*THE EFFECTS OF FEEDBACK AND CONSEQUENCES
ON TRANSITIONAL CURSIVE LETTER FORMATION*

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Twelve first-grade students were employed to analyze the effects of (1) Verbal and Visual Feedback, (2) Verbal and Visual Feedback plus immediate rewriting of trained letters with one or more incorrect letter strokes, and (3) Potential Reinforcement on cursive letter strokes. Students practised both a set of trained and a set of untrained letters during each session. Feedback and reinforcement was administered only for trained letter strokes. The percentage of correct trained letter strokes increased during all conditions. Performance on the untrained but practiced and trained letter strokes followed the same general trend in response pattern. No consistent pattern of generalization was demonstrated with untrained and unpracticed letter strokes.

DESCRIPTORS: handwriting, cursive letter formation, feedback, generalization, first-grade students

The development and evaluation of instructional materials have been a persisting concern to all levels of education (Latham, 1973). Komoski (1974) stated that approximately 99% of all materials used in classrooms have not been subjected to any kind of systematic testing with even one student. Komoski further advocated learner verification and revision. This involves a product's improved learner effectiveness as a result of systematic tryouts with learners followed by revision based on the feedback obtained. The Educational Products Information Exchange (EPIE), a consumer's union for educational products has, through Komoski, called for field-test information on many products, not only for replication purposes but also as a prerequisite for purchase by members ("A consumer's union," 1975).

Over the past three decades however, an avalanche of instructional materials has become available on the educational market. Materials developed for a wide variety of subject areas have frequently not been tested with student or teacher. Handwriting materials and scales are areas where subjectivity has historically been used for evaluation purposes (Bell, 1969; Rodenella, 1963).

In recent years (1968 to the present), attention has been given to the objective measurement of handwriting (Fauke, Burnett, Powers, and Sulzer-Azaroff, 1973; Helwig, Johns, Norman, and Cooper, 1976; Johns, Trap, and Cooper, 1977; Miller and Schneider, 1970; Salzberg, Wheeler, Devar, and Hopkins, 1971; Skinner, 1968). Research has supported the notion that manuscript letters can be measured reliably and that materials used for the measurement of manuscript letters can be used instructionally for handwriting skills. Feedback in the forms of student self-vocalization of accuracy and verbal and visual feedback could be used to improve handwriting legibility through letter formation.

Studies in the area of handwriting, however, have not developed instruments or techniques

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for the objective measurement or analysis of cursive handwriting. Therefore, the first priority of the present study was to develop a set of plastic overlays to measure reliability formation of lower-case cursive letter strokes. The intent was to incorporate the use of these overlays as a source of feedback for improving student performance in cursive letter formation. The present study reports the effects of verbal and visual feedback, rewriting incorrect letter strokes, and a certificate of achievement (potential reinforcement) contingent on cursive handwriting skills. In all conditions, subjects were praised for attending and following directions. Contingent praise for correct letter strokes was administered only during the Verbal Feedback condition. In addition, generalization data were collected for untrained upper-case cursive letters and untrained but practiced lower-case cursive letters.

METHOD

Subjects

Twelve regular first-grade students served as subjects. The eight boys and four girls were 6 to 7 yr of age. All were from an upper-middle socioeconomic suburban community. Two criteria were used in student selection: first, teacher, principal, and parents expressed interest in the study and offered the services of their school; and second, students had not previously demonstrated skill in cursive handwriting. This second criterion was established through parent and teacher verbal reports.

Setting

Students worked at tables in rooms near their classrooms that were not in use during the first period of the morning and afternoon. During one week, data were collected during three home visits because schools were closed due to a weather and energy emergency. These three home visits occurred during baseline.

Each student was seen for three to five sessions per week lasting approximately 15 min

each. Session times varied during the school hours. Experimenters sat beside students while facing the same direction. The work surface contained writing implements, paper, and model letters sheet.

Materials

Model letters. The students used one laminated training sheet of 26 upper- and lower-case cursive letters developed from the Zaner-Bloser Creative Growth Transition Alphabet (1974). The letters, constructed with a line weight of 1 mm, were printed on paper by Zaner-Bloser with sets of black lines. The spaces between the headline and midline, midline and baseline, and descender space below the baseline were 1.1 cm each.

Probe sheet. The students used the portion of the sheet of model letters on which the upper-case cursive letters are found as a probe. At selected times throughout the study, students were given this sheet and asked to copy the upper-case letters with no further directions.

Copy paper. Writing paper number two published by the Zaner-Bloser Handwriting Company for use with Grades 2 and 3 was used. Spacing between the lines was 1.11 cm between the headline and mainline, mainline and baseline, with a descender space of 1.11 cm below the baseline. The paper for copying the letters measured 21.59 cm by 27.94 cm, containing red and green parallel lines.

Evaluative overlays. A set of two transparent overlays were designed to measure deviations of student handwriting samples from model letters. The first measured deviations of 0 to 1 mm deviations from model lower-case cursive letters. The second measured deviations from 0 to 1 mm deviations from upper-case cursive letters. Both overlays were constructed to form a closed curve around each letter with a parameter of 2 mm. When a letter contained a circle stroke, a second closed curve was inscribed within the circle with a parameter of 2 mm. When a letter contained a circle stroke, a second closed curve was inscribed within the circle

with a parameter of 1 mm. For each of the model letters a fine line was drawn so that the model letter was inside a boundary consisting of a set of segments and/or arcs. When a letter contained a circle stroke, a fine circle was inscribed within this stroke. (For a detailed description of construction of overlays, see Helwig *et al.*, 1976).

Certificate of achievement in cursive handwriting. A paper certificate of achievement published by Zaner-Bloser for use with Grades 2 and 3 was used as a potential reinforcer for increasing the percentage of correct trained letter strokes during Interview Three.

Writing implement. Each student was provided with a Zaner-Bloser standard pencil, which was used for all conditions of the study.

BEHAVIOR DEFINITION AND RECORDING²

The following criteria were used to determine the correctness of cursive letter strokes:

1. Containment: the strokes must be totally within the confines of the overlay boundary line.

Example:

2. Length: each stroke not completing a circle or loop must begin and end between the small slash mark and the line forming the confines of the letter. With the exception of top of lower-case letters p and t, length will also be correct if it touches the line on the copy paper and is within the boundaries of the overlay.

Example:

3. Closed circles: all letters, such as a, containing complete circles must be closed curves.

Example:

4. Interstroke contact: all strokes must be in contact with other strokes except for the dot above i and j.

Example:

5. Completeness: the letter must be complete with all strokes present.

Example:

6. The horizontal strike in the t and the diagonal strike in the x must intersect the other stroke near the center of the first stroke.

Example:

7. The line on the overlay must align with the red baseline on the copy paper for the space completely across the paper.

Example:

Evaluation of the strokes by these criteria requires correct usage of the overlays. The overlays have sets of parallel lines that were drawn to match up with the red guidelines of the copy paper. The overlay was placed over the student's handwriting sample so that the line was directly over the red guideline until as many strokes as possible were within the letter boundary on the overlay.

Procedures

During baseline and intervention conditions, students sat beside experimenters. When beginning each experimental session, the experimenter engaged in 1 to 3 min of verbal interaction to increase the possibility that students

²Many of the ideas and criteria in this section come directly from Helwig *et al.*, 1976. Others have been adapted from this source.

would feel at ease. For example: "I'm so glad that you're helping me today." Students were then given a sheet of copy paper, the model letters sheet, and a writing implement with these directions: "I'm going to cover all the letters but this row [does so]. Then I will write each letter one time explaining how. Then you can copy the letter from this sheet [pointing to the model letter]. Let's try the A. This little 1 means this stroke is first. You follow the arrow. Watch closely, I will draw it only once [writes the a, covers her paper]. Now you copy the A." When the students had copied the A, the same procedure continued until all the letters had been copied, moving from one row of letters to another.

The modelling of letter formation by the experimenter continued until the student achieved 50% correct trained letter strokes for three consecutive sessions. After this criterion was met, the student was simply told to copy the letters as best he or she could.

Baseline. After the letters had been copied and students had written their names on the back, the experimenter collected the papers. Before returning to their classrooms, students were thanked for working. At no time did the experimenters give any feedback on the quality of their samples, but they did praise the students for attending and following directions.

Baseline continued for at least five sessions and until the percentage of correctly formed letters had stabilized, begun to decrease, or the mean percentage of correct strokes for the last three sessions had not differed from the mean percentage of correct strokes for the preceding two sessions by more than 10%. All samples for each student were scored using the evaluative overlay. On completion of baseline data, a probe was given to each student before proceeding to Intervention One.

Probe. During the probes, students were asked to copy the upper-case cursive letters from the model letters sheet. All conditions were identical to baseline with two exceptions. Experimenters did not model the letter formations

and questions were answered with: "I'm sorry. I'm not allowed to answer any questions. Do the best you can." The only direction given was to copy the letters just like they were.

Intervention One, verbal and visual feedback and praise. At the initial session of Intervention One, the experimenter explained the slanting of the paper and letters to students before they copied the letters. This was done by showing them that when we print, the paper is straight on the desk and that all the letters are written with straight lines and circles. The experimenter then demonstrated how to slant the copy paper on the desk to help write the letters with a slanted line like the letters on the model letters sheet.

Procedures for modelling and copying the letters remained the same as in baseline. After the letters had been copied, the experimenter placed the overlay over the student sample and verbally evaluated the trained letters (*a, f, b, i, o, q, t, w, x, z*). These letters were randomly selected from the *Zaner-Bloser Creative Growth Transition Alphabet* (1974) letter families. At the first session, the experimenter introduced the overlay by placing it over the model letter sheet, explaining correctness and correcting the letter "a" before giving feedback to the student on his or her sample.

An example of the verbal evaluation would be: "Look at the H. This stroke is too long. See how it doesn't fit inside this line? Good job on this stroke! See how it touches the slash mark but stops inside the boundary lines? Excellent!" The experimenter then returned the child to the regular classroom or home activities, scored the percentage of correct strokes, and plotted the appropriate data on student graphs.

Intervention One continued until the mean percentage of correct strokes had increased 10% over baseline or for 10 sessions, whichever came first. After a probe had been applied, students moved on to Intervention Two.

Intervention Two, verbal and visual feedback, praise, plus rewriting. During Intervention Two, the same procedure was followed as

in Intervention One with one addition. After the experimenter had given verbal and visual feedback, the student was asked to recopy the trained letters with one or more incorrect letter strokes. Students rewrote letters no more than once per session. The first attempt at copying the letters was corrected after each session and data graphed on both the trained letters and the untrained but practiced letters (*b, c, d, e, g, j, k, l, m, n, p, r, s, u, v, y*).

Intervention Two continued until the mean percentage of correct strokes had increased 10% over Intervention One levels or for 10 sessions, whichever came first. After a probe had been applied, students moved on to Intervention Three.

Intervention Three, potential reinforcement. At the initial session during Intervention Three, the potential reinforcement condition, the experimenter showed the students a copy of the Handwriting Certificate of Achievement. The experimenter told the student that he or she could earn a certificate like that one with his or her name on it by getting ——— correct strokes for three sessions. The number required was his or her mean baseline strokes plus 10% on the trained letter strokes. A student who already had met this criterion was required to achieve an increase of 10% over his or her Intervention Two mean. After a student met this criterion, the experimenter praised the student and presented the certificate to the student in front of his or her fellow classmates.

Interobserver Agreement

Three evaluators were trained to use the overlays and recording sheets. Of the three evaluators, one did not know the purpose of the study or the conditions each sample came from. The evaluators were given handwriting samples, appropriate evaluative overlays, and individual recording sheets. The experimenter explained the behavior definitions and demonstrated the correct procedure for placement and use of the evaluative overlays on the model letters. The use of the individual recording sheets was explained as

were procedures for computing percentages. The evaluators practised using the overlays until each met a minimum 85% agreement for total correct responses with the experimenter on a sample of 75 cursive letter strokes. Interobserver agreement was computed by dividing the number of agreements by the sum of the agreements plus disagreements and multiplying by 100. After the interobserver agreement for all evaluators reached the 85% criterion, actual interobserver agreement was obtained at least once for each subject during baseline and each intervention condition.

During baseline, 10 samples were scored with overall reliability ranging from 92% to 100% with a mean of 96%. During Intervention One, verbal and visual feedback, 11 samples were scored, ranging from 87 to 100% with a mean of 95%. During Intervention Two, verbal and visual feedback plus rewriting, 12 samples were scored, with agreement ranging from 84 to 96% with a mean of 92%. During Intervention Three, potential reinforcement, 12 samples were scored, with reliability ranging from 86 to 97% with a mean of 93%. Twelve samples were scored from the probes with reliability ranging from 92 to 100% and a mean of 97%. Overall interobserver agreement for the 57 samples scored ranged from 84 to 100% with a mean of 94%.

The percentage of agreement for correct strokes was computed by dividing the number of agreements for correct strokes by the sum of agreements plus disagreements on correct letter strokes and multiplying by 100.

During baseline, 11 samples were scored with reliability for correct strokes ranging from 57 to 100% with a mean of 83%. During Intervention One, verbal and visual feedback, 11 samples were scored, with reliability ranging from 20 to 100% with a mean of 77%. During Intervention Two, verbal and visual feedback plus rewriting, 12 samples were scored with reliability for correct strokes ranging from 60 to 96% with a mean of 85%. During Intervention Three, potential reinforcement, 12

samples were scored, with reliability for correct strokes ranging from 75 to 98% with a mean of 88%. During the probes, 12 samples were scored, with agreement for correct strokes ranging from 50 to 100% with a mean of 74%. Overall agreement for the 57 samples ranged from 20 to 100% with a mean of 82%.

The percentage of agreement on incorrect strokes was calculated by dividing the total number of agreements on incorrect strokes by the total number of agreements plus disagreements on incorrect strokes and multiplying by 100.

During baseline, 10 samples were scored with agreement for incorrect strokes ranging from 96 to 100% with a mean of 99%. During Intervention One, verbal and visual feedback, 11 samples were scored, with agreement for incorrect strokes ranging from 96 to 100% with a mean of 98%. During Intervention Two, verbal and visual feedback plus rewriting, 12 samples were scored, with agreement for incorrect strokes ranging from 91 to 100% with a mean of 99%. Overall, 57 samples were scored with agreement on incorrect strokes ranging from 84 to 100% with a mean of 98%.

Control for Differential Treatment

The following steps were taken to help control against contamination of data due to differential experimenter treatment between experimenters and subjects. First, experimenters rotated, working with different subjects across sessions. In addition, during each intervention condition, an audiotape cassette recording was made of one session of each experimenter with one or two students. Baseline sessions were omitted because no feedback on correctness was given.

After the session, two evaluators listened to the tape and recorded experimenter statement categories on the Individual Recording Sheet. A statement on correctness such as "The first stroke in the letter *k* is just the right length!" was recorded by placing a plus (+) sign in the first horizontal space next to the letter *k*. A

statement on incorrectness such as "This stroke should be longer" was recorded by placing a minus (−) sign in the corresponding space on the recording form. The total statements were attained by summing the total statements on correct and incorrect strokes for each experimenter. Interobserver agreement was computed by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100. Interobserver agreement between the two observers was 100%.

During all conditions, each evaluator made a total of 30 statements on correctness plus incorrectness with one exception. During Intervention One, Experimenter 1 omitted one three-stroke letter. This was equivalent to a mean of 29.67 statements per session with a variance and standard deviation of 1.00. Data were subjected to a one-way analysis of variance procedure to test for differences between the three experimenters. The resultant analysis of data failed to show any significant differences in verbal treatments of experimenters ($F = 0.0303$, $df = 2/6$).

RESULTS

Effects of Interventions

Data for individual students are presented in Figures 1 through 4 and group data are presented in Table 1.

Verbal and visual feedback. Of the 12 students, 11 increased the percentage of correct strokes during the verbal and visual feedback condition. Increases ranged from 3 to 27% correct with a mean of 15.7%. Ten of the 11 students demonstrating an increase in correct letter strokes progressed from stable baselines. One student (S9) had an ascending baseline.

Verbal and visual feedback plus rewriting. Of the 12 students, 11 achieved at least a 10% increase in the percentage of correct trained letter strokes over the verbal and visual feedback conditions; the one exception showed a 5% increase. Student increases ranged from 5 to 31% over the verbal and visual feedback condition.

Fig. 1. Percentage of correct trained letter strokes for individual subjects across individual sessions. Criterion, defined as three consecutive sessions with a minimum of 50% correct trained letter strokes, was met on the session designated by the letter C. In all conditions, subjects were praised for attending and following directions. Contingent praise for correct letter strokes was administered only during the verbal feedback condition.

Potential reinforcement. All students earned the certificate within a range of three to six sessions. All students showed increases in the percentage of correct trained letter strokes over the verbal and visual feedback plus rewriting condition. Increases ranged from 4 to 25%, with a mean of 12.05% increase. Students earned the certificate in a mean 4.16 sessions and achieved a mean of 71.68% correct trained letter strokes, compared to 59.8% during verbal

and visual feedback plus rewriting, 37.56% during verbal and visual feedback, and 23.95% during baseline.

Generalization

To untrained but practical letter strokes. Student performance on the 10 trained letters was compared to performance on the 16 untrained letters that were practiced along with them. The mean performance of correct trained letters re-

Fig. 2. Percentage of correct trained letter strokes for individual subjects across individual sessions. Criterion, defined as three consecutive sessions with a minimum of 50% correct trained letter strokes, was met on the session designated by the letter C. In all conditions, subjects were praised for attending and following directions. Contingent praise for correct letter strokes was administered only during the verbal feedback condition.

mained higher than the mean percentage of correct untrained but practiced letters throughout the study. Both increased and decreased with the same pattern. However, as the number of sessions increased, the difference in percentages became greater. Data are presented in Figures 5 and 6.

To probe letter strokes. Student mean performance on the trained letters was compared with the percentage of correct upper-case letter strokes. Each student copied the upper-case let-

ters five times throughout the study. Of the 12 students, six students' performance increased on Probe 2, five students' performance decreased and one student's performance remained the same. Performance of the students after intervention procedures were: on Probe 3, eight of the 12 students' performance increased over Probe 2; on Probe 4, one student's performance decreased slightly but not below pre-intervention levels. One student's performance remained the same, and 10 students' performance im-

Fig. 3. Percentage of correct trained letter strokes for individual subjects across individual sessions. Criterion, defined as three consecutive sessions with a minimum of 50% correct trained letter strokes, was met on the session designated by the letter C. In all conditions, subjects were praised for attending and following directions. Contingent praise for correct letter strokes was administered only during the verbal feedback condition.

proved. On Probe 5, three students' performance remained the same; five students' performance increased and four students' performance decreased on the percentage of correct responses. Data are presented in Table 1 and Figures 5 and 6.

DISCUSSION

Two implications for cursive handwriting instruction resulted from this study. First, the

packaged procedure of feedback, praise, and consequences demonstrated improved cursive handwriting. Second, procedures outlined for using the evaluative overlays demonstrated that reliable measurement of cursive letter strokes is possible.

A multiple-baseline design across subjects was used to evaluate the effects of a sequential packaged treatment. The interventions of the packaged treatment included: verbal and visual feedback with praise and immediate rewriting of

Fig. 4. Percentage of correct trained letter strokes for individual subjects across individual sessions. Criterion, defined as three consecutive sessions with a minimum of 50% correct trained letter strokes, was met on the session designated by the letter C. In all conditions, subjects were praised for attending and following directions. Contingent praise for correct letter strokes was administered only during the verbal feedback condition.

any trained letter with one or more incorrect letter strokes, and a potential reinforcer of a certificate of achievement contingent on improved performance. During the first intervention, the experimenter placed the overlay on top of the student's sample, aligned the overlay, and verbally evaluated the student's sample with the student. During Intervention Two, the student immediately rewrote one time any trained letter with one or more incorrect letter

strokes. Intervention Three added to Intervention One the opportunity to earn a certificate of achievement for an increased mean percentage of correct trained letter strokes.

During baseline, students wrote an average of 23.95% trained letter strokes correctly. When students received verbal and visual feedback during Intervention One, they averaged 37.56% correct trained letter strokes. During Intervention Two, verbal and visual feedback

Fig. 5. Mean percentage of letter strokes meeting criterion during each condition for individual students.

plus rewriting, student correct responses on trained letter strokes increased to 59.80%. The percentage of correct trained letter strokes increased to 71.68% during Intervention Three, potential reinforcement condition. The package treatment produced an increase in the percentage of correct trained letter strokes. However, the increase cannot be attributed to any one component due to the design employed.

The evaluative instruments developed for and used in this study are well suited for use by students and teachers for the following reasons.

1. The plastic overlays can be objectively used to measure upper- and lower-case cursive letter strokes.

2. Procedures outlined for using the evaluative overlays demonstrated that reliable measurement of cursive letter strokes is possible.

3. After the initial cost of drawing the overlay master, duplication through the Diazo Process costs approximately 50¢ per overlay. A set of two measuring instruments, one for upper-case and one for lower-case letters could be made for approximately \$1 per student. The nominal cost would make it feasible to provide overlays to teachers desiring to use them.

4. The overlays are made of heavy plastic and are very durable. Throughout the three months of this study, not one overlay needed to be replaced due to deterioration or misuse.

Fig. 6. Mean percentage of letter strokes meeting criterion during each condition for individual students.

5. A short amount of time is needed to train adults to use the overlays and to score student samples. The independent observers were taught to use the overlays reliably in less than half an hour.

To assess generalization, data were kept during baseline and each intervention condition on the percentage of correct strokes for trained letters on which students were given verbal and visual feedback, praise, and consequences; on untrained letters that were practiced with the trained letters; on the probes, upper-case letters that were both untrained and not practiced. The probes were copied five times throughout the study. Overall, the percentage of correct strokes

for both trained and untrained but practiced letters steadily increased throughout the packaged treatment, with the percentage of correct trained letter strokes higher than correct untrained by practiced letter strokes throughout the study. The percentage of correct upper-case letters decreased from Probe 1 to Probe 2. However, once packaged treatment procedures were implemented, the overall mean for correct upper-case letter strokes increased throughout the study at a lower percentage than either the untrained but practiced or trained letter strokes.

The results of studying letters that were not trained but practiced does not support the adage, "practice makes perfect". These data dem-

Table 1

Comparison of mean percentage of correct strokes for probes, untrained but practiced, and trained letters.

<i>Probe/Condition</i>	<i>Number of Samples Scored</i>	<i>Mean Per Cent Correct</i>
Probe 1	12	8.42
Baseline	97	
trained		23.95
untrained but practiced		19.02
Probe 2	12	8.41
Intervention One	65	
trained		37.56
Probe 3	12	12.19
Intervention Two	54	
trained		59.80
untrained but practiced		40.20
Probe 4	12	21.96
Intervention Three	25	
trained		71.68
untrained but practiced		48.69
Probe 5	12	23.50
Total	241	
Probes	60	
untrained but practiced		
and trained	181	

onstrate that practice of successively improving behaviors is important for developing competency. The upper-case letters that were not trained or practiced showed little generalization. However, generalization from the lower case to the upper case may have been additionally handicapped in the division topographical dissimilarity (e.g., letter size).

Models for evaluating instructional material are needed by educators. Traditionally, educators have employed large-scale group comparison utilizing pre/post measures. Groups are given different curricula and the value of each inferred from mean pre/post test results. Repeated measures can allow not only class monitoring of discrete changes in student performance but also revision in components or other aspects of the curriculum during product

evaluation. Technological advancements in curriculum evaluation should occasion improved student academic performance.

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