

*THE EFFECTS OF INTERSPERSAL TRAINING
VERSUS HIGH-DENSITY REINFORCEMENT
ON SPELLING ACQUISITION AND RETENTION*

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This study investigated the effects of interspersing known items during spelling instruction on new words for three mentally retarded students. Following a baseline consisting of the presentation of 10 test words per session, a multielement design was implemented. During interspersal training sessions, previously mastered words were presented alternately with each of 10 test words. During high-density reinforcement sessions, 10 test words were presented and additional reinforcement was provided for task-related behaviors. Throughout all conditions, test words were deleted and replaced after meeting a mastery criterion. Periodic retention tests were administered over mastered words and a cumulative retention test was administered at the end of the experiment. Results showed that high-density reinforcement did facilitate performance over baseline; however, interspersal training was superior to the other conditions in terms of both acquisition rate and short- and long-term retention. In addition, students preferred the interspersal condition when offered a choice.

DESCRIPTORS: academic behavior, high-density reinforcement, interspersal training, spelling performance, mentally retarded students

Several studies focusing on the acquisition of discrete behavioral repertoires such as picture identification (Kircher, Pear, & Martin, 1971) and generative language (Carr, Binkoff, Kologinsky, & Eddy, 1978; Frisch & Schumaker, 1974; Shumaker & Sherman, 1970) have utilized a procedure whereby acquisition or test trials were alternated with similar trials on which correct responding was highly probable. Results of additional research have suggested that this technique of interspersing "known items" among test trials enhances performance (Brigham & Sherman, 1968; Lovaas, Berberich, Perloff, & Schaeffer, 1966; Peterson, 1968). A recent study aimed at teaching spelling and

sightreading skills to mentally retarded students included a direct comparison between interspersal training and baseline task presentation, with the addition of a control procedure (high-density reinforcement) in which the amount of reinforcement was equated to that of the interspersal condition (Neef, Iwata, & Page, 1977). Results showed that acquisition rate and retention during interspersal training were superior to either baseline or high-density reinforcement. One weakness of that study was the brief duration of the high-density reinforcement condition which precluded a clear interpretation of the acquisition data; another was that retention was generally poor even for interspersal training.

The present study attempted to provide a more thorough comparison of interspersal training and a high-density reinforcement procedure which is frequently used as a means of shaping academic performance in tutorial settings. A second purpose was to evaluate the effects of

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using as interspersed items those words most recently learned by students during training. Neef *et al.* (1977) used known words from baseline pretests as interspersed items. The former procedure should facilitate retention further by incorporating a review of previously learned material directly into each training session.

METHOD

Subjects and Setting

Three male students enrolled at the Kalamazoo Valley Multihandicap Center, an educational program for the developmentally disabled, participated in the study. One of the men (Student 2) had been diagnosed as profoundly deaf and the other two as trainable mentally retarded. They ranged in age from 19 to 24 years (mean = 22 years).

During each school day the students received both individual and group instruction on various academic and community living skills. All sessions were conducted in the classroom, a 27.5 × 9.2 m room in which approximately 16 students worked on assignments.

Procedure

Pretesting. Each student was tested individually on spelling words selected from the Dolch Basic Vocabulary list (Forbes, 1956). The experimenter presented a word vocally to each of the two hearing students and in sign language to the deaf student, used the word in a sentence, and then asked them to write it. A correct answer consisted of a written response in which each letter corresponded to that word from the list. This response definition was used for all subsequent experimental conditions. Correct responses were followed by social reinforcement and incorrect responses were ignored. Spelling words were presented twice each, during different sessions. Words correctly responded to on both trials were considered learned and formed an initial pool of "known" words for that student. Words incorrectly responded to on both trials were considered unlearned and

formed a pool of training items. Words correctly responded to on one trial were discarded.

Baseline: noninterspersal training. Each daily spelling session consisted of one trial for each of 10 words classified as training items during pretesting. Correct responses were followed by praise, and incorrect responses were corrected by the experimenter circling the incorrect letters written by the students, vocalizing or finger-spelling the correct spelling, and requiring the student to write the words correctly three times. Mastery criterion for a given word was defined as a correct response over five consecutive sessions. Words for which students met criterion were deleted and replaced by words randomly chosen from the pool of training items.

High-density reinforcement. Following baseline, a condition was introduced in which social reinforcement was delivered noncontingently on correct responding for such task-related behaviors as paying attention, writing neatly, and trying hard. Ten reinforcers were delivered each session (e.g., on each of the 10 trials for a given session, students were told, when appropriate, "You're really paying attention nicely," if they were looking at the paper, or "I'm proud of you for writing so neatly," if the written response was clearly legible). All other conditions were identical to baseline sessions in that correct responses were reinforced and incorrect responses were remediated.

Interspersal training. One interspersal spelling session was instituted daily, concurrent with the implementation of the high-density reinforcement condition. Each session consisted of 20 trials: 10 training words and 10 known words, presented in alternating order. Known words were initially derived from the pool of words spelled correctly on the pretest. However, these were later replaced by mastered training words; as a student met criterion for a training word, that word was then placed in the known item pool and a new training word was then added to the list. Each time mastery criterion was obtained for a training word, training and known words were rotated in this manner. Re-

inforcement and correction procedures were identical to those used during baseline.

Retention testing. Students were given individual retention tests 10 days after they had met criterion on at least 10 words from all conditions combined. Each word was presented individually, and neither correct nor incorrect responses were consequted. During each retention test, one trial was presented for each word, and words from each of the different conditions were presented randomly. The number of retention tests varied across students, depending on the number of words they had mastered. A cumulative retention test was administered individually to each student 10 to 14 days after the completion of all training. The cumulative retention test included all words from previous retention tests.

Response Measurement and Reliability

The dependent variables were the number of training words mastered in the different conditions and the number of words spelled correctly on the retention tests. For reliability checks, an independent observer scored students' first responses as either correct or incorrect. When the observer was present during spelling sessions, the experimenter hesitated 2 sec before reinforcing or correcting responses. The observer was required to determine the correctness of a response and mark the data sheet within the 2-sec period. At other times when the observer was not present during the spelling session, he was later given the list of words along with the students' paper from which he scored the responses. To avoid biasing the observer's data, all corrections and remedial responses during the spelling session were made on an acetate sheet placed over the student's paper. Independent observations were made at least once every eight sessions for each student. Following a session, experimenter and observer data sheets were compared. Interobserver agreement was calculated by dividing the number of agreements on a word-by-word basis by the number of agreements plus disagreements, and multiplying by

100. All reliability observations yielded agreements of 100%.

Experimental Design

This study employed a multielement design (Ulman & Sulzer-Azaroff, 1975), in which the alternating elements were the high-density reinforcement and interspersal conditions. Following baseline, both elements were presented daily in a randomly alternating order. An exception to the procedure occurred on four sessions during which each student was allowed to select one spelling list (interspersal vs. high density) for that day, in order to assess preference.

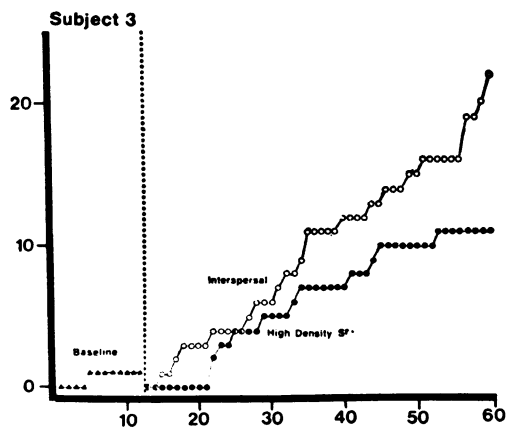
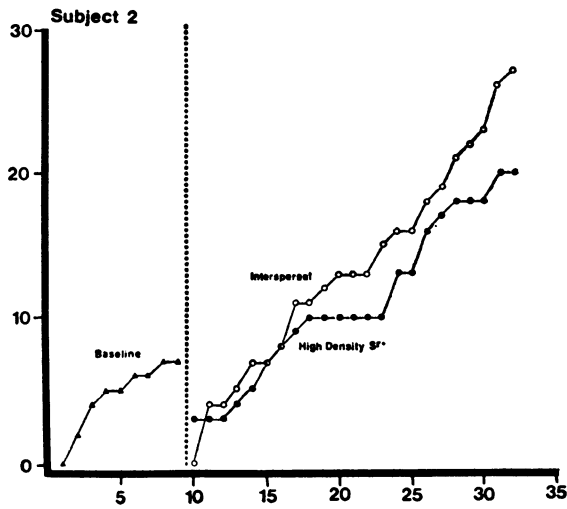
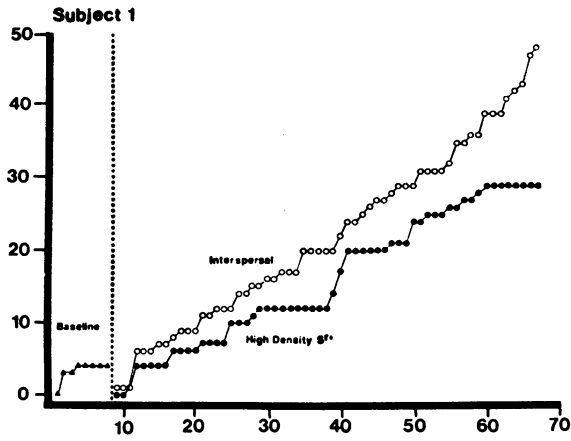
RESULTS

Figure 1 shows the cumulative number of words mastered for students 1, 2, and 3, respectively, across experimental conditions. Despite variations in acquisition rate across students, performance patterns were similar in that all students mastered more words during interspersal training than during either baseline or high-density reinforcement conditions.

Table 1 summarizes the acquisition data in terms of the mean number of words mastered per session. Also shown are the results of the retention tests in the form of percent correct responses. All three students scored considerably higher on retention tests both during and after training on the words mastered in the interspersal condition. Furthermore, two students performed just as well or better on the cumulative retention test for words mastered during interspersal (85.1% and 95.8% for students 2 and 3, respectively), whereas students' retention test scores for the other conditions either decreased over time or were negligible to begin with. Although less effective than interspersal training, the high-density reinforcement condition was superior to baseline.

Preference data indicated that of the four random sessions during which students were allowed to choose between the interspersal and high-density reinforcement conditions, the inter-

CUMULATIVE NUMBER OF WORDS MASTERED



SESSIONS

Fig. 1. Cumulative number of spelling words mastered by Students 1, 2, and 3 during baseline high-density reinforcement, and interspersal training sessions.

Table 1

Mean numbers of words mastered per session across experimental conditions and percent correct on retention tests during training and on the cumulative retention test.

	<i>Mean number of words mastered/session</i>	<i>Percent correct on retention tests during training</i>	<i>Percent correct on cumulative retention test</i>
Student 1:			
Baseline	.63	20.0%	20.0%
High density S ^r	.50	44.4%	17.2%
Interspersal	.83	91.6%	62.5%
Student 2:			
Baseline	.77	14.3%	14.3%
High density S ^r	.97	75.0%	70.0%
Interspersal	1.17	85.1%	85.1%
Student 3:			
Baseline	.08	.0%	.0%
High density S ^r	.23	71.7%	63.4%
Interspersal	.51	91.7%	95.8%

spersal list was selected on three of the sessions by students 1 and 2 and on all four sessions by student 3.

DISCUSSION

Results indicating that interspersal training was more effective than high-density reinforcement in facilitating acquisition replicates the findings of Neef et al. (1977). The data from these two experiments have implications for educational practices, in that the less effective control procedure is a technique frequently used in many teaching situations, in an effort to enhance performance. The present study also offers an extension of Neef et al. (1977) regarding the retention of mastered words. Here, words were incorporated as interspersal items at the point where they were mastered. We believe this daily review plus the use of a more stringent mastery criterion led to consistently high levels of retention both during and after training.

The nature of the experimental design did not permit an analysis of the specific mechanisms responsible for the superiority of the interspersal condition; however, at least two characteristics of interspersal training deserve further examination. First, it is possible that frequent reinforcement accompanying inclusion of known

words facilitates more careful attention to all training stimuli. Thus, a session in which interspersal was employed could serve a discriminative stimulus function, informing students that closely attending to the relationships between the trainer's cue and their subsequent response would be more likely to be reinforced. Second, it is possible that emotional responses elicited by consequences following an incorrect response (e.g., correction) could interfere with attending behavior such that the student would be less likely to observe critical relationships. This possible side effect is to a large extent circumvented during interspersal training. Because known and unknown words are alternated, there was seldom more than one consecutive incorrect response, with its accompanying consequences. Indeed, students preferred the interspersal condition to the high-density reinforcement condition, despite the fact that the former list contained more words.

REFERENCES

Brigham, T. A., & Sherman, J. A. An experimental analysis of verbal imitation in preschool children. *Journal of Applied Behavior Analysis*, 1968, 1, 151-158.
 Carr, E. G., Binkoff, J. A., Kologinsky, E., & Eddy, M. Acquisition of sign language by autistic children.

- I. Expressive labelling. *Journal of Applied Behavior Analysis*, 1978, **11**, 489-501.
- Forbes, C. T. *Graded and classified spelling list for teachers*. Cambridge: Educators Publishing Service, Inc., 1956.
- Frisch, S. A., & Schumaker, J. B. Training generalized receptive prepositions in retarded children. *Journal of Applied Behavior Analysis*, 1974, **7**, 611-621.
- Kircher, A. S., Pear, J. J., & Martin, G. L. Shock as punishment in a picture naming task with retarded children. *Journal of Applied Behavior Analysis*, 1971, **4**, 227-233.
- Lovaas, O. I., Berberich, J. P., Perloff, B. F., & Schaeffer, B. Acquisition of imitative speech by schizophrenic children. *Science*, 1966, **151**, 705-707.
- Neef, N. A., Iwata, B. A., & Page, T. J. The effects of known item interspersal on acquisition and retention of spelling and sight reading words. *Journal of Applied Behavior Analysis*, 1977, **10**, 738.
- Peterson, R. F. Some experiments on the organization of a class of imitative behaviors. *Journal of Applied Behavior Analysis*, 1968, **1**, 225-235.
- Schumaker, J., & Sherman, J. A. Training generative verb usage by imitation and reinforcement procedures. *Journal of Applied Behavior Analysis*, 1970, **3**, 273-287.
- Ulman, J. D., & Sulzer-Azaroff, B. Multielement baseline design in educational research. In E. Ramp & G. Semb (Eds.), *Behavior Analysis: Areas of research and application*. Englewood Cliffs, N.J.: Prentice-Hall, 1975.

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