the control of nail biting. He used twenty young male campers. A record was played in a normal speaking voice six times a night for fifty-four successive nights for a total repetition of the sentence 16,200 times. This sentence was "my fingernails taste terribly bitter" and two control groups were used. At the end of the experimental period, the twenty control subjects were still 100 per cent nail biters, but in the experimental group only 60 per cent continued the practice.⁴

² E.R. Guthrie, The Psychology of Learning (New York: Harpers and Brothers, 1935) p. 120.

³ Charles R. Elliott, "An Experimental Study of the Retention of Auditory Material Presented During Sleep," (unpublished Master's thesis, The University of North Carolina, 1948)

⁴ L. Leshan, "The Breaking of Habit by Suggestion During Sleep," Journal Abnormal Social Psychology, 37:406-408, 1942.

Elliott reports a later study by Leshan wherein he used one subject who learned five equated lists of fifteen nonsense syllables. One of the five lists was played to the subject fifty-six times during the sleep of the night preceding the day he learned the list. The control trials took forty-six, fifty-two, forty-four, thirty trials respectively and the experimental list was learned in sixteen trials. Rather striking results.⁵

In a still later study, Elliott himself conducted such an experiment. He used two control groups of forty male college students with rigid controls in the experiment. The subjects did not know just what the experiment was and an electroencephalograph was used to determine the sleep patterns. Simple word lists were used whereby each group learned them and the number of trials noted for each group; this was done through auditory means, by record. Then the experimental group was subjected to a record playing a different word list during sleep. Again the two groups learned the second word list with the experimental group taking fewer trials than the control group. The results were obtained individually and compared with the trials taken previously to learn a similar but different word list. As a whole, the experimental group also showed an appreciable reduction in learning time on the

5 Elliott, loc. cit.

second word list, both over their own previous time and the time of the control group.⁶

Thus we see from these studies that learning can possibly take place during sleep. It should be noted that all of these studies have been made through the use of auditory stimuli alone and not correlated with accepted teaching methods over an appreciable length of time.

II. LITERATURE CONCERNING LEARNING SPEECH DURING SLEEP

After diligent search, nothing could be found in the literature concerning the learning of speech during sleep except two unpublished studies by Elliott.

Elliott reports that Lynn tried to improve the English pronunciation of a foreign born girl but the subject awakened at each attempt to play the stimulus record during sleep. The other study reported by Elliott was by Estle who played various materials during sleep, such as a Russian song, meaningful paragraph material and vocabulary lists. The results according to Elliott were not conclusive because the sleeping and waking periods were not clearly demarcated.⁷

As was previously mentioned all these studies have been done with the use of audition alone. Since these studies do indicate that auditory stimuli are helpful when given during

6 Elliott, loc. cit.

7 Ibid., p. 7.

sleep, why should they not increase the effects of the regular methods of teaching? The following experiment attempts to answer this question.

CHAPTER III

THE APPARATUS AND MATERIALS USED

The material was presented by means of twelve inch recording discs. The recordings were made with a Presto Y recorder, Type thirty-seven B, and the microphone was a dynamic Unidyne mounted on an adjustable stand; Model 556 A manufactured by Shure Brothers, Chicago.

The records were presented to the subjects with the use of a Cerebrophone which is a specially built, portable, electric phonograph set at voice frequency level. A small Telex pillow speaker was plugged into the Cerebrophone and the speaker itself was inserted into a pillow composed of soft sponge rubber. The subject slept on this pillow with the volume to the speaker turned quite low.

The Cerebrophone complete with pillow speaker and sponge rubber pillow was loaned to the Institute of Logopedics Inc. by Mr. Max Scherover of the Linguaphone Institute for research into speech problems such as this type of experiment.

CHAPTER IV

THE SUBJECTS AND PROCEDURE

Three subjects were selected to be used in the experiment. The experimental subjects had no control subjects and results were obtained by comparable periods in training over a given length of time.

The material was presented to the experimental subjects in their own homes. This was done because each was quite distractible and natural sleeping conditions were desired in so far as possible. The parents of each experimental subject were instructed in the use of the Cerebrophone and they kept a chart of the times the Cerebrophone was used.

Extreme care was taken to watch the wear of records and identical ones were made and used when a record showed signs of scratching or surface noise.

CASE I

Case I was an eleven year old male and diagnosed as follows:

"Probable mental retardation plus childhood aphasia. Remembers like typical brain injury mental retardation. No tonic neck reflexes. Some autistic behavior. Semi-domesticated, uses gestures but is not perfectly reliable."¹

¹ From the Case History file of Case I at the Institute of Logopedics, Inc. Wichita, Kansas, P.8.

When entering training the subject had one sound, "ma-ma", which he used for everything, but used various inflections to distinguish his wants.

After a period of one year the following summary of progress was made:

"Comprehension would seem to indicate a fair capacity for learning speech. However methods employed do not seem to give any results which are consistent. Case seems to try to give responses and then, almost as a substitute response, makes overt act such as kicking chair, looking for or grasping something. Some of responses are on very low level of development, less than one year, others are more advanced. Subject is very happy coming for his lessons and is unhappy when something happens that parents cannot bring. Can see very little if any, improvement in speech although walking and motor activities may be improved slightly."²

Previous to beginning the auditory stimuli experiment the following summary of abilities was made:

"Maximum attention span in the training room is five minutes. Case has several sounds which he can differentiate: 'mama', 'mah'(man), 'bye', 'hi', 'mmm'(smelling sweet smell); gets many others in imitation such as 'wh'(whee), 'bay'(baby), 'ing'(ring, 'oh'(open), 'ou'(out), 'bow-wow', 'choo-choo', 'h-h-h'(panting like a dog). Can paste cut pictures in books and is tying up pictures with objects. Is beginning to imitate some of instructor's tactile cues for sound production. Music, particularly sad or slow, causes tears. Is able to recognize some tunes he hears at home in other places also. Is imitating more gross actions as rocking doll, 'patty cake', using a telephone, making pies etc."³

2 Ibid., p. 26.

3 Ibid., p. 37.

In previous lessons the instructor had been using a scrapbook of cut out pictures trying to elicit responses to the pictures. Therefore the record was made from the material used at the beginning of each lesson and as nearly as possible in the same routine. The voice of the regular instructor was used; the record was three minutes and fifteen seconds long and contained the following:

Hi. Hi Jimmy Hi Hi Jimmy Hi Jimmy
 Oh look Jimmy! Look at the dog! Hear him pant?
 h-h-h (panting like a dog) h-h-h
 Hear the doggie pant? h-h-h
 Hear him Jimmy? You pant like the doggie? h-h-h

Careful that radiator's hot! (on "hot", pitch was exaggerated from high to low)
 Hot! h-h-h hot hot (h exaggerated)

Jimmy, careful, that radiator's hot (h exaggerated)
 Oh look at the fire! Hot Hot That's hot Jimmy, hot
 Careful Hot Hot Jimmy (all h's were exaggerated)

Oh a boat! Oh look! See the boat, boat bo-bo-bo
 Boat bo-bo-bo-bo-boat boat boat
 Boat? See the boat Jimmy? Look at the boat Jimmy!

Oh and who is that? Daddy? Is that Daddy? Daddy.
 Look Jimmy, Daddy Daddy Daddy
 Daddy Is that Daddy? Jimmy, who is that? Daddy?
 Daddy

Mamma. Is mamma out? (t exaggerated) Mamma's out.
 Mamma's out. Yes Jimmy, Mamma's out there. Mamma out.
 Mamma out. Mamma out. Where's Mamma Jimmy? Mamma's
 out.

K K (exaggerated isolated k's) look at the cat!
 K K K cat cat See the cat Jimmy? K K K cat
 Oh nice cat. See the cat. cat Meow! Cat says Meow!
 Meow Meow Meow Meow!

Oh and there's an old cow. Moo! Moo! Moo! Jimmy.
 Moo! Here it comes! Moo Moo Moo!

Shall we turn the light off, Jimmy? Turn the light off.
 Turn the light off, turn the light off, turn the light
 off, turn the light off. (pitch change and accent off)
 Turn the light on. Turn the light off.
 On Off On Off (pitch change opposite for off
 and on)
 That's it, turn the light off. On Off.

Bye Bye Jimmy Bye Bye, bye Jimmy Bye, bye.⁴

Case I had previously given responses to the above
 with the exception of "Daddy" but all were far from being
 consistent or complete in articulation. These responses were

⁴ The record with this material is on file at the
 Institute of Logopedics, Inc., Wichita, Kansas.

"Hi", "h-h-h (panting like a dog, using his own hand for tactile stimuli of air on the h sound), "hhhhh" (drawn out h sound for hot), "buh" (boat), "Mamma ou" (Mamma out) "mow" (meow), "moo" (for cow) "aw" (given for both on and off), "bye".⁵ Throughout the record the instructor used exaggerated melody, rhythm and accent with particular emphasis placed on the pitch change with "on" and "off". "On" was presented with pitch running from low to high pitch and "off" was the opposite in going from high to low (female range).

The record was attempted eight consecutive nights but on the first night every attempt to play the record awakened the Case. The playing time is given in Table I.

It is again pointed out that the auditory material was used as added stimuli and regular training periods were carried on during the experimental period. These training periods were three one-half hour lessons per week and Case I was taught by his regular instructor. The particular problem used in the experiment will be taken up in the next chapter.

CASE II

Case II was a seven year six and one half months old male and diagnosed as follows:

⁵ Case History Files, op. cit. p.37.

TABLE I
RECORD PLAYING TIME FOR CASE I

	<u>Time record on at each attempt</u>	<u>Total time record on</u>	<u>Total number times record was played</u>
1st night	Case awoke at each attempt to play the record.		
2nd night	15 min. 10 min.	25 min.	7.69
3rd night	3 hrs. 30 min.	3 hrs.30 min.	64.61
4th night	1 hr. 15 min.	1 hr. 15 min.	23.07
5th night	1 hr. 40 min. 2 hr. 30 min.	4 hrs.10 min.	76.97
6th night	4 hrs.	4 hrs.	73.84
7th night	2 hrs. 55 min. 3 hrs.	5 hrs.55 min.	109.23
8th night	1 hr. 30 min. 2 hrs. 45 min	4 hrs.15 min.	78.46
<hr/>			
Total		21 hrs.30 min.	433.87
<hr/>			
Average per night		3 hrs.43 min.	61.98

"Post encephalitic aphasia; left hemiplegia. Babbles, says 'you go'. Case is wild and on prominol (a barbiturate). Partially domesticated; by gesture. Will repeat a song; autistic to one song; has occasional minor autisms."⁶

After Case II had been in training one month, a re-examination was made and the following remarks made on progress:

"There is gain in attention span and comprehension. There is no direct response in speech motors by imitation or innervation of speech organs synchronously. No essential awareness yet."⁷

A summary of training including medication on Case II:

"Upon entering training Case was quite infantile, attention span was fleeting; he carried all objects to his mouth and then threw them wildly. He was subject to convulsive seizures. He was placed on glutamic acid, thiamine chloride, and elixir of benadryl. Within four weeks time he showed gain in attention span and comprehension, was more quiet, much less emotional and more cooperative. After three months the seizures were well under control."⁸

A progress report just previous to the experimental period showed:

"Attention span much improved, less fleeting. Obeys simple commands such as 'give me the ball', 'get up'. There is cooperative play. During the first two weeks a ball was his sole interest in motivation but now plays with ball, toys, blocks, peg and discs. Direct conditioning with food showed best responses with candy, pop, and salt; getting an acceptable k, p, and good tongue protrusion (th) respectively. Frequently have been able to get p-p-p voluntarily at sight of bottle of pop. Also getting voluntary movement (both arms) in removing and donning coat."⁹

6 From the Case History file of Case II at the Institute of Logopedics, Inc. Wichita, Kansas, p.8.

7 Ibid., p. 10

8 Ibid., p. 15

9 Ibid., p. 25

The auditory material presented during sleep contained material also used previously in the training situation with inconsistent responses by Case II. The voice of the regular instructor was used; the record was three minutes seven seconds in length and contained the following:

Hi John.

Hi (repeated ten times at five second intervals)

Take off your coat, John.

Off (repeated ten times at three second intervals)

Make the car go, John.

Go (repeated ten times at two second intervals)

Where's the ball, John?

Ball (repeated ten times at two second intervals)

Puppy (repeated ten times at one second intervals)¹⁰

Case II had previously given responses to ball ("bah"), hi ("hi"), go ("go").¹¹ During the experimental period regular half hour lessons were continued daily except for Sundays.

The record was played for two consecutive nights as a trial run to test the equipment and the reaction of Case II for signs of drowsiness the next day. This was done because Case II did not use a pillow to sleep on and the pillow

¹⁰ The record with this material is on file at the Institute of Logopedics, Inc., Wichita, Kansas.

¹¹ Case History file of Case II, op. cit., p. 20.

microphone was tied to the bed post just above the case's head. The volume was turned up higher than with Case I. Case II showed no ill effects and after a lapse of three days, the record was played for thirteen consecutive nights. The playing time is given in Table II.

The particular problem concerned with Case II will be taken up in the following chapter.

CASE III

Case III was a six year, four months old male and diagnosed as follows on the original examination:

"Either childhood aphasia or mental retardation; probably both. Retarded speech, about two to two and one half year level with articulation much more retarded. Melody, rhythm and accent defective. Comprehension seems retarded to about two and one half year level. Apparently did not understand requests to put tongue here, finger here etc. General coordination seems poor (had polio). Probably the disorder is not due to polio. Impression is that aphasia predominates and that a great deal of improvement could be made."¹²

Just previous to entering training Case III was re-examined:

"Speech has improved. Sentence length increased; commonly uses from three to six words. Syntax is pretty good. Comprehension of most simple things said to him although seems to fail to get everything. May be some hearing loss. Voice quality is poor (though somewhat like that of a number of aphasic children). Substitutes sonants for surds and nasals for non-nasals inconsistently. Crude whisper test seemed to indicate

¹² From the Case History file of Case III at the Institute of Logopedics, Inc., Wichita, Kansas, p. 8.

TABLE II

RECORD PLAYING TIME FOR CASE II

	<u>Time record on at each attempt</u>	<u>Total time record on</u>	<u>Total number times record was played</u>
1st night	6 hrs.	6 hrs.	115.51
2nd night	6 hrs.	6 hrs.	115.51
3rd night	6 hrs.	6 hrs.	115.51
4th night	6 hrs.	6 hrs.	115.51
5th night	6 hrs.	6 hrs.	115.51
6th night	6 hrs.	6 hrs.	115.51
7th night	6 hrs.	6 hrs.	115.51
8th night	6 hrs.	6 hrs.	115.51
9th night	6 hrs.	6 hrs.	115.51
10th night	6 hrs.	6 hrs.	115.51
11th night	6 hrs.	6 hrs.	115.51
12th night	6 hrs.	6 hrs.	115.51
13th night	6 hrs.	6 hrs.	115.51
<hr/>			
Total		78 hrs.	1501.63
<hr/>			
Average per night		6 hrs.	115.51

some high frequency loss. Can do h, w, m, b, d, t, n, k, g, s, z. Approximate sh, zh, ch, j, l. No r, p, f, v, th, th. Many liasonic errors. Substitutions very inconsistent. Samples: 'bopped' (stopped), 'gagun' (wagon), 'digs' (pigs), 'nono' (tunnel), 'dash' (banjo). Speech is semi-intelligible; much still unintelligible. Couldn't check auditory memory span or for lingual apraxia and agnosia. To have hearing checked by ear specialist."¹³

The medical report by an ear specialist:

"As near as we were able to make out with this case, his hearing was within normal limits, but we had a distinct impression that he was a case of mental retardation. It was impossible to get him to cooperate sufficiently to do an audiogram but he repeated spoken numbers at forty-five feet and apparently had normal perception of voice."¹⁴

The material used on the record differed somewhat from that of Case I and Case II. The material was presented just as if an actual sound was being taught as in a regular lesson, along with instructions as well as auditory stimuli. No control was used because it was felt that better results could be obtained by using comparable periods of time to learn a different isolated sound. The voice of the regular instructor was used and the record contained the following:

Stick out your tongue, Frank.

Not quite so far--just a little bit.

That's it. Now, blow some air.

Thah (repeated three times at five second intervals)

¹³ Ibid., p. 9.

¹⁴ Ibid., p. 10.

Tha (repeated three times at five second intervals)
 Thih (repeated three times at five second intervals)
 Thee (repeated three times at five second intervals)

Now let's make some words, Frank. Stick out your
 tongue. Not so far. Just a little bit. That's it.
 Blow some air.

Think (repeated six times at three second intervals)
 Thank you (repeated seven times at three second inter-
 vals)

Now let's blow at the end of the word, Frank.

With (repeated three times at one second intervals)
 Teeth (repeated three times at one second intervals)
 Tooth (repeated three times at one second intervals)
 Thank you, Frank (th accented)
 Thank you (th accented) (th used was the surd)¹⁵

During the experimental period Case III had his regu-
 lar half hour lessons three days per week, each containing the
 material on the record at the beginning of each lesson. The
 record was three minutes seventeen seconds in length and was
 attempted for seven consecutive nights. The playing time is
 given in Table III.

The particular problem concerning Case III will be
 presented in the following chapter.

¹⁵ The record with this material is on file at the
 Institute of Logopedics, Inc., Wichita, Kansas.

TABLE III

RECORD PLAYING TIME FOR CASE III

	<u>Time record on at each attempt</u>	<u>Total time record on</u>	<u>Total number times record was played</u>
1st night	4 hrs. 45 min.	4 hrs. 45 min.	86.80
2nd night	4 hrs. 30 min.	4 hrs. 30 min.	82.23
3rd night	Stormy weather interferred with electricity.		
4th night	7 hrs. 40 min.	7 hrs. 40 min.	140.10
5th night	7 hrs.	7 hrs.	127.91
6th night	7 hrs. 45 min.	7 hrs. 45 min.	141.62
7th night	6 hrs. 50 min.	6 hrs. 50 min.	124.87
<hr/>			
Total		38 hrs. 30 min.	703.53
<hr/>			
Average per night		6 hrs. 35 min.	117.26

CHAPTER V

FINDINGS

1. ANALYSIS OF CASE I

An interval of eight weeks was selected as the evaluation period of Case I. This length of time was selected because at the beginning of this period Case I was presented with a particular problem.

The interval to be evaluated began four weeks before the record stimuli were presented to Case I. At that time it was noted by the instructor of Case I that there was lingual apex elevation during the repetition of "Daddy" by the instructor; a picture scrapbook was being used which included a picture of the father of Case I. Case I had never before used a specific response utilizing the consonant d although it had been noted in his babbling at various times. The material on the record, which was given previously, was presented in the same order as in that lesson when the instructor first noticed the upward movement of the tongue and included ten repetitions of the word "Daddy." The other material on the record had previously brought forth responses but these were not consistently given at the sight of the pictures; it was hoped that these responses might become consistent with the use of the Cerebrophone.

In the four week interval between the beginning of evaluation and the presentation of auditory stimuli during sleep, work was continued with Case I trying to get a definite response to "Daddy" as well as the other responses mentioned; each lesson was begun with the scrapbook of pictures being used and the regular teaching methods employed to elicit responses. The methods included auditory, tactile, and kinesthetic stimuli as well as hand analogies.

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During this four week period these responses were given: "h-h-h" (panting of a dog), "hah" (hot), "mam-ma ou" (mamma out), "K" (harsh K for cat). However, these responses were not consistently given when presented to Case I by the use of the picture scrapbook previously mentioned. No upward tongue movement was noted although "da, da, da" was occasionally babbled; this, of course, was immediately re-enforced as "Daddy" and the picture was presented, but no direct response was given. The response "h-h-h" was often given also for "hot" and "home" but was accepted by the instructor for the panting of a dog only. Other responses were given during this period but were not pertinent to the experimental material. During this four week period, Case I missed three consecutive lessons because of illness.¹

¹ Case History File of Case I, op. cit., pp. 8-37.

The auditory material on the record was presented for eight consecutive nights, and Case I also received his regular half hour lessons which came to a total of three during this eight-day period; these lessons were given at the usual times and came on the second, fourth, and seventh days preceding the corresponding nights of auditory stimuli during sleep.

Case I awoke each time the record was turned on the first night. In the lesson the following morning no direct or specific responses were given. More interest was shown in other stimuli presented after no interest at all was shown in the scrapbook routine.

On the second lesson which came after two nights of actual presentation (eliminating the first night of awakening at each attempt to play the record), responses were given for all the material presented on the record with the exception of "Daddy." Case I's tongue was manipulated to the alveolar ridge five times while the instructor repeated "Daddy."

On the third lesson which came after five nights of record stimulation, the record routine using the scrapbook was attempted, but attention continually turned to newer interests and other responses. Much babbling occurred. During the course of the lesson however, the instructor noted more differentiation between "h-h-h" (for dog) and "hah" (for hot); "hah," however, was also given for "home." The record was presented for two more nights and on the lesson following the

last night of presentation, a good definite production of "mama" was given by Case I; there was also much babbling but no response to "daddy."

For the next two weeks inconsistent responses were given to all the record material with the exception of "daddy" and "boat." Interest was not held with the picture scrapbook but turned to newer stimuli and responses.

On the lesson following the twentieth night after record presentation had begun (following the twelfth night after record stimuli was stopped), the record routine was still being presented. There was not much interest but at the end of the lesson Case I responded with "nah" (nasal) after much auditory stimuli of "daddy" accompanied by hand analogies for d. On the next lesson (three days later) all responses were given except "nah" as in the previous lesson. Intense auditory bombardment of "daddy" with hand analogies and tactile stimuli for d, brought a raising of the tongue tip but there was no production of d or n.

The next lesson produced no response to "daddy," but during the following lesson Case I responded with a slight raising of the apex of the tongue to the auditory signal "daddy" accompanied by hand analogies for d. Five lessons later Case I responded to auditory "daddy" (accompanied by hand analogy for d) by raising the apex of the tongue to the alveolar ridge five or six times.²

2 Case History File of Case I, loc. cit.

In the four weeks preceding the record stimuli, Case I gave responses to all the previously mentioned pictures with the exception of "daddy." These responses were not consistent, however. There was no upward movement of the tongue noted in a specific response although "da, da, da" was occasionally babbled.

In the four weeks following the above and including the experimental nights, Case I showed less interest in the scrapbook being used for motivation. There were responses given for all the previously mentioned pictures but again they were not given consistently. There was much more babbling. In the last week of this period Case I responded with "nah" (nasal) to repeated auditory stimuli of "daddy" accompanied by hand analogies for d (n, in this case as most, involved the raising of the apex of the tongue). This raising of the apex of the tongue was again noted later in this last week of the four week period; the stimuli again was repeated auditory and hand analogy.³

From this, it might be said that the experimental process was successful in obtaining faster progress. However, this latter four week period also benefited from the regular lessons given during the first four week period; this perhaps could be off-set by the lack of interest in the scrapbook

³ Case History File of Case I, loc. cit.

during the last four week period, but that is not a measurable item. This same lack of interest in the scrapbook, which was the source of motivation, could possibly have been a negative effect from the use of the Cerebrophone. It is also to be noted that each time the apex of the tongue was raised, hand analogies for d were being used by the instructor as well as the picture and auditory stimulus "daddy." To say that the use of the auditory stimuli during sleep was more responsible for success than the use of hand analogies would certainly not be correct; nor is the reverse acceptable.

However, from the data presented, one thing is to be especially noted; there was much more babbling by Case I after the record stimuli was begun. This was noted by the instructor on the third lesson after the record stimuli was begun (on the day after the fifth night of record stimuli) and was still being noted seventeen days after the record stimuli ceased. In conjunction with the above, the parents of Case I reported a much increased interest at home in the radio and record player. Much babbling was also reported at various intervals in the training reports previous to any of the above evaluation periods but not so consistent over any period of time.

It is difficult to make a definite statement in relation to the use of the Cerebrophone and Case I. It was felt however that the increase in babbling as previously

mentioned was a probable result of the seven consecutive nights of auditory stimuli presented during the sleep of Case I.

II. ANALYSIS OF CASE II

Evaluation of Case II was made over two four week intervals, the second interval including the thirteen nights of auditory stimuli.

Prior to the beginning of the first four week period, Case II had given responses to "hi" (hi), "bah" (ball), and "go" and "o" (go); these responses, however, were not consistent. In addition to the above words (which were later used in the record material), Case II also had given responses of "p-p-p" (for bottle of pop) and "k-k-k" (for candy) in conditioning work that was also being presented by the instructor at this time. Only the responses of "hi," ball," and "go" will be evaluated, however. Lessons were given daily throughout each week with the exception of Sundays.³

On the first lesson of the initial evaluation period, Case II responded with "oo" and "o" each time a toy car was pushed with the instructor giving tactile stimuli under the chin as well as auditory stimuli "make the car go" (accented "go") or sometimes just "go." Case II also responded "oo," "oo," to instructor's auditory stimulus "go" accompanied by

3 Case History File of Case II, op. cit., pp. 8-25.

bodily motion toward the door upon leaving the training room. In this lesson Case II also gave three acceptable "hi" responses.

The next six lessons brought responses to "hi," "ball," and "go" with "hi" remaining the most consistent and only "o" received for "go." This was also true during the second week with the responses to conditioning techniques mentioned previously taking the most interest and more progress being made. In the third week the same responses were given inconsistently, but on the fourth lesson of this week one "go" was received as well as "o's" to auditory "go" while pushing toy car. These were consistent delayed responses (from three to seven seconds) after pushing the toy car.

During the fourth and last week of this initial four week period, the usual inconsistent responses were received, but on the fourth lesson of this final week, the response "go" was received three times and "o" quite frequently in the car play situation. The instructor also noted that Case II seemed to comprehend the command "take off your coat" and "put on your coat." Again on the fifth lesson "go" was received twice in the car play situation.⁴

From this four week period of training, it was felt that progress had been made in the response "go" in the car

4 Case History File of Case II, loc. cit.

play situation. More progress was noted with the conditioning training, however.

On the first lesson of the second four week period (and the day after two nights of record stimuli), the parents of Case II reported that he had been resting well and appeared bright and alert upon awakening; they also reported making progress with the domestication program. During this lesson several "o" responses were received for "go" in car play situation. During the rest of this first week Case II gave responses of "o" and "hi," but he was not felt to be as alert as usual. This possibly was felt to be the result of a bad cold; Case II missed two lessons because of this cold but record stimuli at night was continued. No responses were received during this week for "puppy" or "off" which was material included in the record along with the previously mentioned responses.

On the second lesson of the second week, Case II sat down when he saw the toy cars, took the instructor's hand wanting her to push them; there was later some voluntary movement in play with cars and three "o" responses in this situation. The parents also reported good progress in the domestication program. During the third lesson of the second week, there was again some voluntary pushing movement on "go" stimuli in car play and several "o" responses. On the fourth lesson (record stimuli were presented for the last time on the

night following this lesson) there were again inconsistent "o" responses in car play situation. During the last lesson of this second week (two days after record stimuli was ceased) there were several good productions of "go" in car play situation. Parents reported five consecutive nights with a dry bed. No responses during this week to "puppy" or "off."

The third week showed a similar pattern. Three good productions of "go" were made but with a different object; a toy puppy being used but still auditory and motion stimuli being presented as with the toy car.

During the fourth week no change in responses was noted, but attention appeared more fleeting, and a somewhat wider variety of spontaneous babbling appeared during the last lesson of this final week.⁵

In comparing progress during these two four week periods, no appreciable difference was noted between the two. During both the control and experimental period, good productions of "go" were made by Case II at different times in each period. The two new stimuli "off" and "puppy" received no responses during the experimental period and the older responses were no more consistent. It is interesting to note the parents' report of five consecutive nights with a dry bed while the auditory stimuli were being presented during sleep.

⁵ Case History File of Case II, loc. cit.

However, a good domestication program had been given and started by the parents previous to the evaluation period. This success could not necessarily be attributed to the use of the Cerebrophone.

It was felt that the use of the Cerebrophone with auditory stimuli presented during the sleep of Case II did not appreciably speed up the training and progress with this type of case.

III. ANALYSIS OF CASE III

The speech of Case III was much more developed than Cases I and II. The evaluation periods were selected as the times that two individual consonants, f and th (surd), were introduced in training. The evaluation period for f contained no auditory stimuli during sleep while the evaluation period for th contained six nights of auditory stimuli; these six nights were not consecutive--two nights of auditory stimuli, a lapse of one night, and then four consecutive nights were again presented. Three half-hour lessons were given per week and came at an interval of every other day.

The consonant sound f was introduced to Case III first. On the first lesson after this, Case III produced the f fairly well in isolation, but when attempting a following vowel, he inserted a tongue movement (approximating the consonant t) between the f and the vowel. Case III previously had been substituting the consonant t for f. By the fifth

lesson, one good production of f in the initial position with a vowel was made. In succeeding lessons the medial and final positions of f with vowels were introduced, and by the eighth lesson Case III was producing the final position much the best. By the eleventh lesson the final position with vowels was fairly consistent. On the fourteenth lesson one good initial position of f was again produced with the medial and final positions much more consistent. By the nineteenth lesson the final and medial positions of f with vowels were consistent but the initial position still was only occasionally produced without the tongue movement described above. The twenty-first lesson resulted in several good initial position f's with vowels but still was not consistent. On the twenty-third lesson the instructor reported the f consistent in all positions with vowels except for tongue movement on two initial positions. Then on the twenty-fourth and twenty-fifth lessons, Case III produced the consonant f consistently in all positions with vowels and was also producing the f with words in all positions, but not consistently; this latter was in drill and not in propositional speech.⁶

The evaluation period for th overlapped that of the f evaluation period by eleven lessons, but the auditory stimuli for th was not begun until immediately after the last lesson enumerated above for the f evaluation period. The initial

6 Case History File of Case III, op. cit., pp. 8-15

lesson of the evaluation period for th coincided with the fifteenth lesson of the f evaluation period.

The production of th during the first lesson of the evaluation period by Case III was considered by the instructor to be fair; tongue placement was not quite accurate, and the emission of air was not adequate. By the fifth lesson there were several productions of th in the initial and positions with vowels, but the instructor felt that they were somewhat distorted. On the eighth lesson the th was fairly consistent in isolation. However, on the tenth lesson all work on the th was considered only fair by the instructor. On the second night after the eleventh lesson the auditory stimuli process during sleep was begun. The twelfth lesson came after two nights of auditory stimuli; the instructor reported the production of th in isolation was much more consistently good, and Case III also produced ten in the initial position with vowels, with three of these, however, being almost sonants. There were four more consecutive nights of auditory stimuli, and these all occurred before the next lesson, which was the thirteenth of the evaluation period--this lapse of no lesson was due to the parents of Case III not being able to bring him. On this thirteenth lesson (and after auditory stimuli had ceased the night before) the instructor reported the th much more consistent in isolation and in all positions with vowels. Case III also produced the th in the initial and final positions with words, but these were not consistent.

The mother of Case III reported that he was awake (but still drowsy) the last two mornings when she came in to turn off the Cerebrophone; Case III was lying in his bed talking back to the record and doing just what the record said to do. On the fourteenth lesson the th was missed (emission of air not adequate) only once in the initial position with vowels. There was also production of five words in the initial and final positions. On the fifteenth lesson the th was consistent in isolation and initial position with vowels. The sixteenth lesson showed the th not quite consistent in all positions with vowels; there were several errors due to lack of emission of air. However, Case III produced four good productions of "thumb" and one acceptable "thank." On the seventeenth lesson the th was very good in isolation and initial position with vowels: also, there were four good productions of "thumb." By the eighteenth lesson there still was an occasional error on th, due to lack of air emission. The nineteenth lesson showed a consistently good th in all positions with vowels; there were also three good productions of "thank you" (no k on thank), three good productions of "thumb" and two of "mouth." By the twentieth lesson the th was still consistently good in all positions with vowels. There were also good productions of "thumb," "think," (no k) and "thank" (no k) the first attempt by Case III in this lesson. The th still could not be produced accurately in the

medial position with words, and this position was more slowly accomplished with vowels than the initial and final positions.⁷

A comparison of the two evaluation periods can now be made. Case III required twenty-five half hour lessons to consistently produce the consonant f in the initial, medial, and final positions with vowels. However, this same case took only twenty lessons to consistently produce the consonant th in the same positions with vowels. It is interesting to note the fact that the th in the medial position was the slowest in progress of the three positions. Of course, this is many times also true in the training of any case but the medial position was also the one position not used with the auditory stimuli during sleep. It is also interesting to observe the reactions of Case III when awaking with the record still playing as reported by the mother.

From the above comparison it was felt that the auditory stimuli presented during the sleep of Case III by the Cerebrophone may possibly have speeded the progress. Besides the difference in the over-all time element required for each consonant, the th progress immediately improved after the introduction of the auditory stimuli during sleep.

⁷ Case History File of Case III, loc. cit.

CHAPTER VI

CONCLUSIONS

In the preceding chapters an experimental study of the effects of auditory stimuli presented during the sleep of children with delayed speech was presented. The auditory stimuli process was given to three experimental subjects whose speech disorders have been described. Conclusions regarding each subject will be discussed in the following paragraphs.

Case I was presented with seven consecutive nights of auditory stimuli, and evaluation was made over two four-week intervals, one of which included the above seven nights. The only result of the auditory stimuli was a probable increase in babbling. This type of response is hardly a measurable item but is often indicative of progress in the child with delayed speech.

Case II was presented with thirteen consecutive nights of auditory stimuli, and evaluation was made over two four-week intervals, one of which included the thirteen nights of auditory stimuli. It was felt that the use of the Cerebrophone did not speed up the training and progress of Case II.

Case III was presented with six nights of auditory stimuli, and the evaluation periods used were the number of lessons required to teach the consonants f and th (surd) in

the initial, medial and final positions with vowels. The results obtained showed that twenty-five one-half hour lessons were necessary to consistently produce the consonant f in all positions with vowels. However, only twenty lessons were necessary to produce the consonant th (surd) in the same positions, and this latter period contained the six nights of auditory stimuli presented during sleep. In the study of Case III it is also interesting to note that the only position (the medial) not presented with the auditory stimuli was the slowest to be learned. Still of further interest are the reactions of Case III when waking with the record playing.

Since no known study had previously been made on this problem, three different approaches were used with the material presented on the records. The material presented on the record used with Case I contained a greater variety of stimuli than the other two records, and no attempt was made at uniformity or timing. Action was indicated, but the emphasis was on melody, rhythm, and accent as well as exaggerated pitch change. It was felt that this material contained too varied stimuli. Better results perhaps might have been obtained if the auditory stimuli had been less in number but with more repetitions.

The material used on the record presented to Case II was, however, planned for the number of repetitions with

varying time intervals. Action was indicated, and pitch change was also utilized. However, since no appreciable results were obtained with Case II, these factors cannot be evaluated. It is felt, however, that the manner in which this material was presented could well be used in future investigations to evaluate the use of timing. With a severe case such as was Case II, the number of stimuli in the material might be reduced.

The material used on the record presented to Case III was unique in that action instructions were given along with repetition. This was almost an additional lesson in training. The report by the mother of Case III is certainly interesting in this respect. She reported Case III awoke while the record was still playing and was doing just what the record said to do. Case III was reported to still be "drowsy and half asleep" while doing this. Since the progress of Case III might have been speeded due to the stimuli, could it be that in moments of light sleep or wakefulness he actually practiced the material presented? This, of course, is only speculation but is highly interesting. Why could not the Cerebrophone purposely be turned on previous to sleep and let the case go to sleep with the stimuli? As Palmer has said, one of the most lucrative times for learning is just prior to sleep.¹

¹ Martin F. Palmer, Unpublished material used in the clinic of the Institute of Logopedics, Inc.

It is believed that future investigations should certainly consider this possibility.

There was an evaluation also made with a fourth case. This was done with the idea of perhaps finding a control for Case I. This case was not presented with auditory stimuli during sleep and it was felt that he was further advanced than Case I. Because of this difference in previous progress, he was not used as a control.

The possibilities for further investigations are numerous. This study has been concerned with the more severe cases, and certainly investigations should be made with each of the various disorders in speech. The failure to show much results with Cases I and II does not mean that the auditory stimuli could not be helpful. These cases were more severe than Case III, and any progress with present methods of training must be measured by months and years. If the auditory stimuli had been presented over longer periods of time and perhaps different material presented, there might well have been appreciable progress shown. In future investigations longer periods of stimulation should certainly be attempted. If Case III had received thirteen nights of auditory stimuli (as did Case II) instead of only six, the results might have been even greater.

Since this study has shown the possibility of perhaps speeding the training in one case, the possibilities of

reducing the training time with other types should be attempted by interested investigators. This type of stimulation might very well be successful with the hard of hearing case along with the accepted acoustical method of training. Investigations should also certainly be attempted with the disorders of articulation, stuttering, cleft palate, and dysphonia.

As was pointed out at the beginning of this study, any investigation which results in the reduction of time necessary for corrective training will help more children to live a useful and independent life.

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