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A Study to Determine if There Was a Relationship Between the Brain Dominance and Grade Point Averages of Students at Deep Creek High School

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A STUDY TO DETERMINE IF THERE WAS A RELATIONSHIP
BETWEEN THE BRAIN DOMINANCE AND GRADE POINT
AVERAGES OF STUDENTS AT DEEP CREEK HIGH SCHOOL

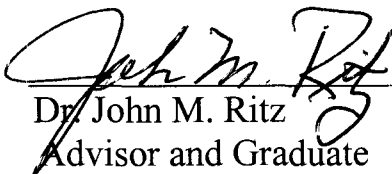
A RESEARCH PROJECT
PRESENTED TO
THE GRADUATE FACULTY OF THE DEPARTMENT OF
OCCUPATIONAL AND TECHNICAL STUDIES
OLD DOMINION UNIVERSITY

IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE
MASTER OF SCIENCE IN EDUCATION

BY
DONALD M. HURWITZ
MAY, 2001

APPROVAL PAGE

This research paper was prepared by Donald M. Hurwitz under the direction of Dr. John M. Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Master of Science degree.

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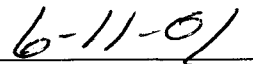

Date

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CHAPTER I

INTRODUCTION

Most children go through the stages of human development in a relatively normal progression. Parents remember their child's milestones, such as the first spoken word and the first step. At one point, children learn the difference between their left and their right. The significance of these two directions becomes more important as the child grows and reaches another milestone- their first day of school.

The left and right directions have greater implications for the first grader than just which hand they are going to use to write. The way students learn and assimilate knowledge is related to the dominance of either the left or right hemisphere of their brain. Left-brain dominant individuals are more analytical, logical, and organized. Their thoughts have what has been described as a linear quality. These individuals possess a type of thought process that makes them well suited to such professions as accounting and engineering. On the other hand, right-brain dominant individuals are creative, artistic, and imaginative. They favor non-linear thinking, and they are successful in professions where they are free to use their unique perspective on the world. These are the idea people, such as writers and painters.

Academicians have studied brain dominance for much of the twentieth century. An outgrowth of brain dominance research has been the study of learning styles. By understanding the ideal way that students learn, educators can fine-tune their lessons to the diverse needs of their class members. Some students are kinesthetic tactile learners, and learn by doing. Others are oral learners and prefer to listen and speak about a topic.

Most students have a mixture of learning styles that work for them because neither hemisphere is completely dominant.

STATEMENT OF THE PROBLEM

The purpose of this study was to determine if the brain dominance of Deep Creek High School students is a determining factor for their cumulative grade point average.

RESEARCH HYPOTHESIS

The following hypothesis was drafted to measure the affects of brain dominance:

H₁: Students with left-brain dominance will have higher cumulative grade point averages than students with right-brain dominance.

BACKGROUND AND SIGNIFICANCE

Learning style inventories are commonplace in certain courses at Deep Creek High School. In Vocational Special Needs classes, the Individual Vocational Education Plan (IVEP) requires that the instructor list the student's learning style and keep a record in the their permanent file. Unfortunately, all instructors are not required to determine the learning styles of their students. They use lesson plans that they create themselves or borrow from colleagues. The classroom activities are generally based on their ease of implementation using existing resources, not their efficacy.

Teachers in core courses are increasingly focused on the Standards of Learning (SOL). School accreditation and student graduation will depend on a series of multiple-choice tests administered at all levels of public education. Test results are published in local newspapers. Schools with a higher percentage of passing scores receive praise. Students and teachers in schools with unsatisfactory scores are pressured to improve their scores. One of the results of this pressure is a phenomenon known as "teaching to the

test.” Classroom activity centers on the acquisition of specific items of information. The lower domains of learning are paramount. A talented, creative student may feel like they are being smothered by a lack of more stimulating learning experiences.

Objective tests like the SOL evaluations are the strong suit of a left-brain learner. As the SOL process continues, right-brain learners will be placed at a disadvantage. Their creativity will be of little use when they are sitting in a silent classroom using a number two pencil to shade in a small circle on an answer sheet.

Teachers that test each student for brain dominance will be able to identify which ones may need special attention. Class work that involves role playing or creative writing will make it easier for the right-brain dominant students to prepare for a test that is not suited to their learning preference. These strategies can also be beneficial for the rest of the class.

By correlating the students’ hemispheric dominance to their grade point average, educators will have proof that current educational practices are favoring one type of learner. With so much at stake, it is imperative that this relationship be examined.

LIMITATIONS

The subjects of the research were ninth through twelfth grade students from Deep Creek High School in Chesapeake, Virginia. The cumulative grade point averages for these students are readily available from their permanent files. There are other measurements available from Literacy Passports and Stanford Nine tests, but the score reports do not always appear in the files in a timely manner. The grade point averages are a part of the Star Base data on each student and are updated on a semiannual basis.

“The Brain” test for determining hemispheric dominance is a public domain evaluation instrument that is easily administered by the use of a computer. It is time efficient and the students enjoy taking it. The questions change on each test so that students cannot coach each other on potential answers. After a brief explanation, a class of twenty-five students can be tested in fifteen minutes or less. It works with advanced placement students as well as those with learning disabilities.

ASSUMPTIONS

In conducting the research, it is assumed that students will give honest answers to the questions. They enjoy reading the results of The Brain test, and realize that the results will only be as good as the answers they provide. It is also assumed that the Star Base GPA data are correct. It is the product of teachers’ grade report sheets.

In addition, it is assumed that the significance of the results will be consistent for all students regardless of their age. Students ranged in age from fourteen to eighteen years of age. Also, it is assumed that the results of a study at Deep Creek High School will have implications for other schools in the Commonwealth.

PROCEDURES

The simplest part of the data collection was obtaining the grade point averages. The Brain test was administered on a day when report cards were distributed. The report cards contain the students’ grade point average.

Administering the Brain test was also relatively easy. With the cooperation of the Deep Creek faculty and the computer lab, the brain test was loaded onto the school’s file server and was accessible to the school’s computer network. Computers in portable classrooms that were not a part of the network required separate installations. Since the

Brain test file fits on a 3 1/2 inch floppy disc, this required only a short period of time to install.

When students completed the test, they printed out a page with their brain dominance. Teachers kept scoring sheets that were used to record the participants' brain dominance. The teachers knew the students names, and verified that they had the correct report card. The GPA was recorded on the scoring sheet next to the students' dominant brain hemisphere. The participants understood that no reference to their names would be recorded.

A sample of the school's student body was selected from all subject areas. Out of a total population of 1800, approximately 150 of the students participated in the study.

DEFINITION OF TERMS

The following terms are defined to assist the reader:

- DCHS- Deep Creek High School, the site of the research.
- GPA- cumulative grade point average. It is the average of all semester grades from ninth through twelfth grades.
- LB- left-brain, in the context of brain dominance theory.
- RB- right-brain, in the context of brain dominance theory.
- SOL- Standards of Learning, a system of student evaluations in the Commonwealth of Virginia.

OVERVIEW OF CHAPTERS

The introduction provided a brief review at brain dominance theory. LB dominant learners are more logical and perform better with objective evaluations. RB dominant learners are more creative and prefer subjective evaluations. Due to the implementation

of the SOL procedures, students and schools are evaluated by objective tests. If teachers are made aware that the brain dominance of their students affects their GPA, they can adjust teaching strategies. Teachers can improve the performance of the RB learners by providing instruction that appeals to their learning styles.

The testing of students was performed on computers at Deep Creek High School. GPA data were collected from permanent school records, report cards. Students were in ninth through twelfth grades.

The Review of Literature looks at the history of brain dominance theory. The characteristics of RB and LB learners will be examined, with attention given to learning styles. Learning styles are significant, because teacher awareness in this area leads to more effective instructional practices. Also, the history of the Standards of Learning program in the Commonwealth of Virginia will be reviewed.

The Methods and Procedures section delineates the background of “The Brain” test and how it was administered to the students. It also explains how the GPA data were obtained.

The Findings chapter shows the correlation of the test results with the GPA. It includes tables and figures of the relationship of the brain dominance with academic performance.

The last chapter summarizes the study. It makes recommendations to enhance the SOL test scores of the students that were studied and makes suggestions that apply to the entire school system.

CHAPTER II

REVIEW OF LITERATURE

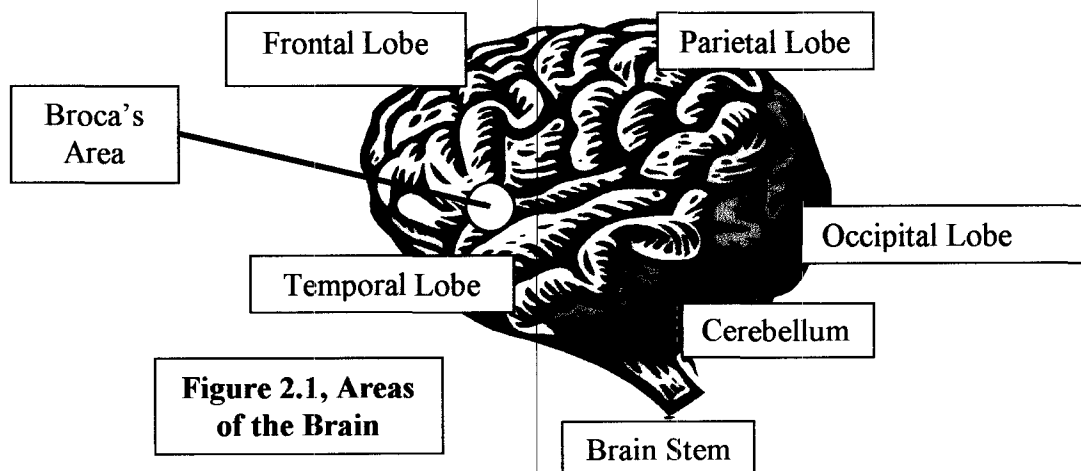
The brain is an amazing thing. It gives the human race their unique abilities that distinguish them from all of the other animals on Earth. Homo sapiens are a truly unique species because of it. All of the human body's other systems function with great similarities to the rest of animal kind. It is the functioning of the brain that gives us that special talent to absorb and synthesize knowledge. A tremendous body of knowledge exists on man's study of this thinking organ. Before initiating the actual testing of the subjects in this study, it was necessary to obtain relevant background information on the work that had been done in the field of brain research and how it relates to education. In order to provide an understanding of the subject matter, this chapter will include sections on:

- 1) The origins of brain research that relate to intellectual performance.
- 2) The applications of brain research to the fields of education and training.
- 3) Some examples of research studies relating brain dominance theory to student performance, and the cultural implications.
- 4) The development of intellectual performance standards in the Commonwealth of Virginia's public schools (Standards of Learning).

BRAIN RESEARCH

It is difficult to perform physical research on the human brain to gain a greater understanding of how we think and function. Physical examination of the organ will most certainly cause injury, possibly death, to the subject being studied. As a result, the earliest studies were done on cadavers. A breakthrough occurred in 1861 with the work of a

surgeon named Paul Broca (Springer & Deutsch, 1981). Dr. Broca was presented with an elderly male patient with a severe infection. The man had experienced a loss of speech and paralysis in one side of his body for a period of years. Within days, the patient died from the infection. The doctor wanted to find out if an abnormality in the man's brain had caused the loss of speaking ability. An autopsy revealed that the subject's brain had lesions, or damage, on the left portion of his frontal lobe. Broca wanted to examine the brains of other people who had suffered speech loss (aphasia) to determine if there was a common cause for the problem. He observed similar damage in the same area in each deceased subject's brain. After presenting his findings to the French Society of Anthropology in Paris, the portion of the brain in the left frontal lobe became known as Broca's Area, which is illustrated in Figure 2.1 below. Dr. Broca had only wanted to find



a cause of aphasia. He had inadvertently opened up a new field of brain study.

As Broca continued his work, he made several other key observations of patients who suffered from aphasia and were paralyzed on one side of their body (hemiplegic). First, every aphasiac person who was hemiplegic had lesions only on the left side of their

brain. Second, the patients with brain lesions on the right side of the brain had suffered no loss of speech. After further study, this finding ultimately provided proof that speech was a function of the left hemisphere. He had been the first to substantiate hemispheric brain functioning with physiological evidence.

In later years, other researchers furthered the study of the brain in regards to which side was responsible for one's abilities and talents. The composer Maurice Ravel suffered a major stroke. It affected the left side of his brain. His ability to read and write music was totally lost. Notably, he had retained his capacity to remember songs and his sense of rhythm (Ehrenwald, 1984). From this and other observations, researchers recognized that creativity was a function of the right hemisphere.

After many years of observation and discovery, the scientific community has recognized that each half of the brain can function independently. Along with this independence, each side has specific differences. While the differences have had various labels, the following words (Springer & Deutsch, 1981) have gained general acceptance as hemispheric descriptors:

Left	Right
Verbal	Nonverbal, visuo-spatial
Sequential, temporal, digital	Simultaneous, spatial, and analogical
Logical, analytical	Gestalt, synthetic
Rational	Intuitive
Western thought	Eastern thought

Table 2.1
Words Associated With Left and Right Hemispheres

APPLICATIONS OF BRAIN RESEARCH

Despite the fact that a great deal had been learned about the function of the brain, brain dominance theory had not found any application in the fields of education and training. During World War II, all of this changed. Isabel Myers and her mother, Katherine Cook Briggs, developed the Myers-Briggs Type Indicator (MBTI). It was designed to assist new entries into the workforce for the wartime industrial effort. Their work expanded brain dominance theory and was based on the Jungian model. The MBTI describes four different pairs of attributes to create a matrix of 16 distinct personality types that incorporate elements of left and right brain characteristics (“Identifying How We Think,” 1997).

The four pairs of attributes are Introversion versus Extraversion, Sensing versus Intuiting, Thinking versus Feeling, and Judging versus Perceiving. The Thinking versus Feeling dichotomy clearly reflects an essential part of brain dominance theory. It measures “how one makes decisions once information is gathered. Feeling types (F) use their emotional intelligence to make decisions based on values – their internal sense of right and wrong.” This is an example of being intuitive, a right brain characteristic. At the opposite end of this continuum, there is the Thinking type (T), which “tend to make decisions based on logic and ‘objective’ criteria- their assessment of truth and falsehood.” (“Identifying How We Think,” 1997). The Thinking type represents the classic left brain characteristic of logic.

The government theorized during World War II that when people went to work for the first time during an emergency situation, a meaningful criterion would be desirable to assist the job selection process. If people were placed into positions that best

suit their personality type, there was a greater likelihood they would be successful. The MBTI has applications in business, psychology, education, and career counseling. Recognizing the brain dominance characteristics of learners in the classroom will place them in a situation where they are more likely to succeed. The MBTI can provide insight into what type of students are being taught by indicating how they process information. This insight will help design a more effective learning process.

Many scholars have designed instructional systems that cater to brain dominance characteristics through examination of teaching and learning styles. Bernice McCarthy seized upon this theory, and described strategies for teaching that incorporate “a two-by-two matrix of preferred ways of perceiving and processing information”. She is best known for a teaching tool named 4MAT. Another is David Kolb’s Learning Style Model. It includes four classifications of perceiving and processing information. The first is divergers- they perceive information concretely and process it reflectively. The second is assimilators- they perceive on an abstract level and process reflectively. The third is convergers- a group that perceives reality through abstract conceptualization and process through active experimentation. The fourth is accommodators- they perceive through concrete experience and process through active experimentation. A final example is the Felder-Silverman Learning Style Model (a continuum from sensing/intuitive to sequential/global). They all measure qualities associated with left and right brain attributes (Dryud, 1997).

In the industrial environment, Ned Herrmann developed the Herrmann Brain Dominance Instrument (HBDI). While serving as a manager for General Electric for over 20 years, he used brain dominance theory to determine which professions would suit a

person best. Engineers would fall into left brain categories described as “analytical, mathematical, and logical.” Artists were decidedly right brain dominant and were described as “emotional, spatial, and aesthetic” (“Identifying How We Think,” 1997).

RESEARCH STUDIES ON BRAIN DOMINANCE THEORY IN EDUCATION

Many research studies have been performed that seek to establish various relationships between student performance and learning styles. One study was conducted in Korea on high school students (Junghee and Michael, 1995). One hundred and ninety-three 11th graders at Mok-Dong High School were tested for their dominant brain hemisphere. An unexpected finding was an overwhelming number of RB dominant students. The researchers concluded that the Korean culture was responsible for this. Asiatic cultures regard creativity in much higher esteem than do Western societies. In American culture, we tend to reward the qualities exhibited by those with left brain dominance (Springer and Deutsch, 1981).

THE VIRGINIA STANDARDS OF LEARNING

On October 26, 2000, the city of Chesapeake conducted an in-service training session for vocational educators on the Virginia SOL. The instructor was Jannette Edwards, Assistant Principal of the Chesapeake Center for Science and Technology. A concise history of the SOL implementation process was outlined at the session.

In 1994, four Virginia school districts were asked by the Department of Education (DOE) to revise standards in English, mathematics, history and social science. They were asked to include input from teachers, the business community, and professional organizations. The Virginia Board of Education adopted the standards in June of 1995.

They applied to every student from kindergarten through grade 12. They are defined as “statements of knowledge, processes, and skills that students need to be successful” (Edwards, 2000).

The SOL process has several component parts. The first part is the actual standards. They are contained in a 101 page document and are cross referenced by subject area and grade level. The second part is the SOL tests. Students are tested in third, fifth, and eighth grades. In addition, completers of certain high school courses in English, mathematics, social science, and sciences are tested. There are two categories for students that pass the test- Proficient and Advanced. Beginning with the graduating classes of 2004, diplomas will be labeled as Standard or Advanced Studies based on the students’ performance on the SOL tests. The third part is accountability. The DOE has a set of rules known as the Standards of Accreditation (SOA). The SOA were designed to hold schools accountable for student achievement on the tests. After 2007, schools could theoretically lose their accreditation. Up until that time, schools are ranked on a tiered scale. The final part is the School Performance Report Card. It communicates the schools’ ranking with parents, taxpayers, and the community at large.

On the following page is a copy of a handout that describes the SOL test results for Deep Creek High School. While not a formal report card, it shows where the school stands in its current state of accreditation. Of particular interest are the data in row two, labeled “English Writing.” The writing exam is the only one of the SOL tests that is not multiple choice. In this portion of the SOL test, the students write an essay based on a prompt. A machine cannot grade this test. It is graded by comparing students’ efforts

Standards of Learning - Pass Rates Summary

Deep Creek High School

School	1999-2000 School Year							2000-2001 School Year		
	Total # Students	Fail		Total Passing		# of Students Needed for 70% Pass	# of Additional Students Needed to Achieve 70% Pass	# of Students within Passing Range (380-399)	Estimated # of Students Enrolled	# Needed for 70% Pass
		#	%	#	%					
English RLR	396	99	25.000%	278	70.455%	278	0		436	305
English Writing	395	107	27.089%	288	72.911%	277	0		435	305
Algebra I	480	196	42.609%	264	57.391%	322	58		506	354
Algebra II	247	106	42.915%	141	57.085%	173	32		272	190
Geometry	449	239	53.229%	210	46.771%	315	105		494	346
Earth Science	488	200	40.984%	288	59.016%	342	54		537	376
Biology	457	164	35.886%	293	64.114%	320	27		503	352
Chemistry	228	63	27.632%	165	72.368%	160	0		251	176
World Geography										
US History	395	293	74.177%	102	25.823%	277	175		435	305
World History to 1000 AD	379	98	25.858%	281	74.142%	266	0		417	292
World History from 1000 AD	235	130	55.319%	105	44.681%	165	60		259	181

Table 2.2

against a rubric that contains desired attributes. It is the only SOL test that measures “appositional thinking.” This term refers to “information processing of the right hemisphere” (Springer and Deutsch, 1981). Multiple-choice questions are measures of

Department of Assessment and SOL Accountability
Chesapeake Public Schools

prepositional skills, such as speaking, writing, and calculation. The majority of the test questions in SOL testing are measures of left-brain activities.

SUMMARY

In this chapter, a brief history of brain dominance research described how scientists first came upon the ideas that the brain has two distinct halves which function independently from each other. Their strengths compliment each other in significant ways. Educators and trainers have capitalized on this knowledge in an effort to make teaching and learning processes more effective by taking into account brain hemisphere preferences. In the Commonwealth of Virginia, academic accomplishments are being measured by tests that primarily measure talents that are associated with left-brain talents.

As the SOL process matures in Virginia, the results of test scores will have greater importance for students, teachers, and administrators. The percentage of students that pass will determine how many schools become accredited. Teachers and administrators will be held accountable for the school accreditation. With proof that right-brain dominant students are not as successful as their left-brain counterparts, educators will have a more significant reason to apply right brain teaching strategies in the classroom.

With that fact in mind, it was necessary to construct a means to measure the success of high school students relative to their dominant brain hemisphere. The measurement would have to provide data that could be used to design instruction that would appeal to a higher percentage of the student population. By following these findings, a school would increase their likelihood of meeting the SOL performance criteria.

CHAPTER III

METHODS AND PROCEDURES

The SOL process in Virginia is moving forward at a carefully planned pace. New instructional requirements have been set forth for core subjects such as Mathematics, Science, English, and Social Studies. It makes sense to study the impact of recent changes in education on the performance of students relative to their brain dominance. As changes take place in the education process, educators must make sure that these changes are not adversely affecting students because of their mental orientation to learning. In order to explain how the research was conducted, this chapter will include sections covering the following topics: 1) The population that was studied, 2) Research variables that were present, 3) Instrument design for testing, 4) Classroom procedures for conducting the research, 5) Methods of data collection, and 6) Details of the statistical analysis.

POPULATION

In studying brain dominance of the students in the Chesapeake Public Schools, Deep Creek High School was chosen as an appropriate site for measurement. Hickory, Western Branch, and Great Bridge High Schools are generally recognized as having populations from higher socio-economic groups. Oscar Smith and Indian River High Schools have students from the poorer sections of Chesapeake. Deep Creek High School students come from a broad mix of socio-economic groups, as well as wide range of learning abilities. SOL tests are given to some Learning Disabled (LD) students, as well as Advanced Placement (AP) classes. Deep Creek is in an old, well-established community, but new construction of homes has created a student body in excess of 1800

students. In the last 10 years, the school building has been enlarged twice. Ten portable classrooms are in use and more will be added in the future. Out of the population of 1800, 150 students participated in this study. The 150 students will come from the ninth, tenth, eleventh, and twelfth grade levels. Their numbers will be in proportion to their grade level's ratio of the total student population.

RESEARCH VARIABLES

Two variables were considered in this study. The first variable, dependent, is the cumulative Grade Point Average (GPA). It takes into account the academic performance of students in both their core courses and their electives. The SOL test score only measures results from core courses. Because high school faculty has been found to “teach to the test,” the GPA reflects a superior measure of student performance in the new SOL learning environment.

The second variable, independent, is brain dominance. An instrument entitled “The Brain Test” was used as a means of measurement. It measured brain dominance in a scale from left to right. It also measured learning style in a scale of visual and auditory ability. The left versus right measurement will demonstrate the dominant brain hemisphere. The visual versus auditory measurement will provide insight into the learning style preference for the test subject. The test results will provide a means to establish a relationship between GPA and brain dominance. Additionally, information about learning styles can be used to design instruction that will be better suited to the preferences of the student population.

INSTRUMENT DESIGN

The Brain Test was obtained from Nick Strahan, via his website at <http://www.algonquinc.on.ca/staff/strachn>. He is Professor of Business Communications at Algonquin College in Ottawa, Ontario. The test is easily stored on a 3.5 inch floppy disc and occupies 1.15 megabytes of memory. It is in the public domain and was originally made available at the website www.mindmedia.com. It is a 20-question multiple-choice test that varies the questions with each participant. It provides a linear scale of left to right brain dominance, and a second measure of visual versus auditory learning style. In addition, it produces several paragraphs that describe the subject's characteristics. The researcher gave a copy of the test to his professor, Dr. John Ritz of Old Dominion University. After completing the test, Dr. Ritz was amazed at how accurately it described his characteristics. Other test subjects have agreed with Dr. Ritz that the test has provided an accurate insight into their learning characteristics.

CLASSROOM PROCEDURES

The researcher administered the test to the students with assistance from cooperating faculty. Some students took the test one at a time in the researcher's classroom; others took it en masse in the school's computer lab. It was found that teachers and students were eager to take the test because the results were of great interest to the respondents. The test was a novel experience and was warmly received by all involved. The researcher or faculty member recorded each student's dominant brain hemisphere from The Brain Test on a log sheet. The student's GPA was obtained from their report card and reported on the log sheet.

METHODS OF DATA COLLECTION

All of the log sheets were assembled. Each GPA value was entered into a Microsoft Excel 2000 spreadsheet to guarantee student identity protection. The values fell into one of three categories- LB dominant, RB dominant, or balanced.

STATISTICAL ANALYSIS

The researcher used Microsoft Excel to compute a standard array of descriptive statistics. In addition, the researcher constructed a Chi-Square test that attempted to correlate the LB dominant GPA values with the RB dominant GPA values. This was done in order to determine if there was a relationship between the two. The test matrix contained labels for left and right brain dominance on the vertical axis. The horizontal axis contained labels for below and above average GPA score. The Microsoft Excel program was used to determine the average of GPA scores.

SUMMARY

The SOL movement will continue to impact schooling for the foreseeable future. It has introduced a new system of testing and accountability at all levels of public education in the Commonwealth of Virginia. In addition, President George W. Bush is also indicating that accountability will be a fundamental part of federal funding for education in the near future. With student testing taking on greater significance in our school systems, it is imperative that these new tests take into account the brain dominance of the students that are being tested. The results of this study will indicate if brain dominance is a factor that needs to be considered in the evaluation of student performance. If GPA scores are affected by brain dominance, then school administrators

will need to accommodate this measure of diversity in order to obtain valid test scores from all students.

CHAPTER IV

FINDINGS

This chapter presents the data collected during a study conducted at Deep Creek High School in the spring of 2001. The purpose of this study was to determine if the brain dominance of Deep Creek High School students is a determining factor of their cumulative grade point average. The researcher used Microsoft Excel to perform descriptive statistics on the data.

REPORT OF THE FINDINGS

A total of 150 students were tested. Of that number, 66 were LB dominant (Group A), 57 were RB dominant (Group B), and 20 were balanced, or had no hemispheric brain dominance (Group C). Six student brain test scores had to be discarded because they had recently transferred and did not have any GPA scores available. The statistics that were generated are shown in Table 4-1.

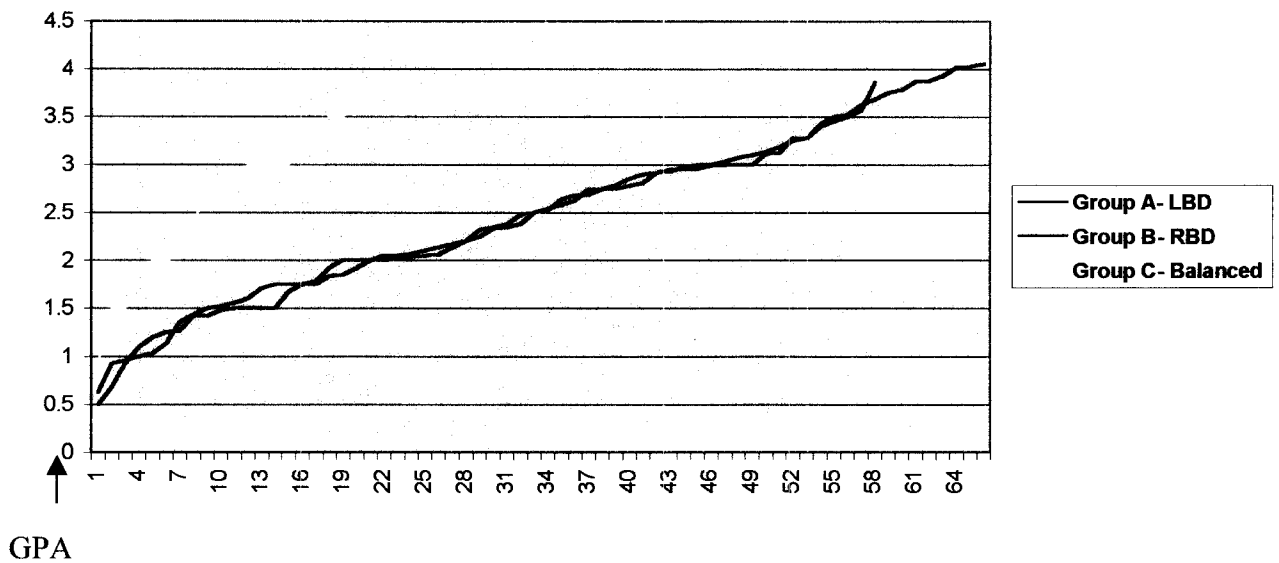
Table 4-1: Statistical Analysis of Data

	Group A	Group B	Group C	All Groups
Mean	2.482273	2.314914	2.6035	2.431701
Standard Error	0.112962	0.101215	0.178447	0.07047
Median	2.52	2.335	2.865	2.49
Mode	1.5	1.75	3	3
Standard Deviation	0.917708	0.770834	0.798039	0.845644
Sample Variance	0.842187	0.594185	0.636866	0.715114
Kurtosis	-0.87712	-0.73189	-0.61505	-0.77796
Skewness	-0.05897	-0.18896	-.48251	-0.10714
Range	3.55	3.23	2.95	3.55
Minimum	0.5	0.63	0.92	0.5
Maximum	4.05	3.86	3.87	4.05
Sum	163.83	134.265	52.07	350.165
Count	66	58	20	144

The group with the highest average GPA was Group C, followed in order by Groups A and B. The mean GPA for all students tested was 2.43.

In order to provide a graphic representation of the data, each groups' GPA scores were plotted in Table 4-2. Group C was the smallest, followed in order by Groups B and A.

Table 4-2: GPA by Hemispheric Dominance



To determine the relationship of frequencies between the LBD and RBD groups, a Chi-square test of significance was performed on the data. Table 4-3 shows the 2 by 2 matrix of the data that were compared. The value of χ^2 was computed to be .4262854.

Table 4-3: Chi-Square Test

	Below Average	Above Average
LBD Group A	32	34
RBD Group B	31	26

SUMMARY

Measures of central tendency were employed to establish trends among the various groups that were tested. The relationship of the two largest groups was tested by a computation for the value of Chi-square. The conclusions based on these findings will be presented in the final chapter.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter begins with a summary that describes why and how the study was conducted. It also provides the findings from the study. The conclusions explains the significance of these findings. The final section makes recommendations based on the conclusions.

SUMMARY

The purpose of this study was to determine if the brain dominance of Deep Creek High School students is a determining factor of their cumulative grade point averages. The following hypothesis was drafted to measure the affects of brain dominance:
H₁: Students with left-brain dominance will have higher cumulative grade point averages than students with right-brain dominance.

Brain dominance and GPA are of greater significance to teachers and students in Virginia because of the Standard of Learning (SOL) tests. Students must achieve state mandated minimum test scores in order to earn a diploma. The state also requires that students in each public school achieve specific pass rates in order for their school to become certified. As a result, teachers are “teaching to the test.” They are designing instruction to produce more favorable results on SOL tests. This instructional design may be creating a learning environment that favors one set of learning abilities over another. Many of the skills required to pass SOL tests favor individuals with certain characteristics in their learning abilities. These learning abilities can be determined by means of a simple test for students’ dominant brain hemisphere. If it could be demonstrated by the results of that test that brain dominance was a determining factor in

GPA scores, then Virginia's schools should consider adapting instructional techniques to capitalize on the strengths of its learners.

This research was conducted at one high school in Chesapeake, Virginia. The test population was the product of random sampling. A public domain test for brain hemisphere dominance was used. Data were collected on the brain dominance and grade point average of the test subjects. A human subjects review panel established guidelines for data collection. Testing was conducted on a day when report cards were issued. This allowed teachers to record brain dominance values and GPAs without the need to record students' names.

Once the data were collected, they were entered onto a Microsoft Excel spreadsheet. The program calculated standard measures of central tendency. This was done to establish characteristics of each group. Students that were LBD had a higher mean GPA than the total group (2.48 vs. 2.43). Students with RBD had a lower average than the total group (2.29 vs. 2.43). The focus of the research was on the two groups that exhibited either left or right brain dominance. The research uncovered a third group of respondents that were balanced between left and right brain dominance. This balanced group was unique in two respects. First, the group was small, comprising only 14% of the sample population. Second, the respondents in this group clearly had the best GPA of any subgroup or of the entire population (2.60).

To determine if there was a correlation of the results, a test was performed to calculate the value of Chi-square. Using the data, a mean GPA was established for the entire test sample. In addition, the numbers of students in groups A and B that were above and below that mean were counted on the original spreadsheet. The numbers of

LBD students with above and below average GPAs were compared to those of students with RBD. With a value for $\chi^2 = .4262853$, it was determined that the scores of the two groups were not independent.

CONCLUSIONS

Based on the research hypothesis:

H_1 : Students with left-brain dominance will have higher cumulative grade point averages than students with right-brain dominance, the LB dominant group had higher mean GPA scores than did the RB dominant group. In addition, the LB dominant group had a higher maximum GPA value than did the RB dominant group. However, the χ^2 of .4262854 did not prove that the two groups were independent of each other. Using the data in table 5-2, the critical values of χ^2 , one must reject the hypothesis.

Table 5-1: Critical Values of Chi Square

Level of significance for one-tailed test

Df	0.100	0.050	0.025	0.010	0.005	0.0005
1	1.640	2.710	3.840	5.410	6.640	10.830

Therefore it can be concluded that there was no significant difference between brain dominance and student grade point average.

The group with balanced brain dominance had the best average GPA of any group in the study. Having a blend of RBD and RBD learning characteristics is preferable to only having left or right hemispheric dominance.

RECOMMENDATIONS

A topic for further study concerns the group with balanced brain dominance. They clearly out-performed either the left or right brain dominant groups. Having a class of students with balanced brain dominance would be comparable to managing a baseball team where all of the batters were switch hitters. They can adapt to anything that is thrown at them. If there was a way to help students emulate the characteristics of balanced brain dominance learners, then they could improve their grades.

As schools across Virginia are faced with low SOL test scores and accreditation problems, educators will need innovative tools to increase student performance. A study of brain dominance and SOL scores would be of value in this area. If it can be demonstrated that a student's brain dominance has a relationship to their performance on standardized tests, this could develop up a new area for consideration. Tests could be re-designed to accommodate the needs of all test takers. Classroom techniques could be modified to enhance the accomplishments of all students.

Some post secondary schools are relaxing their emphasis on entrance examinations score as a means of selecting entrants. They are relying more on answers to essay questions that demonstrate a student's ability to express themselves creatively in writing. This shows that universities recognize the value of RBD skills. Educators need these creative minds along with the LBD thinkers to have a balanced society. By continuing to study the relationship of brain dominance and student performance, educators can find ways for more people to use more of their potential learning power.

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