*ACQUISITION OF ADJECTIVES AND ADVERBS IN SENTENCES
WRITTEN BY HEARING IMPAIRED AND APHASIC CHILDREN*

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The effect of an instructional package, which included modeling, reinforcement, and remedial feedback on the rate, accuracy, and topography of sentences composed by four hearing impaired and aphasic children, was examined. In a specially designed classroom, students wrote sentences describing a stimulus picture on acetate sheets placed on the stage of an overhead projector which was built into each student's desk. This arrangement provided the teacher and other students immediate and continuous visual access to each student's sentences. In a multiple baseline design across behaviors, model sentences were projected and token reinforcement and remedial feedback were made contingent upon writing correct sentences containing prenominal adjectives only, then adverbs only, then prenominal adjectives plus adverbs. During baseline all students displayed poor written language skills and seldom wrote sentences containing modifiers. When the instructional package was implemented, all students demonstrated significant increases in response rate, accuracy, and percentage of correct sentences including prenominal adjectives and adverbs.

DESCRIPTORS: sentence writing, adjectives, adverbs, Visual Response System classroom, overhead projector, deaf children

Furth (1964) estimated that superior expressive language skills are attained by only 4% of the deaf individuals in this country. Eachus (1969) obtained samples of sentences composed by students in the fourth-, sixth-, and twelfth-grade classes at a residential school for the deaf. The types of errors and number of errors made by the twelfth-graders were similar to those committed by the fourth-graders.

Recently, imitation, modeling, and reinforce-

ment techniques have been used to improve the generative usage of several oral language response classes by children with hearing impairments or delayed language (*e.g.*, Bennett and Ling, 1972; Fygetakis and Gray, 1970). However, little behavior analysis research has been reported on written language by hearing impaired and other language delayed children (Eachus, 1971; Piper, Note 1).

One experiment (Eachus, 1971) produced increases in rate, accuracy, and complexity of sentence writing by 10- to 12-year-old deaf students via token reinforcement and remedial feedback. The most interesting aspect of this experiment was the teaching environment, the Visual Response System, described below.

The purpose of this study was to analyze experimentally whether the same techniques employed by Eachus (1971) would result in the incorporation of previously unused language elements, namely prenominal adjectives and ad-

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verbs, into the written sentences of hearing impaired and aphasic students.

METHOD

Subjects

Four students from the aphasic department of a large, state residential school for the deaf served.¹ The students, three female and one male, ranged in age from 8 years 10 months to 10 years 4 months at the start of the study. Students 1, 2, and 3 possessed moderate levels of hearing impairment in both ears ranging from 40 to 55 decibels. Student 4 had no hearing loss. The students were judged to be of average to above average intelligence as assessed by an assortment of standardized test instruments administered by the school. Etiology of the students' hearing impairments or language problems was unknown, except for Student 1 where rubella was a suspected cause.

The students consistently demonstrated poor sentence composition skills prior to the experiment, despite previous instruction. None of the students had any previous experience in the Visual Response System classroom prior to the study.

The students' regular homeroom teacher served as teacher in the experiment.

Setting

The experiment was conducted at the students' school in a specially constructed classroom called a Visual Response System (Heward, 1978; Wyman, 1968, 1969a, b) (Figure 1). The Visual Response System consisted of 10 student stations, each with a built-in overhead projector and an electrically operated counter. The teacher's desk also had a built-in overhead projector with switches to operate the individual

overhead projectors and to advance the counters at each student station. The projection surface was antikeystoned, *i.e.*, tilted forward at the top to produce a square image. The teacher's overhead projector and those of students seated along the back wall were focused on antikeystoned screens secured to the floor and ceiling. The teacher's overhead projector and all student overhead projectors remained "on" during all writing trials throughout the experiment. This arrangement provided the teacher with immediate and continuous visual access to the student's sentences as they were written.

The cost of the Visual Response System employed in this study was approximately \$12,000. This figure includes the cost of remodeling what had been a storage room with sinks and lockers into a Visual Response System that included wall-to-wall carpet, custom-built student stations, and additional audiovisual hardware not used in this study. If no remodeling were required, a 10-student Visual Response System containing all new equipment could be installed for around \$6,000. A detailed cost breakdown, equipment list, floor plans, and suggestions for adapting the Visual Response System concept to various physical environments can be obtained by writing the first author.

Materials

The stimulus materials were 40 overhead transparencies selected from the Northeast Regional Media Center for the Deaf Language Arts Series² (Wyman and Tilley, 1968). All of these transparencies were pictures consisting of heavy black line drawings and depicting some ongoing scene, *e.g.*, a man and a little girl washing a car.

Students wrote with water-soluble marking pens on lined 8½- by 11-inch clear acetate sheets placed directly on the stages of their overhead projectors. Students were supplied with as many acetate sheets as their writing required.

Reinforcers, ranging from candy to coloring

¹Four other students, all with moderate to severe degrees of hearing impairment and diagnosed as aphasic, participated in the study during either the spring or fall segment only. For this reason, data from these subjects are not included in this report, but may be obtained from the authors. Results for these four students are similar to those reported here.

²This transparency series currently is distributed by the National Center on Educational Media and Materials for the Handicapped, Columbus, Ohio.

Fig. 1. Floor plan of Visual Response System classroom.

books and model airplanes, were selected from lists written or spoken by the students prior to the experiment.

Response Definitions and Measurement

Data were gathered after each session via a permanent product recording procedure by visually examining each student's writing. Five dependent variables were recorded on a session-by-session basis for each student.

Rate. Rate was defined as the total number of sentences written. A sentence was defined as any chain of two or more words ending with a period, question mark, or exclamation mark or followed by blank space for the remainder of the line on which it was written.

Accuracy. Accuracy was defined as the percentage of total sentences written which were correct. Sentences had to be accurate grammati-

cally, punctuated properly with all words spelled correctly, and appropriate conceptually to be judged correct. For example, if the picture projected by the teacher's overhead showed a cat sitting on a chair, the sentence "The cat is sitting under the chair" would be incorrect. Sentences copied directly from projected model sentences or another student's writing were not considered correct, nor were sentences already written earlier in the session. However, students were allowed to use the same adjectives and/or adverbs during a given trial or to copy and use adjectives and/or adverbs from another student's writing.

Prenominal adjectives only. Prenominal adjectives only was defined as the percentage of correct sentences that contained a prenominal adjective but did not contain an adverb. A prenominal adjective was defined as any word immediately preceding a noun and modifying that noun. For example, in the sentence "The

girl threw a green ball," the word "green" is a prenominal adjective.

Adverbs only. Adverbs only was defined as the percentage of correct sentences that contained an adverb but did not contain a prenominal adjective. An adverb was defined as any word or phrase that modifies a verb by adding information of where, when, how, or why.

Prenominal adjectives and adverbs. Prenominal adjectives and adverbs was defined as the percentage of correct sentences that contained both a prenominal adjective and an adverb.

Design

The experiment employed a multiple baseline design across behaviors to assess the effects of the instructional package. After an initial baseline period, reinforcement and remedial feedback were made contingent on correct sentences, prenominal adjectives only, adverbs only, and prenominal adjectives and adverbs sequentially in multiple baseline fashion. In addition, several reversal phases were utilized following the prenominal adjectives and the adverbs components of the multiple baseline.

The experiment consisted of 62 sessions, 28 during the final 6 weeks of the school year and 34 during the first 7 weeks of the following school year. There were 12 phases in the experiment, 6 during the spring and 6 during the fall. Three months of summer vacation separated the spring and fall portions of the experiment. Students' data were inspected daily and decisions to begin a new phase were based upon the general stability of those data for the majority of the students. Overall accuracy and the level of acquisition of prenominal adjectives and adverbs in the phases when those elements were being reinforced served as the prime determiners of stability.

Procedure

General procedure. Students met each school day for one class period in the Visual Response System. Each session consisted of two 5-minute writing trials; the remainder of the period was

spent by students walking to and from the Visual Response System and receiving remediation for written sentences. Each trial was initiated by the teacher placing a transparency picture on her overhead projector and providing verbal instructions for sentence writing.

Five experimental conditions were employed: Baseline, Correct Sentences, Prenominal Adjectives Only, Adverbs Only, and Prenominal Adjectives and Adverbs.

Baseline. During the initial baseline, students were instructed, "Write as many correct sentences describing this picture as you can until I say, 'Stop.'" After a 5-minute writing period, the teacher turned off her projector and said "Stop." The teacher then changed the projected transparency picture, repeated the instructions, and a second 5-minute writing trial began. Students' response transparencies were collected immediately after each trial with no comments made regarding the students' writing.

All subsequent baseline phases were conducted in exactly the same manner except that prior to the first trial of each new baseline phase students were also told, "There won't be any points now, but do the best you can anyway." There were five baseline phases during the study.

Correct sentences. During this phase instructions were the same as in baseline. However, while students were writing, the teacher continually scanned their projected sentences. Whenever the teacher saw a correctly written sentence, she would engage a switch immediately which advanced a counter one point at the desk of the student who had written the sentence. Students could not see one another's counters, but a small green light would flash on a student's desk each time he or she received a point. Thus, it was possible for students to tell when classmates received points.

Remedial feedback was also provided in this and all other phases where reinforcement was contingent upon sentence writing. Remediation consisted of the teacher projecting, one at a time, each student's sentences on the teacher's overhead projector, placing check marks next

to correct sentences, and correcting any errors by marking directly on the student's sentences. This remediation was done after each writing trial in full view of all students and usually took about 3 or 4 minutes to complete. During phases when adjectives and/or adverbs were being reinforced, these elements, when they appeared correctly in a student's writing, were underlined by the teacher during remediation.

During this and all other phases where reinforcement was contingent upon sentence writing, students' point totals were recorded after each session. Students were given index cards with their cumulative point totals and could exchange their points for various reinforcers during the last period on the last school day each week. Students could spend all of their points or could save points for more expensive items.

Prenominal adjectives only. Throughout the three phases of Prenominal Adjectives Only the teacher scanned the students' projected sentences, delivering two points for correct sentences containing a prenominal adjective and one point for correct sentences without a prenominal adjective. During all sessions of Adjectives Only-1 and the first two sessions of Adjectives Only-2, an unused student overhead projected a model sentence transparency showing six correct sentences with a prenominal adjective and six correct sentences without a prenominal adjective. Other than pointing out the model sentences and explaining the new reinforcement contingency, the only verbal instruction given by the teacher was to explain that a prenominal adjective modified a noun and was placed directly before a noun.

Adverbs only. During the two Adverbs Only phases, points were delivered in the same manner as in previous phases of contingent reinforcement, except the contingency was changed so that correct sentences containing an adverb were worth three points and all other correct sentences were worth one point. A model sentence transparency containing 12 simple sentences each with an underlined adverb, was projected on a vacant student overhead during

the first five sessions Adverbs Only-1. The only verbal instruction given by the teacher was to explain to the students that adverbs modified verbs by adding information of where, when, how, or why.

Prenominal adjectives and adverbs. During this phase correct sentences that contained both a prenominal adjective and an adverb were worth four points and all other correct sentences were worth one point. A model sentence transparency containing six sentences, each with a prenominal adjective and an adverb, was projected on a vacant overhead during the first four sessions of this phase. No verbal instructions regarding sentences including both components were given by the teacher.

Interobserver Agreement

After the experiment was completed an independent second observer used a random numbers table to select from each session a sample of 10 of the students' sentences. These sentences were then rated by the second observer for correctness and inclusion of prenominal adjectives and/or adverbs. Disagreement with the experimenter's rating on any aspect of the sentence constituted disagreement for the entire sentence. By dividing the total number of sentence agreements (612) by the number of sentence agreements plus the number of sentence disagreements (612 + 8), interobserver reliability was 98%.

RESULTS

Results are presented by session; data for each session represent the mean of that session's two trials.

Response Rate

All students displayed an increase in the number of sentences written when reinforcement and remediation were made contingent upon writing correct sentences for the first time. Baseline-2, Baseline-3, and Baseline-5, generally did not result in a significant decrease in response rate. In fact, subjects often demon-

strated increases in response rate when contingencies for writing sentences containing specified language components were dropped.

When the inclusion of prenominal adjectives only, adverbs only, or both into the students' sentences was required for maximum reinforcement for the first time, all students displayed decreases generally in response rate. Students' individual response rates increased gradually across sessions within experimental phases when new sentence forms were required for the first time.

Response Accuracy

Mean percentage of total sentences correct

for Students 1 through 4 during Baseline, was 2, 4, 16, and 69, respectively. All students displayed increases in accuracy when reinforcement and remediation were made contingent upon writing during the Correct Sentences phase. While mean accuracy per session generally continued to increase during Baseline-2, accuracy usually dropped on subsequent baseline phases which followed a reinforcement phase. In most cases, accuracy dropped during the initial sessions of Adjectives Only-1, and Adverbs Only-1, and Adjectives and Adverbs, when reinforcement was contingent for the first time upon writing correct sentences containing the targeted elements. Mean percentages of total

Fig. 2. Percentage of total correct sentences written by Subject 1 which included targeted language components as a function of experimental conditions.

sentences correct for students 1 through 4 during the final phase of the experiment was 80, 86, 81, and 93, respectively.

Response Topography

Figures 2 through 5 illustrate acquisition of adjectives and adverbs to the students' sentences.

During Baseline-1, Students 1, 2, and 3 wrote no sentences including a prenominal adjective. On session four, Student 4 included prenominal adjectives in three of her correct sentences, giving her a per session Baseline-1 mean of 8% of her correct sentences including adjectives. During Adjectives Only-1, the mean percentage of correct sentences containing prenominal ad-

jectives ranged across students from 65% to 83%. The percentage of correct sentences containing prenominal adjectives for the final two sessions of Adjectives Only-2, when no model sentences were projected, ranged across students from 63% to 100%. During Adjectives Only-3, when no model sentences were projected, the mean percentage of correct sentences with prenominal adjectives ranged across students from 59% to 96%. In subsequent phases when maximum reinforcement was contingent upon writing adverbs or adjectives and adverbs, the percentage of correct sentences containing prenominal adjectives decreased substantially.

Students 1 through 4 included adverbs in

Fig. 3. Percentage of total correct sentences written by Subject 2 which included targeted language components as a function of experimental conditions.

2%, 4%, 8%, and 8% of their correct sentences, respectively, over the 40 sessions of the experiment prior to Adverbs Only-1. The mean percentage of correct sentences including adverbs over the final three sessions of Adverbs Only-1, when no model sentences were projected, was 86%, 93%, 87%, and 83% for Students 1 through 4, respectively. All students displayed a sharp decrease in writing sentences which included adverbs only during the experiment's final phase, Adjectives and Adverbs.

Prior to Adverbs-1, Student 1 wrote a total of one correct sentence including both a prenominal adjective and an adverb; Student 2

wrote a total of two such sentences; and Students 3 and 4 never wrote a correct sentence containing both modifiers. During the sessions comprising Adverbs Only-1, Baseline-5, and Adverbs Only-5, Students 1, 2, and 3 showed a slight increase in the percentage of correct sentences containing both adjectives and adverbs compared to the previous 40 sessions, and Student 4, who previously had never produced a correct sentence containing both elements, wrote 13% of her sentences with both adjectives and adverbs. All students demonstrated a marked increase in their output of sentences containing both modifiers during the final phase. The

Fig. 4. Percentage of total correct sentences written by Subject 3 which included targeted language components as a function of experimental conditions.

mean percentage of correct sentences containing both modifiers over the final two sessions of the experiment, when no model sentences were projected, was 95%, 90%, 92%, and 90%, respectively, for Students 1 through 4.

DISCUSSION

This experiment served as a successful systematic replication of Eachus' (1971) research in demonstrating that the teaching package employed, *i.e.*, modeling, reinforcement, and remedial feedback presented via the Visual Response System, can produce improvements in the rate, accuracy, and complexity of sentences

composed by hearing impaired and aphasic children. Also, this study demonstrates how this teaching package can be used to enable students to combine previously learned language components to produce even more complex sentences. Performance gains attained by the students during the course of the experiment far surpassed the rate of achievement normally realized by hearing impaired students of similar age. (Silverman and Lane, 1970).

Students were given no experimental input suggesting words or phrases that commonly serve as prenominal adjectives or adverbs other than those included in the model sentences. However, the majority of words and phrases

Fig. 5. Percentage of total correct sentences written by Subject 4 which included targeted language components as a function of experimental conditions.

used to modify nouns and verbs in the students' sentences were ones other than those included in the projected examples. In addition, the total number of words and phrases which served as prenominal adjectives and adverbs in the students' sentences increased as the experiment progressed.

Advantages of the Visual Response System

At least three aspects of the Visual Response System seem pertinent to the results obtained. First, the immediate and continuous visual access to the students' sentences as they were written enabled the teacher to deliver reinforcement as soon as desired responses were noted. Second, all teacher-initiated instructions, prompts, reinforcers, and remedial feedback could be projected and/or delivered in a manner that made them clear and understandable in spite of the low language level of the students. Third, student-student interaction, while not objectively measured, was noted. After the fifth session, the students regularly began looking across the room at each other's projected writing and "borrowed" new words and phrases to use as adjectives and adverbs in their sentences.

Limitations

This experiment investigated the effects of a "package" of independent variables—namely modeling, reinforcement, and remedial feedback—systematically introduced in a novel group setting that allowed students visual access to the behavior and consequences of classmates. As such, the role of each of these factors in modifying written composition cannot be ascertained from this study. In addition, no maintenance or generalization measures were obtained to assess the durability and usefulness of the behavior change produced. These issues should be central to future research on the Visual Response System.

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