



A study: Analysis of Brain Dominance and Achievements

Deepali G. Chaudhary and Dr. Bharti W. Gawali

Department of Computer Science and Information Technology,
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

Abstract-Brain Dominance relates preference of one side to other from the Left or Right Hemisphere. It is an important issue in the context which is in need to be taken into consideration of personage's difference. As the different hemispheres of the brain perform differently, this has led to an inquisitiveness in research to find the effect of dominance in different sectors and their achievements. The analysis is conducted to find out the relationship between Brain Dominance and Achievements. It was witnessed that many different types of tools and techniques were used by a different canvasser for the accomplishment or analysis of the difference over worldwide. The revision concluded that there are some of the streams where the effect of Brain Dominance was observed. This awareness of dominance can help students or individuals performing better in their respective academic. The study showcase the fact that every individual is different and prefers a different way of thinking. By knowing how we and others think help us in making better decisions, improve working with empathy and relationship, improving communication, problem solving, and making lasting decisions.

Keywords: Brain, Brain Dominance, Hemisphere, Left Brain, Right Brain and Whole Brain

1. Introduction:

Many functions of the body are controlled or governed by the "Brain" among which few of them are intelligence, emotion, creativity, and memory. The cerebrum part of the brain is divided into two sections known as "Left Brain" and "Right Brain" [1]. Either the Lobes or Hemisphere is connected through a bundle of fibres known as "Corpus Coulson". The different functions performed by these hemispheres are shown in figure 1 below.

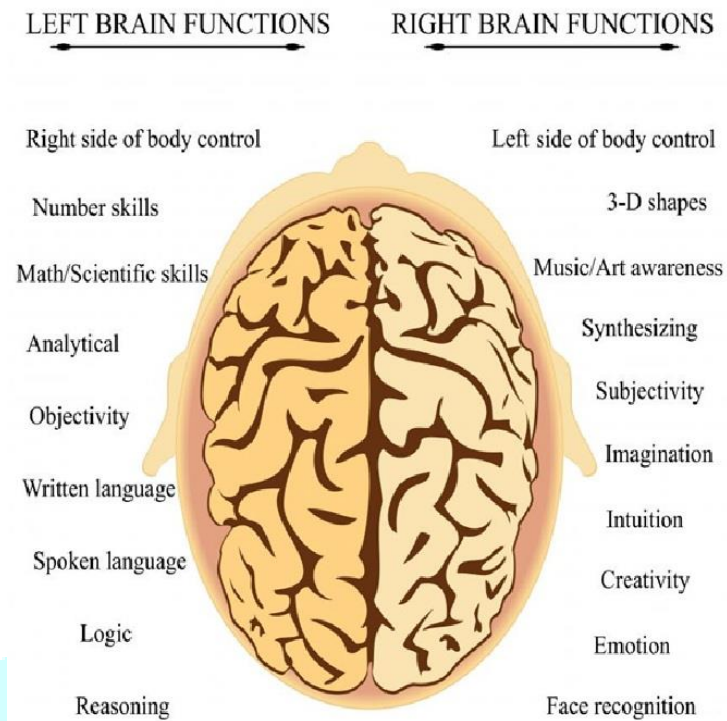


Figure 1: Left Brain and Right Brain

More than 10 billion cells are equally divided into two parts as “Left Hemisphere” and “Right Hemisphere”. Both the hemispheres are symmetric and equal in size but the two sides are not the same and do not perform the same functions. The two hemispheres serve the body in different ways [1, 5]. Table 1 below describes the different functions performed by the two hemispheres and the difficulties faced by the hemispheres while performing the task [1, 5, 9, 10, 18, 24, 26, 32, 44-46, and 52-55].

Table 1: Different Functions Performed by the Brain

Sr. No.	Brain Functions	Left Brain	Right Brain
1	Control on Muscles	Right side of Body	Left side of body
2	Functions	Speech, Language, Logical Analysis, Mathematical Computation, Reasoning	Spatial awareness, Facial Recognition, Intuition, Visual imaginings, rhythm, Music awareness
3	Preference Inventory	Organized and Systematic, Verbal, Analytic, Linear and Controlled, Mathematical Skill, Logical Thinking, Detailed, Rational, Intra Personal, Sequential Thinking, Temporal, Critical Thinking.	Creative and Imaginative, Kinesthetic, Holistic, Concrete, Artistic, Intuitive, Analogical, Non Rational, Inter personal, Emotional, Spatial, Spiritual and Meditative.
4	Personality (Traits)	Linear thinkers, Process Sequentially, Logical Decision Making, Reality Oriented.	Holistic thinkers, Process Randomly, Intuitive Decision Making, Non-Verbal Processing, Fantasy Oriented.
5	Superficial personality traits	Analytical, Logical, Pay Attention to detail.	Creative, Artistic, Open Minded.
6	Thinking	Linear, Detail Oriented (details to whole) approach.	Holistic, Big Picture Oriented (whole to details) approach.
7	Problem Solving	Logical order or pattern perception; emphasis on strategies.	Intuitive spatial or abstract perception; emphasis on possibilities.
8	Thought Process	Sequential, Verbal (process with words).	Random, Non-Verbal (process with visuals).
9	Strengths (Good At)	Mathematics, analytics, reading, spelling, writing, sequencing, verbal and written language.	Multi-dimensional thinking, Art, Music, Drawing, Athletics, Coordination, Repairs, Remembers Faces, Places, Events.
10	Difficulties	Visualization, spatial or abstract thinking.	Following by Sequence, Understanding Parts, Organizing a Large Body of Information, Remembering Names.
11	Characteristics	Intellectual, Remembers Names, Verbal Response to Instructions and Explanations, Experiments Systematically and with Control, Makes Objective Judgments, Planned and Structured, Prefers Established Certain Information, Analytic Reader, Reliance on Language in Thinking and Remembering, Prefers Talking and Writing, Prefers Multiple Choice Tests, Control Feelings, Not Good at Interpreting Body Language, Rarely uses Metaphors and Favors Logical Problems Solving.	Intuitive, Remember Faces, Responds to Demonstrated, Illustrated or Symbolic Instructions, Experiment Randomly and Less Restraint, Make Subjective Judgments, Fluid and Spontaneous, Prefers Elusive, Uncertain Information, Synthesizing Reader, Reliance on Imaging in Thinking and Remembering, Prefers Drawing and Manipulating Objects, Prefers Open-Ended Questions, More Free with Feelings, Good at Interpreting Body Language, Frequently uses Metaphors, and Favors Intuitive Problem Solving.
12	Brain Injury or Stroke	Receptive Language, Expressive Language, Apraxia of Speech, Dysarthria, Computation, Analyzing.	Attention, Left neglect, Visual perception, Reasoning and problem solving, Memory, Social communication, Organization, Insight, Orientation.

Every person has a preference for one or the other side of the brain known as “Left Brain Dominance” or “Right Brain Dominance”. The most significant determinant is that which hemisphere does the person prefers to use in response to sensory input and external stimuli and this preference is called as “Dominance”. With these two brain dominance, the third form of dominance exists generally recognized as “Whole Brain Dominance”. These people equally make use of both the sides or they maintain balance with both sides. These hemispheres facilities in determining the personality and behavior of the person. The people with different personalities due to dominance even have different characteristics in their choices and behavior which can be seen in the table 2 below [3].

Table 2: Behaviour and Characteristics of different dominant individuals

Sr. No.	Area	Left Brain Dominant	Right Brain Dominant
1	Attitude	Have tendency to devalue creativity and spirituality. Are over dependence on Logic, blames self (feel responsible for others discomforts)	Have tendency to 'space out', make use of spirituality for avoiding responsibility, blames others (make others responsible for challenges and problems faced)
2	Disputes or challenges for the individual	Delegation, cleaning out (letting go), intuitive leaps and 'gut'-feelings, relationships with females, receiving or being provided for.	Organised, clear thinking, decision making is rational, relationships with males (esp Father /figures), Providing materially
3	Likes	Control, uniformity, past-oriented, 'knowing', solitude	Socialising, colour, expression, future-oriented
4	Dislikes	Feeling smothered, fussed-over, are untrusted by others (mostly by females), feel inadequate, unworthy	Feeling abandoned, controlled, are betrayed by others (mostly by men), feel incapable, wrong.
5	Needs	MORE: spontaneity, dance, expression, nurturing, social activity LESS: control, clarity, focus, direction, responsibility, analysis	MORE: control, clarity, focus, direction, responsibility LESS: expression, nurturing, social activity
6	Balancing Diet	Fasting, fruits & juices, raw food	Protein, cooked food, vegetables
7	Gifts	Organisation, leadership, achievement	Inspiration, amiability, caring and sharing
8	Life Lessons	Let go, delegate, relax, trust others	Be more responsible, finish the job, meet your commitments, trust yourself
9	Familial preference	Father and brothers (males)	Mothers and sisters (females)

2. Literature Assessment:

The study of the relationship between the left and right hemisphere of the brain was initiated by Nobel Prize winner Dr. Roger W. Sperry [7, 32]. A radical type of brain surgery was conducted by the neurosurgeons, they were treating the patients of uncontrollable “Epileptic Seizures” in the late 1950s and 1960s. The surgeons completely separated the two half of the brain by cutting the corpus callosum. No change was observed in the patients personal or daily life functions and intelligence but they addressed the problem of oddities and curiosities like having difficulty to associate the name with the face, memory difficulty, not having dreams. This report has developed a tremendous interest in brain research. It was analyzed that the patients who were not having dreams where addressed as one side of the brain are responsible for dreams and other for recording, it was due to the separation of the two sides by doctor hence the information was not shared [2].

To study the differences and functions of the two hemispheres Roger Sperry performed experiment on cats, monkeys and humans in in the period of 1950’s and 1960’s. Sperry revealed that left hemisphere of the brain controls the articulation and understanding of languages whereas right hemisphere can recognize words but cannot articulate them. The experiment performed by Sperry was repeated by many researchers for finding the functions of lateralization and brain patterns [41]. The main route of communication between the two hemispheres is corpus callosum. According to human anatomy visual inputs are received by the right hemisphere by left visual field along with controlling the left hand and vice versa. The severing (dividing through cutting or else slicing) of corpus callosum splits visual perception of hemispheres but it don not creates two self-regulating conscious perceivers in one mind [42]. A specific effect of the severing of corpus callosum was observed on memory, control and attention. The effect that was observed is detailed below [43].

2.1.Memory: the subject is confused between the previous knowledge he have and what he has concluded form evidence. Only explicit memory is effected by anterograde amnesia. The hippocampus is being damaged. Forebrain commissures are significant for the formation of some kind of memories.







2.2.Control: the subjects are coordinated, purposeful and consistent in manner whereas the despite conflict in behavior occasionally. The intermural and compensatory phenomena are effected. The competing






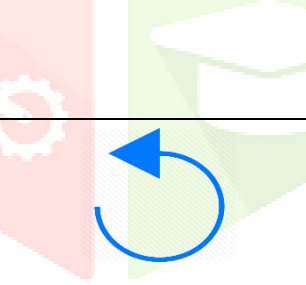
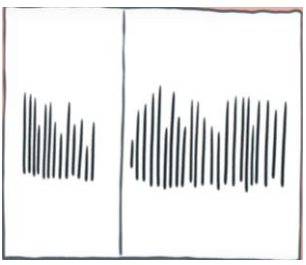
phenomena are received by both the hemispheres at the same time and the behavior is determined by the response mode. There is a possibility of having two different consciousness one on each hemisphere.

2.3.Attention: More attention is paid to landmarks and scenes by the right hemisphere and left hemisphere pay attention to exemplars of categories. The mental rotation is superior by right hemisphere while left hemisphere superiors image generation. The right hemisphere is superior to left hemisphere on modified versions of spatial relation tests and in location testing whereas left hemisphere is superior in object-based. It proves the presence of two different attention systems in the two lobes.

Every individual make more use of either one of the two sides which is usually known as Dominance. This dominance keeps on changing throughout the life of an individual's life where the pattern is determined in childhood. It is essential to understand that brain dominance is an asset which is flexible as well as changeable. However, the performance of the predominant hemispheres changes slowly, roughly talking it takes around 9 months for completing a switch from one side to another side and we can switch easily in a fraction of second. The eyes and other signs of body point to the switching patterns of hemispheres such as the folding of arms in different ways as right over the left or left over the right. The change in the position of the folding of the hand indicates how comfortable the individual was with the first position. Table 3 below presents some of the physical signs through which the dominance of the individual can be analyzed [3, 4].

Table 3: Physical body signs representing the dominance of the Individual

Sr. No.	Body Part	Image/Position	Feature Parameter	Effect In Right Hemisphere	Effect In Left Hemisphere
1. (a)	Iris		Many or Larger brown dots (jewels)	More jewels in left eye indicate more activity in Right Hemisphere	More jewels in right eye indicate more activity in Left Hemisphere
1. (b)	Iris		Many or Larger fibre petals (flowers)	More flowers i.e. fibre petals in left eye indicate more activity in Right Hemisphere	More flowers in right eye indicate more activity in Left Hemisphere
2.	Eye		Winking or eye	If you wink with left eye then more activity in Right Hemisphere	If you wink with right eye then more activity in Left Hemisphere
3.	Hand		Position of placing thumb	The thumb of left hand at the top indicate more activity in Right Hemisphere	The thumb of right hand at the top indicate more activity in Left Hemisphere
4.	Hand		Hand at top	The left hand is at top it indicate more activity in Right Hemisphere	The right hand is at top it indicate more activity in Left Hemisphere
5.	Hand		While clapping the hand at top	The left hand is at top it indicate more activity in Right Hemisphere	The right hand is at top it indicate more activity in Left Hemisphere
6.	Leg		Putting cross legs while sitting	The position of left leg at the top indicate more activity in Right Hemisphere	The position of right leg at the top indicate more activity in Left Hemisphere

					
7.	Thumb		Nail of thumbs having more directed moon (higher & narrower)	Higher moon in left thumb indicate more activity in Right Hemisphere	Higher moon in left thumb indicate more activity in Right Hemisphere
8	Leg		One leg on which you prefer to stand on	If you are standing on left leg then more activity in Right Hemisphere	If you are standing on right leg then more activity in Left Hemisphere
9	Body		Usually while sleeping in bed which side your partner is lying on	If you lie on the left side (facing up) it suggests Right Hemisphere	If you lie on the right side (facing up) it suggests Left Hemisphere
10	Eye		Creating a triangle having opening between forefingers and thumb centring an object with both eye open	By closing the left eye if the object remain at centre then your right eye is dominant eye	By closing the right eye if the object remain at centre then your left eye is dominant eye
11	Rotation		Rotation of the person or draw a directed circle on the paper	Clock wise rotation top indicate more activity in Right Hemisphere	Counter-Clock wise rotation top indicate more activity in Left Hemisphere
12	Hand		Draw a line dividing the page into two section and the draw lines on each part with both the hands at the same time and then count the lines	If you wrote more with your left hand then you are more activity with Right Hemisphere	If you wrote more with your right hand then you are more activity with Left Hemisphere

Dominance presents the relationship between the power at the left and right hemisphere of any homologous location of the cortex [34]. The activity of human brain is represented with the different form of waves through EEG after collecting the electrochemical current from scalp on which the electrodes are placed. EEG is a non-invasive technique i.e. that is no surgical operation is required due to which risk and cost factors are reduced.

Different frequency and amplitude can be found in different people with different age group. The brain waves rhythms are of five types as Alpha, Beta, Delta, Theta and Gamma [1, 35]. Different waves represents different mental states of the subjects [38] and are responsible for different responsibilities [1].

Different experiments were carried out with the help of EEG to find out the effect of dominance. Cerebral lateralization of cognitive processing for emotional processes was carried. The reduced levels of alpha activity occurs during period of behavioral arousal or active task engagement. As compared to left hemisphere, right hemisphere is more involved in emotional processes [36]. Emotions can be recognized with two strategies as Bottom-up (external stimuli) and Top-Down (Internal representation). The gamma frequencies plays important role in “Memory” and “Attention”. These gamma activity serves as a mechanism of gain control. The cognitive control is represented by gamma waves during the detection of emotional expression [37]. The alpha activity is a human brain dominant oscillatory activity that is associated with cognitive functions as attention or memory and divergent thinking which is complex cognitive processing [40].

The dominance shifts the stimulus increase is importance in the subjects mind or it can be said that the dominance changes as the growth or activity increases in subjects mind. The relationship between EEG and memory was attempted to find and was observed that an increase in alpha blocking and beta activity during learning of a list of nonsense syllabus. The dominance was calculated by Right – Left, were low values represents strong activity at any location. Left hemisphere processing shows effortful intentional attention and Right hemisphere processing is less analytic [34].

The higher frequency of beta are more sensitive to the task of hemispheric demands were as the middle frequencies such as low beta and alpha are sensitive to attention in parietal area of brain [39].

Nowadays the researchers are getting more engrossed towards finding the relationship between the different functions of the brain and their effect on the achievements in different fields. The researchers carried out the study by following the steps shown in figure 2 below [13].



Figure 2: Flow for conducting a study on Brain Dominance

2.4. Research Sample:

A Sample is a small collection of units form a population that is for determining the truths about the population whereas the purpose of Sampling is selecting a number of individuals for a study in such a way that the individual represents a large group from which they were selected. The purpose of sampling the data is to gather the data about the population in order to make an inference that can be generalized to population or to identify the participants from whom to seek the information. The major issues faced during sampling are nature of the sample, size of the sample and method of selecting a sample. The three fundamental steps for sampling are the identification of population, defining the size of the sample and selecting the sample.

A. Sample Size:

The size of the sample depends on many factors and researcher devise to provide the statistical information before they can get the answer. The information such as standard deviation, population size, etc. for determining the size of data. According to the rule of thumb for determining the size of the sample, the size of the sample larger than

30 and less than 500 are appropriate for many research. The minimum size of the sample has to be of 30% of the Population.

B. Sampling Techniques:

A sampling technique is a name or another identification of the specific process by means of which the entities of the sample have been selected. There are four techniques for sampling [56-57] and are detailed below:

I. Random Sampling Technique

The random sampling technique allows the selection of subjects in such a way that all the members of the population have an equal and independent chance of getting selected. The researchers have made use of this technique due to different style of the selection of process [11, 13]. The selection process in this technique follows the following rules.

- Identifies and defines the population
- It determines the desired size of the sample
- Lists all the members of the population
- Assign consecutive numbers to all the members in the list
- An arbitrary starting point is selected from the table of random numbers and reads appropriate numbers of digits.

Advantages:

- Easy to conduct
- Great probability of obtaining a representative sample
- Meets assumptions of several statistical procedures

Disadvantages:

- Identification of all members of the population might be difficult
- Contacting all members of the sample can be difficult

II. Stratified Random Technique

The stratified random technique divides the population into two or more groups called strata according to some criteria as grade level, age, income, and subsamples are randomly selected from each stratum. The selection process is made through the following strategies [56].

- Identifies and defines the population
- It determines the desired size of the sample
- It identifies the strata (variables and subgroups) for which you want to guarantee appropriate representation.
- It classifies all the members of the population as a member of one of the identified subgroup.

Advantages:

- The samples are more accurate
- It can be used for both proportional and non-proportional samples
- It provides the representation of subgroups in the sample

Disadvantages:

- Identification of all members of the population might be difficult
- Identification the members of all subgroups can be difficult

III. Cluster Sampling Technique

A cluster is a location within which an intact group of members of the population can be found such as schools, classroom, etc. The cluster sampling technique is a process that randomly selects intact groups, not the individuals within the defined population that shares similar characteristics. The selection process of this technique is illustrated below [56].

- Identifies and defines the population
- It determines the desired size of the sample
- It identifies and defines a logical cluster
- It lists all the clusters that make up the population of the clusters
- It estimates the average number of population members per cluster
- It determines the number of clusters needed by dividing the sample size by the estimated size of clusters
- It randomly selects the number of needed clusters
- It includes all the individual in the study in each selected cluster

Advantages:

- It is very useful with a large population and spreads over a large geographic population.
- Convenient and expedient
- Do not need the names of everyone in the population

Disadvantages:

- Representation is likely to become an issue

IV. Systematic Sampling Technique

In systematic sampling technique, every K^{th} subject from the list of the members of the population is selected. The following points describe the selection process for this technique [56].

- Identifies and defines the population
- It determines the desired size of the sample
- It obtains the list of population
- Determines what K is equal to by dividing the size of the population by the desired sample size
- In the population, list starts at some random place
- Takes every K^{th} individual on the list

Advantages:

- Very easily done

Disadvantages:

- Subgroups
- Some members of the population don't have an equal chance of being included.

C. Study Design

The design of the study defines the type of study (that is Descriptive, Correlational, Semi-experimental, Experimental, Review and, Meta-analytic) and sub-types, research problems, dependent and independent variables, experimental designs, hypotheses. The study design or research design is a framework which is created for finding the answers o research question. There are different types of study designs among which Normal Survey [5], Randomized Control Design [11], Cross-Sectional Study [12, 19], Descriptive-Correlational Method

[13, 21], Descriptive Study [14] and Survey Model [20] were mostly used according to the data. Among which the most used study designs are

I. Cross-Sectional Study Design

The Cross-Section study design is a kind of observational study design. In such observational studies, the investigators do not alter the exposure status. The outcomes and exposure(s) in the population are measured by the investigators and can also study the associations. The drawback while working with this design is that it is a 1-time measurement of exposure and outcome due to which it becomes difficult to derive causal relationships from the cross-sectional analysis. This design can be used for public health monitoring and planning [33].

II. Descriptive-Correlational Study Design

A descriptive correlational study is a study in which the investigator is first and foremost interested in unfolding relationships among variables, without seeking to establish a causal connection.

2.5. Research Tools and Techniques

The tools and techniques are one of the most important parts of the study. Following are the various tools and techniques used by the researchers for studying the effect of brain dominance.

A. Data Collection Tools:

While analyzing the dominance effect on students of different age group and the area it was seen that many different tools were used for acquiring the information. The tools used were the Style of Learning and Thinking (SOLAT) [5, 18], Herrmann Brain Dominance Instrument (HBDI) [6, 11, 13], Questioner with 2 options as “Yes” and “No” need to select “one” (10 Question for students and 20 Question for Teachers) [7], Open Hemisphere Brain Dominance Scale [8, 21, 22, 27], Raven’s Progressive Matrices test [8], Self-Concept Scale [9], Study Habit Inventory [10], Listening achievement test for English [11], NEO Personality Inventory (NEO PI) [13], Raven Intelligence Test and Boxing Cognitive Test [8], Achievement test in Mathematics (Developed by the Investigator) [18], Kolb Learning Style Inventory (LSI) [13, 20, 23, 28], Home Environment Inventory [22], Brain Dominance Questionnaire and Perceptual Learning Style Scale [29], Hemispheric Mode Indicator (HMI) [30], and Video, Audio, and Kinaesthetic (VAK Inventory) [31]. The mostly used some test or questionnaire are detailed below:

I. Herrmann Brain Dominance Instrument (HBDI)

William “Ned” Hermann is considered as the father of the brain dominance technology. This model is also referred to as “Whole Brain Model” or “Herrmann Brain Dominance Inventory”. It is a psychometric assessment which shows how one prefers to think. This model alights the fact that every individual is different and hence the way of thinking is also in a different way. Ned further divided the brain into four quadrants as Analytical, Practical, Relational and Experimental. Each of these parts is represented by a different colour based on their functioning as in figure3. Each quadrant has its own characteristics and due to different functions, it is represented with different colour which can be grasped in table 4 below [45].

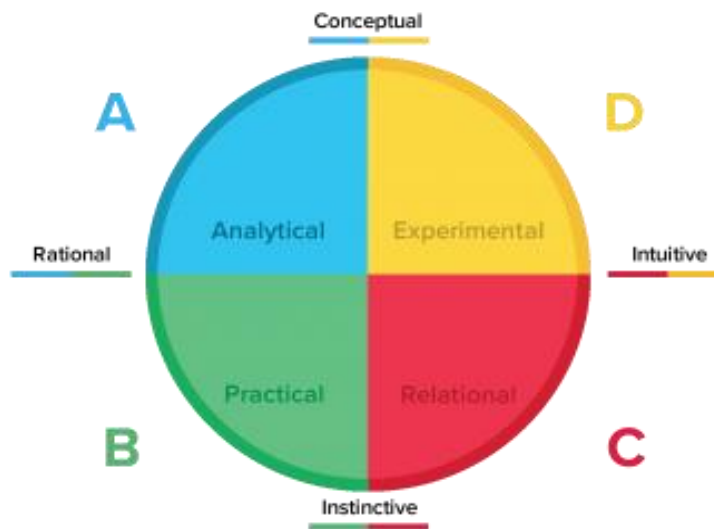


Figure 3: Herrmann Brain Dominance Instrument (HBDI)

Table 4: Functions and Characteristics of HBDI

Quadrant	Quadrant Name	Colour	Characteristic	Colour Represents	Profession
A	Analytical	Blue	Logical, Technical and Financial	Fact, Details and Computing	Engineering
B	Practical	Green	Organized, Detailed and Structured	Form, Planning and Groundedness	Project Manager
C	Relational	Red	Emotional, Sensory and People	Feeling and Emotions	Teacher/ Nurse
D	Experimental	Yellow	Risk taker, Intuitive and Big Picture	Future and Creative Thinking	Entrepreneur

This method consists of 120 questions survey in a profile of preferred thinking preference which helps in making a better decision, solve problems, improve communication, appreciate others, engagement or handling audience in better way, provide feedback, innovation skills, and make a lasting impression [46].

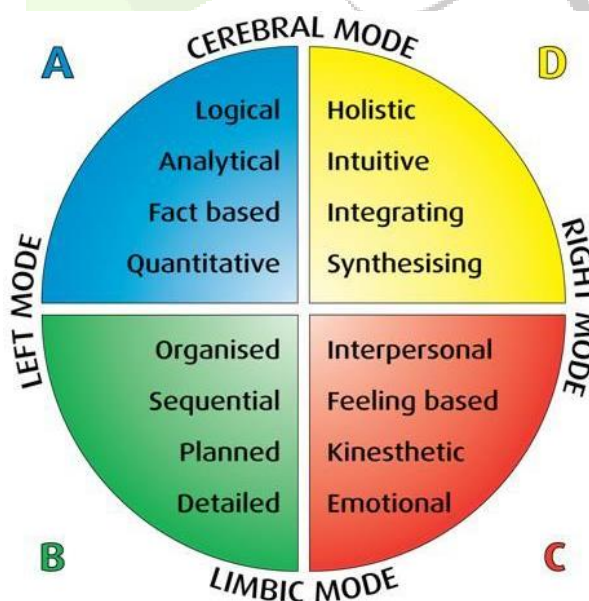


Figure 4: The Whole Brain Model

The figure 4 above illustrates “The Whole Brain Model” with different model thinking process. Along with the preference profile and score the model provides stress profile, which is an extension preference profile. The score obtained from stress profile is used for showing the individual about its preference style while dealing with significant stress [47].

II. Open Hemisphere Brain Dominance Scale

The idea that an individual has a preference to one hemisphere becomes popular in 1970 as the idea of the handedness of an individual. This idea was promoted a lot as an education tool such that individual with different hemisphere learn in a different way and hence teaching should be tailored to the preference. This test was developed to obtain a free and open source measurement of Left Brain and Right Brain personality distinction. This test was developed by selecting the items based on having the correlation with five diverse order scale purported for measuring the construct as the Alert Scale of Cognitive Style, the Wagner Preference Inventory, Philip Carter's test, Madeline Turgeon's questionnaire, and the Polarity Questionnaire can be viewed in table 5 below.

Table 5: Items based on correlation with five diverse order scale

Test	Developed By	Item	Scale	Scale Referred As
Alert Scale of Cognitive Style	Loren D. Crane	20	forced choice scale	Crane scale
Wagner Preference Inventory	Rudolph Wagner and Kelly Wells	12	multiple choice scale	Wagner scale
Polarity Questionnaire	Bruce Eldine Morton	11	true false scale	Morton scale
Philip Carter's test	Philip Carter	40	select 20 adjective check	Carter scale
Madeline Turgeon's questionnaire	Madeleine Turgeon	45	forced choice inventory	Turgeon scale

This collection of data was done through a beta version right brain or left brain personality test. Where 40 personality items completed one reference scale for main section two forms with 80 items are there and the collection of data is made until items have at least 400 observations [44].

III. The Kolb Learning Style Inventory

This test was derived from experimental theory and form the model of learning which was developed by Kolb in the year 1984 and it is established on the contribution of John Dewey, Kurt Lewin, and Jean Piaget.

The most important part of communication is understanding between the field instructor and student related to learning style. Maximum teachers use their own learning style for teaching whereas students may have a different style. The Learning Style Inventory can help both field instructor and student to avoid the misunderstanding and get aware of their own learning style.

The Learning Style Inventory is a practical self-assessment instrument which helps to make use of the unique learning style, with the benefit that it takes only 30-45 minute for completing. Along with learning style, it also tells about our preferred approach of learning in everyday life. This model views learning as a continually recurring-problem solving process and is broken down into four stage cycle as

- I. Concrete Experience (CE)
- II. Reflective Observation (RO)
- III. Abstract Conceptualization (AC)
- IV. Active Experimentation (AE)

The four Learning styles of Kolb is Diverging (feeling and watching - CE/RO), Assimilating (watching and thinking - AC/RO), Converging (doing and thinking - AC/AE) and Accommodating (doing and feeling - CE/AE) [48].

IV. Perceptual Learning-Style Preference

The individuals learn through many different ways such as if the make of their eyes is visual learning, through ears then auditory learning if they prefer experience or hands-on then kinesthetic or tactile learners whereas some individuals learn better while working alone where some in groups [49]. This Perceptual Learning-Style Preference model shows which way the individual prefers to learn even it shows that how the students learn the material in a number of situations. Some of the characteristics of the learner are Visual, Auditory, Kinesthetic, Tactile, Group, Individual, Minor, and Negligible [50, 55].

B. Statistical Techniques:

To obtain a certain conclusion of the study statistical analysis is very essential. This analysis is done after acquiring the information. The same step is used for analyzing the effect of the dominance on the achievements in different fields. For this purpose various statistical techniques were adopted among which these are widely used such as Descriptive Analysis [1], Difference Analysis [1], Relational Analysis [1], Regression Analysis [1], Chi Square-Test [8-10,18], Correlation analysis [9-10,14-15,18,21], ANOVA analysis [9-10], Frequency [11-12,20], Arithmetic mean [11-12,20] Standard Deviation [11-12], Percentage [11-12,14,20] T-test [11-12], Single-factor covariance analysis [11], Range [11-12], Bivariate analysis [12], Correlation Coefficient [29], etc. Among all these techniques most widely used techniques are:

- **Chi Square-Test:** The Chi-Square statistic is generally used for testing the relationships between categorical variables. The null hypothesis of the test is that no relationship exists on the categorical variables in the population and they are independent [51].
- **Correlation Analysis:** The Correlation analysis is a bivariate analysis that measures the strength of association between the two variables and the direction of the relationship.
- **ANOVA Analysis:** Analysis of Variance (ANOVA) is a parametric statistical technique that is used to compare datasets. ANOVA is best applicable where more than two populations or samples are meant to be compared.
- **Frequency:** The frequency of an event is the number of times the event has occurred in the experiment or the study. The frequency is generally represented through a histogram in a graphical fashion.
- **Arithmetic Mean:** The arithmetic mean, also known as the average or average value, is the quantity that is obtained by summing the two or more numbers or variables and then dividing them by the number of numbers or variables.
- **Standard Deviation:** The Standard Deviation is a measure of knowing how the numbers are spread out.
- **Percentage:** A percentage is a number or ratio that represents a fraction of 100. It is frequently denoted by the symbol "%" or basically as "percent" or "pct."

2.6.Research Results:

The research results is the last step where the analysis of the data is made and on the base, this analysis the results or conclusions of the study are obtained.

A. Data Analysis:

The software's widely uses for analyzing the data is Microsoft Excel [7], and SPSS [13-15, 21] Statistical software.

I. Microsoft Excel

The Microsoft Excel is a spreadsheet which is developed by Microsoft for Windows, macOS, Android, and iOS. It provides features as calculation, graphing tools, pivot tables, and a macro programming language known as Visual Basic for Applications. It has been a very widely applied spreadsheet for these platforms. Excel forms part of the Microsoft Office suite of software.

II. SPSS

Statistical Package for the Social Sciences (SPSS) is short for Statistical Package for the Social Sciences, and it is also used by various kinds of researchers for dealing with complex statistical data analysis. The SPSS software package was created for the management and statistical analysis of social science data. It was originally launched in 1968 by SPSS Inc., and was later acquired by IBM in 2009.

B. Consequence of Study:

Depending upon the results obtained from data analysis the conclusion of the study is concluded.

3. Need and Significance of the study

The present generation students are stressed due to the burden of academics and parental pressure. Less attention is given to the preference of students for selection of their higher studies. While the students are forced to do the work as per the parent's preference this decision may lead to creating problems in the performance of students. According to this, it is concluded that parents and teachers need to understand the Brain Dominance of the student and helping them in selecting the appropriate career for the student.

Students are found different for each other and amongst themselves with various dimensions and way. This difference of individual is prejudiced by mental, emotional physical, interests, attitude, beliefs, achievements, aptitude, learning and so on. An important factor is the brain processing that can influence the academic performance and achievements of the students. This has led to finding out the relationship between academic achievements and brain dominance [14, 58].

4. Benefit of knowing the Dominant hemisphere

- It helps to understand the strength of the individual.
- A career can be selected on the bases of dominance for better performance.
- It teachers are also aware of their own dominance it helps them improve the teaching style and influence students in their academic achievements.
- Help in making appropriate decisions.
- Appreciate others through greater understanding own and others thinking preferences.
- It help in better decision making i.e. even consider others perspectives.
- It helps in effective communication as they can present their present their views in such a way that it could be easily understood.
- Better engagement of audience by considering their needs and expectation in a better way.
- Fruitful feedback is obtained through clear delivery.
- Problem solving is enhanced by taking wider implementation and solutions in considerations.
- Innovation can be improved by increasing the place of idea generation, validation and execution.
- Interpersonal and communication effectiveness is enhanced.
- At individual, team and organizational levels the productivity is enhanced.
- Work climates can be build.
- Jobs that open the door for creativity and productivity can be designed.
- Trust and authenticity can be developed.

- Effective teaching can be provided.
- Learning and development is enhanced.
- Fascinates better management.
- Better leadership.
- Counseling can be provided for educational and occupational purpose.
- It can be found that weather the subject or individual is facing problem with study and academics or emotion and creativity.

5. Conclusion

The two hemispheres of the brain serves the body in various ways. There are numerous physical body signs and positions through which the dominance of the person can be identified. The knowing of dominance can help the individual to improve his/her performance and for which many questionnaires is available. According to the need, any of sampling techniques can be used and after applying statistical techniques data can be analyzed for the evaluation of the results. This can help to analyze the effect of dominance in different sectors. This paper attempts to present overview along with the advances achieved in the field of brain research. Understanding the dominance factor can assist individual to understand the learning abilities etc.

6. References

- [1] Priyanka Abahang, Bharti Gawali, S. C. Mehrotra, "Introduction to EEG- and Speech-Based Emotion Recognition", Elsevier Academic Press, eBook ISBN: 9780128045312, paperback ISBN: 9780128044902, March 2016.
- [2] US Army Cadet Command - FT. Monroe, Virginia, "Foundations for Success & Wellness, Fitness, and First Aid", Chapter 5: Left-Brain/Right-Brain.
- [3] Brain Hemisphere Utilisation and orientation, Referred on 21/01/2019 at 4:54 pm <https://middlepath.com.au/eyesite/hemsphr.php>
- [4] Gary Heiting, OD, "Dominant Eye Test: How To Find Your Dominant Eye", Referred on 22/01/2019 at 11:11 am, <https://www.allaboutvision.com/resources/dominant-eye-test.htm>
- [5] K. Ilayaperumal and Dr .V.Ambedkar, "Learning and Thinking Style in Relation Academic Achievement among 11th Standard Students in Puducherry", International Multidisciplinary e-Journal, Vol-III, Issue-I, pp. 9102-9107, Jan -2014.
- [6] E. Horak and J. W. du Toit, "A study of thinking style and Academic Performance of Civil Engineering Students", Journal of the South African Institution of Civil Engineering, pp. 18-24, 2002.
- [7] Merve Oflaz, "The Effect of Right and Left Brain Dominance in Language Learning", Elsevier Procedia Social and Behavioral Sciences, pp. 1507–1513, 2011.
- [8] Mr. Abdulwahab Musa Sari and Dr. V. B. Verma, "A Research Related To Brain Dominance and Intelligence Among Students Living in Different Sociocultural Environment", International Education Scientific Research Journal, Vol. 3, Issue 6, pp. 132-135.
- [9] Parvinder Singh, "Interaction effect of Brain Hemispheric Dominance and Self-Concept on Academic Achievement in Mathematics", International Journal of Engineering and Science, Vol.5, Issue 9, PP. 27-32, September 2015.
- [10] Parvinder Singh, "Interaction effect of brain hemispheric dominance and study habits on academic achievement in mathematics", International Journal of Applied Research, pp. 746-750, 2015.
- [11] İzzettin Kök, "Listening Comprehension Achievement and Brain Dominance", Elsevier Procedia - Social and Behavioral Sciences, pp. 329 – 334, 2014.

- [12] Tan Sing Keat, Viknesh Kumar, Muhammad Shakir B. Rushdi, Norhayatul Akmal Bt. Nazri and Lee Zi Xuan, "The Relationship between Brain Dominance and Academic Performance: A Cross-sectional Study", *British Journal of Medicine & Medical Research*, vol. 13, Issue 6, pp. 1-9, 2016.
- [13] Mohammad Reza Nazemi, Hassan Toozandehjani and Hassan Toozandehjani, "Investigating the relationship between learning styles with brain quadrants dominance and personality traits of male and female students", *International Journal of Pharmaceutical Research & Allied Sciences*, vol. 5, Issue. 2, pp. 446-450.
- [14] Nandhini M., "A Study On Brain Dominance And Academic Achievement Of Higher Secondary School Students In Chennai District", *Review Of Research Journal*, Vol. 7, Issue 1, October 2017.
- [15] Hui-Suan Wei, Tajularipin Sulaiman, Roselan Baki, and Samsilah Roslan, "The Relationship between Brain Dominance and Japanese Language Academic Achievement", *International Research Journal of Education and Sciences*, Vol. 1, Issue 2, pp. 48-51, 2017.
- [16] Nessim Hanna John Wagle A.H. Kizilbash, "Brain Dominance And The Interpretation Of Advertising Messages", *International Journal of Commerce and Management*, Vol. 9, Issue No. 3/4 pp. 19 – 32, 13 February 2015
- [17] Terence Hines, "Left Brain/Right Brain Mythology and Implications for Management and Training", *The Academy of Management Review* Vol. 12, No. 4, 600-606, 13 Jun 2014.
- [18] Michael L. Rothschild Yong J. Hyun, "Predicting Memory for Components of TV Commercials from EEG", *Journal of Consumer Research*, Vol. 16, March 6, 2016.
- [19] Rosihan M. Ali and Liew Kee Kor, "Association between Brain Hemisphericity, Learning Styles and Confidence in Using Graphics Calculator for Mathematics", *Eurasia Journal of Mathematics, Science & Technology Education*, 27 December 2006.
- [20] Kemal Ozgena, Berna Tataroglua and Huseyin Alkan, "An examination of brain dominance and learning style of pre-service mathematics teachers", Elsevier, 2011.
- [21] Essmat A Mansour, Maha El-Araby, Isabelita N Pandaan and Essmat M Gemeay, "Hemispherical Brain Dominance and Academic Achivement among Nursing Students", *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320-1959.p- ISSN: 2320-1940 Volume 6, PP 32-36, May –June 2017.
- [22] Parvinder Singh, "Interaction Effect of Brain Hemispheric Dominance and Home Environment on Academic Achievement in Mathematics", *International Journal of Science and Brain (IJSR)*, Volume 4 Issue 11, November 2015.
- [23] Merva Oflaza, Turgut Turuncb, "The effect of learning styles on group work activities", Elsevier, 2012.
- [24] Michael C. Corballis, "Left Brain, Right Brain: Facts and Fantasises", *School of Psychology, PLOS Biology*, Vol. 12, Issue No. 1, pp. 1-6, Jan 2014.
- [25] Charles J Golden, Sandra S Alcapanas, Fred D Strider and Benjamin Graber, "Left Brain, Right Brain", *Brain of Neurology, Neurosurgery and Psychiatry*, September 1982.
- [26] Julie A. Daymut, M.A., CCC-SLP, "Right Brain vs. Left Brain – What's the Difference?", *National Institute of Neurological Disorders and Stroke*, 2007
- [27] Milind Bhandeo and Dr. Vivek Mishra, "Effect of left, right and integrated hemispheric dominance on performance of female gymnasts", *International Journal of Physical Education, Sports and Health*, 2016
- [28] Rosihan M. Ali and Liew Kee Kor, "Association between Brain Hemisphericity, Learning Style and Confidence in Using Graphics Calculator for Mathematics", *Eurasia Journal of Mathematics, Science and Technology Education*, 2007.
- [29] Dr. Indu, H, "Human Learning and Brain dominance", *Indian Journal Of Research*, Volume: 4, May 2015.
- [30] Jose Ruiz Rodriguez and Adela Fuste, "Individual differences in Hemisphericity: Assessment of "The Hemispheric Mode Indictor" (HMI)", 5th European Conference on Psychology Assessment, 1999.

- [31] V. B. Deshmukh, A. B. Kotil, S.R. Managalwede and D. H. Rao, "A Learning Style Classification Mechanism Using Brain Dominance And VAK Method In m-Learning Environment", Elsevier, 2014.
- [32] Dr. John Robert Dew, "Are You a Right-Brain or Left-Brain Thinker?" Quality Progress Magazine, pp. 91-93, April 1996.
- [33] Maninder Singh Setia, "Methodology Series Module 3: Cross-sectional Studies", Indian Journal of Dermatology, Vol. 61. Issue No. 3, pp. 261-264, May-Jun 2016.
- [34] Michael L. Rothschild Yong J. Hyun, "Predicting Memory for Components of TV Commercials from EEG", Journal of Consumer Research, Vol. 16, Issue 4, pp. 472-478, March 1990.
- [35] Prakriti Trivedi, and Dr. Neeraj Bhargava, "Effect of Left and Right Hemisphere of Brain in both Eye Open and Close state on Minimum Power Values and Frequency of Alpha Wave Activity", International Journal of Science, Engineering and Technology Research (IJSETR), Vol. 6, Issue 2, pp. 233-237, February 2017.
- [36] Geoffrey L. Ahernt and Gary E. Schwartz, "Differential Lateralization for Positive and Negative Emotion in the Human Brain: EEG Spectral Analysis", Elsevier -Neuropsychologia, Vol. 23, Issue 6, pp. 145-755, 1985.
- [37] Yingying Tang, Yingjie Li, Jijun Wang, Shanbao Tong, Hui Li, and Jing Yan, "Induced gamma activity in EEG represents cognitive control during detecting emotional expressions", Conf Proc IEEE Eng Med Biol Soc., pp. 1717-20, August 2011.
- [38] Prakriti Trivedi and Dr. Neeraj Bhargava, "Comparing Alpha Wave Activity of Left and Right Hemisphere of Brain recorded using EEGlab", International Journal of Science, Engineering and Technology Research (IJSETR), Vol. 6, Issue 1, pp. 170-174, January 2017
- [39] William J. Ray and Harry W. Cole, "EEG Activity during Cognitive Processing: Influence of Attentional Factors", Elsevier-International Journal of Psychophysiology, Vol. 3, Issue 1, pp. 43-48, April 1985.
- [40] Benedek M, Schickel RJ, Jauk E, Fink A, and Neubauer AC, "Alpha power increases in right parietal cortex reflects focused internal attention", Neuropsychologia, Vol. 56, pp. 393-400, April 2014.
- [41] Dina A. Lienhard, "Roger Sperry's Split Brain Experiments (1959-1968)", The Embryo Project Encyclopedia, pp. 1-5, December 2017.
- [42] Yair Pinto, David A. Neville, Marte Otten, Paul M. Corballis, Victor A. F. Lamme, Edward H. F de Haan, Nicoletta Foschi and Mara Fabri, "Split brain: divided perception but undivided consciousness", Brain, Vol. 140, Issue 5, pp. 1-7, January 2017.
- [43] Divya Agrawal, Biswa Bhusan Mohanty, Sanjay Kumar, and Prafulla Kumar Chinara, "Split brain syndrome: One brain but two conscious minds?", Journal of Health Research and Reviews, Vol. 1, Issue 2, pp. 27-33, January 2014.
- [44] Eric Jorgenson, "Open Hemispheric Brain Dominance Scale 1.0", April 2015.
- [45] Darren A. Smith "The Ultimate Guide to HBDI® - Herrmann Brain Dominance Instrument", Learning to Learn Tips, May 2016.
- [46] Competency Framework HBDI - Herrmann Brain Dominance Instrument, www.makingbusinessmatter.co.uk.
- [47] Introduction to the HBDI® and the Whole Brain® Model Technical Overview & Validity Evidence Update 2016.
- [48] Kolb D., "The Learning Style Inventory", Experiential learning: Experience as the source of learning and development, Englewood Cliffs, 1984.
- [49] J. A. Beatrice, "Learning Style Inventory", Adopted from Learning to Study Through Critical Thinking.
- [50] Joy Reid, "Perceptual Learning Style Preference Questionnaire", Explanation of learning styles was adopted from the C. I. T. E. Learning Style Instrument, Murdoch Teacher Center, Wichita, Kansas 67208.
- [51] Antony Ugoni and Bruce F. Walker, "The Chi Square Test", Comsig Review, Vol. 4, Issue 3, pp. 61-64, November 1995.
- [52] Robert Zenhausern and Leslie Nicel, "Hemispheric Dominance and Maze Learning", Bulletin of the Psychonomic Society, Vol. 14, Issue no. 6, pp. 435-436, 1979.
- [53] Chapter 4 Methodology by Shodhganga.
- [54] Left Brain vs. Right Brain Dominance: The Surprising /truth Understanding the Myth of Left and Right Brain Dominance, Referred on 04/09/2019 at 4:41 pm

<https://steemit.com/knowledge/@shaktirajawat/left-brain-vs-right-brain-dominance-the-suprising-truth-understanding-the-myth-of-left-and-right-brain-dominance>

- [55] Steven D. Bielefeldt, “An Analysis of Right-And-Left-Brain Thinkers and Certain Styles of Learning”, American Psychological Association, 5th edition, pp. 1-29, May 2006.
- [56] Creswell, J., W., “Educational research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research”, Pearson 4th ed., 2012.
- [57] Patton, M.Q., “Qualitative Research and Evaluation Methods”, Thousand Oaks, CA: Sage, 4th ed., 2002.
- [58] Manashakti Research Center, “Brain Temperatures and Temperaments/Difficult Subjects”.

