

## Cognition in relation with hand dominance

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### ABSTRACT

This was an experimental study done to determine the effect of hand dominance on cognition. 60 female subjects between the age group of 18-25 years from SBSPGI were selected through convenient sampling by using inclusion and exclusion criteria. Subjects were divided in two groups- group A (Right handed individual) and group-B (Left handed individuals). Both the groups were assessed for their cognitive functions i.e. attention, memory and learning using trail making test, modified MMSE and VAK learning questionnaire. Data was analysed using independent t test and descriptive statistics. CONCLUSION: Left handers were found to be better in performing memory and attention tasks as compared to right handers. Majority of left handers were found to have auditory learning style and majority of right handers were found to have visual learning styles.

### INTRODUCTION

Cognitive processes are generally defined as the abilities that enable us to "think" which includes the ability to concentrate (pay attention), remember and learn. It is the method used by the central nervous system to process information and includes knowing, understanding and awareness. Assessment of cognition is the important component under physical examination of patient which includes assessment of memory, orientation and ability to assimilate and manipulate information. Because persons with cognitive deficit often cannot recognize their own impairments

Cognitive intervention is being increasingly used for the treatment of many neurological conditions like parkinsonian disease, traumatic head injury, and stroke. The cognitive component of cognitive intervention focuses on modification of individual thoughts and feelings, through examination of cognition that arises in response to stressors. Complete understanding of cognition is important for planning effective treatment in patients with brain damaged due to various neurological insults.<sup>31</sup> (Stroke, head injury) There are various factors which affect patient cognition like age, gender, pregnancy, handedness, systemic diseases like diabetes, hypertension etc. Naugels et al (1998) stated that left hand dominant individuals are more prevalent among the patients suffering from dementia of Alzheimer disease which begins prior to the age of 65 as compared to right hand dominant individuals. The premotor area of cerebral cortex is involved with the control of hand movements and it is larger in left side of right handed individuals than in the left handed individuals. Studies have found that the left hemisphere is important for language, logical

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decision making, in performing analytical task, mathematical calculation and performing fine motor skills. Each of the two cerebral hemisphere is responsible for specific functions that are not ordinarily performed by opposite hemisphere. The regional specialization is called as hemispheric lateralization.

Hand dominance has been a topic of investigation since so many years but the studies showing its influence over cognition are scarce. Thus, this study attempts to find out effect of hand dominance on cognition. The aim of the study is to found that is there any influence of hand dominance on cognitive components like learning, attention, memory.

## METHODOLOGY

**POPULATION:** 400 female subjects between the age group of 18-25 years I were selected through convenient sampling by using inclusion and exclusion criteria.

**SOURCE:** Subjects were taken from SBSPGI, Balawala, Dehradun

**SAMPLE:** 60 Subjects were subjects were selected for the study on the basis of inclusion and exclusion criteria.

**DESIGN:** This study was an experimental study with descriptive in nature. It was based on comparison of cognitive functions (learning, attention, memory) in right and left handed individuals who were given trail making test for assessing their attention and VAK (visual, auditory, kinesthetic) learning style questionnaire for assessing their learning style and modified MMSE (Modified Minimental status examination) for assessing their memory.

**PROCEDURE:** Subjects were divided in two groups- group A (right handed individual) and group-B (left handed individuals). Firstly attention of both groups were assessed by using trail making test and than memory of both groups were assessed by using modified MMSE scale and lastly learning style were assessed through VAK learning questionarie. Time for completing the attention task for group-A and group-B were noted. The

score and duration of completing memory task were noted and lastly learning style were noted on the basis of number of maximum option as a, b, c. The values of both groups were compared through independent sample t test and descriptive statistics.

**OUTCOME:** Duration for attention task using trail making test, score and duration for the memory task using modified MMSE and scores for the learning styles using VAK learning questionnaire.

## DATA ANALYSIS AND RESULT

An experimental design consisting of 60 subjects (females) of age group 18 to 25 years were allocated in two groups on the basis of their hand dominance for the study. Each group consists of 30 subjects. The values were collected through single task. The data was analyzed by using software SPSS version 11.00.

### COMPARISION OF COGNITIVE FUNCTIONS IN BOTH GROUPS

- Group-A(right handed)
- Group- B(left handed)

### COMPARISION OF ATTENTION TASK IN BOTH THE GROUPS VIA TRAIL MAKING TEST

- Results of trail making test part-a
- Results of trail making test part-b

## DISCUSSION

This study was an experimental study which was designed to find out the effect of hand dominance on cognition i.e. learning, attention and memory. Subjects were divided into two groups on the basis of their hand dominance i.e. group A for right handed individuals and group

**Table 1: Table showing mean and standard deviation of group-A and group-B for their trail making test part-a.**

Attention (Trail making test part-a)			
Groups	Mean And SD	unpaired t test	
		t value	p value
A(right handed)	46.2040±9.7201	4.867	0.001
B(left handed)	34.5630±8.7831		

Mean and SD for group-A (right handed) found to be (46.2040±9.7201) and for group-B is found to be (34.5630±8.7831) for trail making part-a

**Table 2: Table showing mean and standard deviation of group-A and group-B for their trail making test part-B**

Attention (Trail Making Part-B)			
Groups	Mean And SD	Unpaired t test	
		t value	p value
A(right handed)	91.86±27.89	3.173	0.002
B(Left Handed)	73.42±15.33		0.003

Mean and SD for group-A (right handed) found to be (91.86±27.89) and for group-B is found to be (73.42±15.33) for trail making part-b.

**Table 3: Table showing mean and standard deviation of group-A and group-B for their memory (scores)**

Memory-Score			
Groups	Mean And SD	Unpaired t Test	
		t Value	p value
A (Right Handed)	82.66±8.091	-3.926	0.001
B(Left Handed)	89.50±5.042		

Mean and SD for group-A (right handed) found to be(82.66±8.091)and for group-B is found to be(89.50±5.042) for trail making part-b.

**Table 4: Table showing mean and standard deviation of group-A and group-B for their memory (duration)**

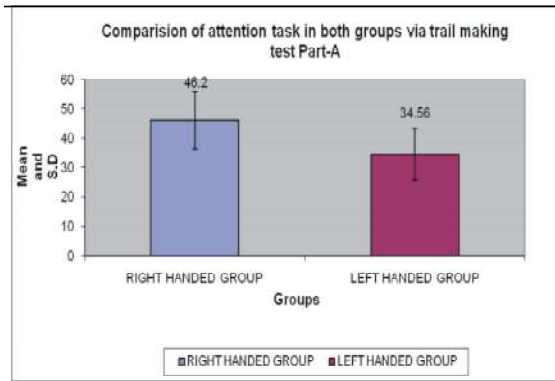
MEMORY-DURATION			
Groups	Mean and SD	Unpaired t test	
		t value	p value
A(RIGHT HANDED)	229.66±35.18	2.491	.016
B(LEFT HANDED)	208.66±30.78		

Mean and SD for group-A (right handed) found to be (229.66±35.18) and for group-B is found to be (208.66±30.78) for trail making part-b

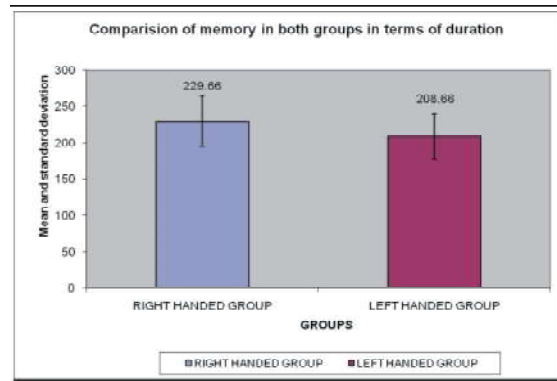
**Table 5: Table showing comparison of learning styles in both the groups**

Groups	Auditory	Visual	Kinesthetic
Group-A	73%	20%	6.7%
Group-B	36.7%	43.3%	20%

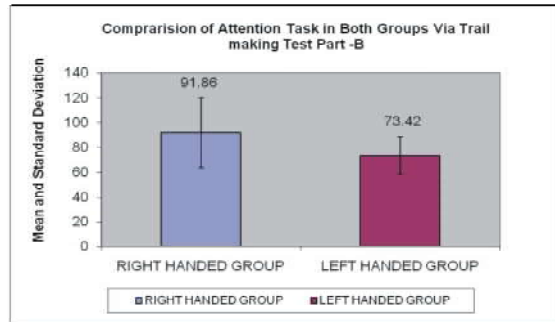
**Graph-1 Showing Mean and Standard Deviation of both groups through Trail Making Test Part-A**



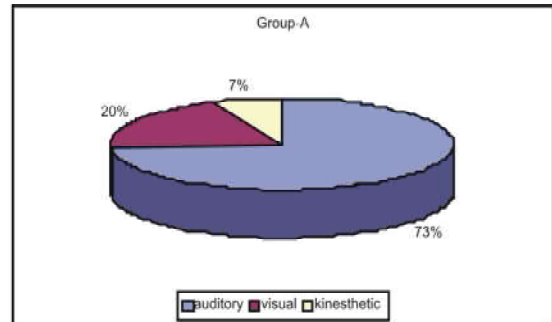
**Graph 4: Showing Mean and SD of Both Groups Through Modified Mmse (Duration)**



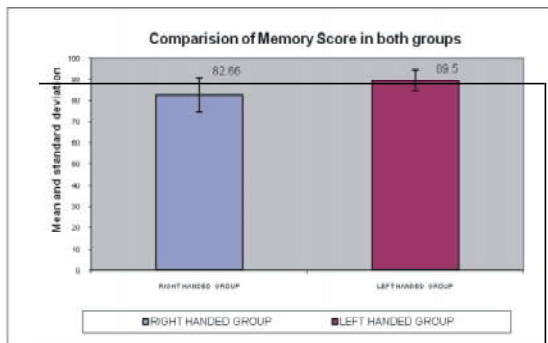
**Graph 2: Showing Mean and Standard Deviation Of Both Groups Through Trail Making Part-B**



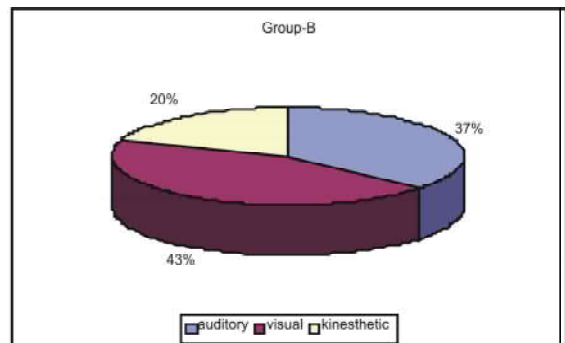
**Graph 5: Pie Diagramme Showing Learning Style Of Right Handed**



**Graph 3: Showing Mean and SD of Both Groups Through Modified Mmse (Scores)**



**Graph 6: Pie Diagrammed Showing Learning Style Of Right Handed**



B for left handed individuals. Both the groups were analyzed for their cognitive functions using trail making test for attention, modified MMSE for memory and VAK learning questionnaire for learning style. Data was analyzed using independent sample t test and descriptive statistics. For the ease of convenience, result of the study will be discussed as follows:

- Attention
- Memory
- Learning style

**Attention:** The results showed that left handed individuals took less time to complete the trail making test as compared to right handed individuals in our study. This finding can be explained by the study done by S F Witelson (1985) and Moffat SD Etal (1998). They stated in their study that corpus callosum, the main fiber tract connecting the two cerebral hemispheres, was larger by about 0.75 square centimeters, or 11 percent, in left-handed and ambidextrous people than in those with consistent right-handers which plays an important role in hemispheric integration. That may be one of the reasons that left handed individuals were found to be more attentive as compared to right handers.

**Memory:** Left handers scored more in memory scale and they took less time to complete the task as compared to right handers in our study. This is in agreement with the study done by JR. Minkel, Stephen D.Christmas and Ruth etal. In their review article, they stated that superior episodic memory is associated with interhemispheric processing which is stronger in left handed individuals. These findings were also supported by another study done by Arthur W Toga Who stated that the anatomical connectivity of the anterior temporal and inferior frontal lobe is thought to be more highly developed in left handed individuals.

**Learning styles:** Majority of right handed individuals were found to have auditory learning style and majority of left handed individuals were found to have visual learning style. The physiological reason for difference in their learning style may be because of differences in processing the information through right and left hemisphere

or in combination as told by Roshian M.Ali in the year 2006 They concluded in their study that learning styles were found to be associated with brain hemisphericity.

Thus in our study, we found that left handers were better in performing attention and memory tasks as compared to right handed individuals. This finding may be explained by the fact that broader and deeper connections exist between the two hemispheres of left handers as compared to right handers. We also found different learning styles in right and left handed individuals in our study.

On the basis of these results, it may be concluded that handedness has greater impact on cognition. So, it provides an important contributing tool for setting the treatment goal and plan out treatment of the patient.

## REFERENCES

1. Alexander etal "Hand dominance and motor unit firing behaviour" journal of neurophysiology, 1998; 1373-1382.
2. Arthur toga and Paula m.thompson etal "Mapping brain asymmetry" Journal of neurosciences, 2003; 4: 37-48.
3. Bradoms, Neurological rehabilitation. tenth edition publication, 2000; 7-8.
4. Carolyn unsworth" Cognitive and perceptual dysfunction "a clinical reasoning approach to evaluation and intervention, 1999; 3-8.
5. Corballis MC,Hattie J et al" Handedness and intellectual development" Journal of neuropsychologia, 2008; 46 (1): 374-378.
6. David S. Geldmacher, MD University of Virginia Department of neurology on women's health and ageing.
7. Doreen kimura etal," Motor function of left hemisphere", brain, 1974; 97: 337-350.
8. Eric R.kandel etal "The textbook of neural sciences" (fourth edition), 2000; 324 - 327.
9. Faraneh vargha etal (1985)" Aphasia and handedness in relation to hemispheric side, age at injury and severity of cerebral lesion during childhood" Department of neurology and neurosciences.

10. Ferrari, Michael "Genetic performance and left handedness comparative analysis in adults with seizures, physical, psychological and learning disorder in rehabilitation setting. Journal of rehabilitation, 2007.
11. Fredric H Martin (fundamental of anatomy and physiology) sixth edition-international edition chapter-14, 470-478.
12. Fearing MK, Browning CA et al "Dual task performance in right and left handed adult through finger and foot tapping study" journal of perceptual skills, 2001; 92 (2): 323-34.
13. Gerard j. Tortora, Principle of anatomy and physiology (tenth edition), 2002; 467-519.
14. Gentlucci M et al "right handers and left handers have different presentation of their own hand "journal of neuropsychologia", 2001.
15. Halperna, mark G. haviland et al in a "study of handedness and sex differences in intelligence: evidence from medical college admission test", 2002.
16. Hiscock m et al 'Asymmetry of verbal-manual interference: dissociation between rate and variability in left hand "journal of brain and cognition, 1995; 299 (3): 307-325.
17. J.J.fleminger et al "Age as a factor in handedness of adults" department of community medicine, neuropsychologia, 1977; 15: 471-473.
18. Judge J, Strling "fine motor performance in left and right handers: evidence an advantage in left handers" neuropsychologia, 2003; 8 (4): 297-306.
19. Laura spinney, "handedness develops in womb.", 2004.
20. Learning style and gender.htm, 2 Of 6.
21. Marzi CA(2007) et al in a study "Left hemisphere superiority for visuospatial functions in left handers". Behaviour and brain sciences, 1988; 30 (2): 183-92.
22. MacDonald et al in a study conducted "sex differences and cognition" Karolinska Institute, NVS, Aging Research Center, Gävlegatan 16, 8tr, S-11330 Stockholm, Sweden, 2007.
23. McManus & Reiss Tynnica et al "Laterality: Asymmetries of Body, Brain, and Cognition", 1999; 4 (3): 287-297.
24. McManus et al "left versus right handed": who is superior' (www. D:\arrnged\right vs. left\Left-handed versus right-handed who is superior - Anatomy - Helium - by Srikumaran Selvarajah.htm.
25. Miekae verfellie et al: hemispheric asymmetries in attention control, Aug 2004.
26. Marian Annett et al, Handedness and cerebral dominance", department of psychology, July 24, 1998.
27. Naugle RI, Cullum Ci et al "handedness and dementia" school of medicine, university of California, and Diego.
28. Obrzut JE et al "verbal and nonverbal auditory processing among left handed and right handed good readers and reading disabled children, 1989.
29. Norman Geschwind and Peter Behan: "Left handedness; association with immune disease, migraine and developmental learning disorder." Proc. natl acad. sci. USA, 1982; 79: 5097-5100.
30. Paolo Vivian, Daniela Perani, Franco Grassi, Valetino Bettinardi, Ferruccio Fazio hemispheric asymmetries and bimanual asynchrony in left and right hander, Experimental brain research, 1998; 120: 531-53.
31. Peter M Durning BM, Footedness of left and right handers, American journal of psychol, 1979; 92 (1): 133-42.
32. Randall L. Braddom Physical medicine and rehabilitation (third edition), 2008; 7.
33. Richard C Atkin, Gardner Lindsey, Richard F Thompson, Text book of psychology, 292-294.
33. Rosihan M. Ali et al. Journal of neuropsychologia university sains Malaysia, 2006.
34. Senol Dane et al: Handedness in deaf and normal children, department of physiology, inter journal of neurosciences, 2002; 112: 995-998.
35. Shimoda et al: "Cerebral laterality differences in handedness: A mental rotation study with NIRS" journal of neurosciences, 2008; 430 (1): 43-7.
36. Simon J. Ellis et al, Hand preference in a normal population, department of medicine, cortex, 1988; 24: 157-163.
37. Susan B. O'Sullivan, physical rehabilitation assessment and treatment fifth edition, JP Brothers. publication, 2000; 11450-1152.
38. Stephen D. Christmas and Ruth E. Propper et al "superior episodic memory is associated with interhemispheric processing" journal of neuropsychologia, 15 (4): 607-616.
39. Simon J. Ellis et al, Hand preference in a normal population, department of medicine, cortex. right brain and left brain learning style explained by

- Simon Wright, 1988, 2002-2008; 24: 157-163.
40. Tan U et al "The relationship between nonverbal intelligence, familial sinistrality and geshwind score in right handed female subjects" *neuropsychologia*, 1988; 43 (3-4): 177-182.
  41. Text book of physiology Guyton Chapter, 2000; 57: 663-665.
  42. Unsworth, C; cognitive and perceptual dysfunction, a clinical reasoning approach to evaluation and intervention FA devis, Philadelphia, 1999.
  43. Victor Adams, variable affecting age. 8<sup>th</sup> Edn, 2000; 520-521.
  44. Volkman et al "Handedness and asymmetry of hand representation in human motor cortex" *journal of neurophysiology*, 1998; 79 (4): 2149-2154.
  45. William R collis. Sandra F. witelson "the brain connection "the corpus callosum is larger in left handers, *Journal of neurosciences*, 1985; 229: 665.
  46. W J Triggs, Rcalving, M levine, R K Heaton and K Mheilman predicting hand performance and performance in motor cortex, 2000; 36: 679-689.
  47. Zoltan, B: vision, perception and cognition: a manual for evaluation and treatment of the neurologically impaired adult, ed 3 Rev, Charles B. Slack, Thorofare, NJ, 1996.
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