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MANUAL ASYMMETRY AND GENDER DIFFERENCE IN MATHEMATICAL AND REASONING ABILITY

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Abstract

The present study was undertaken in order to find out the effects of gender and handedness on mathematical and reasoning ability of the subjects. This study was conducted on 100 students of different colleges of Meerut city. Findings reveal that there is a significant difference between right and left handed subjects in relation to their mathematical ability score as well as reasoning ability score. There is significant difference between male and female subjects in relation to their mathematical ability score as well as reasoning ability score.

Key-word: Manual asymmetry, spatial cognition mathematical and reasoning ability.

Introduction

No two brains are alike, Brains differ in their size, gyral patterns, distribution of gray and white matter, cytoarchitectonics, vascular pattern, neuro chemistry, "The human brain is the most complex and complicated piece of organic matter to understand. This may be due to the fact that we are trying to understand brain by means of the brain itself. It is our brain and its way of functioning that has made us uniquely human. It is by virtue of the unique capacity of our brain that we have the trait creativity guided by purpose"- Jordan and Street (1973)

To explain our capacity for cognitive thinking in terms of brain localization and / or interaction of various neuronal circuits, researchers have tried to put forth the several hypotheses. Some researchers influenced by the split brain, Sperry (1964) have localized cognitive behaviour in the right cerebral hemispheres. According to the notion of cerebral asymmetry the two hemispheres (the right and the left) are functionally asymmetrical. The left cerebral hemisphere (LH) sub serves the propositional aspect of our cognitive functioning and is believed to have substantial localization for various functions. In contrast right cerebral hemisphere (RH) is thought to be better equipped for non-sequential holistic visuospatial and nonverbal aspects of cognition. The RH neuronal organization is also believed to have a more diffused state and because of this, the localization of various functions in the RH is probably less functionally distinct. The neural organization of the RH appears to be better suited to handle (organize) information from diverse inputs and may tend to mediate out dreams, fantasies (Torrance, Reynolds, Ball and Riegal 1978, Mitchell 1988) and cognitive behaviour (Wheatley 1973).

From ancient times, men have used symmetry, particularly left right symmetry, as an organizing principle in painting, sculpture, architecture and designs. Experiments on aesthetic preference among meaningless shapes indicate that most people judge symmetrical shapes to be more interesting and pleasing than asymmetrical ones, although the reverse is true of artists, few works of art perfectly symmetrical although there is often a rough symmetry which leads coherence or balance to a work. Wey (1952) remarks that "seldom is asymmetry merely the absence of symmetry. Even in asymmetric designs one feels symmetry as the norms from which one deviates under the influence of forces of a non-formal character." Further he says "symmetry signifies rest and binding, asymmetry notion and too serving. The one law and order, the other arbitrariness and accident, the one formal rigidity and constraint, the other life, play and freedom.

One of the most obvious source of individual variation in the behaviour of humans is gender; males and females behave differently. The question is whether any differences in cognitive behaviours between males and females can be attributed to biological differences between the brains of two sexes. If any one principle can be abstracted to distinguish the sexes, it is that females tend to be more fluent than males in the use of language and males tend to be better than females at spatial analysis. There differences have been attributed to the possibility of a difference in the pattern of cerebral organization between the sexes.

The place to start in the study of cognitive difference between males and females is with the 'Psychology of Sex difference', a book published by McCoby and Jacklin in 1974. In their thorough review of the literature to 1974, they found four reliable sex differences. First girls have greater verbal ability than boys. At about age 11, the sexes begin to diverge, with female superiority increasing through high school and possibly beyond. Girls score higher on tasks involving both receptive and productive language and on high level verbal tasks.

Second, males excel in visual spatial ability. This means that on tests of recall and detection of shapes, mental rotation of two or three dimensional figures, geometry, maze learning, map reading, aiming at tracking objects and geographical knowledge, males performs better on average than do females.

Third, boys excel in mathematical ability. Although the two sexes are similar in their early acquisition of quantitative concepts and their mastery of arithmetic begins at about age 12 to 13 boys mathematical skills increase faster than girls. The better mathematical skills of boys is partly a function of the number of mathematics course since boys do take more courses but this accounts for only part of the difference. Recently a controversy has arisen over the basis of sex difference but there is a little argument over the fact that males perform at math.

Three tests were given to school age children and sex difference was found on two of the tests. On the 'Draw a bicycle test' males performed better than females, on the 'Chicago Word Fluency Test' females performed better at same ages by as much as 10 words than males. On the copy and recall of the Rey figure there was not sex difference.

The sex difference described by McCoby and Jacklin have often been described as a spatial advantage for males and a verbal advantage for females but more recent researches indicate that this dichotomy is too simple. There is a broader pattern of differences that can not be labeled easily as verbal and spatial. According to Harshman and his co workers recent review, females excel at both perceptual speed and visual memory whereas males are better, at perceptual closure and the disembedding of visual pattern from complex arrays. The fact that female are superior at perceptual speed and visual memory is not predicted from a simple "verbal" description of their superior abilities, although males still appear to perform best at spatial type tests. Finally some researchers have been impressed by anecdotal evidence that males appear to excel at chess and musical composition. In the Soviet Union, Where chess is a national pastime, no women have achieved grand master status and women compete in separate tournaments. In music women appear to be as competent in performing as men but fewer excel in composition. It has been suggested that men have an advantage in these fields because both involve spatial ability.

Major sex differences in intellectual function seem to lie in patterns of ability rather than in overall level of intelligence (I.Q.).We are all aware that people have different intellectual strengths. Some are especially good with words, other at using objects for instance, at constructing of fixing things. In the same fashion, two individuals may have the same overall intelligence but have varying pattern of ability.

On the basis of review of literature following hypothesis regarding the above mentioned factors were formulated:

(1) There would be significant difference between the mean Mathematical ability score of right and left handed subjects.

(2) There would be significant difference between mean reasoning ability scores of right and left handed subjects.

(3) There would be significant difference between the mean Mathematical ability scores of male and female subjects.

(4) There would be significant difference between mean reasoning ability scores of male and female subjects.

Method:

Sample: - The present study is conducted on the population of students aged from 15 to 25 of Meerut City. For this purpose 3 schools and 2 colleges were approached. One hundred subjects (50 males and 50 females) participated in the present study. 50 subjects were left handed (25 males and 25 females) and 50 subjects were right handed (25 males and 25 females). None of these subjects had known neurological disorder. The selection of the sampled subjects from the total incidental population was done with the use incidental method of sampling. Those present in the class of the first day of data collection were included in the sample. Moreover selected sample was matched in terms of their gender and handedness.

Tools:

The following tools were used-

(1) Handedness Questionnaire: It consists 15 items. It was based on the shorter version of Waterloo handedness questionnaire (Steenhuis & Bryden 1989). The subjects were asked to mark any of the five response categories i.e. always left, usually left, equal, usually right and always right.

(2) Mathematical Ability Test: It is self prepared by the researcher. It consists of 25 sums. Each sum has five alternatives. Subjects were asked to mark correct alternatives for each sum. Time limit was 20 minutes.

(3) Reasoning Ability Test: It is self prepared by the researcher. It consists of 15 nonverbal problems of reasoning. Time limit was 15 minutes. Subjects were asked to mark correct answer for each problem.

The above mentioned measuring devices were administered to the subject in small groups (4 to 5 subjects) after establishing rapport with them.

Result and Discussion:

Mathematical ability: In order to test the hypothesis that there would be significant difference between the mean mathematical scores of right and left handed subjects. Students were classified into two groups right and left handed subjects on the basis of their response in handedness questionnaire. Analysis of variance (ANOVA) and Mean was used to analyze the results.

Table1: One Way Analysis of Variance for Right and Left Handed Subjects with respect to their Mathematical Ability Scores:

Analysis of Variance

Source of Variance	Sum of Squares	d.f.	Mean Square Variance	F-Ratio
Between Group	104.04	1	104.04	18.45*
Within Group	552.92	98	5.64	

* Significant at .01 level of significance.

The obtained 'F'-ratio for 'between group' which is 18.45 found to be significant at the level of .01. Hence the hypothesis that there would be significant difference between the mathematical score of right and left handed subjects is accepted, it means there is a significant difference between the two group means with respect to their mathematical ability score.

Table2: Means of Mathematical Scores for Right & Left Handed Subjects:

Mean of Mathematical ability Score

Subgroup of Sample	Mean
1. Right-Handed Subject	21.34
2. Left-Handed Subjects	24.02

It is obvious from table 2 that right handed subjects have scored (Mean= 21.34) on mathematical ability test and left handed subjects have scored higher (Mean= 24.02) on mathematical ability test. It means left handed subjects are found better than right hander subjects on mathematical ability test.

Table3: One way Analysis Variance (ANOVA) for Male and Female subjects with respect to of their Mathematical ability scores:

Analysis of Variance

Source of Variance	Sum of Squares	d.f.	Mean Square Variance	F-Ratio
Between Group	179.56	1	179.56	15.13*
Within Group	1163.20	98	11.86	

*Significant at .01 level of significance.

The obtained 'F'-ratio for 'between group' which is 15.13 found to be significant at the level of .01. Hence the hypothesis that there would be significant difference between the mathematical score

of male and female subjects is accepted, it means there are significant differences between the two group means with respect to their mathematical ability score.

Table 4: Means of Mathematical Scores for Male & Female Subjects:

Mean of Mathematical ability Score

Subgroup of Sample	Mean
1. Male Subject	23.50
2. Female Subjects	21.46

It is apparent from table 4 that male subjects have scored higher (Mean=23.50) than female subjects (Mean=21.46) on mathematical test. Gender had been taken as criterion for classifying subjects into two groups.

Reasoning Ability: ANOVA was employed to test the hypothesis that there would be significant difference between the mean reasoning scores of right and left handed subject. Subjects were classified into two groups on the basis of their response given in the handedness questionnaire.

Table 5- One Way Analysis of Variance for Right and Left handed subjects with respect to their Reasoning Ability scores

Analysis of Variance

Source of Variance	Sum of Squares	d.f.	Mean Square Variance	F-Ra
Between Group	67.2	1	67.2	
Within Group	206.36	98	2.11	31.8

*Significant at .01 level of significance.

The obtained 'F'-ratio for 'between group' which is 31.84 found to be significant at the level of .01. Hence the hypothesis that there would be significant difference between the Reasoning ability scores of right and left handed subjects is accepted, it means there are significant difference between the two groups mean with respect to their Reasoning ability score.

Table 6: Mean of Reasoning Score

Subgroup of Sample	Mean
1. Right-Handed Subject	11.42
2. Left-Handed Subjects	13.22

It is evident from Table 6 that right handed subjects have scored (Mean=11.42) and left handed subjects have score higher (Mean=13.22) on reasoning ability test. It means left handed subjects are found to be better than right handed subjects on Reasoning ability test.

Table7: One Way Analysis of Variance for Male and Female Subjects with respect to their Reasoning Ability Scores.

Analysis of Variance

Source of Variance	Sum of Squares	d.f.	Mean square Variance	F-Rat
Between Group	228.01	1	228.01	100.(
Within Group	224.02	98	2.28	

*Significant at .01 level of significance.

The obtained 'F'-ratio for 'between group' which is 100.00 found to be significant at the level of .01. Hence the hypothesis that there would be significant difference between the Reasoning ability scores of male and female subjects is accepted, it means there are significant differences between the two groups mean with respect to their Reasoning ability score

Table8:

Means of Reasoning Scores

Subgroup of the Sample	Mean
1. Male subjects	14.02
2. Female subjects	11.00

It is obvious from table 8 that male subjects have scored higher (Mean=14.02) than female subjects (Mean=11.00) on reasoning ability test. It means male subjects are found better than female subjects on reasoning ability test.

There are several factors which affect mathematical and reasoning ability of the subjects. Researchers have paid their attention on genetic factors. Some researchers have also observed psychological variables like anxiety motivation, intelligence etc as correlates of mathematical and reasoning ability. Handedness and gender as factors of mathematical and reasoning ability has not been given much more attention especially in Indian cross-cultural societies. The findings of the present study were as follows:

(1) Mathematical ability scores differentiated significantly right and left handed subjects.

(2) Mathematical ability scores differentiated significantly male and female subjects.

(3) Reasoning ability scores differentiated significantly right and left handed subjects.

(4) Reasoning ability scores differentiated significantly male and female subjects.

The following general conclusion can be drawn from the present study:-

(1) Handedness is substantially significant in affecting the mathematical ability of the subjects.

(2) Gender of the subjects influence significantly the mathematical ability of the subjects

(3) Handedness is substantially significant in affecting the reasoning ability of the subjects.

(4) Gender of the subjects influence significantly the reasoning ability of the subjects

Cerebral dominance poses prominent problems of neuropsychological research. Brain is the complete network of neurons incorporating both functional and anatomical asymmetry. Each half of the brain is able to perform and chooses to perform a certain set of cognitive task which the other side finds difficult to perform. The left side process the language and hand movements where as the right side perceives the form and does visuospatial tasks, Stimulus presented in the left perceptual area projects in the right visual cortex, where as right perceptual area projects in the left visual cortex. Generally, persons using their left hands have right hemisphere developed more for visual stimulation. It is observed that the right handed subjects pay more attention towards the stimulus presented in the right visual field (Which is related to the left hemisphere) than that in the left visual field. Certain correlation has even been studied in the pattern of hand preference and visual half field.

Results have shown that there is significant difference between right and left handed subjects and males and females on mathematical ability as well as reasoning ability test. Male subjects were found better than female subject on mathematical ability test as well as reasoning ability test. Left handed subjects were found better than right handed on mathematical ability as well as reasoning ability test. The present study has however limited focus. It is based on 100 students. Obviously, this needs to be carried out in rural, semi-urban and urban setting covering relevant variable as covered in the present study are not exhaustive. Some attempts should be made to highlight the role of genetics and environmental factors responsible for mathematical ability of the subjects. In spite of certain limitation of the present study, it may prove a guideline for future research to be conducted in this area.

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