AN EXPERIMENTAL ANALYSIS OF VERBAL IMITATION IN PRESCHOOL CHILDREN¹

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A model presented English words to three preschool children and reinforced accurate imitation of these words. The model also presented novel Russian words but the subjects' imitation of these words was never reinforced. As long as the subjects' imitation of English words was reinforced, their accuracy of imitating non-reinforced Russian words increased. When reinforcement was not contingent upon imitation of English words, accuracy of imitating both the English and the Russian words decreased. These results support and extend previous work on imitation.

Imitation as a class of behaviors has become increasingly important, both as a potential method of producing socially significant behavioral changes (Metz, 1965; Lovaas, Berberich, Perloff, and Schaeffer, 1966; Baer, Peterson, and Sherman, 1967) and as a key concept in theoretical analyses of language development and socialization (Lovaas *et al.*, 1966; Bandura and Walters, 1964; Bijou and Baer, 1965). Recent experimental studies of imitation have produced two consistent findings: if a class of imitative responses is developed in a child, then a relatively novel response can be taught by demonstration without direct shaping of that response (Metz, 1965; Lovaas *et al.*, 1966; Baer *et al.*, 1967); if some imitative responses directly produce reinforcement, then other imitative responses may be maintained even though they never directly produce reinforcement (Baer and Sherman, 1964; Metz, 1965; Lovaas *et al.*, 1966; Baer *et al.*, 1967).

Lovaas *et al.* (1966) reported another related finding in the area of verbal imitation beyond that reported in other recent studies of imitation. Their subjects were two autistic children who were taught imitative speech through a

long process of imitative training. After imitation of English words had been established, novel Norwegian words, interspersed with English words, were presented. Imitation of English words was reinforced, but imitation of Norwegian words was not. In spite of non-reinforcement, the subjects attempted to mimic the novel Norwegian words and improved in accuracy of imitation on these words. These findings have important implications for theories of language learning and methods of speech therapy. However, the study by Lovaas *et al.* did not include procedures specifically designed to examine whether or not continued reinforcement of English imitations was necessary to develop and maintain imitative accuracy of Norwegian words. The purpose of the present study was to replicate, with normal children, the Lovaas *et al.* study and to examine the relationship between reinforcement of some imitative responses and the improvement of other unreinforced imitative responses.

METHOD

Subjects

The three subjects were 4-yr-old boys of normal linguistic and physical development; all attended the Human Development Laboratory Preschool of the University of Kansas.

Procedure

In each of several experimental conditions, English and Russian words were presented. The experimental manipulations consisted of

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reinforcement of accurate English imitations, reinforcement of behavior other than English imitations, and pairing of English words with reinforcement. Imitation of Russian words was never reinforced and accuracy of imitation of these words was examined as a function of the operations performed on English imitations.

Training was conducted four days a week in the morning, Monday through Thursday, each session lasting approximately 20 min. The reinforcers for Subject 1 were assorted candies such as M & Ms and after-dinner mints. For Subjects 2 and 3, assorted candies were used in three of the four weekly sessions, and once a week the children were able to earn tokens which they could trade for a toy.

The first session for each subject tested whether he imitated the experimenter's verbal cues. The subject was seated at a low table across from the experimenter. He was told that the experimenter would read a list of words one at a time and that the child could earn candy (or tokens) if he correctly repeated the word after the experimenter said it. The stimulus words for the first session were 15 English words of varying complexity such as apple, capital, reverse, cartoon, represent, and dog. Each word was presented twice in an unsystematic order. Each time the child correctly reproduced the stimulus word, he was immediately given a token or candy, and also praised for his performance (e.g., "Good", "Very good"). If the child failed to repeat the word correctly, the experimenter said nothing, and then presented the next stimulus word. The criterion for reinforcement of the subject's imitation was based simply on the experimenter's ability to understand the subject. This allowed for a small variance from a hypothetical exact pronunciation. (For example, a slight elongation of the last vowel sound in "cartoon" was acceptable, but the substitution of a "g" for the "s" in "represent" was unacceptable.) During the first session, each subject attempted to imitate all of the experimenter's verbal models and thus was continued in the program.

Reinforcement for imitation of English words. The procedures in Sessions 2 through 6 for Subject 1 and Sessions 2 through 5 for Subjects 2 and 3 were basically the same as those for the first session, with two major exceptions. The instructions at the beginning of

the sessions were deleted (the subjects were given no further instructions throughout the study). In addition, Russian stimulus words were added. The Russian words were presented in the same manner as the English words; however, the Russian words were never followed by reinforcement. When a Russian word was presented, if the subject responded the experimenter presented a new stimulus word no sooner than 10 sec after the subject's response. If the subject did not respond, the next stimulus word was presented no sooner than 10 sec after the experimenter's demonstration. Fifteen different stimulus words (English and Russian) were presented to subjects in all sessions, with each word being presented twice in an unsystematic order. The number of sessions for each procedure and the Russian words presented to each subject per session are summarized in Table 1. As shown in Table 1, the number of different Russian words was increased over sessions. This was done to minimize the possibility that the results obtained might be a function of the specific Russian words employed. Since the number of different words presented each session was always 15 (each word presented twice), the increase in Russian words was accomplished by a decrease in the proportion of English words.

Reinforcement of behavior other than imitation: DRO. Following reinforcement of English imitations, a schedule of differential reinforcement of behavior other than imitation of English words (DRO) was used. During the DRO procedure, none of the subjects' imitations was reinforced. Instead, reinforcement was delivered at least 5 sec after the last imitation of each English word. No reinforcement was presented after Russian words. That is, the experimenter presented an English word; if the subject imitated it, reinforcement was delivered no sooner than 5 sec after the response. If the subject repeated his imitation, reinforcement was delivered at least 5 sec after the last imitation. If the subject did not respond, reinforcement was delivered at least 5 sec after the stimulus word was presented. The actual time between response and reinforcement varied from 5 to 20 sec with a mean of approximately 10 sec. After this DRO interval had elapsed, but before the next stimulus word was presented, the experimenter occasionally delivered additional praise to the subjects non-contingently. This was done to keep the rate

Table 1

Summary of Russian words presented to each subject per session. The Russian spellings are approximate as the Cyrillic alphabet differs from the Roman. The letters in the representations of the Russian words were chosen for their similarity in shape to the Cyrillic letter and have little to do with the pronunciation of the letter.

Procedure	Subject 1		Subjects 2 and 3	
	Sessions	Russian Words*	Sessions	Russian Words*
Reinforcement of English imitation	1	none	1	none
	2	1, 2, 3	2	1, 2, 3, 7
	3	1, 2, 3	3	1, 2, 3, 7
	4	1, 2, 4, 5	4	1, 2, 3, 5, 7
	5	1, 2, 3, 4, 5,	5	1, 2, 3, 5, 7
	6	1, 2, 3, 4, 5,		
Reinforcement of behavior other than imitation (DRO)	7	1, 2, 3, 4, 5	6	1, 2, 3, 5, 7
	8	1, 2, 3, 4, 5	7	1, 2, 3, 5, 7
	9	1, 2, 5, 6, 7	8	1, 2, 3, 6, 7
	10	1, 2, 5, 6, 7	9	1, 2, 3, 5, 6
Reinforcement of English imitation	11	1, 2, 5, 6, 7	10	1, 3, 5, 6, 7
	12	1, 2, 4, 6, 7	11	1, 2, 5, 6, 7
	13	1, 2, 4, 6, 7	12	1, 2, 3, 5, 6
			13	1, 2, 3, 5, 7
Pairing of English words with reinforcement			14	1, 2, 3, 4, 5, 8
			15	2, 3, 4, 5, 6, 8
			16	2, 4, 5, 6, 7, 8
			17	2, 4, 5, 6, 7, 8
Reinforcement of English imitation			18	1, 2, 3, 4, 7, 8
			19	1, 2, 3, 4, 5, 6
			20	1, 2, 3, 4, 5, 6, 8
*1. tob paw	3. moloko	5. clobap	7. malruk	
2. kapandaw	4. knuga	6. deborka	8. ctena	

of praise approximately constant over the different experimental procedures.

In the third session of the DRO period for Subject 1, two new Russian words were added. One new Russian word was introduced in the third session of DRO for Subjects 2 and 3. The Russian stimulus words added during the DRO are labelled Russian₂; the Russian stimulus words introduced previously are labelled Russian₁. Since the number of Russian words presented during DRO sessions for each subject was held constant, the introduction of the Russian₂ words required that the number of Russian₁ words be reduced. To avoid any biasing of the sample, all Russian₁ words were continued as possible stimuli, and those used in each session were selected randomly. The purpose of adding Russian₂ words was to investigate whether the DRO procedure affected the acquisition of accurate pronunciation of Russian words as well as maintenance of accurate pronunciation. Due to an error in the

preparation of the list of stimulus words, the Russian₂ word was not presented in Sessions 13 and 14 for Subjects 2 and 3.

Reinforcement for imitation of English words II. After four sessions of the DRO procedure, imitation of English words was again reinforced. Again, only the imitation of English was reinforced; the imitation of Russian words was not.

Pairing of English words and reinforcement. Subjects 2 and 3 were presented with a procedure in which English words were paired with reinforcement (similar to a classical conditioning paradigm). The experimenter presented an English stimulus word and at the same time delivered candy or tokens to the subject. Whether the subject responded correctly, incorrectly, or not at all, the experimenter waited approximately 20 sec and then presented the next stimulus word. Only the English words were paired with reinforcement. After the 20-sec interval following rein-

forcement had elapsed, but before the next stimulus presentation, the experimenter occasionally delivered praise to subjects non-contingently. Two new Russian words were added during this procedure, as a probe for the effects of this new condition on the acquisition of accurate pronunciation of new Russian words. These new words were labelled Russian₃. The Russian₂ word was continued, and, as before, the Russian₁ words presented in each session were selected randomly.

Reinforcement for imitation of English words III. Contingent reinforcement of correct imitation of the English stimulus words was reinstated. As in the two reinforcement procedures before, the subjects' responses to the Russian words were never followed by experimental reinforcement.

Scoring of verbal responses. The data from all sessions were tape recorded. The Russian words were analyzed and scored in detail for pronunciation. The English words were not; the English scores presented in the Results section are based simply on the number of English words correctly pronounced divided by the total number presented. Correctness was determined by the experimenter's immediate judgment of accuracy during sessions.

Scoring of the Russian words was done by two analysts working independently. One analyst scored all of the sessions; the second analyst scored a random but representative half of the sessions for reliability determinations. The scoring of the Russian words was carried out in a manner similar to that used by Lovaas *et al.* (1966). Each letter pronounced correctly was given one point; each syllable pronounced correctly was given three points. The points were totaled and divided by the total number of points possible, yielding a degree of correctness score expressed as a percentage. A reliability

score for each Russian stimulus word in a session was determined by dividing the highest point score assigned by one analyst into the point score assigned by the other analyst. These reliability scores for individual words were summed and divided by the number of Russian words presented to give an average reliability score for that session. Another measure of analyst reliability was computed in which the analysts' judgments of whether the Russian pronunciation was correct or incorrect were compared. When the two analysts agreed that a word was either correct or incorrect, it was scored as one point; if they disagreed, it was scored as zero. The total was then divided by the total number of agreements possible to give a percent-agreement score for that session. Table 2 contains a list of all the Russian stimulus words used in the experiment, the approximate Russian spelling of each word, the phonetic spelling, and the points assigned to each word.

RESULTS

The results for the two measures of analyst reliability, degree of correctness and percent-agreement, yielded scores ranging from 80% to 100% with a mean of 93% for the degree of correctness score and a mean of 93% for the percent-agreement score. Further, reliability of scoring did not appear to differ across the various experimental conditions or across different Russian words. The high scores for analyst reliability over the sessions sampled indicate that the changes in the subjects' imitation of Russian stimulus words were clearly observable and objectively scoreable.

The major results of the study are graphically presented in Fig. 1, 2, and 3.

Table 2
Russian Stimulus Words Used in the Experiment

Approximation of Spelling	Approximate Phonetic Spelling	Points	
		Letters + Syllables =	Total
1. tabapaw	tah var ish	12 345 67 + 9	16 points
2. kapandaw	care an dash	123 45 678 + 9	17 points
3. moloko	mal a koy	123 4 567 + 9	16 points
4. knuga	kuh nee guh	12 34 56 + 9	15 points
5. clobap	slo var	123 456 + 6	12 points
6. deborka	da borch ka	12 3456 78 + 9	17 points
7. malruk	mal chick	123 456 + 6	12 points
8. ctena	sten na	1234 56 + 6	12 points

Fig. 1. Accuracy of imitation, English and Russian words, Subject 1.

The subjects' performances throughout the experiment were very similar. All improved steadily in their Russian pronunciation during the initial reinforcement period. The subjects' English imitation, although scored in a less precise manner, showed a parallel improvement.

When the DRO condition was introduced, performances of all subjects on the Russian words promptly decreased. The initial drop was to a point approximately equal to the subjects' scores for imitation of Russian words at the beginning of the study. In the third session of the DRO period, two new Russian words were presented to Subject 1 and a single new Russian word was presented to Subjects 2 and 3. The scores for the Russian₂ words were below the initial scores for Russian₁ imitation during the first reinforcement period and also below the scores for the Russian₁ words during the third session of the DRO. For Subjects 1 and 3, English imitation scores again closely

paralleled the scores for Russian imitation.

When reinforcement of English imitation was reinstated, subjects' imitation of both English and Russian promptly improved. All subjects again reached a high level of performance on the English and Russian₁ words, but their scores on the Russian₂ words remained somewhat lower.

In the first session of stimulus pairing, the subjects' imitation of the Russian₃ words added during this session was very accurate, and the imitation of the Russian₁ words dropped only slightly. However, as the procedure was continued, performances on all Russian words again dropped to a level lower than the preceding reinforcement period. Imitation of the English words followed a similar course, eventually deteriorating to the lowest level of the experiment in the last session of the stimulus pairing procedure.

The second reinstatement of reinforcement for English imitations again resulted in a pro-

Fig. 2. Accuracy of imitation, English and Russian words, Subject 2.

nounced improvement in the subjects' imitation of all Russian words. The Russian scores during this procedure were among the highest of the experiment, and near the scoring ceiling. Once again, the improvement in the Russian imitation was closely associated with a parallel improvement in imitation of the English words.

The changes in the accuracy of imitation scores represent a change in the topography of the imitative responses, not a failure to make imitative responses. Subjects 1 and 3 made a vocal response after every Russian stimulus presentation throughout the experiment. Subject 2 failed to make a vocal response to Russian words twice in Session 15 and once in Session 17. Although these failures to respond were scored as zero for the presentation, if they were left out of the scoring it would not change the basic shape or direction of the curves. Some examples of the decrease in accuracy after very accurate imitation of the same stimulus words are the responses: "to-

pot" for the stimulus word "slovar", "borsha" for "deborchka", and "keyliga" for "kaneega".

DISCUSSION

The results of this study replicate and extend the initial findings of Lovaas *et al.* (1966) related to improvement in imitation of unreinforced stimulus words. Possibly most important for the extension of the findings of Lovaas *et al.* (1966) to the problem of normal speech development is the fact that the subjects for this experiment were normal speakers. That is, their language behavior was apparently the result of normal processes of speech development, not of extensive experimental procedures designed to teach them speech. Also, these subjects were of an age when their vocabulary was rapidly increasing in size and complexity. Thus, their extensive imitative skills (first session English imitation scores of 75, 85, and 95 per cent correct) may be very important in the process or processes of vocab-

Fig. 3. Accuracy of imitation, English and Russian words, Subject 3.

ulary elaboration. This possibility is further strengthened by the main findings: the subjects improved in their never-reinforced imitation of the Russian words, indicating that it was not necessary to reinforce differentially every imitative verbal response to obtain generalized improvement in accuracy. Studies by Baer and Sherman (1964) and Baer *et al.* (1967) have reported similar results. They demonstrated that it was possible to maintain imitative responses which were never reinforced, as long as some of the subjects' imitative responses were reinforced. These studies also reported that if reinforcement was discontinued for all imitative responses, and delivered contingent on the occurrence of other responses instead (DRO), then the probability of occurrence of all imitative responses decreased. The present study extends these results to accuracy of verbal imitation. During reinforcement for behavior other than verbal imitation, the accuracy of both the formerly reinforced and non-reinforced imitative responses decreased. When reinforcement of the

imitation of English words was reinstated, both the reinforced and non-reinforced imitative responses again increased in accuracy.

The stimulus pairing procedure also involved discontinuing contingent reinforcement of all imitative responses. The data from the last two sessions of this procedure show a similar decrement in accuracy of imitative responding. Since the amount of reinforcement delivered to the subjects remained fairly constant over the experiment, it is probable that the difference in performances was the result of the way the reinforcers were delivered. When the experimental procedures and results are considered together, it appears that, under conditions where some imitative responses are directly reinforced, all imitative responses increase in accuracy; under conditions where this direct reinforcement is discontinued, all imitative responses are inaccurate or decrease in accuracy.

There are several possible explanations of these results. A number of recent papers on imitation have suggested that the development

of non-reinforced imitative behavior can be analyzed as a result of the experimentally developed reinforcing properties of behavior similar to a model (Lovaas *et al.*, 1966; Baer *et al.*, 1967). A corresponding account may be applied to findings of the present study. During reinforcement of English imitation, vocal productions which matched those of the experimenter were reinforced. Since vocal matching (similar auditory stimuli) preceded and was discriminative for reinforcement, it may have become a conditioned reinforcer. If this were the case, improvement on the Russian words could have been a function of the increased amounts of conditioned reinforcement involved in closer approximations to a good pronunciation (thus producing more closely matched auditory stimuli). When the relationship between matching vocal productions and reinforcement was withdrawn in the DRO and stimulus pairing procedures, the conditioned reinforcing effects of matching auditory stimuli should decrease, accounting for the decreased accuracy of matching the unreinforced Russian words found during these two procedures. However, since the auditory consequences to the subjects of their own vocalizations were not directly manipulated, it is not possible to state definitely that the present findings were a result of the indirect manipulation of the conditioned reinforcement value of auditory similarity.

An alternative analysis of the improvement

in Russian imitations is that subjects failed to discriminate the differential consequences between the English words and Russian words. If this were the case, the general improvement of accuracy of Russian imitations may be accounted for on the basis of a variable-ratio schedule of reinforcement for imitative responding. That is, the procedures which reinforced accurate English imitations may have functionally reinforced accurate verbal imitation in general. Similarly, the converse may have been true of the DRO and pairing procedures.

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