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ABSTRACT

The paper examines the nature and remediation of reversal errors in five severely learning disabled boys (9-11 years old). Results of four phases (baseline and incentive conditions) are analyzed for timed and untimed performance of letter recognition. Among results cited are that for all Ss, errors in naming occurred with the letters p, d, b, and q, and not for the other letters. Data on the four letters are presented separately for two experiments. Results from both timed and untimed experiments are said to provide persuasive evidence that, in general, the reversal errors made by the Ss were easily manipulated. Findings are explained to support an educational rather than neurological explanation for reversals. Persistence of reversal problems is traced to assumptions by educators that the errors are neurological in origin and that direct intervention is unwarranted. (CL)

An Experimental Analysis of the Nature of Reversal Errors in Children with severe Learning disabilities

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Running Head: Reversal Errors

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One of the problems most commonly observed among children with learning disabilities is a high percentage of errors in responding to the alphabet letters b, d, p, and q. The occurrence of what are called "reversals" in saying and writing these letters is frequently the basis for referral to diagnostic testing and, subsequently, an important factor in labeling a child as dyslexic or learning disabled. As a result of such diagnostic labels, children may be placed in perceptual training programs to improve their discrimination skills. Teacher referral, diagnostic labeling, and process remediation are all based on the assumption that reversal errors are manifestations of disorders which are neurologically based. (Orton, 1925). In a recent review of the relevant research, however, Moyer and Newcomer (1977) seriously challenged the perceptual deficit assumption and, instead, hypothesized that letter discrimination is a learned cognitive skill. That neurological dysfunction as a basis for perceptual dysfunction is considered to be a viable hypothesis explaining the occurrence of reversals, however, is evidenced by the fact that it is consistently included in widely used texts (c.f., Hallahan and Cruickshank, 1973) and is presented as a fact in the popular media (Horvath, 1977).

Recent applied research provides important evidence that reversal errors can be eliminated through direct training. Lahey and McNees (1974), for example, report success using a match-to-sample procedure combined with token reinforcement to reduce the letter reversal errors made by twenty-nine preschool children. Again with preschool children, Griffiths & Griffiths (1976) found that combining a stimulus fading procedure with reinforcement was more effective than reinforcement alone in reducing errors during initial teaching of letter names. In the same vein, Tawney (1972) rapidly trained four-year-old children to discriminate letters by reinforcing responses to the critical features of letter-like stimuli. Somewhat surprisingly, Sidman and Kirk (1974) have found that letter reversals in naming and writing disappeared with nothing but continued testing, and Hasazi and Hasazi (1972) demonstrated that digit reversals could be a function of teacher attention.

Collectively, the experimental research is persuasive that the reversal errors commonly made by young children are correctable through direct training. Gelfand and Hartmann (1976) have made the point, however, that success in changing a behavior by environmental manipulation cannot, ipso facto, be taken as evidence that the behavior originated solely as a function of environmental experience. The evidence that reversal errors can be reduced through training is, therefore, weak evidence that reversal errors are controlled by the environment. Further, since the available training research has been conducted with very young normal children, we have no evidence bearing on the nature of reversal errors made by students with severe learning disabilities. The traditional view is, of course, that reversal errors made by severely learning disabled students are a function of neurological problems. An alternative view is that such errors might more parsimoniously be explained by psychological concepts such as motivation, and prior learning.

The present study was designed to provide evidence bearing on the plausibility of the neurological explanation for reversal errors made by severely learning disabled children. The design of the study was based on the assumption that if perceptual dysfunction exists which is neurologically based, and reversal errors are a manifestation of such a problem, then such errors cannot easily be altered through simple environmental manipulations - that a child who, in fact, perceives symbols as twisted or in mirror image cannot perform correctly simply because sufficient reason exists to do so.

METHOD

The experimental question was examined through use of a combined multiple baseline (across subjects) and reversal design (Hersen and Barlow, 1976).

Subjects and Setting

The children who served as subjects for the study were enrolled in a special day school program for children with severe learning disabilities. The children in this program have all previously failed in learning disability resource programs in their home schools and are progressing at less than one half the rate of their nondisabled peers in reading. The program enrolls approximately 25 students at the elementary level at any one time. Those 25 students constitute .02 percent of the elementary aged population of a Midwestern Metropolitan school district and constitute the core of that school system's population of classically defined student with severe learning disabilities. The teachers in this program were asked to identify their students who consistently reversed letters. Five males were selected who ranged in age from 9 years 4 months to 11 years 11 months. The median age was 10 years 6 months. The older children in the program were selected in an effort to minimize similarity between the subjects of this research and the young children employed as subjects in previous reversals research. The fact that these older children were still making reversal errors into the intermediate grades would ordinarily be taken as evidence that the problem exceeded the bounds of normal development and might ordinarily be taken as a sign of neurological or perceptual dysfunction.

Procedures

Each student participated in two successive short duration experiments differing only with respect to the pacing of the stimulus materials. Each experiment was conducted in a small, quiet room regularly used for psychological testing. One student at a time was taken individually to this experimental room and seated at a table across from the experimenter. A few minutes were spent in casual conversation to put the student at ease. In both experiments the dependent datum consisted of the percentage with which the students correctly named the letters b, d, p, and q. The datum was collected throughout four experimental phases:

Phase 1. (Baseline 1): Following the orientation period the subject was told that the purpose of the session was to "help teachers figure out better ways to teach you." The student was told he would be presented with a series of letters printed on a card and that he had 30 seconds to name as many letters as he could. He was then presented a 5 X 8 index card on which were presented the alphabet letters, printed in random order consisting of 4 rows with 16 letters in each row. One half the letters in each row were p, d, b, and q which were interspersed among eight other letters from the alphabet. Thus 32 of the 64 letters on each card were p, d, b, and q. The experimenter used a stopwatch to time the 30-second intervals, and recorded the data on a matching 5 X 8 card. The student was neither told that he was right nor wrong, nor was he given any praise or comment for his responses. Similar stimulus cards with different random orders of the four letters were presented in eight successive 30-second trials to establish baseline performance on the task.

Phase 2. (Incentive 1): During this phase the stimulus materials presented and the naming response required of the student were identical to Baseline 1. In addition, however, the student was told in advance that he and the experimenter would count the number of correctly named b, d, p, and q letters at the end of each trial, and that for each correct naming he would be given a colored plastic bead which could be exchanged for pennies at the end of this experimental phase. The exchange ratio was designated as one penny for every 10 beads. As with Baseline 1, Incentive 1 consisted of eight 30-second timed trials.

Phase 3. (Baseline 2): This phase was identical to Baseline 1. Each student was told that the task was the same but pennies would not be given. Baseline 2 consisted of four 30-second timed trials.

Phase 4 (Incentive 2): The identical treatment procedures as Phase 2 were repeated for four more 30-second trials. Each of the students was simply told that the plastic beads and pennies would again be given contingent upon correct naming responses.

The above four phases constituted the experiment in which trials were timed. A short rest period was then provided and each student then participated in a second experiment in which performance was untimed.

The accuracy of naming single letters under an untimed condition was studied by using the same stimulus materials. The experimental procedures and treatment phases were identical to those in the timed presentation except that the stopwatch was not used for the 30-second timing and the student was told to take his time in discriminating and naming the letters presented. Under this condition, the student attempted to name all of the 32 b, d, p, and q letters without the time or speed constraint. The number of trials per treatment phase was foreshortened to 6, 6, 3, and 3 successively to reduce the burden for students.

RESULTS

An analysis of the data revealed that, for all students, errors in naming occurred with the letters p, d, b, and q, and not for the other letters. The median percentage correct for naming other letters was 100 for all students in both experiments. The data on naming p, d, b, and q are presented separately for the two experiments.

Timed Presentation

The percentage of correctly named letters b, d, p, and q when they were presented in 30-second timed trials was graphed for each student and is shown in Figure 1. As can be seen from inspection of Figure 1, all five students correctly named letters some of the time during Baseline 1. Accuracy ranged from a median low of 40% (Subject A) to a median high of 87% (Subject B). In addition, the within subject range during Baseline 1 was as great as the between subject range. The trend of the data during Baseline 1 was clearly downward for Subject D and relatively stationary for all other subjects.

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Insert Figure 1 about here

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When the incentive condition was introduced during Incentive 1 the median level of correct naming increased to 100% in two cases (Subjects B and E), by more than 30% for Subject A, by over 20% for Subject C, and by only 6% in the case of Subject D. After the 16th trial when the treatment procedures were withdrawn (Baseline 2), the performance of Subjects B and C continued at the same level as for Incentive 1, the performance of Subjects A and E decreased to a level between that for Baseline 1 and Incentive 1. The performance of Subject D decreased 6% back to the original baseline level.

The reintroduction of incentives during Incentive 2 produced few noteworthy changes in performance save for the lowest level obtained for Subject D.

Untimed Presentation

Figure 2 shows the percentage of correctly named b, d, p, and q letters for the five students when they were presented under the untimed condition.

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Insert Figure 2 about here

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The Baseline 1 performance level for all of the subjects ranges from 60 to 83% correct. Since the students had completed the timed experiments their higher accuracy during Baseline 1 is not noteworthy except for student D whose median accuracy was higher than for any phase in the timed experiment. When the incentive was introduced after six trials, increases occurred for all five students. Four of the five students, including D, named these letters with better than 90% accuracy. These effects were replicated in Phases 3 and 4. In contrast to the results obtained during the timed experiment, the performance of Subject C changed little from phase to phase.

Discussion

The results from both timed and untimed experiments provide persuasive evidence that, in general, the reversal errors made by the students were easily manipulated. A review of the results from the first two phases of both the timed and untimed experiments reveals that clear changes occurred in accurate letter naming for all the students when the treatment shift was made between the original baseline condition to the first incentive condition. The change in responding was consistent across both timed and untimed presentations for three students, occurred clearly in the timed condition but less clearly in the untimed condition for a fourth student, and clearly in the untimed condition but less clearly in the timed condition for the fifth student. The data from the first two phases is most relevant since we cannot confidently predict that increases in accurate letter naming produced by the introduction of an incentive condition will be followed by decreases in accurate letter naming when the incentive condition is removed. Once accurate performance increases, variables other than those manipulated experimentally may exert control over the behavior involved. Another reason to be cautious when analyzing the results from the last two phases is that the number of data points in those phases is small.

The research presented here was designed to explore the hypothesis that reversal errors made by students with severe learning disabilities are a function of neurological rather than instructional problems. We take as the primary evidence bearing on that hypothesis the malleability of the reversal errors made by the students. The experiments demonstrate that even with these "hard core" learning disabled children it is possible to rapidly increase accuracy in discriminating among b, d, p, and q by simply providing an incentive for correct performance. As remarkable as the fact that the effects were obtained in a period of ten minutes on one day is the fact that the effectiveness of the incentive system used was not empirically determined for each student in advance of the experiment; never-the-less, that incentive system combined with feedback on number correct proved to be an intervention sufficient to effect substantial change.

Certainly, a study of this type cannot be considered definitive; yet, it would be difficult to argue that the results support a neurological dysfunction hypothesis. To accept a neurological explanation would require the conclusion that a rapid alteration occurred in the neurological processes which underlay the reversal errors, and that the neurological change was produced by the incentive/feedback treatment.

We believe that it is more parsimonious to explain the reversal errors in educational rather than neurological terms. The research presented here, we believe, supports the conclusion that the incidential and intentional learning environments of many of the students who are eventually labeled learning disabled accidentally produce children who make a high percentage of reversal errors with symbols which are easiest to confuse. These errors, then, are durable because no one takes the time to provide the necessary direct instruction to eliminate those errors. The problem persists, apparently, because the responsible educators assume, or are at least persuaded, that its origins are neurological, and that direct intervention is unwarranted. The net effect is that the errors continue, become a criterion for labeling the child as learning disabled, and are used in explanations for failure in reading and spelling.

A final comment should be made concerning the limited duration of the treatment used in the present study. Since our concern was how rapidly it was possible to effect change in reversal errors and not how best to eliminate such errors, the treatment was limited to one session on one day. Were more sessions to have been required, we would have found more plausible the explanation that reversal errors are a product of neurological dysfunction. As it presently stands, we see no reason to assume that the variables controlling reversal errors made by older children identified as severely learning disabled are qualitatively different from those made by young children who are not so identified. Further, we predict that the educational approaches to eliminating reversal errors cited earlier which have already been successfully used with young children will prove as effective with learning disabled children.

References

Hallahan, D. P., & Cruickshank, W. M. Psychoeducational foundations of learning disabilities. Englewood Cliffs, N. J.: Prentice Hall, 1973.

Hasazi, J. E., & Hasazi, S. E. Effects of teacher attention on digit reversal behavior in an elementary school child. Journal of Applied Behavior Analysis, 1972, 5, 157-162.

Hersen, M., & Barlow, D. H. Single case experimental designs: Strategies for studying behavior change. New York: Pergammon Press, 1976.

Holz, W. C., & Azrin, N. H. Conditioning human verbal behavior. In W. K. Honig (Eds.), Operant behavior: Areas of research and application. Englewood Cliffs, N. J.: Prentice Hall, 1966.

Horvath, I. (Producer). The invisible handicap. 60 Minutes, vol. 9, no. 48. New York: CBS Inc., August 28, 1977. (TV News Magazine)

Lahey, B. B., & McNees, M. P. Letter-discrimination errors in kindergarten through third grade: Assessment and operant training. The Journal of Special Education, 1975, 9, 191-199.

Moyer, S. B., & Newcomer, P. L. Reversal in reading: Diagnosis and remediation. Exceptional Children. 1977, 43, 424-429.

Orton, S. T. "Word-blindness" in school children. Archives of Neurology and Psychiatry, 1925, 14, 581-615.

Sidman, M., & Kirk, B. Letter reversals in naming, writing, and matching to sample. Child Development, 1974, 45, 616-625.

Tawney, J. W. Training letter discrimination in four-year-old children. Journal of Applied Behavior Analysis, 1972, 5, 455-465.

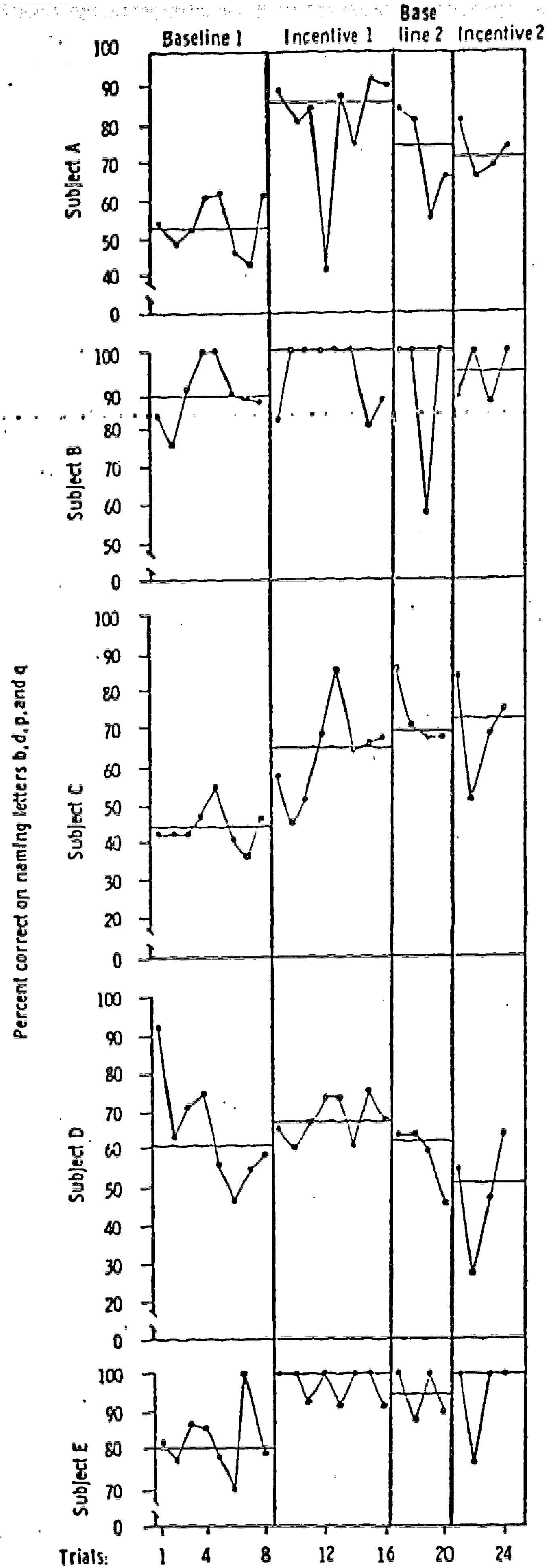

Figure 1: 30 second Presentation of the Letters

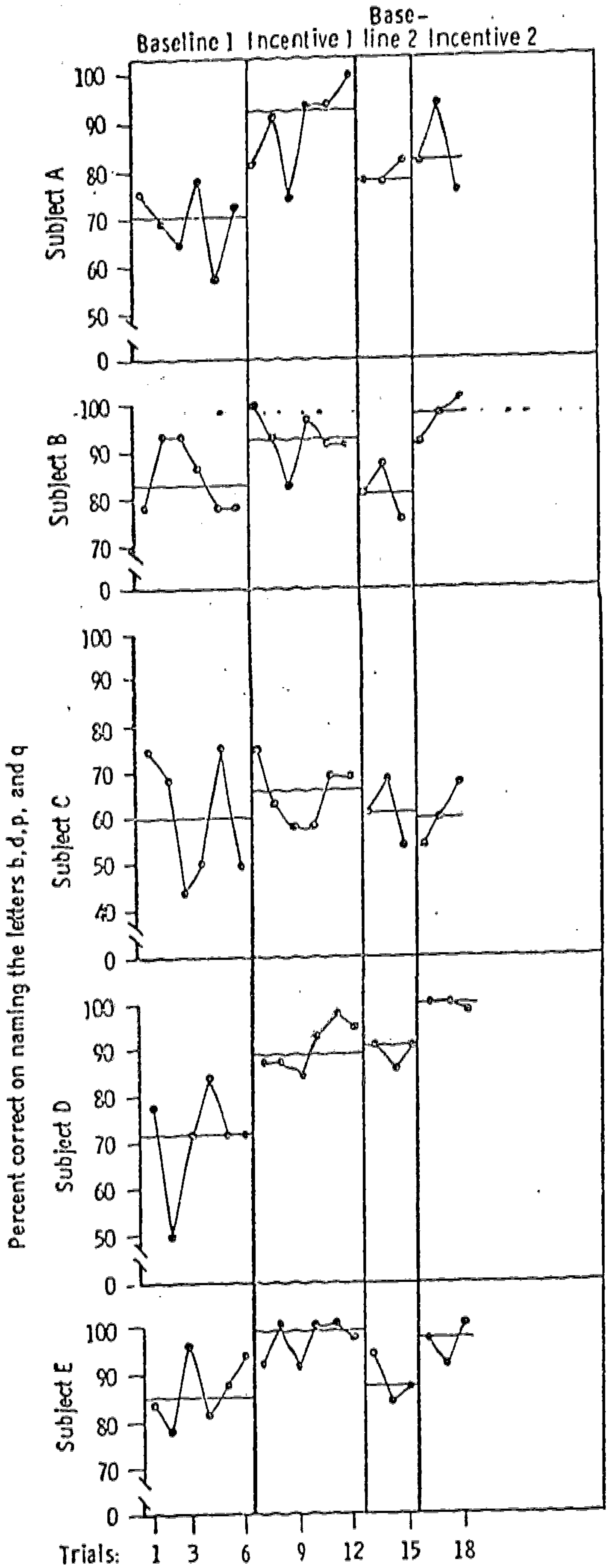

Figure 2: Untimed Presentation of the Letters