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LANGUAGE AND GROWTH: THE RELATIVE EFFICACY OF EARLY AND DEFERRED VOCABULARY TRAINING, STUDIED BY THE METHOD OF CO-TWIN CONTROL*

From the Yale Psycho-Clinic

By

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I

PURPOSE AND METHOD

The purpose of the present investigation is to compare language development at two developmental levels, during a given length of time, by an experimental analysis of the influence of vocabulary training in relation to maturity. Incidentally it was hoped that the study would throw some light on the hygienic as well as developmental conditions of learning.

The method employed is that of co-twin control, as presented in a recent monograph by Dr. Arnold Gesell and Dr. Helen Thompson (1). By this method one of a pair of identical twins is trained experimentally, and the other reserved as a control. The subjects in the present investigation are the same pair of identical twins described in that monograph.

The validity of the method depends, of course, upon the establishment of the degree of correspondence of the twins. By a series of systematic studies of these children between the ages of one month and eighteen months, a remarkable degree of correspondence, both physical and behavioral, was demonstrated. After considering physical appearance, anthropometric measurements, skin pattern, and developmental history (including dentition, daily temperatures, and medical history), Gesell and Thompson conclude that "the evidences of physical correspondence are thoroughgoing" (1, p. 26). To quote further, "These physical correspondences are sufficiently pervasive to be of considerable value for a comparative study. The method

of co-twin control, however, requires that there should be a demonstration of a high degree of antecedent correspondence in the field of behavior" (1, p. 26). Accordingly, evidence of a functional correspondence in the twins was established by means of a series of twelve developmental examinations in which 612 comparative ratings were made; 513 of these ratings indicated complete or nearly complete identity of behavior. It was finally concluded, then, that "The degree of correspondence was so great as to justify the use of one twin (Twin *C*) as a virtually duplicate control for the experimental study of Twin *T*" (1, p. 115).

The results of the study made by Gesell and Thompson in the field of locomotion and of prehension and manipulation point consistently to the preponderant importance of maturational factors in the determination of infant behavior pattern. It seemed pertinent, then, to test these factors in another field—that of word learning. An experiment was devised, therefore, in which Twin *T* of the first study was again the trained twin, and Twin *C* was reserved as a control.

No marked differences in the language behavior of the twins were brought out in records previous to this study. When the twins were 69 weeks old, an observation period at the nursery home, for the purpose of comparing their behavior in that respect, showed no observable difference. Both indulged in brief vocalizations with an evident social reference, but neither had any words established at that time.[1]

[1]Cutujian, Frances. Unpublished record, November 1, 1928.

A regular developmental examination at the age of 79 weeks,[2] showed that "there was more referred vocalization on the part of *T*, but the total output was not decisively in her favor. Both twins vocalized in brief snatches which sometimes reached the level of expressive jargon. They definitely represented a pre-conversational relation with an adult, but in amount and complexity this jargon was scarcely up to the normal 15 months level."[3]

The experimental period was directly preceded by a developmental examination at the nursery home, when the twins were 84 weeks of age.[4] The results of this examination again emphasized the remarkable similarity of behavior pattern. As had been the case consistently throughout their history, the final ratings for both indicated identical developmental levels. As regarded language, specifically, responses to language as well as spontaneous vocalizations showed a high degree of similarity. Both children handed a box to the experimenter on command without gesture, both put the pellet in the bottle on command, and both on command with gesture withdrew the rod from one hole of the performance box, and put it to another. During the course of the examination, Twin *C* vocalized some-

[2]Clinical record for January 7, 1929.

[3]The clinical ratings of developmental level of these children have shown a fairly consistent degree of retardation. The general behavior picture is one of rather attractive though subaverage normality. The approximate developmental quotients calculated on the basis of the clinical ratings (subtracting a constant of two weeks from the chronological age to correct the two weeks of prematurity) give a series of quotients ranging in round numbers from 75 to 85.

[4]Clinical record for February 11, 1929.

what more frequently that did *T*, but *T'*s vocalizations were more apt to have a social reference. In spite of this slight difference of emphasis, neither child vocalized in a situation in which her twin did not also vocalize at some time during the afternoon. No difference could be detected in the variety of sounds produced.

At the time of this examination, both twins were known to have acquired the word "up" and to use it at appropriate times. Both definitely made some attempt to imitate words repeated to them, but, except for the word "up," no other word was definitely established.

In summary, then, it may be said that the subjects for the experiment were identical twins whose behavior under detailed study from the time they were a month old had been shown to be remarkably similar; whose responses to language during the developmental examination immediately preceding the experiment were identical; and whose language, as indicated by willingness to imitate words repeated, by the variety of sounds produced and by the definite possession of one word each, was at the same level. There was every evidence to believe, that at this age (84 weeks) both twins were near the threshold of speech acquisition.

II

EXPERIMENTAL ARRANGEMENTS

Through the cooperation of the superintendent and staff of the nursery home in which the twins were, a set-up was arranged in which it was possible to maintain continuous experimental control. The experimenter, with the twins and an assistant nurse, was established in a suite of rooms in which there could be complete isolation from other individuals as well as isolation of twin from twin. Figure 1 gives the floor plan of the experimental suite.

Rooms 1 and 2 were the ones occupied by the twins. Each twin slept and had her meals in one room on one day, and in the other room the next, in order to equate environmental conditions. Room 2 was the regular training room, while Room 1 was used for the Spanish period. Room A and the sun porch were used for free-play periods.

The general plan of the experimental study was as follows: Twin *T* was given intensive vocabulary training for a period of 5 weeks, beginning when she was 84 weeks old and continuing through her 88th week. Twin *C* was given the same course of training for a period of 4 weeks, beginning at the age of 89 weeks. Both children received considerably more language opportunity and socialized attention as a result of the study than they would have received under ordinary circumstances.

To insure comparative control, the environment and opportunities of the twins were kept as identical as pos-

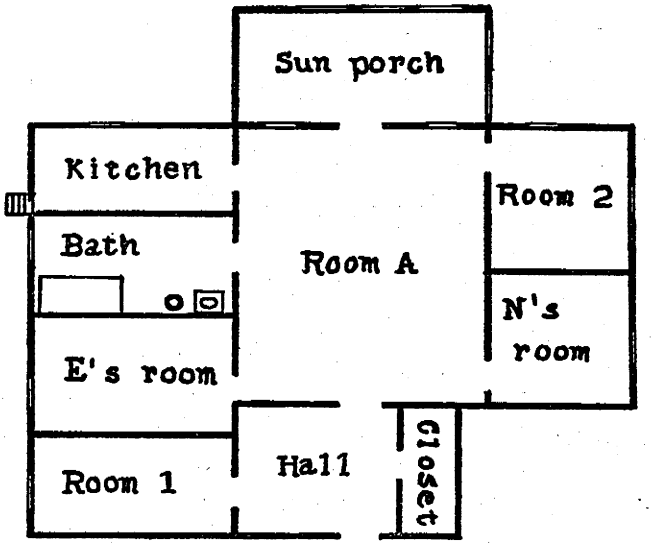

FIGURE 1

FLOOR PLAN OF THE EXPERIMENTAL SUITE
E, experimenter; *N*, nurse

sible, except that vocabulary training was completely deferred for Twin *C*. She was isolated from Twin *T* and every other individual except the nurse and the experimenter,[5] both of whom refrained from verbal

[5]There was one exception to this, which was beyond the control of the experimenter. The father of the children saw them together once a week for a period of one hour (a total of four hours during the non-language period of Twin *C*). During that time, Twin *C* was talked to as much as Twin *T*. However, the experimenter was present at all of these visits (which occurred outside of the experimental rooms), and was able to keep a complete record of events. While ideally it would seem best to rule out such an exception, nevertheless this unavoidable relaxing of the strict conditions imposed, served as a valuable check period in which an interesting comparison of the twins could be made. That it was essentially ineffective in influencing the language behavior of Twin *C* will be brought out later.

language in her presence.[6] It became evident at once that Twin *C*'s joy in life was in no way curtailed by her being deprived of our conversation. She retained opportunity for expression through gesture and vocalization. Gesture was employed by the nurse and the experimenter in certain natural situations, and both made use of humming and wordless singing in which Twin *C* took keen delight. Vocalization was not discouraged by social disapproval, nor encouraged by any practical response. Like Twin *T*, she was freely encouraged in games and activities by demonstration, dramatic presentation, and the like, but without verbal vocalization.

In order to reduce to a minimum the possibility of sounds from one child being overheard by the other, the twins were kept as widely separated as the suite of rooms permitted. When one twin was on the porch or in Room A, her co-twin was kept in Room 1, shut off by two sets of doors, rather than in Room 2. Thus, although absolutely sound-proof rooms were not available, careful investigation showed that under the arrangement adopted, vocalizations of one child could not be heard by the other. This precaution was necessary to insure complete independence in language development, in order that the control twin might not be affected in any way by Twin *T*'s training.

[6]In order that even incidental training might be entirely dependent on the experimenter, and thus subject to control, the nurse maintained complete silence with both children. This rule of silence was relaxed for Twin *T* with regard to a few established commands (page 235) after her training was complete. It was maintained for Twin *C* throughout the entire period of investigation.

At the close of Twin *T*'s training period, Twin *C* was trained for four weeks, the period beginning when she was 89 weeks of age, and continuing through her 92nd week. Since Twin *C* had heard no articulate words (with the exception noted) during the period of *T*'s training, it seems safe to assume that, at least as far as formal vocabulary was concerned, she was no further advanced than both *T* and *C* had been at the beginning of the experimental period. She was, however, five weeks older than Twin *T* had been when her training was begun.

Twin *C*'s training was as nearly identical with Twin *T*'s as it was possible to make it. Daily routine, time and place of training, objects used, and words taught were the same, and the method of training was duplicated as closely as possible. The variable, then, was the greater age of Twin *T* at the beginning of training.

III

TRAINING PROCEDURE

The methods and conditions of training employed are presented below in some detail. The description applies equally, of course, to the training of *T* and to the subsequent training of *C*.

The training can be considered under two main classes: (*a*) formal, in the sense of following systematically a definite, intensive procedure in which the child's attention and interest were persistently directed to the training materials or activities; (*b*) informal, or incidental, in which the training was a function of the child's daily routine. Each of these may now be considered more specifically.

FORMAL TRAINING

The principal formal training period was a period of an hour and a quarter in the morning.[7] It took place in Room 2,[8] which was furnished at that time with the child's crib, a child's wicker arm chair, a toilet chair, a chair for the examiner, and a dictaphone machine. Into this standard setting were introduced various objects and toys to be described later, which were used in the training.

The method consisted, in bare outline, of presenting

[7]Whenever the term "training period" occurs in the study without any qualifying statements, it refers to this morning period of formal training.

[8]On the Days 4, 5, 6 and 7 of Twin *C*'s training period, training had to be given in Room 1 because of a temporary medical isolation imposed on her.

to the child an object or toy, naming it, and attempting to secure from her some repetition of the word. As learning progressed, the object was presented with the question, "What is it?" If it were not named, or were incorrectly named, the word was supplied by the examiner, and the procedure repeated. After some degree of learning had been evidenced, an opportunity was usually given for the child to correct her own error. Throughout the period, every effort was made to keep the training in the nature of a game. Frequent shift of material was made, as well as slight variations of presentation, in order to maintain the child's interest. In teaching the word "ball," for example, teacher and pupil played ball vigorously, the ball being held poised for throwing but not thrown by the experimenter until it was named. The toy cat was made to perform numerous gyrations, with periodic pauses in which the name was required. Later, the child herself initiated play with the objects, in which spontaneous naming was prominent. That the training period was an enjoyable one for the subjects was indicated by the excited way in which they hurried ahead of the experimenter into the training room and by the evident anticipation which they showed, as well as by their obvious interest throughout the period.

It should be pointed out that differences in the frequency of repetition of a given word did occur between *T* and *C*. After careful consideration, it was decided that in an experiment of this kind any attempt to hold the number of repetitions entirely constant would create a highly artificial situation. With length of train-

ing time and forms of training kept constant, number of repetitions depended on the child's own receptivity. If Twin *C* showed a capacity to progress faster, it did not seem justifiable to limit arbitrarily her tendency to do so. There was a certain minimum of drill which remained constant for both subjects. Variations in excess of that were a function of the child's own responsiveness. This excess, in turn, could not be so great as to cause any marked discrepancy of drill between the two subjects because of the definite time limitation of the training period.

The procedure adopted was further justified by evidence which had not been anticipated but which became apparent as the experiment progressed. This was the tendency to self-initiated practice which was observable in both *T* and *C*. Very frequently the subject would continue to repeat a given word long after the experimenter would have changed the subject. On Day 7 of *C*'s training, for example, she showed the keenest enjoyment of the hand-shaking, with its accompaniment of "How do you do," and initiated it repeatedly by reaching for the experimenter's hand and shaking it. Examples could also be cited for Twin *T*. She was especially persistent in naming objects, continuing at times for 30 or 40 repetitions and increasing in vehemence until the experimenter became responsive. In such situations, mere lack of encouragement was usually of no avail, and it seemed more disruptive of experimental conditions to refuse cooperation or give actual discouragement than to allow the child to conduct her own drill, even though it meant that total repetitions would exceed the total for her co-twin.

The objects used in the training were not introduced all at once but were added gradually to the original nucleus of four or five. The complete list of objects used is as follows: a ball, a wooden duck, a shoe, a red paper cap, a stuffed toy cat on wheels, blocks, a wooden rabbit on wheels, a small toy train, a small wagon, a basket, and a picture book.[9]

Besides drill in the naming of these objects, training was given by means of directions concerning the same objects. The commissions were very simple, being for the most part simply "Bring the —— to me," or "Put the —— on the chair." They involved the selection of the correct object, however, from a group of several objects. As in the case of object-naming, the experimenter gave opportunity for a correction whenever there was failure or an error, and demonstrated if the error persisted. Towards the end of the experimental training, more complexity was introduced into the directions by such commissions as, "Put the —— on the bed; in the wagon; in the basket"; etc.

At the end of the first week of training for both subjects, a picture book[10] was introduced, and daily training given in picture pointing. The experimenter named a picture, secured some attempt at repetition on the part of the child, and then tested her ability to point to that picture on request, both in its original setting and in others. The direction given was, "Show me the ——," or "Put your finger on the ——," or "Where

[9]Eulalie—Baby's First Book. No. 727. The Platt and Munk Co., Inc.

[10]See footnote 9.

is the ——?" In order to control the possibility of page position cues in the picture-pointing, the same pictures selected for training were made available in cut-out form, so that they might be combined with any other of the pictures and so that their position in reference to each other might be varied. While it would have been desirable from the standpoint of control to have paired each picture with each other picture in order to test discrimination, it was found that practically this could not be done. It was impossible to retain the child's interest for so long a series, even when the picture test was alternated with other material. The plan was adopted, therefore, of presenting the pictures always in threes (a greater number gave evidence of being beyond the immediate attention span), with the position factor carefully controlled. A complete record was kept from which it was possible to determine the correct responses and the errors for each trial. From time to time an opportunity was given the child to name the test pictures, but during the period of the controlled experiment no definitely positive results were obtained.

The pictures chosen for specific study were the following: a horse, ball, spoon, doll (named "baby"), chair, teddy, duck (named "quack-quack" in order to add further phonetic variations as well as to avoid confusion in this particular case with the wooden duck), and table.

Throughout the whole formal training period, a complete record was kept of the language of the experimenter and of the child. It was possible to record

the number of times a given word was repeated by the examiner, the number of responses by the child, her errors, and her successes. A phonetic record of her attempts in response to a series of stimulus words was also made. Besides this record by the examiner, daily dictaphone records were made of these responses.

The use of dictaphone records in the study of language development offers decided advantages, in spite of certain difficulties. It does provide a more or less permanent record, by means of which it is possible to reinstate vocalizations at any given stage and to compare them with any other stage. It reproduces with a fair degree of accuracy variations in pitch within a word, as well as from word to word, or from child to child, and gives some hint as to intonation and typical speech rhythm. Its disadvantages are largely a function of the difficulty of recording a child's voice mechanically. The instrument is sufficiently delicate to record the clear, normally loud speech of an adult talking directly into the mouth-piece, but the child's vocalizations, having usually less volume, especially when an unfamiliar sound is attempted, and being uttered frequently at a distance from the mouth-piece, are sometimes reproduced indistinctly. This is especially true of consonant values. However, when the dictaphone record is supplemented by an accompanying phonetic record, it offers a valuable aid to the study of language development.

Through the cooperation of the local dictaphone agency, the dictaphone used in the present investigation was equipped with a specially sensitive recording

device which aided materially in securing usable records. After the children had had some experience with the machine, they adapted to it readily, and it was possible on the whole to have them respond directly into the mouth-piece. A technique was worked out whereby the experimenter's stimulus word was recorded, and the mouth-piece turned to the child in time to catch her response. As they grew accustomed to having the tube placed in front of them, it was even possible to secure a record of their laughter and of the spontaneous jargon (the phonetic recording of which was the despair of the experimenter) without in the least disturbing them or interrupting their fluency. Both children showed the keenest delight in the dictaphone situation. Both ran to get it and brought it spontaneously and unassisted from the hall to its place in the training room at the beginning of the period, showed obvious enjoyment in talking into it, and, after the words "all gone" were learned, marked its being put away with a lugubrious "gaw gaw."

Words were added gradually to the original two or three stimulus words first given in the dictaphone situation. By the end of the training period, some 50 words were used, to most of which there was a recordable response. The list of words used will appear in the discussion of the data.

The order of events in the training period followed a definite sequence, as follows: A test for object names; drill in the repetition of a given list of words with the responses recorded on the dictaphone; a series of directions or commissions involving the test objects; and

picture-pointing. With the exception of the dictaphone recording, the events were repeated as often as time permitted.

The second formal training period was 15 minutes in duration and consisted of training given in naming and pointing to parts of the body, the Spanish names for those parts being used. The period came in the afternoon after the child had had her bath and was dressed in night clothes. It immediately preceded supper. This time was chosen for several reasons. First of all, it was hoped that some evidence of rivalry between Spanish and English might be brought out, yet we were extremely desirous that the rivalry might not be so great as to unduly disturb the morning period on which especial emphasis was placed. The separation in time, it was thought, would help to minimize that danger. In the second place, observation during the week before the training in Spanish was begun indicated that that time of day was exceptionally favorable for vocalization and that the children were characteristically in excellent good humor.

The child remained in her crib during this training period. Again the game method was employed in pointing out her eyes, mouth, nose, hair, hand, and toes, and in having the child point out those parts on request. A doll, a toy dog, and a celluloid frog were added to this situation. Training in naming them was given as in the morning period, except that the Spanish names were used.

Although this period had seemed especially favorable for a short learning period, actual trial proved it

somewhat deceiving. Spontaneous vocalization was especially prominent—so prominent that there was often great difficulty in offering the stimulus word or of being sure that it was heard at all. The child was apt to be in such high spirits that self-initiated romping interfered with any definite experimental procedure. The shortness of the period and the fact that the child remained in her crib during the training probably also affected the results somewhat adversely. However, since both children responded to the situation in exactly the same way, and the conditions were equally unfavorable for both, the results, however meager, are comparable.

Informal or Incidental Training

By informal training is meant that which was a function of the child's daily routine. While, in most cases, it was no less regular than the formal training, it was not so intensive. It was, perhaps, more natural in that it made use of the manifestly absorbing activities of dressing and eating, as well as of spontaneous play situations.

Informal training took place chiefly during dressing, at two meals, during the daily walk, and during certain periods of free play under standardized conditions. During dressing, it consisted of brief drill in naming shoes, stockings, dress, pins, etc. The experimenter was with the child being trained for two meals, and with the other child at the third. It did not seem advisable to emphasize training at meals for fear of disturbing the excellent eating habits already estab-

lished. Training was limited, therefore, to naming the bib when it was put on, the food, when it appeared ("dinner"), and to the regular use of "all gone" when a dish or cup had been emptied.

Training on the daily walk followed spontaneous interest showed by Twin *T*. Twin *C*'s subsequent training during her walk was made to conform to the selection thus made by *T* in order that such incidental training might be given a fairly high degree of control. The training consisted of naming objects met, such as cars, dogs, horses, people, birds, water (a small pond), and the like, and giving some chance for repetition and for use in response to "What is it?" Simple commands such as "Come," "Run," "Stay on the sidewalk," and the like, had a very natural place.

The free play periods usually took place on the sun porch, even when the weather was so severe as to necessitate outside wraps. The main set-up remained constant, although variations were introduced at will, so long as the same variations were introduced into the training of both subjects. The standard equipment included a large rocking chair, a straight chair, a staircase[11] of four treads leading up to a long table, and a playhouse or compartment. The playhouse was a one-room compartment having a side window-opening of adjustable size, a real front door through which the child could pass without stooping, and was topped by a gable roof and a flag pole. Into this setting a

[11]The staircase was 60 cm. high and 59 cm. wide. Each tread rose 15 cm. The third tread had a breadth of 28 cm. The other treads were 19 cm. in breadth.

wooden rabbit on wheels, a paper cap, blocks, and a toy wagon were introduced. Although, in the main, the child was allowed to set her own pace for training in this situation, a certain regularity was maintained. For example, a peek-a-boo game around, or in, the playhouse was a regular feature, as well as a drill in "up" and "down" as the child went up and down the steps in play. "Bang" was taught in connection with the banging of the door of the playhouse, in which each twin in turn indulged with the greatest delight. A how-do-you-do game was also introduced into this period. Cars and people were named by the experimenter as they passed the porch whenever the child showed interest in them by pointing, vocalizing, or some other indication.

From the above description, it is evident that even in the informal or incidental training there was a certain regularity of method and material which justifies the assumption that the training of Twin *T* and of Twin *C,* informal as well as formal, was practically identical and that, therefore, differences in end result are in all probability a function of some other factor.

In order to have further check on object-naming besides the daily checks of the examiner, Twin *T* was tested in another environment (the Yale Psycho-Clinic) and by another individual (A. G.), at the end of four weeks of training, and again at the end of five weeks of training. On both of these occasions an attempt was made (by A. G.) to teach a new word to both *T* and *C*, separately, for comparative purposes.[12] At the

[12]It should be noted that, except for this test situation instituted for comparative purposes, silent conditions were as carefully maintained as within the experimental rooms.

end of *C*'s training a similar test was given her, a retest was given *T*, and both subjects were again taught a new word.

Separate developmental examinations were conducted at the end of *T*'s training (which, of course, marked the beginning of *C*'s). The examination for *C* was conducted silently, and results were noted by a second observer in order to eliminate the customary dictation on the part of the examiner. At the end of *C*'s training period, a simultaneous back-to-back developmental examination was given both.

While Twin *T* was being trained, Twin *C* was by no means neglected. Although her vocabulary training was being deferred, care was taken that her social and expressional experience should be rich in other directions. The experimenter spent about half as much time with her as with her co-twin. During the time spent with her, many of the same games which were played with her twin were played with her, except that they were silent. Vigorous games of ball, peek-a-boo, and hand-shaking (the last initiated at first by *C* herself) were favorites. Music, in various simple forms, was introduced. Both nurse and experimenter made use of humming in situations annoying to the child (face-washing, nose drops, and the like), in which they would ordinarily have talked to her. The experimenter made somewhat more definite use of it in a given play situation. One of Twin *C*'s favorite games was to rock the experimenter as she sat in a rocking chair. The experimenter entered into the game by humming, in rhythm to the rocking, the tune

of the nursery song, "See Saw, Marjorie Daw." This was done consistently whenever *C* initiated the rocking, and resulted in an interesting development which will be described later.

A harmonica was supplied, and, after wordless demonstration, *C* learned to blow it. She had a small Swiss music-box which was played by turning a handle and around which a number of activities were developed. Although it could hardly be called musical, a crying doll was given her at certain periods. It might be noted in passing that we found no evidence of imitation of its wail!

Expressive gesture was used by both the nurse and the experimenter, such as nodding and smiling for approval, head-shaking in places where "No, no" was used for Twin *T,* and beckoning and pointing in simple wordless directions.

During the subsequent training of Twin *C,* Twin *T*'s training was discontinued, but she remained in a relatively normal language environment. The experimenter talked to her as she had throughout the experiment, but gave no drill and did not stimulate the use of words by questioning. No new words were given or used even when there was opportunity for them. The nurse did not talk to her, except for a minimal use of the following expressions: "Come," No, no," "Stand up," "Sit down," "Toilet," and the child's name.

A record of her language and the situation in which it occurred was kept as in the training period. It must be admitted, however, that at times, because of the rapidity and amount of her speech, the experimenter

DAILY SCHEDULE

A. M.	Twin *T*	Twin *C*
6:45	Put on toilet chair. Milk.	Put on toilet chair. Milk.
7:00	Dressed by experimenter.	Dressed by nurse.
7:50	Breakfast, nurse present.	Breakfast, experimenter present.
8:30	Free play in Room A, nurse present.	Free play in Room 1, experimenter present
9:00	Training period in Room 2.	Walk with nurse or free play in Room 1.
10:15	Orange juice.	Orange juice.
10:30	Nap. Put to bed by experimenter.	Nap. Put to bed by nurse.
P. M.		
12:00	Taken up from nap by experimenter.	Taken from nap by nurse.
12:15	Dinner, experimenter present.	Dinner, nurse present.
12:45	Walk with experimenter, or free play on porch.	Free play in Room A (if Twin *T* was outside), or in Room 1, nurse present.
1:45	Free play in Room 1, nurse present.	Free play on porch, experimenter present.
2:45	Free play on porch, experimenter present.	Free play in Room 1, nurse present.
3:30	Bath, by nurse.	Free play (romp) in Room 1, experimenter present.
4:00	Spanish period in Room 1.	Bath, by nurse.
4:15	Left alone in crib with toys.	Left alone in crib with toys.
4:30	Supper, experimenter present.	Supper, nurse present.
5:00	Put to bed by experimenter.	Put to bed by nurse.

was forced to abandon word-for-word recording, and to content herself with noting only the first occurrence of a word during a given period of observation, except in cases where its repetition involved a new reference.

Before proceeding to a presentation of results, an

outline of the daily schedule of the twins is perhaps appropriate. The schedule given on the preceding page is the one followed during the training of Twin *T*. The same schedule was used for Twin *C*'s training in turn, Twin *C* taking the place of the *T* of the schedule here presented, and Twin *T* being substituted for *C*.

It should be noted in passing that adequate toilet habits had not been established for either twin, and that training in this respect was undertaken for both. Twin *T* was given the word "toilet." Twin *C* could not be given the word, but her training was equally regular. She was given approval for successes by nodding and smiling and a toilet chair always was kept in the room so that there might be opportunity for her to go to it or indicate it by gesture.

IV

RESULTS

The results of the experiment will be considered in three sections: the behavior of Twin *C* while she remained in a non-verbal environment; a comparison of the language behavior and development of Twin *T* and Twin *C* from the point of view of comparable days of training; and the behavior and language development of Twin *T* in the four-weeks' period subsequent to her training.

Twin *C*: Non-Verbal Control Period

The reactions of Twin *C* to the conditions of the control environment were from the beginning gratifying and reassuring. These conditions were carefully safe-guarded to insure her social experience, emotional life, and self expression. Neither the writer nor an independent observer (A. G.) noted any adverse effects in the postponement of the vocabulary training. There was a gradual shift or modification in behavior which seemed to result from the non-verbal environment, but at no time was any problem presented.

There was at first some evidence of strangeness in the new situation which was slightly more marked for Twin *C* than for Twin *T*. However, the same fact had been noted at the beginning of the developmental examination on the preceding afternoon, when conditions were the same for both twins. The final adjustment of *C* was fully as good as that of Twin *T*. Both twins gained in weight more rapidly during the experi-

mental period than they had before, Twin *C*'s rate of increase being slightly greater than *T*'s.

At the beginning of the experimental period, Twin *C*'s vocalizations could not be distinguished from her co-twin's, either in variety, inflection, or in amount. As the experiment progressed, however, differences in vocalizations could be noted as well as in what may be more generally termed language behavior.

As has been mentioned before, Twin *C*'s vocalizations, although not discouraged, were not specifically encouraged by social approval or by making any observable response to them. She very soon, therefore, adopted other means of attracting attention. Grunting, coughing, and throwing kisses appeared, as well as a highly artificial "laugh." This last was the most persistently used, and appeared on the sixth day of the experiment, continuing throughout the rest of the period and even into the training period when language was encouraged. Although its origin probably lay in a true laugh, it soon ceased to be recognizable as one. It was a rough "heh-e-heh-e-heh" sound, produced by a vocalized breathing in and out. It seemed to have no emotional content. At first it was used following a vocalization to which the examiner had paid no attention, but later it came to be used alone as definitely as any verbal summons.

Approval was given Twin *C* by means of nodding and smiling, and by the middle of the third week this form of expression had become very prominent in *C* herself. She nodded when commendation was due her for success in toilet-training, when she had succeeded

in following the experimenter's demonstration in play with the blocks, when she handed an object to the experimenter to be repaired (the handle of the Swiss music-box always came off when turned the wrong way), and when the repaired object was returned to her. The nodding frequently appeared during meals when she had finished her food. On a few occasions the nodding was accompanied by vocalization, but usually there was only smiling with occasional pointing. Twin *C* responded as well to a head shake as her co-twin did to "no, no." On several occasions, however, there was some silent arguing with the experimenter. The first time it occurred, Twin *C* was engaged in a forbidden activity, and the experimenter, having attracted her attention, shook her head in disapproval. *C* hesitated a moment, then with a mischievous grin nodded emphatically several times and continued, entirely unconvinced! Later the same day there was more agreement. The experimenter shook her head at *C* for pouring her milk on the table. *C* at once began to shake her own head and continued for some time to do so whenever the experimenter looked at her.

Although there was little evidence that the total amount of Twin *C*'s vocalizations became less as the experiment proceeded, there is abundant evidence of modification as to the situations in which it appeared, and of increasing disparity between her vocalizations and Twin *T*'s, as the latter's training progressed. As has been mentioned, by the sixth day *C* was attracting the experimenter's attention by "laughing" instead of

vocalization. Jargon of a conversational type, and even simple vocalizations directed to the experimenter, showed a steady decline. During the first week of the period, the child always vocalized to the experimenter when handing her an object. During the second and third weeks she was sometimes silent, merely nodding. By the fourth week she was as likely to be silent as to vocalize; but by the fifth week she vocalized in only about a third of the occurrences, the other two-thirds being silent presentations. Even as early as the 11th day there is evidence that the experimenter's silence in her presence was having a noticeable effect. On that day, the experimenter, going into Room 1 to investigate the switching on and off of the light, found a twin standing up, playing with the light cord. Twin *T* should have been having her nap there, and, without investigating, the experimenter said, "No, no; lie down." The child showed such evident surprise that it was suspected that a mistake had been made. Inquiry revealed that an unexpected shift of rooms had been made, and that the twin addressed had been Twin *C*. (It is quite certain that no other mistakes of a like nature were made!)

On the 18th day, the following summary appears in the notes: "Whether or not the absolute amount of vocalization at this time is different in *T* and *C*, it seems evident that there is a well-defined difference in kind. Twin *T* shows a characteristic tendency to turn to the experimenter with vocalizations of a questioning nature or with a series of syllables suggesting a statement of fact, and to use less often than *C* the purely

sound-play type of vocalization. Even when there is no change of situation, she is apt to point and vocalize, looking at the experimenter. She is tending now, also, to use some of her drill words in vocalization when she is alone.

"Twin *C,* on the other hand, is apt to vocalize at any change. Her sounds tend to be of an exclamatory and sound-play type. She vocalizes to the experimenter only rarely, and never has the questioning intonation. Her sounds are more staccato than *T*'s, generally, with fewer liquid sounds, and are more apt to be repetitive. Usually when specifically engaged in play with the experimenter she is entirely silent, merely nodding. Such vocalizations as she does use during these situations seem to be called forth by a sudden change or event such as a dropped block."

It should be noted here that vocalizations on the occurrence of a sudden event, at the arrival of a person, or on a change of situation (such as the bringing in of the table for a meal), were just as frequent at the end of the control period as they had been in the beginning. They suggest a reaction of a more fundamental nature than is the case with more socialized situations.

The richness of gesture, apparent early in Twin *C*'s non-language period, could be noted both in a social situation involving the experimenter and in more purely individual activities. Her spontaneous vocalizations, although in themselves less varied than Twin *T*'s, tended as the experiment progressed to be accompanied by an abundance of hand-waving, nodding, head-shaking, and play of facial expression from frowning to

beaming smile. Although these were indulged in in the experimenter's presence, they were most often entirely without reference to her in any way.

As has been mentioned previously, the weekly visit of the twins' father constituted the only relaxing of the experimental conditions which was permitted. He did not see them the first week of the experiment, so that the total time of vocabulary environment was only four hours. It would not have been unexpected if there had been some evidence that Twin *C* had been influenced by this language stimulation. To our surprise, however, the very opposite seems to have been true; there were definite indications that the control period carried over in some measure into the other situation. The following summary appears in the notes for Day 20:

"Twin *C,* under stimulation from her father, pointed and vocalized, and responded, in jargon suggestive of conversation, to remarks directed to her. However, in the midst of a vocal exchange with her father, she brought a book to the experimenter, stopped vocalizing, and smilingly handed the book, nodding silently. Throughout the visit, she reverted to silent nodding whenever she approached the experimenter." Her vocalizations did not have the questioning inflection noticeable in Twin *T,* but her use of expressive gesture was more marked.

More than usual care was taken to record vocalizations of both children in the hour following the father's visit each time, in order to reveal any carry-over of specific words. In no case was any evidence of per-

severation found. Twin *C*'s one word, "up" (uh-pi-di di), which was never entirely lost but reappeared from time to time during the silent period, occurred no more frequently after a visit than at any other time, although practice in it was usually given by her father.

The checks made at the Yale Psycho-Clinic at the end of the fourth week of the experiment and again at the end of the fifth week gave further evidence of a silent attitude for Twin *C*, more apparent because of the comparison with Twin *T* who was in the midst of her training period. On the first occasion, the new examiner (A. G.) repeated the word "rubber" 37 times, and Twin *T* made some vocal response 36 times. After the word "can" had been repeated 16 times by the examiner, with 12 responses from *T*, she named the can correctly several times. To the next 20 repetitions, she made 21 responses, frequently naming the can on question. Twin *C*, on the other hand, made no response at all to 98 repetitions of "rubber." The examiner then shifted to the word "can." After 46 repetitions to which there was no response, Twin *C* said "ca," began to smile, and gave obvious signs of an emotional satisfaction. After the first response, she continued to say "ca," although several repetitions by the examiner were often necessary to elicit one response. After the release on the word "can," the word "rubber" was again attempted, and for each repetition by the examiner she made a response. She did not name either the can or the rubber on question.

In the following week, under the same conditions, differences in the type of response made by the twins

were noticeable, although not as marked as in the first case. Twin *T* responded 34 times to 35 repetitions of the word "bottle" by the examiner (A. G.), and 8 times to 5 repetitions of the word "cork." The responses to the first word were not consistent; the response to "cork," however, was always "ca," and was used in naming the cork on question. Twin *C* made 10 responses to 14 repetitions of the word "bottle," and 16 responses to 17 repetitions of the word "cork." For neither word were the responses consistent, thus making it impossible to check naming. It is interesting to note that in spite of the fact that the time allowed for the tests was the same for both children, Twin *T*'s responses were so much more ready that her total practice was much beyond *C*'s.

The mimetic tendency of Twin *C* during the control period was extremely interesting. This tendency was much more marked for *C* than it was for *T* at any time in the experiment, and outside the vocal field was greater than it was for *C* during her subsequent training period. Her nodding and smiling in the same way the experimenter did has already been noted. By the ninth day of the experiment, she was definitely humming with the experimenter on the accented beats of "See saw, Marjorie Daw"; by the eleventh day, she occasionally began to hum before the experimenter started or continued after she stopped; and by Day 14 she hummed alone, while rocking herself, in the proper rhythm, and with some variation of pitch: "ah-aaa, ah-aaa, ah-aaa." By Day 25, she was keeping the pitch extremely well. About Day 17, a tendency to

rhythmical vocalization, by reason of its pitch variation suggestive of syllabic humming, appeared. The experimenter's humming had always been entirely non-syllabic.[13]

On Day 18, the experimenter observed Twin *C* holding a folded piece of paper in front of her, moving her lips silently as though reading, and nodding from time to time. No immediate explanation could be given for this new game, but inquiry revealed the fact that the nurse, when reading in *C*'s presence, moved her lips silently. *C* had adopted this new activity entirely spontaneously.

Although *C*'s world was devoid of word language, it was not devoid of sounds, and she showed a marked tendency to imitate certain of them. The experimenter and the nurse had adopted a code of whistles for communication in the presence of Twin *C*, and by the twelfth day *C* was definitely imitating the whistle with an "o͞o-o͞o" vocalization in which the pitch was identical with that of the whistle. On Day 18, she imitated with surprising accuracy the yelp of a dog outside. She definitely awaited his yelp, and followed it each time with her own imitation. On Day 28, a fire engine with siren sounding passed outside, and *C*, running to watch it, gave several recognizable vocal imitations of the siren.

[13]It would have been interesting to have set up the same humming conditions for Twin *T* at the conclusion of her training in order to compare her responses to *C*'s. However, since the first interest lay in tracing her language development after the elimination of drill, it was decided not to make the situation any more complex by the addition of new conditions.

While it would be unjustifiable to place too much emphasis on such evidences of imitation, nevertheless, the fact that they were prominent only during the control period suggests that they were to some degree a substitute activity; that there was a certain readiness to respond imitatively, which found expression later in a language situation.

One more result needs brief mention. Twin *C*'s toilet training was undertaken without the use of a toilet word. Her training was in all respects as regular as Twin *T*'s, but the only way she could indicate a need was to approach the chair. This occurred only four times during the five weeks of the control period. Twin *T*, on the other hand, was asking for the toilet with some degree of regularity by the fifth week. Although she was by no means infallible, the habit was much better established in her than in her co-twin. Any conclusion as to the superior efficacy of a toilet word in training is unfortunately somewhat clouded in the present case because of a kidney infection which became apparent in Twin *C* shortly after her own language training was begun. This complication very definitely affected her during the training period.

A Comparison of Twin *T* and Twin *C* as to Language Behavior and Development on Comparable Days of Training

Stages of Learning. The next step in the presentation of the experimental results is a comparison of the language behavior and development of Twin *T* and Twin *C* from the point of view of comparable days of

training. Throughout this section, day numbers refer to *days of training*.[14]

The general procedure and method of training has already been described. One variation in the training conditions for Twin *C* must be noted, however. On Day 3, Twin *C* developed an infection which necessitated medical as well as experimental isolation for several days. On Days 4, 5, 6 and 7, therefore, training had to be given in Room 1 instead of Room 2. On Day 8, the difficulty was so acute that in the afternoon Twin *C* was confined to her crib, remaining there until the afternoon of Day 12. On the ninth and tenth days, her crib was moved into Room 2 for the training period, and the training was carried on as well as it could be while she remained in bed. On Days 11 and 12, however, she was permitted to be up for the training period only, and the regular procedure was followed in Room 2. The obvious effect of these necessary variations was to impose on Twin *C* somewhat more severe conditions than had been maintained for *T*. Twin *C*'s spontaneity was noticeably reduced, probably both by her physical condition and by the necessarily narrow limits of her environment. The daily walk, for example, had to be omitted for several days, even after she was out of bed.

Something should be said here concerning the selection of the words used for training. As will appear later, a great many of them are object names. This

[14]For Twin *T*, days of training correspond in number to experimental days. For Twin *C*, of course, 35 must be added to the number of the training days in order to obtain the number of experimental days.

emphasis was given in order that, for the major part of the vocabulary taught, the opportunity for the use of a word might be given at will. The wooden duck, for example, might be presented at any time, and was never subject to a combination of circumstances which it might not be possible to reinstate at a given moment. In addition, if it had been learned, an object name could be called forth in answer to a definite question, "What is it?" while, in a "bang" situation, the child could be stimulated to the use of the word if she failed to use it spontaneously only by the experimenter's repeating it. Such a repetition would, of course, obscure any demonstration of the child's ability to use the word.

A comparatively large number of the words taught were more or less spontaneously selected by Twin *T*. That is, her natural interests were followed as a guide for the addition of new words. Twin *C*, on the other hand, was taught *only those words which had been used in Twin T's training,* and any different interests of *C* were disregarded. This again served to increase the severity of conditions for Twin *C*.

Words were added gradually to the training list for both *T* and *C*, as learning progressed. Both were allowed to go as fast as they could. In the case of Twin *C*, words were presented in the same order in which they had been given to *T*.

The apparent encouragement of infantilism of speech in such words as "go-go," "birdie," "bunny," and "night-night," it should be explained, was for the purpose of simplifying the word as much as possible (a consideration made necessary by the relatively limited

time at our disposal), and also because a double syllable was easier to identify in the child's imperfect imitation.

In this connection, it should be pointed out that the conception of "word" in this study is an exceedingly broad one from a phonetic standpoint. Although accuracy of imitation was always encouraged and an attempt made to secure it, phonetic perfection was not made a criterion of a word. Any sound, when used consistently as a response to a given stimulus, even though that sound was far from approximating the stimulus word, has been called, for the purposes of this experiment, a word. Gradual variations in the phonetics of a "word" (which were usually in the direction of greater accuracy) are of course admitted. In the case of any radical change, the word was thrown in doubt until further evidence was accumulated. That this procedure was a legitimate one seems to be borne out by follow-up work on doubtful words, after the experiment proper had been concluded.

A study of the records of *T* and *C* revealed the fact that certain well-defined stages of development could be observed in their learning. These stages were remarkably similar in kind and in order of appearance, though there were differences in relative time of appearance. A brief description of the steps will be given, therefore, before we turn to a discussion of actual vocabulary.

At first it was necessary, in the cases of both *T* and *C*, to repeat a stimulus word many times before the child made any attempt to repeat it. Although this

tendency reappeared from time to time throughout the course of the experiment in the case of new words, it was not characteristic of Twin *T* after the first week, nor of Twin *C* after the second day. In fact, it appears in the notes that Twin *C* frequently made more than one response to a given stimulus word on the second day, while for Twin *T* it was not until the eighth day that the number of responses even equalled the number of repetitions by the examiner.

After the initial stage in which there was marked reluctance of response, there appeared a willingness to make a sound in response to "Say," but the response was largely undifferentiated. That is, there was a tendency to say repeatedly a word which had just been drilled, even though the stimulus word had been changed, or to respond with what seemed to be a generalized response word. For Twin *T* the generalized response was an indefinite "kgn"; for Twin *C* it seemed to be "dăty."[15] The marked readiness of response began for Twin *T* on Day 8, and for Twin *C* on Day 6; and about Day 12 for Twin *T* and Day 11 for Twin *C* persistence in an undifferentiated response began to decline. It never entirely disappeared for either child, but tended to be prominent whenever a new word was introduced.

As training progressed, a given sound was repeated

[15]Although "da-ty" seemed to be Twin *C*'s indefinite response, it was so consistently used for the word "toilet" that in that connection it was considered a word. The follow-up study in this case substantiated the decision. The word became successively, "de-ty," "te-ty," "toi-te," "toi-tŭ," and finally, seven weeks after the close of the experiment, "toi-tū."

more and more often after a single stimulus, and in spontaneous use an object was named repeatedly. This appeared in Twin *T* by the twelfth day and in Twin *C* by the eighth. On Day 11, Twin *T* incorporated into her spontaneous jargon the word "ki-ki" (her response to "kitty"); by Day 15, she was occasionally including the last training word repeated by the examiner; and by Day 18, her spontaneous vocalizations frequently included several of the taught words. Although Twin *C* began to run through her entire vocabulary earlier in the training, she did not incorporate it so completely into her vocalizations when alone until Day 21. She did, however, begin to use taught words in the midst of jargon addressed to the experimenter, by Day 16. It is an interesting fact that for both twins there was a noticeable shift of pitch whenever a sound consistently given in response to a given word was incorporated into spontaneous vocalization of an indefinite nature. The taught word was definitely lower in pitch, and thus tended to be somewhat set off from the other sounds.

Both children apparently attempted to attract the experimenter's attention by running through the list of learned words—Twin *T* by Day 18, and Twin *C* by Day 7, after the latter had first been unsuccessful with a "laugh" characteristic of the silent period. Both, in attempting to name a given object, would give several words in succession if approval were not given for the first one. At times, when the naming was entirely spontaneous, the child gave every outward appearance of searching for the right word. The first

words were said hesitatingly and with no evidence of conviction. When the correct word was finally said, however, it was uttered forcefully, usually with a smile, and was then usually repeated again in a firm manner. Twin *T* developed the rather amusing habit of saying "kĭ-kĭ," propitiatingly, whenever she was scolded for anything. The experimenter has no explanation for this unless it is the fact that the word "ki-ki," being one of the first used in training, had received a relatively great amount of approval from her!

Very early in their training both *T* and *C* pointed to objects and, turning to the experimenter, vocalized inquiringly. The inquiry had a fairly constant form and was typical for each twin. Twin *T*'s question was, approximately, "ōō′-ē-lū-ä?" (with descending pitch on each syllable), or a somewhat more complicated ōō′-bĭng-ĭng-blä-thlūth?" Twin *C*'s question was more nearly "Ă-wĭ′-tĭ-wĭ?" or "ōō-wĭs′-ĭ-wĭs′?" This question was usually satisfied in both cases by the experimenter's naming the object pointed out. Later, Twin *C* followed her own questioning jargon by naming the object immediately herself. This did occur with Twin *T* by Day 30, but never became prominent.

By Day 17, Twin *T* was occasionally naming an object encountered in play without any reference to the experimenter, and by Day 25 this had become quite usual. Twin *C*'s object-naming, on the other hand, maintained quite definitely its personal reference, any object met with in play being brought to the experimenter and named, or named after her attention had been secured. Both twins at times spontaneously

brought all of the training objects to the experimenter in rapid succession, naming them voluntarily. This occurred first with Twin *T* on Day 30, and with Twin *C* on Day 22.

In the case of both twins, the usual level of responsiveness to the language training was broken by a sudden marked increase of interest. There was almost continuous vocalization involving, for the most part, a proper use of training words. Each word was repeated 10 or 12 times in succession, often actually shouted, and there was a rapid transition from one word to another. There was almost a frenzy of gleeful speech, as the child picked up one object after another, named it repeatedly, and insistently drew the experimenter from her frantic recording to some objective acknowledgment of her pupil's prowess. This sudden spurt occurred for Twin *T* on Day 22; for Twin *C* on Day 26.

In summing up these somewhat scattered results, two or three general tendencies can be pointed out. In the first place, the typical stages of development were strikingly alike for both *T* and *C,* including even an unexpected impetus which changed the whole tenor of response. In practically every phase, however, Twin *C* was slightly in advance of her co-twin on comparable days of training, making the shift from one stage to a higher one a little more quickly. The most obvious exception to this is the appearance of the sudden increase of interest in language, which occurred four days earlier for Twin *T* than for Twin *C.* While such a spurt was necessarily dependent on a certain degree

of accomplishment in the language field, it appeared also to be of an emotional nature. This might in part explain Twin *C*'s lag. During the period of her medical isolation and her necessary confinement to bed (about five days), her zest for living had been obviously reduced. That the narrowing of her experiences and her physical discomfort would affect adversely, or delay, her subsequent responses, is not untenable. Too much weight, however, should not be placed on it. In spite of the one finding in favor of Twin *T*, the general results suggest a greater maturity of response for Twin *C*, slight but definite, and it is this fact which is of most importance in the light of other data to be presented.

Vocabulary. We can turn now to a consideration of actual vocabulary acquired. As has been noted before (page 250), any sound used consistently in response to a given stimulus or in a given situation was considered a word, for the purposes of this experiment, even though the sound were not phonetically accurate. In all tables, lists, and graphs here presented (unless otherwise noted) an object name is considered learned if it were correct in 100% of the opportunities given. Words such as "dirty," "all gone," "bang," and the like, are considered learned if they were used correctly by the child without the aid of a repetition by the experimenter. While the 100% criterion for object names seems somewhat stringent, it was adopted in order to keep those words closely comparable to other words which were dependent on situations. That is, a word such as "dirty" or "all gone" either appeared

or did not appear, and could not be correct only a part of the time. If the word appeared once, it seemed to be just as strong evidence that the child knew that word as if it had appeared in every situation in which it might have been used. An object name, on the other hand, called forth in response to the question, "What is it?" might be correct for any proportion of the trials given.[16]

Table 1 gives a daily comparison for Twin *T* and Twin *C*, on the basis of number of learned words.[17] It includes all of the words acquired, with the exception of the Spanish, and is not limited to those which were a function of any one phase of training. The same data are expressed graphically in Figure 2. Table 2 gives the daily vocabulary list for Twin *T* and Twin *C*. (Twin *T*'s vocabulary for the post-training period is also included in this table.)

A comparative study of the daily vocabulary material reveals some interesting facts. In the first place, Twin *C* began to acquire words earlier in the training

[16]Although they are not presented here, organizations of the data were made in which object names correct 50% of the time or more, and 75% or more, were made the basis of comparison. It was found that such organizations in no way changed the relative standing of *T* and *C*.

[17]If no opportunity for the use of a specific word occurred on a given day, but the word had been used correctly on the preceding day and was correct on the day following, it was counted as correct for the intervening day. For example, on Day 26 Twin *T* named a bird correctly; on Day 27 there was no opportunity to name one; and on Day 28 it was again correctly named. Under such circumstances it seemed justifiable to assume that Twin *T* knew the word "bird" on Day 27 even though it did not occur, and it was consequently included in her total vocabulary for that day.

TABLE 1
NUMBER OF WORDS IN VOCABULARY

Day of training	Twin *T*	Twin *C*
1	0	0
2	0	1
3	0	1
4	0	1
5	0	2
6	1	2
7	2	4
8	2	8
9	2	5
10	2	7
11	3	7
12	5	13
13	5	13
14	6	14
15	8	15
16	7	15
17	7	18
18	10	15
19	11	19
20	8	21
21	10	23
22	13	26
23	12	24
24	18	26
25	21	27
26	21	28
27	22	29
28	23	30
29	23	
30	26	
31	29	
32	33	
33	34	
34	34	
35	35	

than did Twin *T*. Throughout the four weeks of her training period, her daily vocabulary total always exceeded Twin *T*'s on comparable days of training, by from 1 to 13 words. At the end of *C*'s training, she had 7 more words than Twin *T* on the 28th day—a more impressive fact when one considers that it represented about 30% of Twin *T*'s total vocabulary at that

TABLE 2
Daily Vocabulary List

Words	Days 1		2		3		4		5		6		7		8		9		10		11		12	
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*
all gone																		+		+	+	+	+	+
all right																								
baby																								
ball										+		+		+		+		+		+		+		+
bang																								+
basket																								
bib																								+
birdie																								
block																								+
boo												+		+		+		+		+		+		+
book																								
boy																								
bunny																								
button																								
bye-bye																								
cap																								
car																								
chair																								
choo-choo																								
comb																								
dinner																								
dirty														+		+		+		+		+		+
doggie																								
down																								+
dress																								
duck																								
eye																								
go-go																								

TABLE 2 (*continued*)

Words	Days 1		2		3		4		5		6		7		8		9		10		11		12	
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*
good girl																								
hello																+								
horse																								
hot																								
how-do-you-do																+		+		+				+
kitty																							+	
night-night																								
now																								
orange juice																								
pin																						+		+
run																								
shoe																								
stocking																+				+			+	+
sweater																								
tail																								
tick-tick																						+		+
there																								
toilet																+								
up			+		+		+		+		+		+	+	+	+	+	+	+	+	+	+	+	+
wagon																								
water																								
wheel																								
yes																								

TABLE 2 (*continued*)

Words	Days 13		14		15		16		17		18		19		20		21		22		23		24	
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*
all gone	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
all right																								
baby																								
ball	+		+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+		+		+
bang		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
basket																								
bib		+		+		+		+		+		+		+		+	+	+	+	+	+	+	+	+
birdie														+		+		+		+		+		+
block								+				+				+				+			+	+
boo	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
book		+								+				+	+	+	+	+	+	+	+	+	+	+
boy																								
bunny										+	+						+		+	+	+		+	+
button																								
bye-bye																	+		+			+		+
cap										+			+								+	+	+	+
car														+		+		+		+		+		+
chair																						+		
choo-choo																								
comb																								
dinner																								
dirty		+		+		+		+		+		+		+		+		+	+	+		+		+
doggie										+		+		+		+		+		+		+		+
down		+		+		+								+		+		+		+		+		+
dress																							+	
duck																								
eye				+		+		+		+		+		+		+		+					+	+
go-go											+		+		+						+		+	
good girl																								

TABLE 2 (*continued*)

Words	Days 13		14		15		16		17		18		19		20		21		22		23		24	
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*
hello				+		+		+		+		+		+		+		+		+		+		+
horse																								
hot																								
how-do-you-do		+				+		+		+		+		+		+		+		+		+	+	+
kitty					+												+		+	+				
night-night		+		+		+		+		+		+		+		+		+		+		+		+
now																								
orange juice																					+		+	
pin		+		+		+		+		+				+		+		+		+		+		+
run																				+		+		+
shoe																	+		+	+		+		+
stocking	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	+
sweater																								
tail																								
tick-tick		+		+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
there																								
toilet			+		+		+				+		+	+		+	+	+	+	+	+	+	+	+
up	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
wagon																								
water																								
wheel																								
yes																							+	

TABLE 2 (*continued*)

	25		26		27		28		29	30	31	32	33	34	35	36	37	38	39	40	41
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*
all gone	+	+	+	+	+	+	+	+	established												
all right																					
baby																					
ball	+	+	+	+	+	+	+	+	established												
bang	+	+	+	+	+	+	+	+	established												
basket											+	+	+	+							
bib	+	+	+	+	+	+	+	+	established												
birdie		+	+	+	+	+	+	+	established												
block		+		+	+	+		+		+	+	+	+	established							
boo	+	+	+	+	+	+	+	+	established												
book		+	+	+	+	+	+	+	established												
boy	+								+			+	+	+	+	+					+
bunny	+	+		+		+	+	+	established												
button																					
bye-bye		+		+		+		+													
cap	+		+		+	+	+	+	established												
car		+	+	+	+	+	+	+	+	+	+		+	+	+	+	established				
chair		+						+				+	+	+	+	established					
choo-choo				+				+	+	+	+	+	+	+	+						
comb																					
dinner				+							+	+	+	+	established						
dirty	+	+	+	+	+	+	+	+	established												
doggie		+		+		+		+					+	+	+	+	established				
down		+		+		+		+													
dress	+									+	+	+	+	established							
duck				+											+	+	established				
eye	+	+	+	+	+	+	+	+	+	+	+	+	+								
go-go	+		+		+		+		established												
good girl																					
hello		+		+		+		+				+	+	+	+	established					

TABLE 2 (*continued*)

	25		26		27		28		29	30	31	32	33	34	35	36	37	38	39	40	41
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*	*T*
horse																		+	+	+	+
hot																					
how-do-you-do	+	+	+	+	+	+	+	+	established												
kitty	+					+	+					+			+						
night-night		+	+	+	+	+	+	+	established												
now																+	established				
orange juice	+		+		+		+		established												
pin		+				+		+		+			+		+	+	established				
run		+		+		+		+					+	+	+	+	established				
shoe	+	+	+	+	+	+	+	+	+	+	+	+			+	+	established				
stocking	+	+	+	+	+	+	+	+		+	+	+	+	established							
sweater																					
tail											+	+		+	+						
tick-tick	+	+	+	+	+	+	+	+	established												
there																					
toilet	+	+	+	+	+	+	+	+	established												
up	+	+	+	+	+	+	+	+	established												
wagon						+		+				+		+		+			+	+	+
water													+	+	+						
wheel		+		+		+		+			+	+	+	+				+	+	+	+
yes	+		+		+		+		+	+	+	+	+	+	+	+				+	+

TABLE 2 (*continued*)

Words	Days 42 T	43 T	44 T	45 T	46 T	47 T	48 T	49 T	50 T	51 T	52 T	53 T	54 T	55 T	56 T	57 T	58 T	59 T	60 T	61 T	62 T	63 T
all gone	established																					
all right																						+
baby														+	+	+	+	+				
ball	established																					
bang	established																					
basket																						
bib	established																					
birdie	established																					
block	established																					
boo	established																					
book	established																					
boy								+	+	+		+	+	+	+	+	+		+	+	+	+
bunny	established																					
button			+	+	+	+	+	+	established								+	+	+	+			
bye-bye																						
cap	established																					
car	established																					
chair	established																					
choo-choo																						
comb												+										
dinner	established																					
dirty	established																					
doggie	established																					
down																						
dress	established																					
duck	established																					
eye																						+
go-go	established																					
good girl																				+	+	

TABLE 2 (*continued*)

Words	Days																				
	42 *T*	43 *T*	44 *T*	45 *T*	46 *T*	47 *T*	48 *T*	49 *T*	50 *T*	51 *T*	52 *T*	53 *T*	54 *T*	55 *T*	56 *T*	57 *T*	58 *T*	59 *T*	60 *T*	61 *T*	62 *T*	63 *T*
hello	established																					
horse	+	+	+	established																		
hot													+	+	+	established						
how-do-you-do	established																					
kitty																						
night-night	established																					
now	established																					
orange juice	established																					
pin	established																					
run	established																					
shoe	established																					
stocking	established																					
sweater									+	+	+	+	established									
tail																						
tick-tick	established																					
there																		+	+			
toilet	established																					
up	established																					
wagon	+	+	+	established																		
water																						
wheel	+	+	+	established																		
yes	+	+	+	established																		

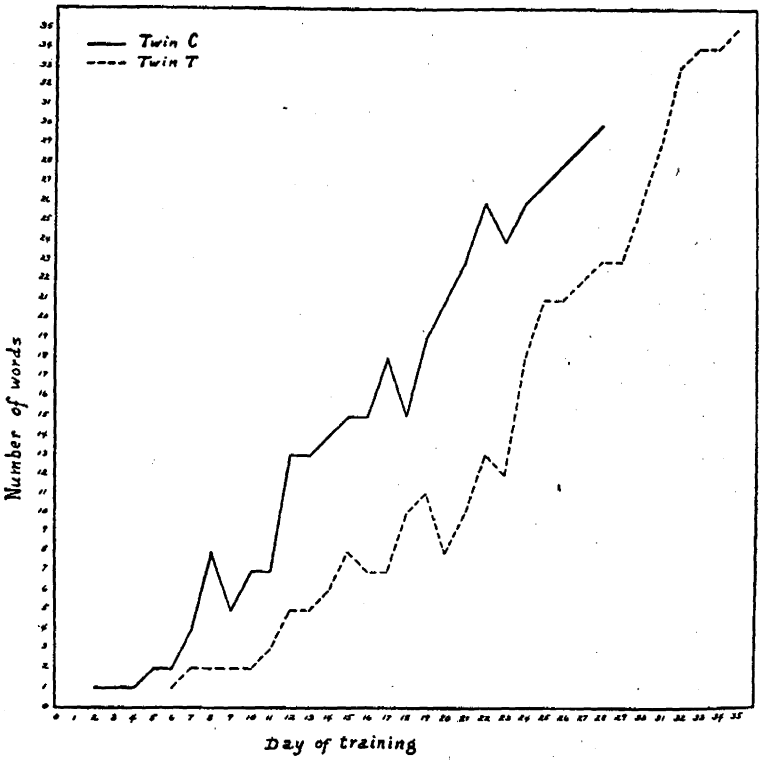

FIGURE 2

VOCABULARY LEARNING CURVES OF TWIN *T* AND TWIN *C* DURING THEIR RESPECTIVE TRAINING PERIODS

time. Although Twin *C* did not accomplish in four weeks as much as her co-twin did in five weeks (Twin *T* having 5 more words on Day 35 than Twin *C* on Day 28), her consistent lead should not be disregarded.[18]

[18]It would have been interesting to have continued Twin *C*'s training for another week. This was impossible, however, for several reasons, most important of which was the fact that on the day after the four weeks' mark was reached for Twin *C*, she had a return of acute symptoms from her kidney infection, ran an extremely high temperature, and had to be kept quietly in bed for some days. No attempt at training could be made, of course, under those conditions.

The curves of word-learning for *T* and *C* are very much alike in general appearance. They differ mainly in that Twin *C*'s curve begins earlier and remains consistently at a higher level. Rather often there are similar rapid rises in the curve, which, however, begin a little earlier for *C* than for *T*. There is a slight flattening of the curve during the last few days of Twin *C*'s training so that its general direction is rather toward the level of *T* than above it. The experimenter offers as a possible explanation the fact that Twin *C* may have been in a less favorable physical state at that time, as a result of conditions which became acutely evident the day after her training was concluded.[19]

In considering explanations for the apparent superiority of Twin *C*, several factors must be recognized. The possibility of any marked native difference in endowment seems to have been satisfactorily ruled out by the long series of observations made on these twins. Their standing at the time when Twin *T*'s training was begun was verified by a developmental examination immediately preceding the beginning of the experiment. The results, as has already been indicated (page 217), revealed identical developmental levels. Their standing was again checked by another examination immediately preceding the beginning of Twin *C*'s training. As in the previous examinations, the similarities of response were the most remarkable finding, and their developmental ratings were equal. It is interesting that one of the few differences in their behavior was that Twin *T* showed a degree of dis-

[19]See footnote 18.

crimination in her responses to directions concerning the box, cup and plate, while for Twin *C* there was no differentiation.

As has been shown in some detail, every effort was made to keep the training methods as nearly identical as they could be made. There is, of course, the possibility that unconsciously the experimenter's greater familiarity with the subjects and with the training methods might have contributed somewhat to the advantage of Twin *C*. It is not probable, however, in view of the great care exercised to maintain constant conditions, that the extent of advantage acquired in that way would have been very great. On the other hand, there are factors which would tend to act in the other direction. One of these is the fact that while Twin *T* came to the training period from a language environment, normal, except, perhaps, as to the amount of personal and individual attention possible, Twin *C* was introduced into it from a five weeks' control period in which there had been no vocabulary training. There is abundant evidence of the carry-over of some of the behavior characteristic of this period into the training period, in the occasional recurrence of a tendency to use gesture instead of verbal expression. As late as Day 7, Twin *C* resorted to a "laugh" in an attempt to attract the experimenter's attention. The silent nodding never entirely disappeared. For some days it remained prominent even in the midst of intensive language drill, and on Day 12 she repeatedly nodded at the experimenter silently instead of attempting to repeat the word "cap."

Twin *C*'s illness might also be expected to have exerted a somewhat limiting effect on her learning. She was in some physical discomfort and was subjected to a monotony of environment which obviously affected her emotional reactions. The influence of this factor is in some degree substantiated by a reference to the vocabulary graph. Day 12, which shows the sharpest rise of any part of the curve, was the day on which Twin *C* was allowed to leave her crib. There is no doubt that, in the case of certain specific words, Twin *C*'s enforced quiet effected a lessening of the opportunity for learning. "Go-go," for example, was necessarily omitted for a while, since Twin *C* could not be taken for the usual walk.

A third factor which increased the severity of Twin *C*'s training conditions is the fact already mentioned that the words used in training were largely selected in accordance with the spontaneous interests of Twin *T*. For Twin *C* there was no such opportunity to select her own vocabulary, since she was limited entirely to the list of words used in the training of Twin *T*.

While it can never be shown conclusively that the disadvantages just presented could offset any unconscious improvement in the training of Twin *C*, it seems to the experimenter that the weight of evidence favors the conclusion that there was no advantage in Twin *C*'s training conditions which would account for her consistent superiority, and that any difference in training conditions lay rather on the side of greater severity. It would appear, then, that the more rapid attainment

of Twin *C* in the field of language was in some way a function of her greater age at the time of training.

Extended Applications of Words. It was possible to make certain other comparisons of vocabulary in a direction in some respects less directly dependent on immediate training. Each child, having learned a word in one context, tended after a while to widen the use of the word and to apply it in slightly different connections, or in a situation which varied somewhat from the original situation in which it was taught. For example, the experimenter taught the word "dirty" by giving only one application, the case of hands obviously dirty. Eventually this term came to be applied by Twin *C* to dried grass on her sweater, and by Twin *T* to bread crumbs on her bed. This widening of application from a narrowly specific use to one which is in some cases suggestive of generic application marks a definite advance in language maturity. The child who can make use of a given word in three slightly varying situations has, to however slight an extent, made further progress than the child who can apply it in only two situations. This is true, the experimenter believes, even in so simple a widening of use as the ability to name a shoe while it is worn as well as when it appears as an object entirely apart from the child, and it appears with even greater definiteness in expansions which, generically, may be considered the matrix from which concepts appear.

In order to make adequate comparisons of the twins as to range of application for the words taught, general classifications were made under which all occurrences

TABLE 3

CLASSIFICATION OF USES OF WORDS

Words		Day on which use occurred Twin *T*	Twin *C*
All gone			
*1.	Food all gone	11	9
2.	Object removed from sight	19	11
3.	Object removed from reach	28	15
4.	Child removed object from sight	26	27
5.	Child removes object from reach	28	22
6.	Person leaves room	30	15
7.	Person passes (outside)	37	7
8.	Moving object disappears (cars, usually)	36	15
9.	Animals disappear	28	16
10.	Experimenter ceases activity		18
11.	Child ceases activity		26
12.	Sounds cease	32	
13.	Object lost	13	14
14.	After naming object not present	33	19
15.	After naming object usually present in that situation, but not in sight	34	19
16.	View intercepted	30	19
17.	Empty object	25	25
18.	Object emptied	47	
Bang			
1.	Noise produced by child by dropping object	15	13
2.	Noise produced by child by throwing object	18	12
3.	Noise produced by child by hitting object	15	16
*4.	Noise produced by child by banging door	17	14
5.	Noise incidentally produced by manipulating object	16	12
6.	Noise incidentally occurring from manipulating an object other than the one producing the noise	17	11
7.	When an object falls	19	5
8.	When a door bangs	36	22
9.	When the experimenter drops an object	18	22
10.	Noise produced by the experimenter as she manipulates an object	47	19
11.	Sudden sound from the experimenter (a sneeze) etc.	37	
12.	Noise from an unseen source	43	24
13.	As slips	17	15
14.	As falls	20	19
15.	As bumps head	18	15
16.	As sits suddenly	16	28
17.	As bumps into object	28	25
18.	As chokes	41	
19.	Sudden happening to material	20	18
20.	Game		28
21.	Subsequent to usual stimulating situation	26	

TABLE 3 (*continued*)

Words		Day on which use occurred Twin *T*	Twin *C*
Birdie			
*1.	Seen (on ground or flying)	21	19
2.	Sound		19
3.	Trolley wires (insulators)	33	22
4.	Location (where birds usually seen)	32	25
5.	Other moving objects in air	34	19
Boy			
*1.	Sight	25	19
2.	Sound, talking	29	27
3.	Sound, whistling	48	
4.	Sound, footsteps, skating	27	
5.	Own image	57	
Car			
*1.	Seen (moving)	32	17
2.	Partially seen		22
3.	Sound only	34	16
4.	Street car	25	28
5.	Seen (parked)	25	18
Dirty			
*1.	Dirty hand	25	7
2.	Extraneous matter (other than "dirt") on hand	41	
3.	As experimenter washes or wipes hand	45	13
4.	As experimenter washes own hand	46	28
5.	Extraneous dirt (mud on shoe; grass on sweater)	33	21
6.	As experimenter brushes extraneous dirt	32	13
7.	As child brushes extraneous dirt	34	
8.	Dirty objects (stockings; day-sheet on bed)	33	22
9.	Discolorations (other than dirt)	33	25
10.	Water	39	
11.	Disinfectant	48	
12.	As experimenter mops floor	54	
Go-go†			
*1.	Wraps, own	18	
2.	Wraps, nurse's or experimenter's	37	
3.	People in wraps	29	
4.	Place wraps kept	30	
5.	Usual time for walk	36	
6.	When dressed during day	34	
7.	Change of scene	36	
8.	Outside door	40	
Shoe			
*1.	Dressing	20	10
*2.	Training	25	21
3.	While worn, own	21	27
4.	While worn, experimenter's	37	
5.	Other than than own (not worn)	60	

TABLE 3 (*continued*)

Words	Day on which use occurred Twin *T*	Twin *C*
Stocking		
*1. Dressing	24	12
2. While worn, own	30	26
3. While worn, experimenter's	47	
4. Other than own (not worn)	26	26
Toilet		
*1. Preparation	14	22
*2. Placed	15	21
*3. Process	15	8
4. Names	19	19
5. Asks	24	24
The rest of the extension listed occurred only in the period subsequent to Twin *T*'s training period.		
Button		
1. Own, on dresses, rompers	44	
2. Very large coat button	60	
3. Detached	60	
Dinner		
*1. Food	31	
2. Table	39	
3. Tray	41	
4. Milk	40	
5. Bib, before food in sight	51	
Doggie		
*1. Seen	33	
2. Bark only	43	
Hot		
1. Radiator	56	
2. Dishes	59	
3. Chair (near radiator)	59	
4. Cereal	60	
Now		
1. When experimenter completes activity	36	
2. When child completes activity	37	
Sweater		
1. Own	50	
2. Experimenter's	60	
3. Nurse's coat	61	
Wagon		
*1. Toy wagons	39	
2. Wheelbarrow	45	
3. Doll carriage	50	
4. Tricycle	52	
5. Grass-roller	56	
6. Image of wagon in door	57	
7. Real wagon on street	59	
Wheel		
*1. Wagon's, etc., as taught	31	
2. On crib	47	
3. Duck's "feet"	59	

*Drill situation.
†This word was never learned by Twin *C*.

of a given word could be grouped. Groupings were necessary in order that mere frequency of repetition of one class of use might not be overweighted in any comparison. For example, if Twin *T* exclaimed "Bang" when she dropped a block, and when she dropped the cat or the duck, there was no real extension of application, but if she also used the word when she bumped her head, it constituted a slightly wider use. It was for the purpose of more closely delimiting extensions that classifications were made.

Table 3 lists the classifications or groups adopted. No attempt has been made to arrange them in order of complexity, since such a procedure would involve somewhat arbitrary selection on the part of the experimenter. The criteria for the specific classifications under each word were that each one should represent, in the light of the total situation,[20] a definite extension of use, that they should be mutually exclusive, and that it should be possible to include under them all of the occurrences of any given word.

Beside each item of classification in the table appears the number of the training day on which an example of that item occurred. The starred items are those which constituted the drill situation. *T* and *C* desig-

[20]Some of the classifications, from the adult point of view, do not appear entirely logical, but considered in relation to the total situation in which they occurred, they seem justifiable. For example, the word "shoe" was learned and correctly used in the dressing situation by both children some time before it could be correctly named in the training period. The ability to name it on both occasions, therefore, represented a definite though relatively simple advance. (The word "shoe" was not included in the vocabulary list, of course, until the shoe could be named in any situation.)

nate the twins. For the sake of coherence, as well as for comparative purposes, classifications and records for Twin *T* in the period subsequent to her training are presented in the same table. Day numbers over 35, therefore, indicate a day subsequent to training. It will be noted that several of the words showed no widening of application until that period.

Figure 3 summarizes the comparative data for comparable days of training by means of a composite, cumulative graph.[21] For each day is plotted, on the basis of the whole list of words in which extensions occurred, the total number of different uses acquired up to that time. It was assumed that an extension once used remained a potentiality; hence the number for each day represents the total acquired on the preceding days, plus any new extensions occurring on that day. One further point should be carefully noted. No word was included in the graph until the day on which the first extension was observed. For example, Twin *T* had learned the word "dinner" by Day 31, but not until Day 39 was there a broadening of use beyond the original specific one in which training was given. That word would have no place in the graph, therefore, until Day 39, when both uses would be added to the accrued total of uses for all words having extensions.

The numerical values for the composite treatment appear in Table 4.

A study of the data of Table 4 reveals the fact that out of 59 extension items which were common to both subjects, 46 occurred earlier for Twin *C* than for Twin *T;* 4 occurred at the same relative time of training;

[21]Corresponding data for Twin *T*, for the period subsequent to training, are presented in Figure 7.

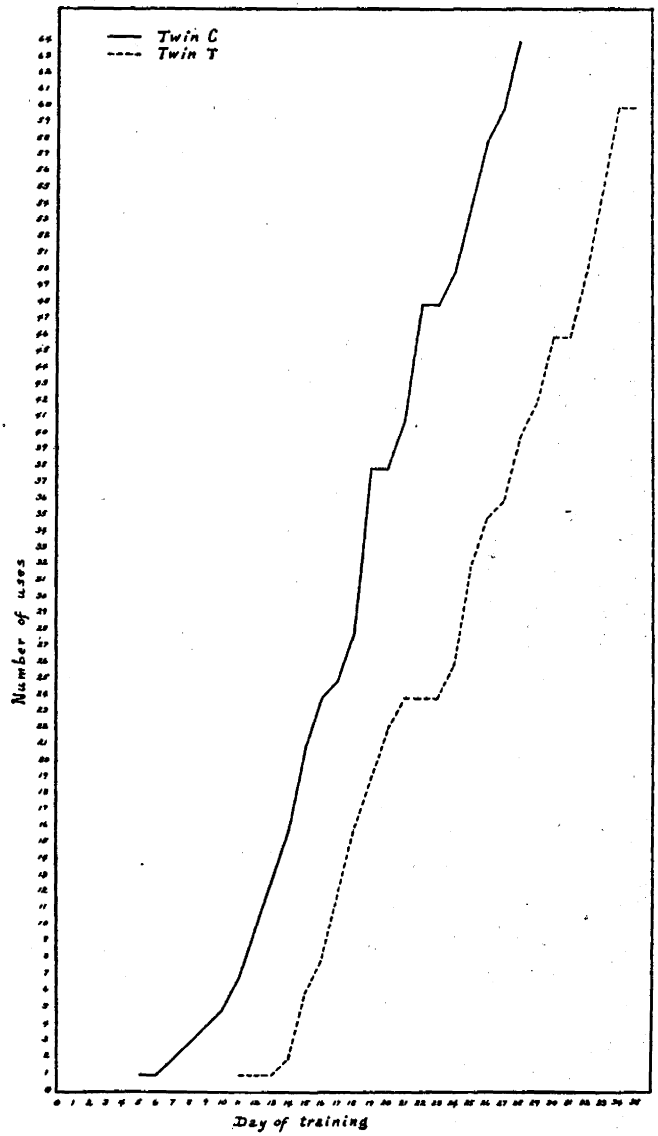

FIGURE 3

EXTENDED APPLICATION OF WORDS

Curves of composite cumulative totals for Twin *T* and Twin *C* during their respective training periods

TABLE 4

COMPOSITE CUMULATIVE TOTALS FOR EXTENDED APPLICATION OF WORDS

Day of training	Total applications Twin *T*	Twin *C*
5		1
6		1
7		2
8		3
9		4
10		5
11	1	7
12	1	10
13	1	13
14	2	16
15	6	21
16	8	24
17	12	25
18	16	28
19	19	38
20	22	38
21	24	41
22	24	48
23	24	48
24	26	50
25	32	54
26	35	58
27	36	60
28	40	64
29	42	
30	46	
31	46	
32	50	
33	55	
34	60	
35	60	

while in only 9 items did Twin *T* show a time advantage over Twin *C*. During the training period, Twin *T* showed 8 extensions which were never used by Twin *C*, while *C* showed 12 which did not occur for *T*. Four of the uses exclusive with Twin *T* occurred for a word which *C* never acquired, "go-go." (As has been pointed out, her experiences with this word were limited.)

Figure 3, in which data from all the extended words are combined, shows several significant facts. In the first place, the curves for *T* and *C* are remarkably alike. Even the occasional short plateaus show a degree of correspondence which suggests an underlying similarity of mechanism. For Twin *C,* however, the whole curve is shifted back to an earlier stage of the training period. She begins sooner to expand the uses of words acquired, and attains a slightly higher level at the close of her four weeks of training than Twin *T* had attained after five weeks of training. These results are the more important since they are dependent, for the most part, on the child's spontaneous expansion of use from the specific situation in which drill was given by the experimenter, and not on mere multiplicity of simple word acquisitions. They further confirm the suggestion made under the discussion on vocabulary, that the superiority of Twin *C* in the field of language is due to certain maturational factors which are a function of her greater age at the time of training.

Two-Word Sequences. The first occurrence of the use of two words in immediate succession was on Day 22 for Twin *T,* and on Day 17 for Twin *C.* In both cases the name of an object was used with the word "all gone," Twin *T*'s remark being "bda gaw gaw" (block all gone), and Twin *C*'s "ti ti gaw gaw" (tick tick all gone). Both children combined "all gone" with other object names before the end of the training. Twin *T* used it only with "birdie" (Day 34), Twin *C* used it with "cap" (Day 19), "stocking" (Day 20),

"car" (Day 20), "birdie" (Day 21), "shoe," and "pin" (Day 23), and "doggie" (Day 27). On Day 24, Twin *T* used "bda eh" (block yes) in immediate succession, obviously as a request for a block which was out of reach. She also combined "yes" with other words, as follows: "bunny" (Day 24), "tick-tick" (Day 25), and "cap" (Day 32). On Day 35 she said "ca do" (cap no). By that time, however, she had completely confused "yes" and "no," and, since the above use was definitely a request for the cap, it does not constitute a true extension. Twin *C,* unfortunately for comparative purposes, never learned the word "yes" at all; hence there was no opportunity for combining it. Although Twin *C* combined "all gone" with more different words than Twin *T* did, nevertheless Twin *T,* having used two entirely different two-word sequences, excelled her co-twin in that respect.

Phonetic Comparison. Table 5 presents a phonetic comparison of the responses made by *T* and *C* to the words which became incorporated into their vocabularies during their respective training periods. A full phonetic history of each word is not attempted, but the most characteristic responses and the major changes are indicated. The number following a word indicates the training day on which that response was noticed. Occasionally two slightly different responses were used interchangeably at a given period. The symbols used for the responses are those given in the guide to pronunciation of Webster's International Dictionary, since those are perhaps as widely familiar as any others.

TABLE 5

RESPONSES FOR WORDS LEARNED DURING TRAINING PERIOD
(Numbers in parentheses indicate the day of training on which that response was noted)

Word intended	Response	
	Twin *T*	Twin *C*
1. all gone	gäw-gäw äw-gäw (33)	gäw-gäw
2. ball	bă bă-bă (9) bă (24)	bäw-bäw bäw (3)
3. bang	bá bĭ (9) bá (34)	bá bĭ (27) bá (28)
4. basket	bá-gn; bä-kn	gá-ge
5. bib	bĭ	bĕ
6. birdie	bĕ-tă	bĭ-tĕ′
7. block	bdä (very staccato)	bă (very staccato) bă (25)
8. boo	bĭ	pbū
9. book	bĭ	bĕ
10. boy	bō bō-wă (29)	bō bŏ (21)
11. bunny	bŭ-bĭ; bŭ-pĭ bĭ′-tá (21) bŭ-pĭ (23)	bĭ-tá-bĭ-tá bŭ-pĭ (7) bĭ-tá′ (12)
12. bye-bye	bye-bye	bye-bye
13. cap	că	cá
14. car	că căh (33)	cáh
15. chair	tŭ	á cĕ (20)
16. choo-choo	tū-tū	tzĭ-tzĭ
17. dinner	dĭ-dn dŭ-dn (29)	cĕ dĭ-kĕ′ (24)
18. dirty	dĭ-ty	dĭ-ty
19. doggie	gō-gn; gŏ-gn	gŏg-gie
20. down	dŭ	dá (drawled almost to two-syllable length)
21. dress	bĭ dĕ (29)	cĕ
22. duck	kŭ gu (27)	gĕ
23. eye	eye	eye
24. go-go	gō-gō	gĕ-gĕ
25. hello	ō	áh-tĕ há-tĭ (6) áh-tĕ (17) Usually greater pitch drop from first to second syllable than for how-do-you-do

TABLE 5 (*continued*)

Word intended	Response	
	Twin *T*	Twin *C*
26. how-do-you-do	dă-tŭ	dá-ty há-tĭ (7) áh-tĭ (10) ăh-tĭ (15) Two syllables about equally accented
27. kitty After experimenter called a real cat	kĭ kĭ tĭ-gĭ'-tĭ-gĭ	kĕ-kĕ kŭ-tŭ'-kŭ-tŭ
28. night-night	kĭ-kĭ kĭ-kĭ (22) kŏk-ĭ (24)	dá-ty dá-dá (5) dĭ-dĭ (24)
29. orange juice	ŏh wĭs	Indefinite
30. pin	pĭ ptĭ (30)	bĕ (very short and staccato)
31. run	wĭ	rĕ wĕ (18)
32. shoe	o͞oh o͞oh (19)	o͞o-ăh
33. stocking	kŏk-kĭe	kŏk-kĭe
34. tail	tŭ-tŭ; tŭ-tn	Indefinite, occasionally tá or ĭ
35. tick-tick	kĭ-kĭ; gĭ-gĭ (distinguished from word for "kitty" by the greater quickness with which it was said. The first syllable for the "kitty" response tended to be drawled.	tĕ-tĕ tĭ-tĭ (11)
36. toilet	toi-tŭ	dă-ty
37. up	ŭh	ŭh-pĭ-dĭ-dĭ; ŭp-pĭ-dĭ-ĭ
38. wagon	wĭ-tá wá-gă (30) wĭ-gă (35)	găh-gă
39. water	wĭ-tă	Indefinite
40. wheel	wăy whăy (30)	whĕ whăy (25)
41. yes	ĕh	áh

Any phonetic representation is at best inadequate, since it cannot indicate variations of rhythm, pitch, inflectional quality or force of utterance. All of these aspects were of importance in distinguishing between two responses for which the phonetic notation is the same. For example, Twin *T*'s word for "book" and the one for "boo" may both be represented by "bĭ." It was, however, easy to distinguish between them by the fact that the response to "boo" was said brightly, in a definitely playful manner, while the word for "book" was entirely without such emphasis or coloring. Some of the words included in the list seem to show little relation between the word meant and the sound actually used. It should be remembered that, although sounds for all of the words incorporated by either child are included here, no doubtful sound was considered part of the child's vocabulary unless there was confirmatory evidence for doing so, in the data accumulated during the follow-up period. It is not possible to present those data here, but an example has been given[22] for Twin *C*, in the word "toilet."

Table 6 presents a similar phonetic comparison for a few words which were not incorporated into the vocabularies during the training periods. Some of the words were given solely for the purpose of testing the child's ability to reproduce a new sound, and had no place in the training. Dictaphone records, supplemented by phonetic notations made by the experimenter at the time, form the basis for the material of this table. Again an attempt is not made to give all the

[22]See footnote 15.

TABLE 6

RESPONSES FOR NON-TRAINING WORDS

Stimulus word	Response	
	Twin *T*	Twin *C*
1. baby	bĕ-bĕ; bĕ-bē; bā-bē	bĕ-bĕ
2. bed	bĕ; bĭ	bə̆; bĕ
3. bell	bĕ	
4. button	bə̆-bm	bĭ-tĕ
5. daddy	də̆-dĭ; də̆-ty	də̆-ty
6. horse	hŏ; ō; hŏ	hŭ; hŏ; hō
7. house	ŭh; ho(w)	
8. milk	bĭ; bŏ; bŭ; dŭ; tŭ	
9. no	dŭ; dō	nə̆; dō; nō; dŏ; nōh; dō
10. quack-quack	kə̆ kŭ; kŏ kō; kŭ gn; kə̆ kə̆	kŭ-kŭ; kə̆-kə̆
11. teddy	də̆-ty; tĕ-ty; tə̆-tĭ; də̆-ty; tə̆-ty; də̆-ty	də̆-ty; tə̆-ty
12. thank you	də̆-tū	də̆-ty (sliding inflection closely approximating the experimenter's); hə̆-ti; də̆-ty

various responses made to a given word, but only to note the more common ones. Some of them had not reached stability by the end of the training period. Variations are presented in order of occurrence, without reference to the day on which they occurred. The list presented in the table does not represent all of the words which were attempted in the dictaphone situation, since for some of them no definite response was ever obtained.

A comparison of Twin *T* and Twin *C* as to their phonetic accuracy of response is of some importance. It might be expected to throw light on the question of whether five weeks' additional maturity of articulatory mechanisms would result for Twin *C* in speech in any degree less infantile than Twin *T*'s. An examination

of the two comparative tables seems to give no evidence of this result, and even to suggest on the whole a slight superiority of articulation for Twin *T*. An accurate comparison is made more difficult, of course, by the fact that for certain words the responses of both children are so exceedingly inaccurate that it is impossible to say whether one is inferior to the other. However, on the basis of recognizability of words, and of complexity of elements represented, the experimenter would conclude that Twin *T* showed a definite, although slight, advantage over her co-twin during their respective training periods. Since Twin *T* had a week more of practice than her co-twin, the results would suggest that perhaps in this connection length of practice is of an importance to equal or overshadow any superiority accruing from a maturity advantage of only five weeks.

The most consistent differences noted in the comparative phonetic material is the somewhat more frequent occurrence of broad and full vowel sounds in the speech of Twin *T*, as compared to a certain flatness of vowel sounds often observed in Twin *C*. (Compare, for example, their responses to "car," "down," and "go-go.") This difference was also noted earlier in their spontaneous vocalizations.

Certain striking similarities of response, and even of response series, occur. Some similarities would be expected, of course, since the more nearly the attempts approach the stimulus word, the more nearly alike they would be apt to be. However, there are certain resemblances which cannot be explained so easily. For

example, the initial response of both children to the word "bang" was "bă." After a period of use, the word became "bĭ" for both, and by the end of the training period, both were consistently using "bă" again. In the responses to "bunny," "bŭ' pĭ" appears for both children, transiently for Twin *C;* more permanently for *T*. A transient response of Twin *T* to the same word was "bĭ' tă" (accented on the first syllable), while the response which became consistent for Twin *C* was "bĭ tă" (accented on the last syllable). Both *T* and *C* gave a two-syllable response to the word "ball," Twin *C* dropping the habit more readily than did Twin *T*. These correspondences are the more remarkable when one considers the fact that all possibility of the imitation of one child by the other was carefully ruled out. Again, there is the suggestion that only as a function of an underlying similarity of fundamental organization could such correspondences occur.

Commissions. In order to obtain objective data on recognition of object names, as well as ability to use the names actively, a part of the training period was devoted to commissions regarding test objects. The commissions were very simple, but involved the selection of an object from several others. Differences between the twins appeared not only in the degree to which they were able to make these selections, but also in their ability to execute the commissions.

The first commission, "Bring me," was correctly responded to by both twins, on Day 1, although the selection of objects was, of course, not accurate. To the second commission, "Put the . . . . on the chair," both

responded by going to the chair, sitting in it, or bringing it to the experimenter. On Day 4, Twin *T* could successfully follow a window-sill–(where the test objects were placed) to–chair rhythm once established by several demonstrations, but could not successfully execute the commission under any other circumstances. For Twin *C,* on the comparable day of training, it was sufficient for the examiner to look at the chair. The commission was not carried out without some such indication. By Day 16, Twin *T* showed no further tendency to bring the chair when directed to place something on it. On that day, too, she occasionally executed the commission without the need of an immediately preceding demonstration. On Days 17, 20, 21, 29, and 33 no demonstration was necessary. On the other days it was occasionally necessary to start her towards the chair before the direction would be carried out. The correct response, therefore, was never established with any degree of stability, during the training period of 35 days. For Twin *C,* the tendency to bring the chair did not appear after Day 8, and on that day demonstration or other indication by the experimenter ceased to be necessary. Both children consistently showed a tendency to make more errors in the selection of the object named when the direction "Put the . . . . on the chair" was given, than when the experimenter said, "Bring me the . . . ." Throughout the training period Twin *T* made frequent errors in selection when the direction involved the chair, while Twin *C* had a total of only three errors of selection in that commission after Day 20.

On Day 30 another commission was added for Twin *T*, "Put the . . . . on the bed." On that day she failed repeatedly, in spite of frequent demonstration. The same was true for Day 31. During the remaining four days of the training period she responded correctly only after a demonstration, or at best an initial correction by the experimenter. She was not required in this commission to select the object to be placed, in view of her evident confusion. The new direction was introduced for Twin *C* on Day 25, and was immediately correct, without any demonstration whatever. Selection of the objects involved was entirely accurate. So assured was her response, that the difficulty was increased by giving the three commissions, "Bring me the . . . ."; "Put the . . . . on the chair"; and "Put the . . . . on the bed," in varying orders, instead of following the usual practice of giving a series of the same commission, in which the only variation was the object to be selected. Even with this increased complication, she made no errors in the selection of the objects involved, and no wrong response to a direction which was not self-corrected on a second repetition of the commission, by the experimenter. The two initial errors made consisted of a start towards the bed instead of towards the chair or the experimenter, as the respective directions required. On the next day, the 26th, she made one error of execution in seven trials involving the three commissions in irregular order; on Day 27 one error in ten trials; and on Day 28 again one error in seven trials. In every case, the error was corrected on a second repetition of the commission.

There was one error in selection on the last day; none on the other days.

The evidence shows rather plainly that in the execution of commissions Twin *C* showed herself definitely superior to Twin *T*, even with a week's less training.

A comparison of *T* and *C* on the basis of their ability to select the required object from a group of others is equally revealing. Both *T* and *C* definitely distinguished the ball from the shoe on the first day of training. Neither twin made any errors in selecting the ball for the commission "Bring me." Twin *T* failed to select the ball once on Day 21, in the direction involving the chair; Twin *C* failed once on Day 18, in the same connection. Twin *T* selected the cap correctly by Day 5, with only one error in the "Bring" commission on Day 14. One error was made on Day 15. and one on Day 21, in the chair commission. Twin *C* selected the cap correctly on Day 2, making one error in the "Bring" commission on Day 4, and one in the chair commission on Day 22. The shoe was selected by both *T* and *C* as long as there were few alternatives; but with increasing complexity of possibilities, both of them made errors. Twin *T* made no errors after Day 21; Twin *C* none after Day 15. Both subjects, from the very beginning, confused the duck and the cat. Consequently, a series of tests was given, involving only those two objects, care being taken to control position factors. Even after the 35 days of training, Twin *T* never consistently discriminated between the cat and the duck. She showed greater facility in selecting the bunny from the other two objects, but even there her

responses were apt to be doubtful.[23] Twin *C*, on the other hand, had overcome her original confusion and was selecting with perfect discrimination the cat, duck, and bunny by Day 23. After Day 20, Twin *C* was consistently selecting correctly the ball, cap, shoe, cat, and duck, while Twin *T*'s list included only the ball, cap, and shoe. The block must be added to Twin *C*'s list on Day 21, the bunny on Day 22, the train on Day 25, and the book on Day 27. Twin *T*, after Day 26, selected the bunny without many errors, except when it was grouped with only the cat and the duck, in which case her responses were less accurate. After Day 31 she was almost always successful in selecting the block, but the train and the basket (which was not included in Twin *C*'s commissions, due to its very late introduction into her training) were not discriminated.

One more comparison may be made in this connection. The experimenter, holding the toy cat in the horizontal position with reference to the child, asked that its tail or its eye be pointed out. Twin *T* made no errors in pointing out the eye after Day 23; Twin *C* after Day 11. Twin *T* made no errors in showing the cat's tail after Day 24; Twin *C* after Day 20. Twin *C*'s success in pointing out the tail is rather surprising in view of the fact that the only consistent response which could be secured from her to the word "tail" was "eye"!

[23]Twin *T* came to distinguish between the duck and the bunny during the period subsequent to her training. During that time she did not see the cat at all. On a retest given her on Day 63 of the experiment, she made only two errors out of 11 trials in discriminative responses involving the duck, bunny, and cat.

On the basis of these results, it can be concluded that Twin *C,* after her 28 days of training, was definitely better than Twin *T* after 35 days of training, both in ability to execute simple commissions and in recognition of object names, as indicated by a selective and discriminative response to them. In the cases of both twins, ability to select an object correctly was usually somewhat in advance of ability to use the correct word in naming the object.

Picture-Pointing. One other aspect of the morning formal-training period remains to be treated, the results of the training in pointing to pictures. In the case of both *T* and *C,* the picture book was introduced on the seventh day of training. Twin *T* showed more interest in it than did Twin *C,* although both quite evidently enjoyed it. The results are presented in Table 7 as percentages of correct response for each picture. The translation into percentages was necessary because of the fact that, due to fluctuations of attention, the number of trials given in the daily tests of accomplishment occasionally varied. Blank spaces occur within the table when it was impossible to secure any degree of attention to a given word. The results for Twin *T* were too few to warrant inclusion in the table before Day 11; for Twin *C,* before Day 9.

The comparative attainments of the twins in the picture-pointing are obvious from the table. Certain points, however, may be emphasized. On Day 28 of her training, Twin *C* made no errors in pointing, on request, to the ball, the spoon, the chair, the teddy-bear, the duck (called "quack quack"), or the table. She

TABLE 7

PERCENTAGE OF CORRECT RESPONSES IN PICTURE-POINTING DURING TRAINING PERIODS

Day of training	Picture presented: baby (doll) Twin		ball Twin		chair Twin		horse Twin		quack quack-(duck) Twin		spoon Twin		table Twin		teddy Twin	
	T	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*	*T*	*C*
9		66.7		87.5		100.0		0.0		100.0						33.3
10		100.0	85.7	75.0		66.7		0.0		100.0						100.0
11	100.0	0.0	60.0	80.0		66.7		0.0		100.0		0.0	0.0			100.0
12	100.0	66.7	25.0	83.3	0.0	100.0	100.0	33.3		100.0		33.3	0.0	0.0		66.7
13	0.0	66.7	80.0	37.5		50.0	25.0	0.0		100.0		28.7	0.0	100.0	0.0	100.0
14	100.0	66.7	50.0	58.3		83.3	100.0	16.7	100.0	50.0		83.3	0.0	0.0	16.7	66.7
15	25.0	100.0	50.0	75.0		100.0	66.7	50.0	100.0	75.0		75.0	100.0	0.0	0.0	50.0
16	0.0	57.1	83.3	91.8	100.0	100.0	100.0	71.4	100.0	100.0	33.3	80.0	66.7	66.7	25.0	83.3
17	33.3	82.7	28.5	92.8	0.0	80.0	75.0	44.4	100.0	80.0	100.0	80.0	100.0	60.0	100.0	25.0
18	0.0	60.0	50.0	87.5	66.7	66.7	33.3	50.0	66.7	100.0	100.0	100.0	50.0	33.3	50.0	66.7
19	0.0	75.0	50.0	100.0	33.3	100.0	100.0	50.0	50.0	100.0	33.3	100.0	50.0	100.0	50.0	100.0
20	66.7	75.0	33.3	81.8	50.0	100.0	100.0	31.2	100.0	100.0	66.7	100.0	0.0	50.0	0.0	100.0
21	66.7	100.0	50.0	100.0	0.0	50.0	100.0	50.0	100.0	100.0	66.7	100.0	0.0	100.0	0.0	50.0
22	50.0	100.0	75.0	100.0	0.0	100.0	100.0	100.0	100.0	100.0	50.0	100.0	100.0	100.0	100.0	100.0
23	40.0	66.7	12.5	100.0	0.0	100.0	80.0	66.7	66.7	100.0	100.0	100.0	66.7	100.0	66.7	100.0
24	50.0	100.0	25.0	100.0	25.0	100.0	71.4	50.0	60.0	100.0	80.0	100.0	25.0	100.0	25.0	100.0
25	0.0	100.0	0.0	100.0	0.0	100.0	75.0	66.7	0.0	100.0	66.7	100.0	100.0	100.0	100.0	25.0
26	83.3	83.3	16.7	100.0	0.0	100.0	83.3	50.0	33.3	100.0	66.7	100.0	33.3	100.0	33.3	100.0
27	20.0	75.0	44.4	100.0	0.0	100.0	50.0	75.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	50.0
28	50.0	75.0	16.7	100.0	0.0	100.0	75.0	75.0	0.0	100.0	50.0	100.0	50.0	100.0	50.0	100.0
29	100.0		0.0		0.0		57.1		100.0		50.0		50.0		50.0	
30	60.0		16.7		0.0		20.0		0.0		75.0		33.3		50.1	
31	50.0		25.0		0.0		25.0				75.0		50.0			
32	20.0		0.0		20.0		100.0				100.0					
33	50.0		8.3		75.0		87.5		50.0		100.0		0.0		50.0	
34	71.4		33.3		0.0		100.0		50.0		100.0		25.0		0.0	
35	50.0		16.7		50.0		90.0		50.0		66.7		25.0		50.0	

occasionally failed on the horse and the doll (named "baby"). Twin *T*, on the other hand, had by no means reached that level of accomplishment even by Day 35. On that day she made errors in pointing to every picture. Although there were occasionally days on which she made no errors in pointing to a given picture on request, for none of them could correct responses be said to have been definitely established. Twin *C*, however, in several cases had a rather long series of perfect responses. She made no mistakes in pointing out the ball after Day 19; none in pointing out the spoon after Day 17; none in pointing out the chair after Day 21; none for the duck after Day 17; and none for the table after Day 20.

A typical curve of learning in this situation is presented for the picture of the spoon, in Figure 4. It illustrates tendencies which were characteristic of all of the curves. Not only does Twin *C*'s curve remain at a consistently higher level than Twin *T*'s, but its upward trend is more regular. The fluctuations are rarely as sharp, and reversals not as frequent. This greater consistency and more regular progression suggest a greater maturity of response, a conclusion which receives confirmation in follow-up work which was done with Twin *T* after the close of the experiment proper. Twin *T* had received no training in picture-pointing during the course of Twin *C*'s training. Two days after the close of the experiment, however, her training with the pictures was resumed, and was continued for two weeks, in order to determine whether or not she could be brought to the level of attainment which

TABLE 8

PERCENTAGE OF CORRECT RESPONSES IN PICTURE-POINTING FOR TWIN *T* DURING SUBSEQUENT TRAINING

Additional days of training	Picture presented: baby (doll)	ball	chair	horse	quack-quack (duck)	spoon	table	teddy
1	87.5	21.4	66.7	100.0	14.3	83.3	83.3	16.7
2	63.6	40.0	16.7	90.9	20.0	100.0	60.0	83.3
3	92.3	42.3	40.0	85.7	44.4	100.0	37.5	77.7
4	80.0	18.7	66.7	100.0	66.7	100.0	12.5	100.0
5	100.0	43.4	83.3	80.0	83.3	83.3	12.5	100.0
6	100.0	64.2	40.0	100.0	100.0	100.0	20.0	100.0
7	100.0	64.2	80.0	100.0	60.0	100.0	0.0	100.0
8	80.0	64.2	40.0	77.7	100.0	100.0	40.0	100.0
9	100.0	59.2	0.0	88.8	100.0	100.0	20.0	100.0
10	100.0	66.7	75.0	100.0	100.0	100.0	0.0	100.0
11	100.0	83.3	100.0	100.0	100.0	100.0	25.0	100.0
12	100.0	71.4	60.0	100.0	100.0	100.0	40.0	100.0
13	100.0	72.7	100.0	100.0	100.0	100.0	75.0	100.0
14	100.0	66.7	100.0	100.0	100.0	100.0	100.0	100.0

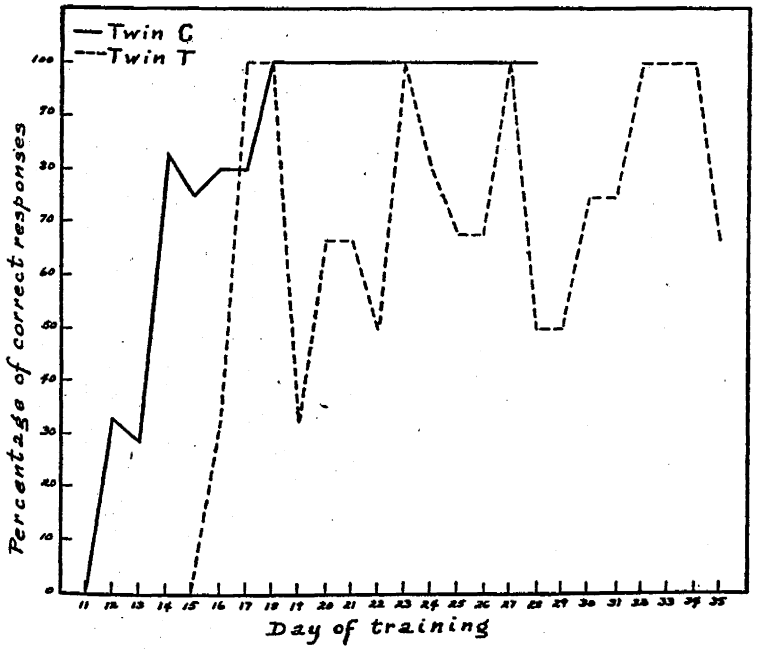

FIGURE 4

CORRECT RESPONSES IN POINTING, ON REQUEST, TO THE PICTURE OF THE SPOON

Learning curves for Twin *T* and Twin *C* during their respective training periods

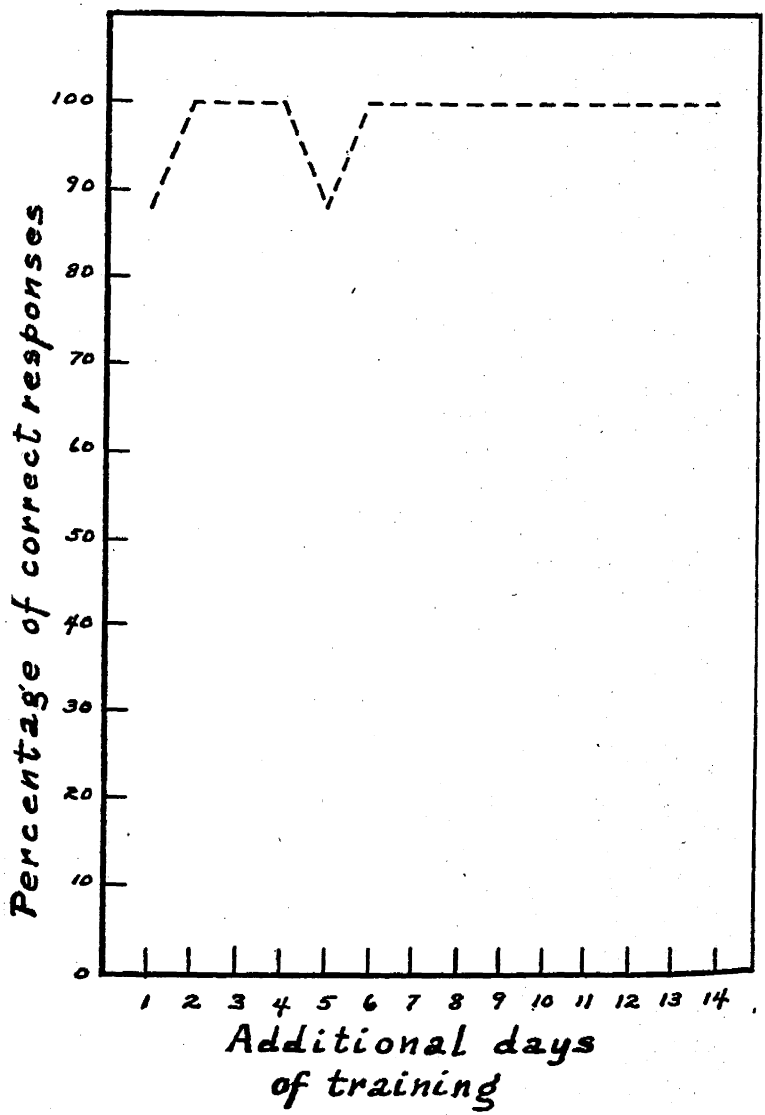

FIGURE 5

CORRECT RESPONSES IN POINTING, ON REQUEST, TO THE PICTURE OF THE SPOON

Learning curve for Twin *T* during her subsequent training

Twin *C* had reached by the close of the experiment. The results are shown in Table 8. Except in the case of the ball, the chair, and the table, she rapidly attained a high degree of correctness which equalled or even excelled slightly the best record of Twin *C*. In this subsequent training with the pictures, the curves of Twin *T*'s learning are very similar in general aspect to the curves of Twin *C*, and do not exhibit the highly irregular character which appeared in her own earlier curves. Figure 5 presents, as typical, the data for the subsequent training on the basis of the same picture used for Figure 4, the spoon. No great importance can be attached to a comparison of Twin *C*'s results with the later results for Twin *T*, as regards time intervals involved, because of the fact that Twin *T*'s second training came after a lapse of four weeks. However, the results do show that she could learn to point correctly, although she had not done so under the first conditions. The fact that her second learning curves show so much greater stability suggests that the factor of maturation was a very important one. It further supports the conclusion that the difference between results first obtained for Twin *T* in picture-pointing, and those for Twin *C*, were due to the fact that Twin *C* was five weeks older than Twin *T* at the beginning of training.

It is interesting to note in passing that, in the first period of training, Twin *T* showed a steady decline in correctness of response when she was asked to point to the ball. She seemed to deliberately avoid pointing to it in any combination. Even during the second

period of training she never attained any degree of success with it. The experimenter can assign no very conclusive reason for this reaction, unless it was due in some way to a confusion with the real ball. On several occasions, when she was asked to show the ball, she turned from the pictures and secured the real ball.

Spanish Period. As has already been mentioned, 15 minutes in the late afternoon were given over to training in naming and pointing to the parts of the body, employing the Spanish names for those parts. For both children, this phase of training was begun on Day 8 of the training period. The results are rather meager, due perhaps in part to the fact that so little time was involved, and also to the fact that since the time of day was so extremely favorable for spontaneous vocalizations, it was difficult to introduce a rival activity.

The words taught were "boca" (mouth); "ojo" (eye); "mano" (hand); "pelo" (hair); "narez" (nose); "dedo" (toe); and "nina" (used for the doll). To these were added for Twin *T* "rana" (frog); and "perro" (dog).[24] Only two of the words, "ojo" and "nina," ever came to be used by either child, although there were correct responses to the other words.

On the 19th day of training in Spanish (Day 26 of the training period), Twin *T* began to name her eye "ōh" on question. Two days later she several times named it "eye" on question, in spite of training in the other word. (The word "eye" had been established

[24]These objects were not introduced into *C*'s training because of the fewer numbers of training days available for her.

four days previously in the morning training period.) Throughout the rest of the training period, she continued to name her eye "eye," although she pointed correctly when the experimenter gave the word "ojo." When the dog was introduced, Day 32, she spontaneously named his eye "eye," and no amount of training could dislodge the response.[25]

Twin *C* began to name her eye "äh-äh" on the 13th day of the Spanish period (Day 20), but there were occasional lapses until Day 25. On that day she pointed to the examiner's eye some time after the end of the training, and named it "äh-äh." On Day 28 she again named the examiner's eye "äh-äh" just before the morning training was begun.

Twin *T* began to name the doll on Day 32 and Twin *C* on Day 14. The experimenter, in an attempt to secure a more definite response to this word, had repeated it in a somewhat sing-song manner, with a decided drop in pitch from the first syllable to the last. Both twins reproduced this sing-song perfectly, even before their syllabic response was at all consistent. For Twin *T*, the syllables became "ŭh-nä," and for Twin *C*, "äh-nĕ." The inflectional quality of the two responses was identical.

The frog and the dog, introduced into the Spanish period for Twin *T* on Day 32, were never named or

[25]On Day 59 of the experiment, Twin *T*, having had no training since Day 35, pointed to her eye and named it "oh." The word "eye" had been drilled in connection with the toy cat, which she did not have after the close of her training. This may account for the sudden ascendency of the word "oh" which had once been routed by "eye."

selected correctly, and no definite response was made to either word when the experimenter repeated it.

For neither twin did the responses to the Spanish words ever become very consistent, although Twin *C* appeared somewhat better in this respect than did Twin *T*. She at least had a series of sounds which, although not consistent for any given stimulus word, were used consistently in the Spanish situation, and which she applied indiscriminately outside of that situation while pointing out her hair, her own nose, and the experimenter's nose. Twin *T* showed no tendency to apply any sound to parts of the body outside of the Spanish period, and her responses to the Spanish words degenerated into an entirely undifferentiated vocal response, no matter what the stimulus. Nothing the experimenter could do succeeded in breaking up this complacent mumble. That it was in some degree dependent on time of day or general circumstances seems likely, in view of the fact that on a dictaphone record of her responses to Spanish which was made in the same room but, owing to unavoidable circumstances, at a different time of day, her attempts at repetition were better to a surprising degree.

A comparison of the twins as to success in pointing out parts of the body named by the experimenter shows that by Day 28, Twin *C* was doing as well as her twin on Day 35. On each child's last day of training, she pointed without error to mouth, eye, hand, hair, nose, and toe, on a number of trials. The number of trials possible in so short a period were not enough to warrant the presentation of statistical data, but there is

nothing in the data available to suggest a real advantage for either twin.

Summary of Results from Training Periods. From the detailed comparison of the twins on comparable days of training, certain conclusions may be drawn. Twin *C,* in spite of such disadvantages as her illness and the carry-over into the training period of some of her silent attitude towards the experimenter, began to acquire words earlier in the training period, and had on each comparable day of training a vocabulary greater than that of her twin. Her total vocabulary at the end of 28 days of training was greater by seven words than Twin *T*'s after an equal amount of training, although this total was not as high as that reached by Twin *T* at the end of 35 days of training. That this faster learning on the part of Twin *C* was not due to unrecognizable differences in the training methods is confirmed by the fact that in extended application of the words, which was not directly dependent on drill, she showed an even greater superiority, attaining by Day 28 a total number of extensions greater by four than Twin *T* had attained by Day 35. In the use of two-word sequences, Twin *T* showed to better advantage than Twin *C,* making combinations with two words, while Twin *C* made them with only one. In phonetic accuracy, also, Twin *T* showed a slight advantage. It is suggested that in this connection the factor of length of practice is of importance, and that to this may be due her slight superiority. (This suggestion is further confirmed by evidence from the post-training period of Twin *T*.)

From the data on commissions in regard to the training objects, it appears that Twin *C* was markedly superior to Twin *T*, not only in ability to execute the commissions, but in ability to select correctly the object named in the commission. Twin *T* never learned to discriminate among the duck, cat, and rabbit, while Twin *C* was making no errors after Day 22.

In the picture-pointing, Twin *C*'s advantage was even more marked. By the end of her training, Twin *C* was making no errors in pointing to the ball, the spoon, the chair, the teddy-bear, the duck, and the table, on request, while for Twin *T* definitely correct responses had not been established for a single picture, even by Day 35.

In the Spanish period, Twin C applied correctly the words "ojo" and "nina" after fewer days of training than did Twin *T*. Aside from that fact, no real advantage was found for either twin.

It seems to the experimenter, then, that in spite of the exceptions noted in Twin *T*'s favor (two-word sequences and phonetic accuracy), the weight of the evidence is decidedly toward the conclusion that Twin *C*'s advancement in language behavior was more rapid than Twin *T*'s, and that after 28 days of training she was equal, if not superior, to Twin *T* after 35 days of training. Under the conditions of the experiment, we must account for this superiority on the basis of the greater maturity of Twin *C* at the time her training was begun.

LANGUAGE BEHAVIOR OF TWIN *T* IN THE PERIOD SUBSEQUENT TO TRAINING

General Comment. In the four weeks during which Twin *C* was being trained, Twin *T*, although she was not receiving any training, showed a marked absorption in language. Her use of words, far from showing any falling off, continued to increase. Her typical behavior when with the experimenter was to hold up her toys one by one, naming each in rapid succession, with numerous repetitions of each word. Unless the ex-

TABLE 9

NUMBER OF WORDS IN VOCABULARY, TWIN *T*, POST-TRAINING PERIOD

Day	Number of words
36	33
37	31
38	32
39	33
40	34
41	35
42	34
43	34
44	35
45	35
46	35
47	35
48	35
49	36
50	37
51	37
52	36
53	38
54	38
55	39
56	39
57	39
58	40
59	40
60	40
61	40
62	39
63	40

perimenter accorded her a sufficient amount of acknowledgment, the repetitions reached an almost unbelievable crescendo of volume and rapidity. She talked continuously, mixing a conversational jargon with the recognizable words, and often after she was put to bed for the night she could be heard practicing almost her entire vocabulary for some minutes before she went to sleep. During this period an increased inflectional quality was noticeable in her jargon, as well as in certain words. "All gone," for example, came to be said in an expressively mournful tone. In any new situation, she pointed and said enquiringly, "ō̄o-ĭl-lĕ?"

On Day 51, she imitated vocally the experimenter's signal whistle to the nurse, a trick which Twin *C* had learned by Day 34.

Vocabulary. The daily vocabulary of Twin *T* during the period subsequent to her training appears in Table 9. Figure 6 presents the same data graphically. Although specific training had been eliminated, Twin *T*'s vocabulary continued to grow slowly during this time. The increase was due in part to an elimination of errors in words already taught, and in part to the fact that a few words were spontaneously acquired. In the latter class, for example, appear "hot," "now," "comb," and "good girl." One interesting development was the use of the self-coined expression, "dō wāy," which appeared on Day 59 and which seemed to indicate that an object which was out of reach was wanted, since after several repetitions of that expression which had not resulted in a response from the experimenter, she would name the object and follow it

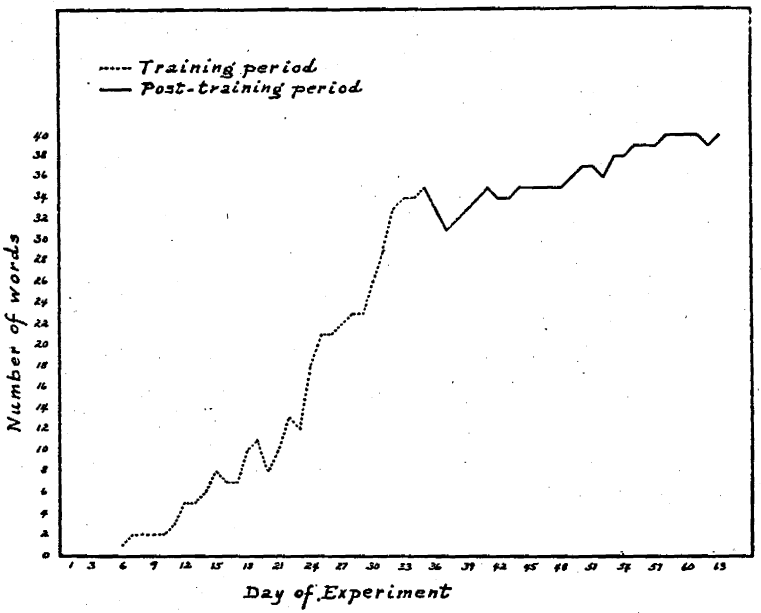

FIGURE 6

VOCABULARY-LEARNING CURVES FOR TWIN *T* DURING TRAINING AND POST-TRAINING PERIODS

by "yes," as she had done during training. The experimenter was unable to trace any phonetic antecedents for "do-way."

After the close of Twin *T*'s training, she was allowed to play with all but three of the training objects. The cat, the train, and the basket were reserved in order to see what result an interval during which she did not see the objects would have on the object-name. On Day 63, she was retested on all of the training objects, including the cat, the cat's tail, the train, and the basket. None of the names which had been established

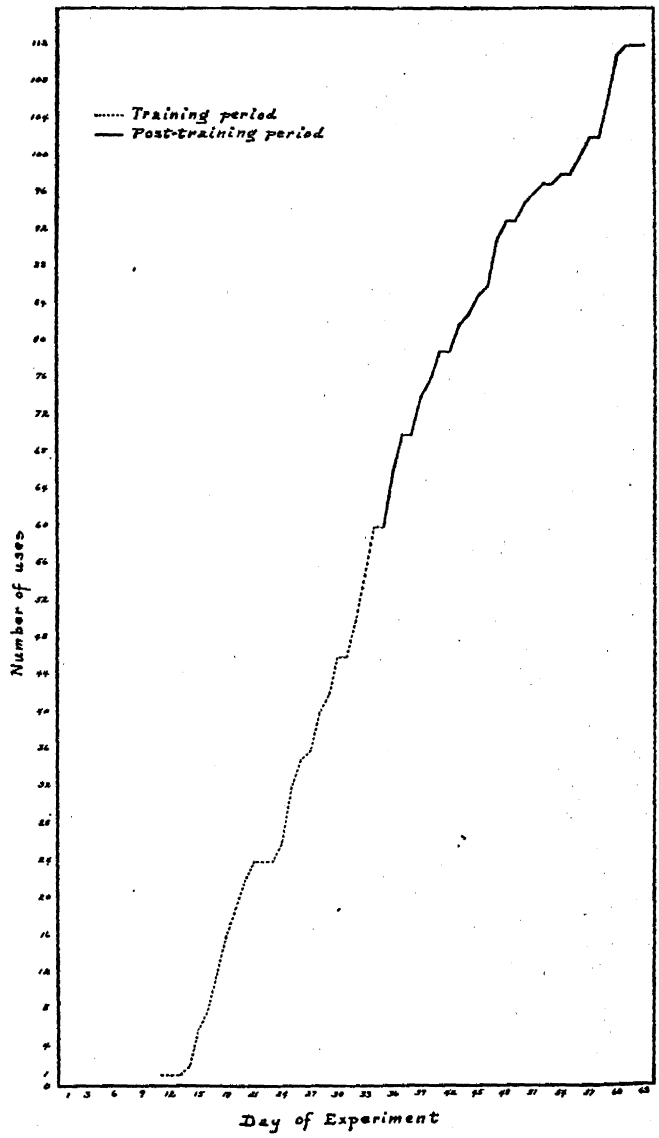

FIGURE 7

EXTENDED APPLICATIONS OF WORDS

Curves of composite totals for Twin *T* during training and post-training periods

during training were lost for objects with which she had been allowed to play during the intervening period, but none of the other four were retained.

Extended Applications of Words. In the matter of the extension of uses of given words, Twin *T* during this non-training period showed a steady development. Not only were there additional extensions for words for which there had been several uses during the training period, but words which had had only one specific use during that time were extended, as well as words which were spontaneously acquired in the latter period. These extensions are included in Table 3. The composite, cumulative graph of the different uses acquired appears in Figure 7. The data for the graph (Table 10) follow the same rules set up for the comparative data on uses given in Table 3. It is obvious that the difference between the training period and the subsequent period as to relative rate of increase in number of words in vocabulary is much greater than the difference between those periods as to number of extensions in the application of words. In fact, the extensions of use proceed almost as rapidly when all drill is eliminated as they did during the training period. This gives a further measure of confirmation to the statement already advanced that the extensions of application were not as immediately dependent on drill as were mere acquisition of vocabulary. A word (according to the definitions adopted for this study) must first have been acquired in some specific use before there could be a broadening of application, but its further broadening was not dependent on specific

TABLE 10

COMPOSITE CUMULATIVE TOTALS OF TWIN *T*'S EXTENDED APPLICATIONS OF WORDS IN THE POST-TRAINING PERIOD

Day of experiment	Total applications
36	66
37	70
38	70
39	74
40	76
41	79
42	79
43	82
44	83
45	85
46	86
47	91
48	93
49	93
50	95
51	96
52	97
53	97
54	98
55	98
56	100
57	102
58	102
59	106
60	111
61	112
62	112
63	112

training in those other situations in which it came to be used.

Two-Word Sequences. By the end of Twin *T*'s training, two words, "all gone" and "yes," were being used in two-word sequences with a variety of object names. These continued to be used after the close of the training period, the frequency of their occurrence increasing. On Day 44, there was a new combination, "bang" with the word "duck," used when the duck fell. "Gi-gi ba" (tick tick bang) was used on Day 54. On

Day 50 she said "Go go baby," in immediate succession, while watching some children in outdoor wraps walking past her window, and on Day 54, "go go boway," (go go boy). By the end of the experiment, therefore, Twin *T* was using "all gone," "yes" (or "no" when "yes" was obviously intended), "bang," and "go-go" in immediate sequence with various object names.

Phonetic Development. During the period subsequent to training, improvement was noticed in Twin *T* as to the phonetic accuracy of some of the words she had already acquired, and in addition a few new words were added. No attempt will be made to consider the phonetic changes in great detail, but it seems worth while to note the end result, that is, the pronunciation which was characteristic on the last day of the experimental period. Only entirely new words, or words which showed a shift of pronunciation from the one given in Table 5, are included in the following list:

all right	äw-wī	horse	hŏ
ball	bäw	hot	ŏh
button	bĭt-tĕn	now	dow
cap	că	sweater	wĕ-tĭs
comb	cō	there	dĕ
doggie	gō-gn	wagon	wă-gā
good girl	gū-gūh		

Twin *T*'s pronunciation at this time, both in phonetic accuracy and in variety of sound produced, was definitely ahead of Twin *C*'s. To afford a further definite comparison of their ability to pronounce a given word, an attempt was made on the last day of

the experiment to teach each twin a new word. This test was conducted at the Yale Psycho-Clinic, and the training was given by a second examiner (A. G.). The words attempted were "ribbon" and "keys." Twin *C*'s only response to the word "ribbon" was "bĭ tĕ." Twin T, however, achieved "rĭ rĭ" and finally "rĭ bĭ," a noticeable improvement over her co-twin's attempts. To the word "keys" both responded with more or less indefinite syllables which became "ptĭ" for Twin *T* (her word for "pin"), and "cĕ" for Twin *C*. Twin *C*'s response appears to be better than Twin *T*'s, but since "cĕ" was very often *C*'s response to any new word, too much importance must not be attached to it.

It seems, therefore, that both on the basis of vocabulary words and on the basis of a specific test situation, Twin *T* by the end of the experiment had reached a level of phonetic reproduction which was to some degree higher than Twin *C*'s. Twin *T*, however, had had more practice in pronouncing words, both in response to training and in her spontaneous repetitions; hence, the evidence seems to give additional weight to the suggestion previously made, that in the matter of pronunciation practice of a specific nature is an important factor.

Spanish. Mention has already been made of the fact that on Day 59 Twin *T* spontaneously named her eye "o," her response to the Spanish word "ojo." This was the only recognizable occurrence of Spanish during the post-training period. On the last day of the experiment, Twin *T* was tested on her ability to point to the parts of her body in response to the Spanish

words, and without error she showed her eye, mouth, hair, hand, and nose. In response to the word "dedo," she looked at her feet. In view of the fact that she had her shoes on at the time, it was probably the best response she could make. An interesting occurrence was noted in the Guidance Nursery of the Yale Psycho-Clinic during a period of free play for Twin *T* on the last day of the experiment. She secured a negro doll and named it "baby," then picked up a doll of the usual type and applied to it the Spanish "uh-na" (nina).

Summary of Post-Training Results. The results from the post-training period for Twin *T* may be summed up briefly as follows: Twin *T*'s vocabulary continued to increase after training was discontinued, although the gain was much less rapid than in the training period. The extensions of applications of words, on the contrary, showed themselves to be much less dependent on drill than was vocabulary, and increased almost as rapidly as in the training period. Not only did number of applications increase, but in some cases the broadening of use definitely suggested an approach to a true concept. (The word "wagon," for example, Table 3.) Two-word sequences were used more frequently than in the training period, and the number of words involved in combinations with object names was increased from two to four. Phonetic accuracy for words already learned increased somewhat, and several new words became phonetically consistent, some of them being rather easily recognizable. Twin *T*'s pronunciation

at the end of the experiment was noticeably better than Twin *C*'s at the end of her training, suggesting the importance of length of practice in that connection. Finally, although Twin *C* had reached a higher level of accomplishment in the field of language at the end of four weeks of training than Twin *T* had attained after five weeks of training begun at a chronological age earlier by five weeks, she had by no means caught up to Twin *T* in final accomplishment at the close of the experiment. It seems safe to assume that eventually differences in language behavior would be entirely eliminated as increasing chronological age lessened the proportional importance in total life span of the few weeks of training. Indeed, during the present experimenter's further contacts with the twins, a period of about three months, there was evidence that differences were disappearing if not entirely gone.

V

SUMMARY AND CONCLUSIONS

General Comment

The findings in the present experiment seem to indicate rather consistently in the field of language that a maturational difference of even five weeks has a definite influence on the relative effectiveness of training. Gesell and Thompson found much the same results for the effectiveness of training in the locomotor field (stair-climbing), although they are careful to point out that the appearance of the activity seems not to be a function of training but of maturational level (1, pp. 114 ff.). In the present experiment, of course, readiness for the acquisition of language was already obvious in the case of both twins. The data bear, then, not on the appearance of an activity, but on the effectiveness of training at two maturational levels, and on the pattern of response to training. Not only was training which was begun with a maturational advantage of five weeks more effective than earlier training, but the pattern of response was more mature. Twin *C,* although her acquisition of vocabulary had been deferred, showed, when opportunity for advance was finally given, a more rapid elimination of such infantilisms as the need for several repetitions of a given word before a response was made, the doubling of a syllable (ba-ba for ball), in response to a one-syllable word, and the need for a definite question by an adult to elicit the use of a word. There was less interference of asso-

ciation, she incorporated the new words more quickly into her spontaneous jargon, and extended their application earlier and more widely, using them more often. Such tendencies seem to be relatively independent of training, and to be rather a function of maturational level. That training cannot transcend maturational level is obvious from the fact that in spite of intensive drill and training, neither of the two subjects was able to attain a vocabulary equal to that of the average child of their chronological age, a result to be expected in view of their consistent degree of retardation rated as sub-average normality. The greatest active vocabulary recorded was for Twin *T* at the end of the experiment, and totaled only 40 words. Nice (2), on the basis of published vocabulary studies, found that 53 vocabularies at 18 months varied from 1 to 523 words, averaging 71, while the vocabularies at two years ranged from 5 to 1212 words, averaging 328. Even the intensive training given *T* and *C* in the field of language, therefore, was not sufficiently effective to overcome their developmental retardation and accord them, at 21½ months, a vocabulary equalling the average for 18 months.

To summarize briefly, then, the factor of maturation influences not only the effectiveness of training in vocabulary but the general pattern of behavior. Training, although it cannot transcend maturational level, is to some degree effective in increasing vocabulary.

General Summary

The experiment deals with a comparison of language development at two developmental levels, by the

method of co-twin control, the subjects being a pair of identical twins. Twin *T*'s training was begun when she was 84 weeks of age, and continued through her 88th week. Twin *C* was reserved as a control, and during Twin *T*'s training she remained in a non-verbal environment. Training was begun for Twin *C* when she was 89 weeks of age and continued through her 92nd week. During Twin *C*'s training Twin *T* remained in a normal language environment, but was given no further training. The same experimenter trained both children, and the words and objects used were identical. The method of training was kept as nearly identical for both as possible.

The following results were obtained:

1) Twin *C* made as satisfactory an adjustment to the experimental situation as her twin, in spite of her non-verbal environment. During the control period Twin *C* noticeably increased her use of expressive gesture, such as silent nodding, and pointing, and adopted a highly artificial "laugh" which was used as definitely to attract attention as any verbal summons. A rather marked mimetic tendency was shown during this period, expressing itself in humming, imitation of the experimenter's whistle, and the like. Twin *C*'s spontaneous vocalizations during this period lacked the variety and expressiveness which Twin *T*'s came to have as her training progressed.

2) The typical stages of development in the acquisition of language were strikingly alike for both twins, but in practically every phase Twin *C* was slightly in advance of Twin *T*.

3) In spite of certain disadvantages for Twin *C*, such as a period of illness, and the carry-over into the training period of an occasional use of gesture instead of verbal expression, she had 7 more words in her vocabulary at the end of 28 days of training than her twin had after an equal amount of training. She failed, by 5 words, to attain the level reached by Twin *T* after 35 days of training.

4) That this faster learning on the part of Twin *C* was not due to unrecognizable differences in the training methods is confirmed by the fact that in a phase less immediately dependent on training, the extended application of words from the narrowly specific situation in which each was taught, she showed an even greater superiority, attaining by Day 28 a total number of extensions greater by 4 than Twin *T* had attained by Day 35.

5) In the use of two-word sequences Twin *T* showed to better advantage than Twin *C*, making combinations of object names with "all gone" and "yes," while Twin *C* made them only with "all gone." The first combination, however, occurred five days earlier for Twin *C* than for Twin *T*.

6) In phonetic accuracy Twin *T* showed a slight advantage over her co-twin. Her five weeks of training had afforded her an opportunity for seven days more of practice in the specific vocabulary sounds than Twin *C* had had, with only four weeks of training. It seems possible, therefore, that in this connection the factor of length of practice is of importance and that to this may be attributed Twin *T*'s slight superiority.

This suggestion is further confirmed by evidence from the post-training period of Twin *T*.

7) From the data on commissions involving the training objects, it appears that Twin *C* was markedly superior to Twin *T*, not only in ability to execute the commissions, but in ability to select correctly the object named in the commission. Twin *T* even after 35 days of training had not learned to discriminate among the duck, cat, and rabbit, while Twin *C* was making no errors after Day 22.

8) In picture-pointing, Twin *C* by the end of her training was making no errors in pointing to the ball, the spoon, the chair, the teddy-bear, the duck, and the table, on request; while for Twin *T* definitely correct responses had not been established for a single picture even by Day 35. In a subsequent training period of two weeks given after the close of the experiment, Twin *T* reached a level of perfection equal to Twin *C*'s, giving further confirmation to the conclusion that the earlier superiority of Twin *C* was a function of her greater maturity at the time of training.

9) Twin *C* applied correctly the words "ojo" and "nina" after fewer days of training in Spanish than did Twin *T*. Both children, by the end of their respective training periods, had learned to point to mouth, eye, hand, hair, nose, and toe, for which the Spanish words had been used by the experimenter.

10) Twin *T*'s vocabulary continued to increase after training was discontinued, although the gain was much less rapid than in the training period. She had a total of 40 words at the conclusion of the experiment.

11) Extensions of applications of words increased almost as rapidly in the post-training period as they had during the training, suggesting that such extensions of use are much less dependent on drill than is the acquisition of a word in a specific situation. The quality of the extensions made during the post-training period were such as to suggest, in a few cases, the development of a concept.

12) Two-word sequences were used more frequently than in the training period, and the number of words involved in combinations with object names was increased from two to four. The new words combined were "bang" and "go-go."

13) Phonetic accuracy for Twin *T* in words already learned increased during the period subsequent to training, and several new words became phonetically consistent and rather easily recognizable.

14) Twin *T*'s pronunciation at the end of the experiment was noticeably better than Twin *C*'s at the end of her training, suggesting again the importance of length of practice in this connection.

15) Although Twin *C* had reached a higher level of accomplishment in the field of language at the end of 28 days of training than Twin *T* had attained after 35 days of training begun when she was five weeks younger, Twin *C* had not then caught up to Twin *T*'s accomplishment at the close of the experiment. Follow-up contact with the twins over a period of three months after the close of the experiment, however, showed that the differences were disappearing, if not entirely gone.

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LANGAGE ET CROISSANCE: L'EFFICACITÉ RELATIVE DE L'ENTRAÎNEMENT DE VOCABULAIRE COMMENCÉ DE BONNE HEURE ET CELUI REMIS À UNE ÉPOQUE ULTÉRIEURE

(Résumé)

Cette expérience compare le développement de vocabulaire à deux niveaux de maturité, par la méthod de deux jumelles comme contrôles, les sujets étant une paire de jumelles identiques. On a commencé l'entraînement de la Jumelle T quand elle a eu 84 semaines, et on l'a continué jusqu'à la fin de la 88me semaine. On a réservé la Jumelle C comme contrôle, et elle est restée dans un milieu entièrement non-verbal pendant l'entraînement de la Jumelle T. On a commencé l'entraînement de la Jumelle C à l'âge de 89 semaines, et on l'a continué jusqu'à la fin de la 92me semaine. Pendant l'entraînement de la Jumelle C, T est restée dans un milieu normal de langage, mais sans autre entraînement. Le meme expérimentateur a entraîné les deux enfants, et les mots et les objets employés ont été identiques. On a employé autant que possible la même méthode d'entraînement pour les deux. L'entraînement s'est composé: d'un exercice quotidien intensif d'une heure et un quart où elles ont nommé des objets, où on leur a donné des directions sur les mêmes objets, et où elles ont montré des tableaux au doigt; d'une période de quinze minutes pendant laquelle on les a entrainés à nommer et montrer au doigt les parties du corps, employant les noms espagnols de ces parties; et de l'entraînement occasionnel des mots employés pendant l'habillement, deux repas, la promenade quotidienne, et les périodes de récréation libre. On a enregistré par dictaphone les réponses de l'enfant à une série de mots servant de stimuli.

Après un entraînement de 28 jours, la Jumelle T a eu un vocabulaire de 23 mots, tandis que la Jumelle C en a eu 30. La Jumelle T a eu un total de 35 mots le 35me jour. La Jumelle C a montré spontanément un emploi plus étendu de ses mots, ayant pour son vocabulaire entier un total de 64 emplois le 28me jour, tandis que le total de la Jumelle T n'a été que 60 emplois pour le 35me jour.

La Jumelle T a fait des groupes de deux mots avec "disparu" ("all gone") et "oui" ("yes"), tandis que C les a faits seulement avec "disparu." La Jumelle C a formé cependant la première combinaison plus tôt de 5 jours que la Jumelle T.

La précision phonétique de la Jumelle T a été un peu plus grande que celle de la Jumelle C.

Après un entraînement de 28 jours, la Jumelle C a égalé la Jumelle T après un entraînement de 35 jours, à l'égard de la capacité de montrer les parties du corps au doigt quand on lui a demandé de le faire. Elle a été supérieure à T dans la capacité de faire des commissions, de choisir correctement ls objets dont il s'gissait dans les commissions, et de montrer correctement au doigt des tableaux découpés.

L'évidence semble indiquer la conclusion que la Jumelle C a avancé plus rapidement dans le comportement de langage que la Jumelle T, et qu'après un entraînement de 28 jours elle a été égale, sinon supérieure à la Jumelle T après un entraînement de 35 jours. Dans les conditions de l'expérience, il faut rendre compte de cette supériorité sur la base de la plus grande maturité de la Jumelle C à l'époque du commencement de son entraînement. La maturité semble influer non seulement sur l'efficacité de l'entraînement de vocabulaire, mais aussi sur la forme générale du comportement. L'entraînement, bien qu'il ne puisse dépasser le niveau de maturité, est en quelque sorte efficace dans l'accroissement du vocabulaire.

STRAYER

SPRACHE UND WACHSTUM: DIE RELATIVE WIRKSAMKEIT DES FRÜHEN UND SPÄTERBEGONNENEN WORTSCHATZTRAININGS

(Referat)

Das Experiment vergleicht den Erwerb eines Wortschatzes auf zwei Stufen der Entwicklungsreife, durch die Methode der Zwillingskontrolle, wonach die Versuchspersonen einiige Zwillinge sind. Das Training des Zwillings T hatte begonnen, als sie 84 Wochen alt war und wurde bis Ende der 88. Woche fortgesetzt Zwilling C wurde als Kontrollperson reserviert, und während des Trainings der andern blieb sie in einem absolut wortlosen Milieu. Das Training des Zwillings C begann, als sie 89 Wochen alt war und wurde bis Ende der 92. Woche fortgeführt. Während des Trainings von C blieb T in einem normalen Sprachmilieu, hatte aber keine weitere Übung. Beide Kinder hatten denselben Experimentator, die Wörter und Gegenstände waren gleich für beide Kinder. Die Methode wurde für beide so gleich als möglich behalten. Die Übung bestand aus täglichem, intensivem Drill für je eine und eine Viertelstunde in der Benennung und im Zeigen der betreffenden Gegenstände und Hinweisen auf Bilder; ferner für eine Viertelstunde in der Benennung mit spanischen Wörtern und im Zeigen der betreffenden Körperteile; und endlich im zufälligen Wortschatztraining beim Ankleiden, während zweier Mahlzeiten, beim täglichen Spaziergang und während des freien Spiels. Man nahm täglich Diktaphonaufnahmen der Kinderreaktionen auf eine Serie von Reizwörtern.

Nach 28 Tagen des Trainings hatte Zwilling T einen Wortschatz von 23 Wörtern, Zwilling C von 30. Zwilling T erreichte im Ganzen 35 Wörter bis zum 35. Tag. Zwilling C wandte ihre Wörter spontan häufiger an; sie hatte im Ganzen 64 Anwedungen ihres gesammten Wortschatzes an zum 28. Tag, währenddem T im Ganzen Anwendungen bis zum 35. Tag aufwies.

Zwilling T bildete Zweiwörtersätze mit "Alles weg" und "ja," währenddem sie C nur mit "Alles weg" machte. Die erste Kombination ereignete sich 5 Tage früher für Zwilling C als für T.

Zwilling Ts phonetische Genauigkeit war ein wenig grösser als die der Schwester C.

Nach 28 Übungstagen war Zwilling C dem Zwilling T mit 35 Übungstagen gleich hinsichtlich der Fähigkeit, die benannten Körperteile zu zeigen. Sie übertraf T in der Fähigkeit Aufträge auszuführen, in der richtigen Auswahl von Gegenständen, die in den Aufträgen einbegriffen waren, und im richtigen Zeigen von ausgeschnittenen Bildern.

Die Beobachtungen weisen auf die Schlussfolgerung hin, dass Zwilling Cs Fortschritte im Sprachverhalten schneller war als Ts, und dass sie nach 28 Übungstagen der Schwester T mit 35 Übungstagen gleich, wenn nicht überlegen war. Unter den Bedingungen des Experiments müssen wir für diese Überlegenheit die grössere Reife der Zwillingsschwester C zur Zeit des Trainings verantwortlich machen. Die Reife scheint nicht nur die Wirkung der Übung, sondern auch die allgemeine Verhaltungsweise zu beeinflussen. Übung, obschon sie den Reifegrad nicht übersteigen kann, ist bis zu einem gewissen Grad wirkungsvoll zur Bereicherung des Wortschatzes.

STRAYER