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Bachelor of Science in Education

Using Educational Kinesiology as a Method for Alleviating Letter Orientation Errors

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Introduction:

Letter reversals are a commonly observed error in children's reading and writing. While these errors are not necessarily indicative of a deficiency in emerging literacy, the continuation of this type of error beyond the age of six may be cause for concern (Badian, 2005). As such, reversal errors have been the subject of considerable research regarding learning disabilities. Reversing letters that, when incorrectly oriented, form another letter, can cause particular difficulties for a reader. These "reversible" letters include *b*, *d*, *p*, and *q*, which can be rotated horizontally or vertically to form one another. Other reversible letters include *N* and *Z*, *s* and *z*, *n* and *u*, and *m* and *w* (Terepocki, Kurk, & Willows, 2002). Exchanging one letter for another can completely alter the meaning of a word. This difficulty can be compounded if a student has not yet grasped the rules of written English or has poor phonological awareness. For example, if the *b* in the word "bat" is reversed, the resulting word "dat" could be interpreted as "that." If the primary purpose of reading is to obtain meaning from a text, reversal errors have the potential to significantly interfere with this objective (Milligan, 1993). Likewise, if a reader has great difficulty distinguishing between letters, reading will be a slow and arduous task. A student will likely be unable to comprehend the meaning of a passage if he has to decode each individual word. Automatic letter recognition, including proper orientation, is necessary for quick, fluent reading. Furthermore, if a writer wishes to effectively communicate with an audience, proper letter orientation will be necessary to create a message that can be read by others. With these difficulties in mind, it becomes evident that habitual and prolonged letter reversals can be detrimental to a student.

Neurological dysfunction is frequently cited as the cause of letter reversals. Students are said to lack proper visual discrimination skills and therefore misinterpret the spatial orientation of letters (Badian, 2005). It has also been argued, however, that letter reversals are a learned behavior and can be altered with training (Deno & Chiang, 1979). In a study conducted by Deno and Chiang, the incidence of letter reversals were found to greatly decrease when students were offered an incentive for correct orientation. They suggested that letter orientation errors persisted because educators do not provide susceptible students with enough intervention. Students also come to school with varying levels of background experiences with text. Students who do not come with the prior knowledge that text moves from left to right will have greater difficulty discriminating between similarly shaped letters. By providing students with increased textual experiences and sufficient instruction on orientation, incidence of letter reversals may be reduced.

Many types of intervention strategies are used within classrooms to help students establish a firm grasp of proper letter orientation. A significant number of these strategies appear to have no basis in research and include such methods as labeling the student's hands and identifying a cue word such as "dog" to memorizing the appearance of that cue word. Similar strategies also include using phrases such as, "First the bat, and then the ball," to form the letter b. Strategies that have been used in research studies include match-to-sample procedures combined with a reinforcement strategy (Koenigsberg, 1973). A stimulus-fading procedure also had proven effective. In a study conducted by Caldwell and Hall (1969), students displayed significant improvement when provided with instruction on what constitutes similarities and differences in the two

dimensional realm of text. These direct instruction strategies can be contrasted with other programs that claim to help the learner cross the midline and use both hemispheres of the brain (Dennison & Dennison, 1989). These programs include commercially marketed titles such as Audiblox and Brain Gym. It is the aim of these programs that, in training students in how to cross the midline, letter reversals and other learning difficulties will be eliminated.

For the study reported in this paper, Brain Gym was chosen as the method for alleviating letter reversals. Dennison and Dennison (1989) developed Brain Gym in the 1970's, following studies in educational kinesiology. Brain Gym is a group of physical activities, which are designed to be task-specific. Categories of movements include integration of the left and right hemispheres of the brain, focusing, and relaxing. There is no specific sequence of activities to be followed, and the educator is encouraged to select the activities that appear useful to the students. The "Midline Movements" of Brain Gym were of particular interest in this study. These movements focus on developing binocular vision as it relates to near-point work such as reading and writing. It is the aim of this study to determine if such instruction in crossing the midline has the potential to reduce the incidence of letter orientation errors.

Method:

This experiment took place in a first grade general education classroom in which no students had been identified as having a learning disability. Of the 19 students in the class, 2 participants who exhibited a high percentage of letter reversal errors in work samples were selected for observation and study. The researcher was present in the

classroom twice per week for eight weeks. During this time, the researcher led all students in the class through a 10 to 15 minute series of predetermined Brain Gym activities. After the Brain Gym activities were completed, the researcher individually assessed the two target students. The Brain Gym activities utilized in this study were:

- Hook-ups
- Brain Buttons
- Positive Points
- Cross Crawls
- Lazy 8's
- The Elephant
- Neck Rolls

For a complete description of each activity, see Appendix A. Each activity was performed once per session, and the target students were specifically observed by the researcher to insure proper participation in the activities.

Data was collected twice each week as the researcher individually assessed the two target students. The students were asked to write a series of predetermined words and letters. These words and letters were selected from student work samples because of their high probability for reversal errors. The words and letters used for assessment in this study were:

- bed
- dig
- bet
- rob

- thump
- tube
- was
- j
- b
- d
- s
- z
- Y

The assessments were conducted immediately following the performance of the activities. The assessment was given in a manner similar to a traditional spelling test with the researcher orally saying the word or letter and the student writing the word or letter on his or her paper. A letter reversal error was defined as rotating any letter around its horizontal or vertical axis. The percentage of letters reversed out of the total number of letters written was noted for each day. The data collected did not reflect if the word was spelled correctly. Brain gym activities and data collection occurred for six weeks, then a two-week period followed with no activities, and finally brain gym and testing were continued for the final two weeks for a total of eight weeks of data collection.

Results:

The data were tested for any evidence suggesting a correlation between letter reversal errors and increased exposure to Brain Gym activities. The data were analyzed at two distinct times during the study: 1) at the conclusion of week six and 2) at the

conclusion of the final two weeks of the study. A moderate, negative linear correlation was found for Student A, and a weak negative linear correlation was found for Student B, suggesting a decrease in the number of reversed letters for both students over time.

Figure 1 shows the data and the corresponding linear correlation for Student A at the conclusion of week six. Figure 2 shows the data and linear correlation for Student A through the end of the study. Figures 3 and 4 are the corresponding charts for Student B. The regression equations and R^2 values are found in Tables 1 and 2 for Student A and B respectively.

Figure 1: Percentage of Letter Reversal Errors for Student A through Week 6

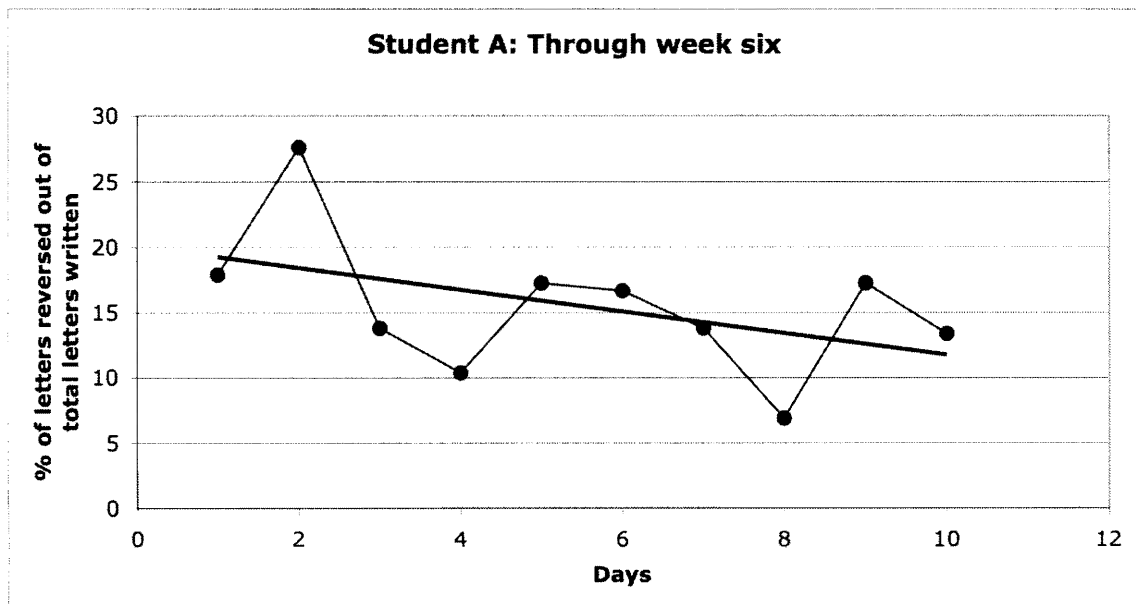


Figure 2: Percentage of Letter Reversal Errors for Student A through the Conclusion of the Study

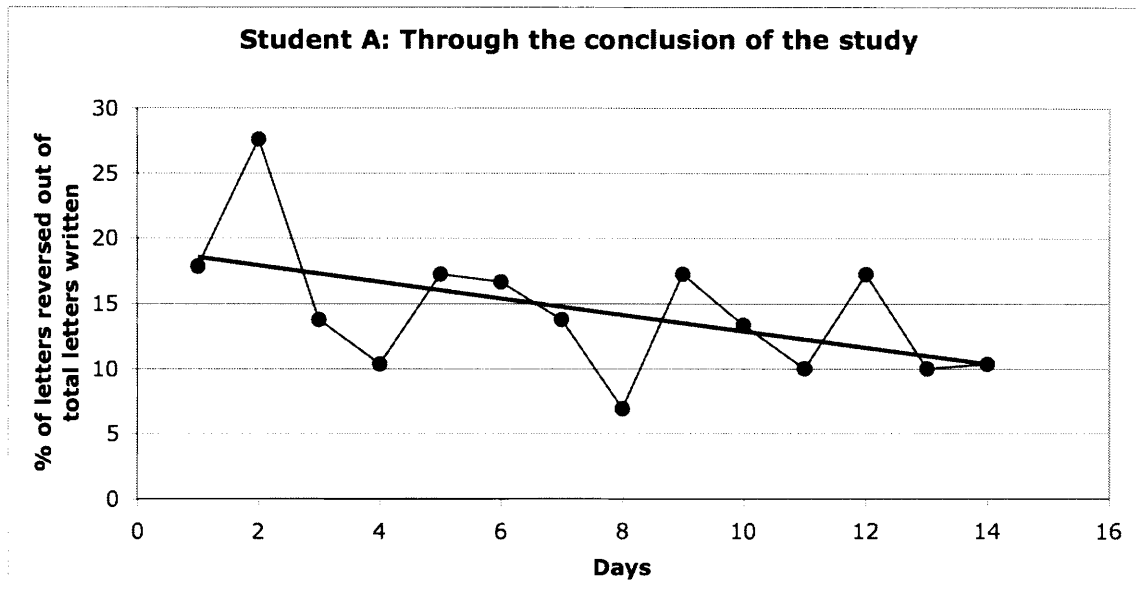


Figure 3: Percentage of Letter Reversal Errors for Student B through Week 6

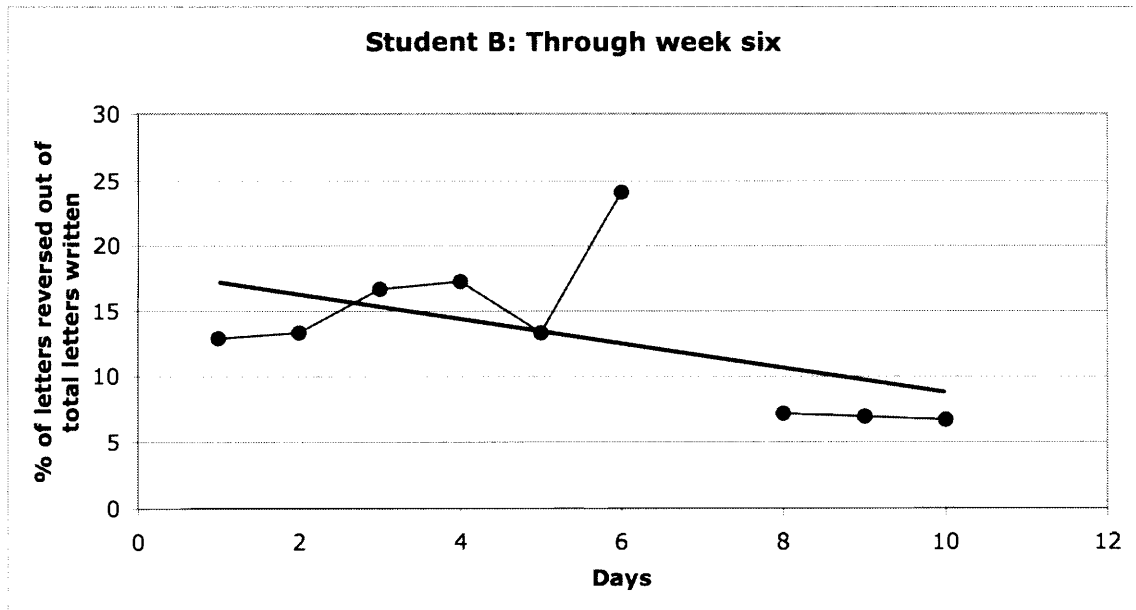


Figure 4: Percentage of Letter Reversal Errors for Student B through the Conclusion of the Study

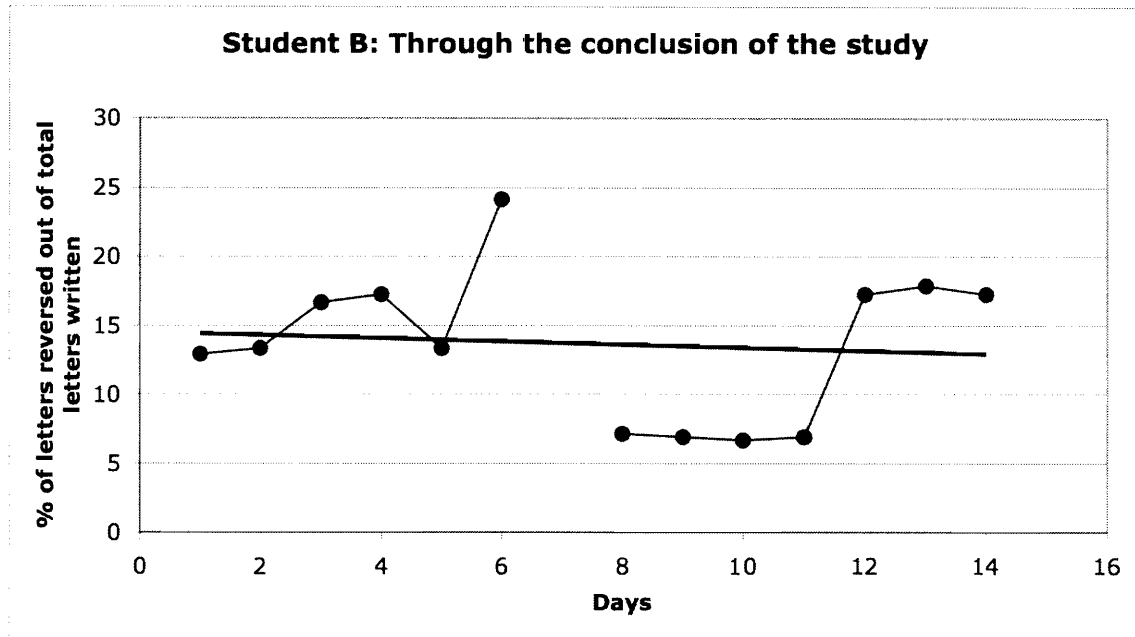


Table 1: Regression Results for Student A

Student A	Regression Equation	R ² Value
Through Week 6	$y = -0.0084x + 0.2007$	$R^2 = 0.2131$
Through Conclusion	$y = -0.0063x + 0.1919$	$R^2 = 0.2628$

Table 2: Regression Results for Student B

Student B	Regression Equation	R ² Value
Through Week 6	$y = -0.0094x + 0.1816$	$R^2 = 0.2642$
Through Conclusion	$y = -0.0012x + 0.1453$	$R^2 = 0.0085$

The regression results and R² values show that only a small portion of the variance can be explained by this study.

Next, the beginning and ending proportions of correctly oriented letters were tested to determine if the ending proportion was statistically larger than the beginning proportion. Again two time events were tested: 1) at the conclusion of week six and 2) at the conclusion of the study. The null hypothesis (H₀) was that $p = p_0$. The alternative

hypothesis (H_1) was that $p > p_0$. The Z statistic was used with an $\alpha = 0.10$. In the data through week six, both students had a Z statistic less than $Z_{\alpha} = 1.28$, therefore the null hypothesis could not be rejected. (See Table 3)

Table 3: Proportion Statistics for Data Collected through Week 6

	Z statistic
Student A	0.615
Student B	1.0185

However, considering the final data at the conclusion of the study, Student A's proportion was tested. At the conclusion of the study, Student A had a $Z = 2.011$, which was greater than $Z_{\alpha} = 1.28$ indicating the beginning and ending proportions of correctly oriented letters were significantly different. The final proportion for Student B clearly demonstrated no need for further testing. It should be noted that no nonparametric techniques were used to evaluate the data.

Discussion:

It cannot be said with any certainty that Brain Gym contributed positively to Student B. However, there is some slight statistical indication that Brain Gym may have contributed positively to Student A by the conclusion of the study. There were many confounding factors that could not be controlled in this study, which may have contributed to the wide variance in the data. The fact that most students appear to "grow out" of reversing letters indicates that any improvement might be due to natural processes rather than Brain Gym activities. Further confounding factors were the physical and psychological wellness of the students. Social difficulties with peers or unhealthy environments outside the classroom might have contributed to poor performance, such as

that exhibited by Student B on day 6. Furthermore, such a small sample size (2 students) cannot lead to any conclusions that can be generalized as to the overall effectiveness of Brain Gym. The general conclusion from this study indicates that Brain Gym may have positive effects for some students, but not all. Brain Gym was demonstrated to have no negative effects on student performance. Further study is needed to include a larger sample size and a control population. This future study could also address possible benefits of Brain Gym that were not addressed by this study. This study found that Brain Gym activities, when implemented with an entire classroom population, might produce positive effects on letter orientation errors for some students, but no strong evidence was found to conclude that Brain Gym produced significant improvements in all students experiencing letter orientation difficulties.

Appendix A: Description of Brain Gym Activities (Dennison & Dennison, 1989).

Cross Crawl: The student balances on one foot while raising his opposite knee in front of his body. The student places the opposite hand on his raised knee and maintains his balance. The student then alternated to the opposite leg and opposite hand. In a variation of the cross crawl, the student balances on one foot while raising his opposite foot behind his body. He then grasps the foot with the opposite hand. The student then alternates legs and hands.

Lazy 8's: The student raises one hand in front of himself and points with his index finger. The student then traces the shape of an infinity symbol several times in the air in front of his body. The student repeats this movement with the opposite arm. To conclude the movement, the student clasps both hands together and points ahead with both index fingers together and traces the shape again.

The Elephant: The student performs the arm movements as described in the first two steps of the lazy eight. However, before the student begins tracing the infinity symbol, the student rests his ear on the shoulder of the arm he will be using. The student then traces the shape by rotating his entire trunk.

Neck Rolls: The student gently leans his neck right and left, forward and back, and then rotates his head in a circular motion.

Hook-Ups: The student sits in his seat with his left foot resting on his right knee. The student crosses his arms and places one hand on his left foot and one hand on his left knee. The student maintains this position with eyes closed for several seconds. The movement is then repeated on the opposite side.

Positive Points: The student sits in his seat and rests his elbows on the desk. The student then gently rubs his forehead just above his eyebrows.

Brain Buttons: The student gently rubs the area just below his collarbones.

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