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THE EFFECTS OF RECEPTIVE LANGUAGE TRAINING ON ARTICULATION[1]

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The present study attempted to assess one condition of language exposure that might be operative in a normal environment, and experimentally determine its relevance to the acquisition of productive speech. The results demonstrated that the development of receptive language skills can be functionally related to productive speech. Specifically, the data indicated that exposure to words that have stimulus control over a subject's nonverbal pointing behavior can facilitate later articulation of those same words. Thus, this study draws attention to the fact that at least some classes of operants, in this case verbal, can be affected not only by their consequences, but by not obviously related antecedent events as well.

So far, the functional analysis of language has been based on the concepts of differential reinforcement (or shaping) and imitation. It has been shown, for instance, that the rate of vocalizations of infants can be controlled by consequent stimuli (Rheingold, Gewirtz, and Ross, 1959; Weisberg, 1963; Todd and Palmer, 1968; Wahler, 1969). Other research has demonstrated the importance of reinforcement within imitation paradigms to establish or modify verbal repertoires in normal as well as retarded children (Lovaas, Berberich, Perloff, and Schaeffer, 1966; Baer, Peterson, and Sherman, 1967; Brigham and Sherman, 1968). These techniques have been used successfully to modify pathological speech problems (Risley and Wolf, 1967; Goldiamond, 1965; Lovaas *et al.*, 1966, Guess, Sailor, Rutherford, and Baer, 1969).

Such research has amply demonstrated that much of verbal behavior can be established, maintained, and modified by reinforcement, especially in combination with imitative stimulus control. However, this does not preclude the possibility that language development may be influenced by other antecedent events as well. One such antecedent may be exposure simpler than that involved in the imitation paradigm. There are a number of such forms of exposure that may influence a child learning language in the normal environment. For example, some language is paired with possible reinforcers, such as attention, food, and the removal of aversive stimuli.

On the other hand, much language that a child hears is uncorrelated with reinforcers: people talking to one another in the child's presence and television, are but a few examples. Furthermore, the child's own vocal productions are correlated with his specific mouth, tongue, and lip movements and positions that produce characteristic sounds, which constitutes a sort of "self exposure", that might teach certain articulatory skills (Fry, 1968).

Finally, observations of normal language development typically note that young children "understand" language before their own use of it (Gesell and Thompson, 1934; McCarthy, 1954; Frazer, Bellugi, and Brown, 1963; Lenneberg, 1968). Thus, some exposure has resulted in stimulus control by language over non-language behavior. Clearly, this exposure has some behavioral function. A knowledge of the possible functions of exposure might facilitate a child being taught language in an applied behavioral program.

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Nevertheless, few studies have made functional investigations of the practical benefits to be gained by exposure to language. Winitz and Preisler (1965) suggested that experimentally established discrimination of certain sounds can remedy misarticulation of those sounds. Similarly, Pimsleur (1963) concluded that discrimination training can affect phonemic (if not phonetic) production of sounds. By contrast, a recent study by Guess (1969) trained retardates to point correctly to single or paired objects after hearing singular or plural labels. Unreinforced probes interspersed in this receptive training measured the productive use of singulars and plurals, and showed a lack of generalization from receptive training to correct productive usage: "receptive language and expressive speech can be two separate and functionally independent classes of behavior" within certain conditions.

Thus, the relationships of exposure resulting in receptive language, to productive speech remains equivocal. However, conditions may well exist where these two classes of behavior are functionally related. The purpose of the present study was to ascertain whether exposure to specific words that had stimulus control over a subject's nonverbal behavior, could facilitate later articulation of these same words. This type of exposure to words that had stimulus control over the subject's nonverbal behavior was chosen to insure the subject's attention to the words presented, and because this type of exposure may frequently occur in a child's normal environment.

METHOD

Experiment 1

Subjects

Two normal children, both attending the Edna A. Hill Laboratory Preschool of the University of Kansas, served (Subjects 1 and 2). Their ages were both 4 years and eight months.

Stimuli

Two matched sets of words were used, an Experimental Set that the subject would hear many times and a Control Set that the subject never heard until the experimenter probed the subject's articulation of both sets.

Both the experimental and the control set contained four words each, with two important characteristics:

(1) All words were nonsense words to minimize previous history and to prompt partially incorrect articulation.

(2) With one exception, the same vowels, consonants, and number of syllables occurred in each matched set of words. That is, matched experimental and control words had identical vowels and consonants, differing only in their arrangement within each word. However, one pair of words was equated only in the number of phonemes, but otherwise differed in their phoneme content in ways thought to be interesting to the ease of later imitation.[2] These words are listed in Table 1.

The experimental words used for Subject 1 were the control words for Subject 2, and the control words used for Subject 1 were the experimental words for Subject 2.

The stimuli used as presumptive reinforcers for all subjects were social praise from the experimenter (*i.e.*, "Very good" or "Nice work"), and poker chips that could be traded in at the end of a session for the choice of a small toy.

Procedure

The experimental procedure consisted of two phases. During Phase 1, the subjects were exposed to the experimental words. In Phase 2, the effects of this treatment on the articulation of those words was assessed.

Phase 1: exposure and discrimination training. The subject was seated in front of a small table facing the experimenter. On the table were four nonsense objects[3] (always shown in the same relative position throughout the experiment). Each object had been assigned one of the four experimental words by the experimenter; this assignment was held constant throughout the exepriment for a particular subject.

The subject was required to point to the correct nonsense object in response to each of the four experimental words, as they were repeatedly presented to him.

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[2]This possible difference did not in fact emerge, and will not be expanded on. The statement is offered only in explanation of all four pairs of words not matching.

[3]The nonsense objects were a large electrical relay, a selenium rectifier, a rubber suction cup connected to an L-shaped piece of metal, and an irregularly shaped piece of styrofoam.

Table 1

List of matched experimental and control words presented to each subject in the two experiments.

	Experimental Words	*Control Words*
	EXPERIMENT 1	
S 1	1. Lir-kob-jad-gad-pes-vuz	1. Daj-bok-ril-zuv-sep-dag
	2. Lir-kob-jad-man-sit-def	2. Daj-bok-ril-fed-tis-nam
	3. Shplit-stev-sku-ya*	3. Ik-stach-so-wat-lik*
	4. Ferd-zak-klub	4. Kaz-bluk-dref
S 2	1. Daj-bok-ril-zuv-sep-dag	1. Lir-kob-jad-gad-pes-vuz
	2. Daj-bok-ril-fed-tis-nam	2. Lir-kob-jad-man-sit-def
	3. Ik-stach-so-wat-lik*	3. Shplit-stev-sku-ya*
	5. Kaz-bluk-dref	4. Ferd-zak-klub
	EXPERIMENT 2	
S 3	1. Lir-kob-jad-gad-pes-vuz	1. Daj-bok-ril-zuv-sep-dag
	2. Lir-kob-jad-man-sit-def	2. Daj-bok-ril-fed-tis-nam
	3. Zilm-flaz-gark-buf-jek	3. Malz-karb-glij-kef-zuf
	4. Wot-bluk-gev-kaz-dref	4. Fek-trov-zad-weg-klub
S 4	1. Daj-bok-ril-zuv-sep-dag	1. Lir-kob-jad-gad-pes-vuz
	2. Daj-bok-ril-fed-tis-nam	2. Lir-kob-jad-man-sit-def
	3. Malz-karb-glij-kef-zuf	3. Zilm-flaz-gark-buf-jek
	4. Fek-trov-zad-weg-klub	4. Wot-bluk-gev-kaz-dref

*Words not phonemically balanced.

A prompt-and-fade technique was used initially. One pair of objects was singled out at a time. The subject was then told: "These two things (pointing to the pair) have funny names. I will tell you the names of each thing and point to it also. Whenever you point to the correct thing after I say its name, I'll give you a poker chip. When you fill these three cups with poker chips, we will stop and I'll give you your choice of one of these toys" (showing box of toys).

The experimenter's prompting (pointing) was quickly faded out. Meanwhile, every correct pointing response immediately produced praise and a poker chip. Every incorrect response was followed by the experimenter saying: "That's wrong," and then removing one of the poker chips from a cup. The same word was then repeated.

After approximately 10 presentations of each word, the same procedure was then shifted to the other pair of objects using the other two experimental words. Each pair of words and objects was alternated during a session. The experimental words were each presented between 20 to 25 times within a 20-min session. One session was conducted each day, four days per week, for two weeks. The total number of times that each of the four experimental words was presented to a subject was approximately 185. Thus, each subject made an approximate total of 740 pointing responses. (During the last 400 pointing responses, each subject made fewer than 10 errors).

Phase 2: assessment of articulation. In the first session following the two-week training phase, the subject was again seated in front of the small table facing the experimenter. The nonsense objects were removed from view after the subject had been exposed to approximately 10 training trials on each experimental word. A microphone was tied loosely around the subject's neck, and his responses were recorded on one channel of a stereo tape recorder. The other channel recorded the experimenter's presentations. The subject was instructed as follows: "I am going to say some words one at a time and I want you to say the same word after me. When you fill these cups with poker chips, we will stop and you can trade them in for your choice of any three toys you wish" (showing the box of toys).

The experimenter verbally presented a sequence of easily pronounced words interspersed unsystematically with either a control or an experimental word, as shown in Table 2. When the subject correctly imitated one of

Table 2

Probe session of Phase 2.
The sequence of easily pronounced words interspersed unsystematically with either a control or an experimental word.(*)

1. Mother	19. Kas-bluk-dref* or Fek-trov-zad-weg-klub**
2. Stepladder	20. Motorcycle
3. Chimney	21. Grandmother
4. Airplane	22. Shoeshine
5. Ferd-zak-klub* or Wot-bluk-gev-kaz-dref**	23. Birdnest
6. Dogcatcher	24. Lir-kob-jad-man-sit-def*
7. Father	25. Animal Trainer
8. Mickey Mouse	26. Movie Star
9. Shoelace	27. Daj-bok-ril-zuv-sep-dag*
10. Indian Chief	28. Baby
11. Butterfly	29. Waterfountain
12. Daj-bok-ril-fed-tis-nam*	30. Paintbrush
13. Train Station	31. Ic-stach-so-wat-lik* or Malz-karb-glij-kef-zuf**
14. Newspaper	32. Snowman
15. Muchachito	33. Farmer
16. Donatello	34. Tiger
17. Lir-kob-jad-gad-pes-vuz*	35. Shplit-stev-sku-ya* or Zilm-flaz-gark-buf-jek**
18. Mountain	

*or ** Indicates words used for either Subjects 1 and 2 (Experiment 1) or Subjects 3 and 4 (Experiment 2) respectively.

the easily pronounced words, the experimenter said, "Very good" and delivered a poker chip. When the subject imitated either a control or an experimental word, regardless of his articulation, there were no scheduled consequences and the experimenter presented the next word after 10 sec had elapsed from the time of the subject's last imitation. Each sequence of words, including the four control and the four experimental words, was defined as one trial. Each subject underwent 10 trials, which composed the last session of the experiment.

Scoring of Verbal Responses

Both control and experimental words were analyzed and scored in detail for articulation. Scoring of these words was done by two naive observers working independently from the subject's track of the tape recording. One observer scored all the trials of each subject to provide the data of this report; the second observer scored alternate trials of each subject for reliability determinations.

The unit used to quantify the overall accuracy of the responses was the percentage of phonemes correctly articulated. This measure was obtained by summing the phonemes in either the four experimental or the four control words of each trial, and dividing that number into the sum of the phonemes correctly articulated in the correct sequence for those words.

For a detailed analysis of the articulation of matched experimental and control words, the percentage of each word correctly articulated was calculated, by dividing the total number of phonemes in each word into the number correctly articulated in the proper sequence by each subject (*cf.* Lovaas *et al.*, 1966; Brigham and Sherman, 1968).

A reliability score for alternate trials of the imitation session was obtained for the responses of each subject. This was done by dividing the total number of phonemes in a trial into the sum of the number of phonemes both observers agreed were and were not articulated correctly in the proper sequence. These reli-

ability scores for each trial were summed and divided by the number of trials scored, yielding an average sampled reliability score for each subject's session.

Accuracy of articulation scores were also obtained for the experimenter's verbal presentations to the subjects. Both observers independently scored the experimenter's presentations to each of the subjects on Trials 2, 6, and 10. The same unit used to quantify the overall accuracy of the verbal responses of the subjects was used to quantify the experimenter's verbal presentations. Reliability scores were obtained using the same procedure used on the subjects.

EXPERIMENT 2

Subjects

Subjects 3 and 4 were normal children, both attending the same preschool as were Subjects 1 and 2 of Experiment 1. Their ages were 4 yr one month and 4 yr six months.

Stimuli

As in Experiment 1, two sets of words were used, an Experimental Set that the subject would hear many times and a Control Set that the subject never heard until the experimenter probed the subject's articulation of both sets.

For Subjects 3 and 4, two words (*i.e.*, an experimental and its matched control word) used for Subjects 1 and 2 were replaced with different words because they were too easily pronounced, with or without exposure. Two other words, "Shplit-stev-sku-ya" and "Ik-stach-so-wat-lik," which were not balanced, were also replaced, this time with balanced words. Thus, all words used for Subjects 3 and 4 were phonemically balanced, as shown in Table 1.

Except for the changes made in the stimulus words mentioned above, the procedures used in Experiment 2 were an identical replication of those used in Experiment 1. Similarly, reliability and accuracy of articulation of the experimenter's presentations, and reliability of scoring subjects' responses were determined as in Experiment 1.

RESULTS

Reliability and Accuracy of Articulation of the Experimenter's Presentations

The two observers agreed that the experimenter's accuracy of articulation of his verbal presentations to Subjects 1 and 2 (Experiment 1) and 4 (Experiment 2) was 100% on the three trials that were assessed for each of these subjects. For Subject 3 (Experiment 2), accuracy of the experimenter's articulation was 100% for Trials 6 and 10. However, for Trial 2, one observer noted the omission of one phoneme and the other observer noted the omission of a different phoneme, yielding a mean percentage of agreement of 98.6% for Subject 3.

Reliability of Scoring Subjects' Responses

The percentages of agreement between the two observers' scores for the verbal responses of Subjects 1 and 2 (Experiment 1) and 3 and 4 (Experiment 2) were 88%, 87%, 91%, and 90% respectively. The mean percentage of agreement for all subjects was 89%.

Subjects' Imitations

In general, each of the experimental words was more accurately articulated than its matched control word. However, two exceptions should be noted. Subject 1 of Experiment 1 articulated experimental word number 4 (see Table 1) with less accuracy than its matched control word; and Subject 4 of Experiment 2 articulated experimental word number 1 with approximately equal accuracy with its matched control word. Another point to be noted is that Subject 2 (Experiment 1) made no imitative response to the first presentation of control word number 1. He responded instead with: "I can't understand that one". Likewise, Subject 3 (Experiment 2) made no imitative responses to the first presentations of all the control words (Trial 1), and no response to control word number 4 on Trials 2 and 3. This subject's initial responses to the first three presentations of the control words were: "I don't think that's easy enough", "I don't know that word", and "I don't know how to say it". Such absences of an imitative response were assigned a score of 0%. For all subjects, the articulation of words in improper sequences was negligible.

Figure 1 presents graphically the overall accuracy of the subjects' verbal imitations. The experimental words, on the average, were more accurately articulated than the control words by all subjects on every trial. On the average Subject 1 imitated 83% of the phonemes in the experimental words and 60% in the control words; Subject 2 imitated 66% in the experimental and 44% in the control; Subject 3 imi-

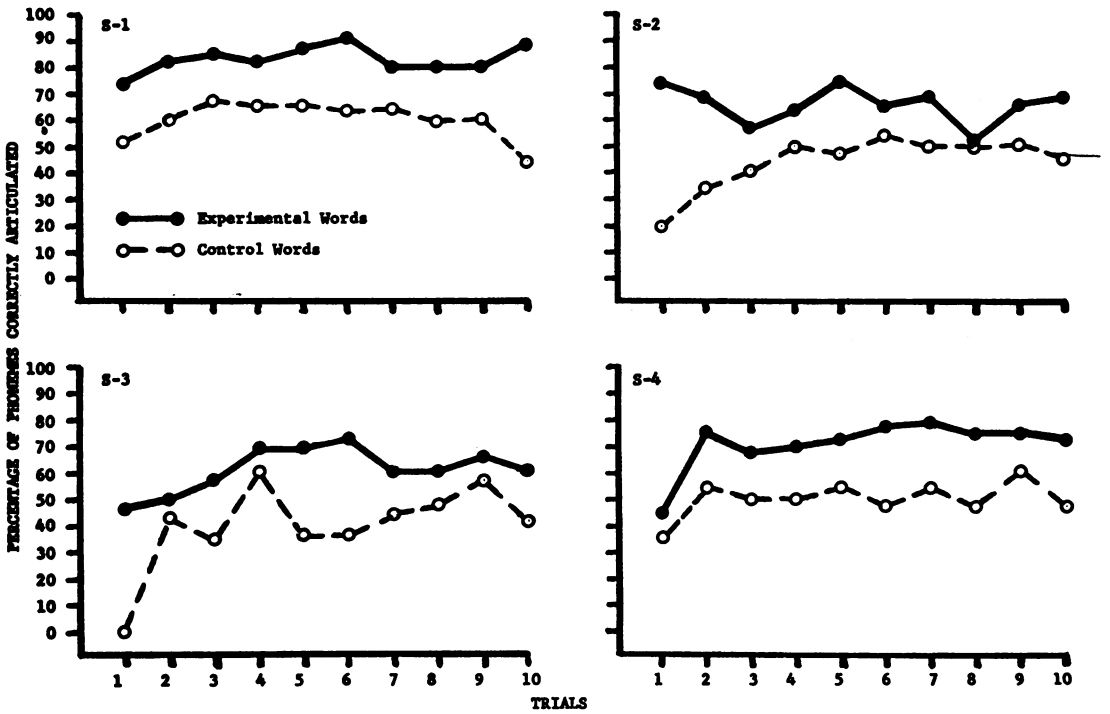

Fig. 1. The overall accuracy of verbal imitations by Subjects 1 and 2 (Experiment 1) and Subjects 3 and 4 (Experiment 2). The four experimental and four control words were "nonsense" words that had been matched by number and content of phonetic units. The subjects had been trained to respond to each experimental word by pointing to one of four novel objects before these 10-imitation trials.

tated 61% in the experimental and 41% in the control; and Subject 4 imitated 71% in the experimental and 51% of the phonemes in the control words.

DISCUSSION

Operant research in the area of language traditionally has emphasized the importance of the consequent events of verbal behavior as a determinant in language development and modification. Relevant research has been extremely cogent in demonstrating that verbal behavior can be affected by its consequences. However, relatively little attention has been given to antecedent variables that might also be relevant. Infants are exposed to hundreds of hours of language without themselves verbally responding, under a number of differing conditions. This language may be paired with reinforcers; it may also take on discriminative properties. The data of this study suggest that one such condition of language exposure can be relevant to the acquisition of productive speech. Specifically, the data indicate that exposure to words that have stimulus control over a subject's nonverbal behavior can facilitate later articulation of those same words.

An alternative procedure for this study might have been to take a baseline of the subjects' articulation on both experimental and control words before initiating the exposure procedure. The same probe technique used in the assessment phase of this experiment (Phase 2) could have been used as a baseline procedure. However, the authors feared that even a few exposures to these control words in a baseline probe might have had a large effect on articulation. It was therefore deemed safer that none of the subjects knew until just before the imitative probe that he would be required to produce imitative responses. This was designed to minimize the probability of any practice or rehearsal effects. However, even in the unlikely event that every subject consistently better articulatd words in one list or the other before experimental training, the probability of all four being assigned the list they best articulated as their experimental list is only one in 16.

Thus, the present results support the conclusions of Winitz and Preisler (1965) and Pimsleur (1963), that discrimination training can be a functional antecedent to sound production. The present research also extends their findings further by suggesting that articulation not only of single sounds, but of chains of sounds (*i.e.*, "Words") can be facilitated by the proper type of exposure to language.

However, it should be pointed out that the present study did not isolate the specific stimulus or combination of stimuli responsible for the facilitation effect. Coming under the nonverbal stimulus control of words subsumes several conditions of language exposure. The relevant variable may have been the mere repeated exposure to the words, or the fact that these words were paired with reinforcers (a reinforcer followed each word presentation if the subject made a correct pointing response). Coming under the stimulus control of these words may not have been a necessary condition for the effect to take place; however, it was apparently sufficient, it was useful to insure the subjects' attention to the words presented, and it may well occur frequently in a child's normal environment.

A subject variable of possible importance is the extent to which the subject is imitative. The subjects used in this study had imitative repertories. (Indeed, they were so chosen to minimize the training time otherwise necessary to establish imitation.) It may be that similar facilitation of productive speech will not occur with pre-imitative children. The child's prior amount of exposure to language may also be related to a facilitation effect. Other possible parameters include the length of the words used, and their difficulty of articulation, especially if they include novel phonemic structures. (The nonsense words used in this experiment were all constructed of phonemes that normally occur in the English language.) Finally, the method of assessment, or probe, probably will seriously affect the experimental outcome. For instance, imitation after receptive language training (as was employed in the present study) may be a relatively sensitive probe; but non-imitative verbal reproduction following such training may well be insensitive.

Thus, it is clear that although conditions do exist wherein receptive language and productive speech are functionally independent, as demonstrated by Guess (1969), still these two classes of behavior can be functionally related, as in the present study.

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