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Use of Error Drill, Feedback, Praise, and Fading to Increase the Legibility of D'Nealian Handwriting with Two Special Education Students

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The effects of error drill combined with corrective feedback and verbal praise for improving the legibility of D'Nealian handwriting were evaluated with a male and female sixth-grade student identified as health impaired and learning disabled, respectively. The criteria provided for judgment of legibility were based upon variables related to individual handwritten letter formation: size, slant, and letter ending. After the initial error drill, a fading procedure was implemented on the probe sheets to fade out models of the individual letters. Precision Teaching techniques were used to count, record, chart, and make instructional decisions about the appropriate individual handwritten letters produced on probe sheets by the students. Results revealed an increase in the frequency of correct individual letters written for student 2, with differential effects appearing related to learning opportunities (i.e., incorrect size, slant, or individual letter endings) for the D'Nealian handwriting style for both participants. Important instructional implications related to measurably superior data-based procedures for improving handwriting legibility are discussed.

Written expression combined with legible, and more easily read handwriting are some of the most important modes of communication in our society (Helwig, Johns, & Cooper, 1976). Legible handwriting is viewed as a prerequisite skill for success in a variety of settings in our society. From filling out job applications, including writing one's name, to completing assignments in school, the legibility of an individual's handwriting plays an important role in determining how well a person functions in these settings. In fact, as McLoughlin and Lewis (1994) pointed out, illegible handwriting leads not only to academic performance problems in school, but may become a determining factor as to whether a student is referred, assessed, and eventually placed in a special education setting for students with learning disabilities. There are several commercially available handwriting programs for use in the schools. They range from systematic Direct Instruction programs in cursive handwriting (Miller & Engelmann, 1980) to more traditional approaches (e.g., Zaner-Bloser, 1984). One of the most successful handwriting programs to teach students cursive letter formation was the *Write and See* program developed by Skinner and Krakower (1968). Unfortunately, this program is no longer commercially available to the schools.

Incorrect letter formation is said to be one of the most probable causes of illegible handwriting (Hansen, 1978). Accuracy in formation of letters is the key to success in mastering the alphabet and producing readable handwriting (Helwig et al., 1976). Accuracy in the formation of cursive and manuscript letters is generally assessed by evaluating the size, shape, slant, spacing, and general appearance of individual letters (Johns, Trap, & Cooper, 1977; Peck, Askov, & Fairchild, 1980; Sweeney, Salva, Cooper, & Talbert-Johnson, 1993; Talbert-Johnson, Salva, Sweeney, & Cooper, 1991). Several authors have successfully employed a variety of procedures to improve the legibility of handwriting with students (Johns et al., 1977; McLaughlin, 1981; Talbert-Johnson et al., 1991). Self-evaluation procedures (Sweeney et al., 1993), academic positive practice and response cost (McLaughlin, Mabee, Byram, & Reiter, 1987), and Precision Teaching measurement strategies (Brunner, McLaughlin, & Sweeney, 1993) have all been employed successfully to improve the legibility of difficult to read handwriting. All of these intervention approaches discuss the importance of ensuring correct letter formation through modeling, direct instruction and practice, and immediate error correction.

The majority of early instruction in handwriting in the primary grades tends to focus on the use of manuscript style, commonly known as printing (e.g., Askov, Otto, & Askov, 1970; Manning, 1986; Peck, 1980). However, Early, Nelson, Kleber, Treegoob, Huffman, and Cass, (1976) discovered that beginning with and teaching cursive alone did not impair one's progress in the development of their writing skills. Further, Early et al. (1976) stated cursive writing may [even] lead to frustration if students are immediately expected to stop writing manuscript and learn "real handwriting." The transition from manuscript to cursive handwriting can be a difficult and frustrating process for some students even though the differences in letter production and instruction, regardless of choice of alphabet, have been reported in the literature (Porter, Cooper, Hill, & Swisher, 1984).

Teachers report the main methods used for teaching handwriting are copying, exercises and drills, tracing, rhythm, and manual guidance. (Askov et al., 1970) found tracing or some variation of tracing to be most effective, and "easier than freehand drawing." Teachers also claim correct letter formation to be "the most important aspect of writing" (Hartley & Salzwedel, 1980). In the past, children have been given minimal assistance in recognizing and correcting/improving their own handwriting. A child needs "to be able to compare a letter mode directly to the desired letter form expected by the teacher...[to create development of] accurate perceptions of letter forms" (Hartley & Salzwedel, 1980). The teacher needs to provide immediate feedback (i.e., corrective feedback) as to where problems exist and how the learner can improve in his/her formation of individual letters. Steps should be presented in smaller/more component units at a manageable pace. Recent research in the areas of self-management and self-evaluation are beginning to address the issues related to accurate perceptions of correct and incorrect letter formation and handwriting legibility (Sweeney et al., 1993).

Generally, most handwriting scales are "unreliable" (Helwig et al., 1976) considering the subjective nature of the area of handwriting and the lack of measurement procedures sensitive enough to be able to discriminate discrete differences in letter formation and legibility. It is suggested that one measure handwriting by the following possible criteria: teacher judgment, the utilization of an individual thought to have expertise in handwriting, the adoption of a transparency template of handwritten letters, or employment of an evaluative strategy such as the block out procedure (Sweeney et al., 1993; Talbert-Johnson et al., 1991). The vital factor is that one must simply be consistent in which form of measurement is chosen (Talbert-Johnson et al., 1991).

The purpose of this study was to evaluate the effectiveness of Precision Teaching measurement procedures combined with error drill, immediate corrective feedback, praise and fading techniques in the development of D'Nealian handwriting skills. The investigation focused on the correct and incorrect letter formation of two sixth-grade students in a special education resource room.

Method

Participants and Setting

The two participants were a sixth-grade boy, identified as health impaired, and a sixth-grade girl who was receiving special education services and was labeled as learning disabled. Both students qualified for special education services pursuant to the state and federal definition for these two handicapping conditions (Washington Administrative Codes for Special Education, 1994). Assessment results indicated that both these students exhibited large deficits in academic achievement related to written language. The boy was 4.1 years below grade level, while the girl, 4.0 years below grade level in written language, according to the *Woodcock-Johnson Tests of Academic Achievement-Revised* (Woodcock & Johnson, 1990). Data from this assessment showed that letter identification was adequate for both participants, but slant, size, and ending needed improvement.

The study took place in a special education resource room, at a public elementary school, in the Northwestern United States. Along with the experimenter and students, the staff in this room consisted of two certified special education teachers and two teacher's aides.

Curricula Probe Sheets and Materials

The curriculum employed was composed of probe sheets with models for each of the individual letters of the cursive and manuscript alphabet. This instructional procedure was consistent with previous research related to instruction of D'Nealian handwriting (Porter et al, 1984). Probe sheets for error drills and time trials were developed prior to the beginning of the study. The sessions lasted a total of 15 minutes, three times a week (Monday, Wednesday, and Friday).

Movement Cycle and Measurement Procedures

The students participated in a see/write movement cycle evaluating the formation of individual handwritten letters on the basis of size, slant, and ending of D'Nealian handwriting. The three variables related to the evaluation criterion for letter formation and legibility consisted of size, slant, and ending and were each worth one point. Each handwritten letter was evaluated on the basis of these three legibility variables, therefore, each individual letter was worth a three possible points as they related to the individual legibility variables. These points were then totaled for all of the letters written during a given timed trial. The students participated in three time trials per session, using the probe sheets that were developed. The highest score, of the three timed trials per session, was recorded on the Standard Celeration Chart. The intermediate instructional aim was 75 correct responses based upon the evaluation criterion with no learning opportunities (i.e., errors) during the one minute timed trials. This instructional aim was a modified version of the performance standards developed during the Seattle-Tacoma-Spokane (i.e., STS Project) Child Service Demonstration Project (Intermediate School District No. III, 1974) and the Precision Teaching Classroom Learning Screening Instrument (Koenig & Kunzelmann, 1977; Koenig & Kunzelmann, 1980). Although the performance standards from these two programs recommended between 40 to 60 letters written correctly per minute for sixth-grade students, the classroom teacher and the third author suggested a modified fluency aim of 25 or more letters written correctly, combined with the three part evaluation system as an appropriate intermediate instructional aim related to legibility for these students (Howell, Kaplan, & O'Connell, 1979; White & Haring, 1976).

Design Elements and Experimental Conditions

An ABC single case replication design (Cambell & Stanley, 1966; Kazdin, 1982) was used to evaluate the effects of error drills, immediate corrective feedback and praise to teach D'Nealian handwriting skills.

<u>Baseline</u>. During baseline conditions the first author simply presented blank probe sheets with nothing but lined paper (i.e., top and bottom lines being solid, and a dashed middle-line). Students were instructed they would be given one minute to write in cursive, "A-Z," all the letters of the alphabet they knew. To alleviate anxiety due to the time trials, the first author told the students that she just wanted to see what letters they knew, so there was no need to worry. The participants were told to look only at their own papers, and not at their neighbors' papers or the wall, which contained wall strip models of the D'Nealian alphabet. Since the students were unable to complete the entire alphabet in one-minute, the researcher also had the participants practice writing the alphabet "A-Z," with no time limit after their three timed trials. This practice period was implemented to ensure that the students, given adequate time, would be able to complete all the letters from the alphabet using D'Nealian handwriting. Letters needing improvement were selected from the three time trials and the separate writing of the alphabet.

<u>Practice, error drill, and corrective feedback</u>. During this intervention condition, students were instructed to concentrate on curve, slant, and ending in handwriting. Also, they were told to "make use of their lines." In other words, the researcher directed them to form each part of their letter stroke(s) to the appropriate top, bottom, and middle lines. Focus for improvement was placed on letters identified during Baseline, especially *t*, *f*, *g*, *q*, *d*, *b*, and *p*. Five minutes were allocated to the students to complete the error

drills. During these error drills, specific letters selected previously for remediation were dispersed in three separate segments of four or five letters for each student to work on during this phase. Three one minute time trials followed the error drills. These time trials were then evaluated, and the highest score was selected and plotted. This condition was in effect for two school weeks.

Error drill, corrective feedback, praise and fading of the model. The same basic conditions and procedures employed in the first intervention were continued, but the models of the letters employed on error drills and time trials were gradually faded. Traditionally, in Precision Teaching, three consecutive days, with the number of corrects above the instructional aim and the minimum rate of progress line and the learning opportunities below 5 per minute, inform the researchers that students are making satisfactory progress towards mastering the skill (Sweeney, Omness, Janusz, & Cooper, 1992). In this case, however, the authors were concerned about ensuring mastery and transfer of learning from probe sheets with models of the letters written on the lines above, to actual assignments with no model. Thus, probe sheets, error drills, and time trials were presented with faded lettering in conjunction with praise statements for increasing corrects responses and decreasing learning opportunities. This condition was in effect for five school days.

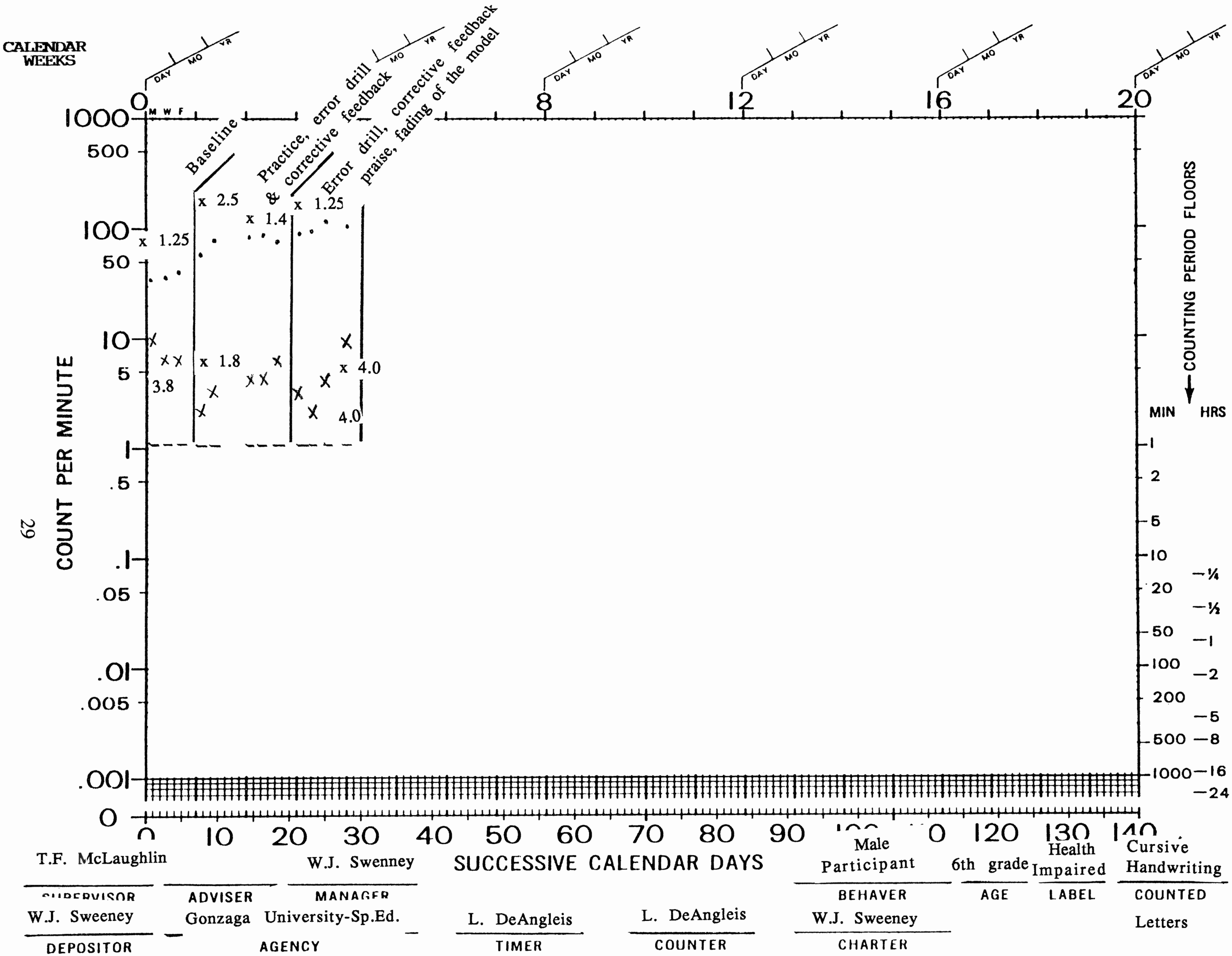
Results

Male Participant

The data on Chart 1 indicated improvement in the legibility of D'Nealian handwriting with the use of error drill, feedback, praise, and fading with the male participant. During 3 baseline sessions, the median number of correct responses related to size, slants, and individual letter endings for D'Nealian handwritten letters was 57 per minute, with scores ranging from 38 to 69 per minute. This was compared with the 5 sessions conducted during the practice, error drill and corrective feedback condition that resulted in a median number of correct responses for D'Nealian handwritten letters of 78 per minute, with scores ranging from 58 to 84 per minute. Finally, data from the 4 sessions during the error drill, corrective feedback, praise, and fading of the model condition showed the male participant's median performance for the number of correct responses related to D'Nealian handwritten letters as 96.5 per minute, with scores ranging from 87 to 119 per minute.

During 3 baseline sessions, the median number of learning opportunities related to size, slants, and individual letter endings for D'Nealian handwritten letters was 6 per minute, with scores ranging from 6 to 9 per minute for the male participant. This was compared with the 5 sessions conducted during the practice, error drill and corrective feedback condition that resulted in a median number of learning opportunities for D'Nealian handwritten letters of 4 per minute, with scores ranging from 2 to 6 per minute. Finally, data from the 4 sessions during the error drill, corrective feedback, praise, and fading of the model condition showed the male participant's median performance for the number of learning opportunities related to size, slants, and individual letter endings as 3 per minute, with scores ranging from 2 to 9 per minute.

Data from Chart 1 indicated a slightly improvement in performance of the number of correct responses related to size, slants, and individual letter endings accelerating at x1.25, while learning opportunities decreased by ÷3.8 during baseline. Results from the 5 sessions conducted during the practice, error drill, and corrective feedback condition, indicate an accelerating data trend for the number of correct responses related to the D'Nealian handwriting. The initial celerations for number of correct responses related to size, slants, and individual letter endings for the male participant showed an increase of x2.5 for the first 2 sessions, with the data path leveling out for the remainder of the condition resulting in an overall celeration of x1.4 during this condition. Learning opportunities also accelerated by x1.8 during this condition. Finally, the data from the 4 sessions during the error drill, corrective feedback, praise, and fading of the model condition revealed an accelerating data path of x1.25 for the male participant. Celerations for learning opportunities related to D'Nealian handwriting showed a turn-up phenomena for the male participant during this condition. Data showed an initial deceleration during the first 2 sessions of ÷4.0, with a turn-up in learning op


CALENDAR WEEKS
DAY MO YR
0 8 12 16 20
M W F
Baseline
Practice, error drill & corrective feedback
Error drill, corrective feedback praise, fading of the model
x 1.25
3.8
x 2.5
x 1.8
x 1.4
x 1.25
x 4.0
4.0
1000 500 100 50 10 5 1 .5 .1 .05 .01 .005 .001 0
COUNT PER MINUTE
COUNTING PERIOD FLOORS
MIN HRS
1 2 5 10 20 50 100 200 500 1000
¼ ½ 1 2 5 8 16 24
0 10 20 30 40 50 60 70 80 90 120 130 140
SUCCESSIVE CALENDAR DAYS
T.F. McLaughlin
SUPERVISOR
ADVISER
W.J. Swenney
MANAGER
Male Participant
BEHAVER
6th grade
AGE
Health Impaired
LABEL
Cursive Handwriting
COUNTED
W.J. Sweeney
DEPOSITOR
Gonzaga University-Sp.Ed.
AGENCY
L. DeAngleis
TIMER
L. DeAngleis
COUNTER
W.J. Sweeney
CHARTER
Letters

portunities during the final 3 session, resulting in acceleration of x4.0. Overall performance changes for correctly written D'Nealian letters across the three conditions celerated at a x1.9, x1.7, and x5.0, respectively, for the male participant. Overall performance changes for learning opportunities related to D'Nealian letter writing across the three conditions celerated at a ÷1.9, x2.5, and x5.0, respectively.

Female Participant

Data from Chart 2 showed accelerating learning trends for corrects across baseline and practice, error drill, and corrective feedback conditions, with a stable learning trend during the final experimental condition. Further, while learning opportunities were below 5 per minute throughout the study for the female participant, data revealed an important deceleration during the practice, error drill, and corrective feedback condition. This decrease in learning opportunities, with the exception of the final session, maintained below the record floor during the error drill, corrective feedback, praise, and fading of the model condition.

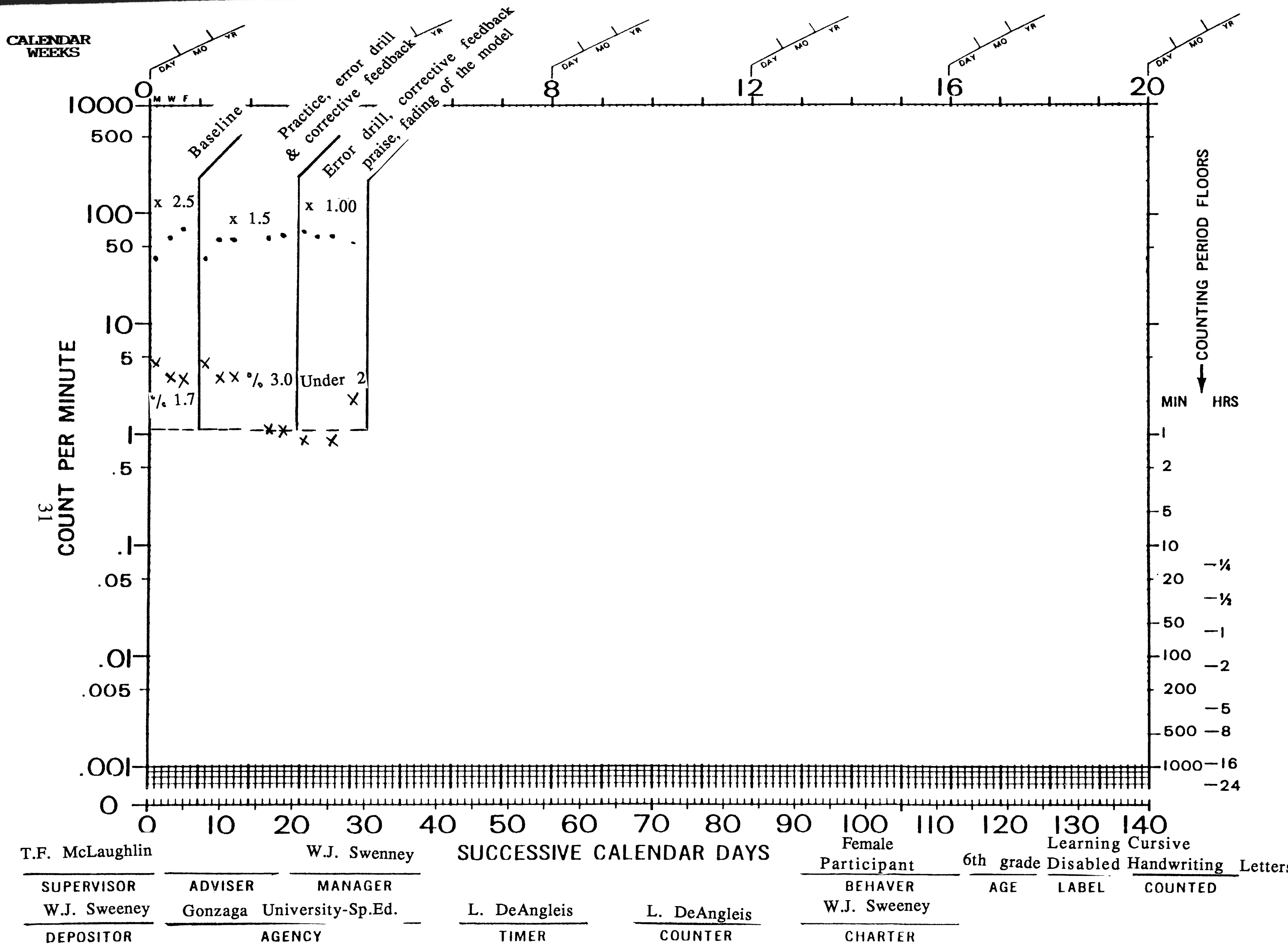
During 3 baseline sessions with the female participant, the median number of correct responses related to size, slant, and individual letter endings for D'Nealian handwritten letters was 36, with a range of 33 to 39 responses per minute. In the second experimental condition (i.e., practice, error drill, and corrective feedback), the median frequency for correctly written D'Nealian letters for the female participant was 54, with a range of 38 to 60 responses per minute. In the final experimental condition, (i.e., error drill, corrective feedback, praise, and fading of the model), the median frequency for correctly written cursive handwritten letters for the female participant was 60 with a range of 52 to 60 response per minute.

During 3 baseline sessions, the median number of learning opportunities related to size, slants, and individual letter endings for D'Nealian handwritten letters for the female participant was 3, with a range of 3 to 4 during this condition. During the 5 sessions of the practice, error drill, and corrective feedback condition, the female participant's median frequency of learning opportunities related to D'Nealian handwritten letters was 3, with a range of 1 to 4. Finally, data from the error drill, corrective feedback, praise, and fading of the model condition revealed median learning opportunities for D'Nealian hand writing of 0 per minute, with a range of 0 to 2 per minute during these three sessions.

Data from Chart 2, for the female participant, showed celerations of performance for the number of correct responses related to size, slants, and individual letter endings accelerating at x2.5, while learning opportunities decreased by ÷1.7 during the baseline condition. Results from the 5 sessions conducted during the practice, error drill and corrective feedback condition indicated an accelerating data trend for the number of correct responses related to the D'Nealian handwriting of x1.5, with learning opportunities decelerating at a ÷3.0. Finally, the data from the 3 sessions during the error drill, corrective feedback, praise, and fading of the model condition revealed an accelerating data path of x1.00 for the female participant. Celerations for learning opportunities related to D'Nealian handwriting for the female participant during this condition remained below the record floor, with the exception of the final day of the study where 2 learning opportunities appeared. Overall performance changes for correctly written D'Nealian letters across the three conditions celerated at a x2.0, x1.7, and ÷1.25, respectively for the female participant. Overall performance changes for learning opportunities related to D'Nealian letter writing across the three conditions celerated at a ÷1.5, ÷5.0, and x2.0, respectively.

Discussion

Both the male and female students in this study successfully improved their D'Nealian handwriting legibility through the use of error drills combined with corrective feedback and verbal praise. The remediation of size, slant, and individual letter endings to improve the individual letter formation was consistent with previous studies focusing on improving handwriting legibility (Brunner et al., 1994; Early et al., 1976; Porter et al., 1984; Sweeney et al., 1993; Talbert-Johnson et al., 1991). The male participants's learning picture appears to show a more consistent celeration of corrects across both intervention conditions, when compared to baseline scores. His learning opportunities did show an


CALENDAR WEEKS
DAY MO YR
0 8 12 16 20
M W F
Baseline
Practice, error drill & corrective feedback
Error drill, corrective feedback praise, fading of the model
x 2.5
x 1.5
x 1.00
°/o 1.7
°/o 3.0
Under 2
1000 500 100 50 10 5 1 .5 .1 .05 .01 .005 .001 0
COUNT PER MINUTE
COUNTING PERIOD FLOORS
MIN HRS
1 2 5 10 20 50 100 200 500 1000
¼ ½ 1 2 5 8 16 24
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
SUCCESSIVE CALENDAR DAYS
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accelerating learning trend in both the error drill and the error drill combined with corrective feedback and verbal praise experimental conditions. Since the corrects continued to improve, and the learning opportunities never exceeded 10 per minute, it was decided to continue with the program that was then in place with this student. Even though this was the case, the first author believed it was advisable to conduct a further error analysis in an effort to decrease the learning opportunities in the future.

The female participant's learning picture also showed improvements in both the number of correctly written D'Nealian handwritten letters, as well as in a decrease in learning opportunities to almost zero by the end of the study. Unfortunately, these results need to be interpreted cautiously because of the accelerating learning picture in baseline. It could be assumed that just the opportunity to have supervised practice in handwriting skills, as evidenced by the improving learning pictures in all three experimental conditions, may have been adequate for improving this student's handwriting legibility. Further, one may cautiously assume that the intervention conditions may have been more related to decreasing learning opportunities, rather than functioning to improve the number of correct responses. Additionally, although the male participant met the instructional aim of 75 or more individual letters formed correctly per minute, the female participant was not able to meet this goal by the conclusion of the study. Therefore, it was recommended that further fluency training (i.e., speed and accuracy combined) be implemented in an effort to make the correctly formed handwritten letters become automatic.

Although both participants improved their D'Nealian handwriting legibility during this study, the authors were unable to discern whether these students were able to transfer the skills learned over to their daily work in the regular classroom. It would be beneficial for future research to probe the legibility of the students' handwriting on their daily classroom work to determine whether any of the skills taught with the probe sheets had generalized to other settings, people, and assignments (Cooper, Heron, & Heward, 1987; McKenzie, & Budd, 1981; Stokes & Baer, 1977). This future research would bolster the assumption that increases in fluency of skills are related to generalization of skills to across other conditions (Howell & Lorson-Howell, 1990).

The use of error drill combined with corrective feedback and verbal praise are low cost, effective, and efficient strategies for improving the handwriting legibility of students. These strategies, augmented with data-based measurement tactics such as Precision Teaching and the Standard Celeration Chart, provide a powerful means of evaluating the effectiveness of specific instructional strategies currently employed in the classroom. Further, the development of probe sheets and other materials commonly found in the classroom, as well as short but intense instructional and assessment periods (Miller & Heward, 1992; Whalen, Willis, & Sweeney, 1993) could produce important instructional gains without greatly taxing a teacher,s time and resources. Training students in the classroom to count, record, and chart their own data on Standard Celeration Charts could further reduce the teacher's cost by reducing the time needed to implement such a procedure. Finally, public posting of the Charts could serve as a reinforcer for students' performance, as well as a evaluative tool for the teacher to determine if the current instruction is effective (Van Houten, 1980).

Some may claim that focusing remedial instruction on improving handwriting is unnecessary and a waste of valuable instructional time in light of the prevalence of mechanical communication devices such as word processors, typewriters, and computers. No one will argue the increasing importance of mechanical and technological modes of communication within our society. However, the importance of legible handwriting remains an important means of individual expression, creativity, and competence. The legibility of an individual's handwriting, whether it be on a job application or a personal communication, is one way we are perceived and thereby, communicate with the world around us (Brunner et al., 1993; Manning, 1986; McLaughlin et al., 1987). Legible handwriting, will in all probability, continue to be an important and functional skill in the future; thus, it would be prudent to continue to encourage, assist, and remediate students' handwriting legibility in the classroom (Brunner et al., 1993; Manning, 1986; Nelli, 1982; Peck et al., 1980).

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