

# Sex Related Difference in Handedness

Shakti Mehrotra<sup>1</sup> and Ambakila Sinha<sup>2</sup>

\* Services Selection Centre East, Allahabad, India, 211001

\*\* Department of Humanities and Social Sciences, MNNIT, Allahabad, India, 211001

**Abstract-** In the present study an attempt is made to investigate sex related difference in handedness among adults. It was hypothesized that there will be a difference in the performance of males and females on measure of handedness. 704 males and 840 females were given a group test of handedness. The result indicates that females tended to score significantly high on performance test of handedness than males. The sex difference was statistically significant for right-handers but not for left-handers.

**Index Terms-** Sex difference, Handedness

## I. INTRODUCTION

Handedness is an attribute of human beings defined by their unequal distribution of fine motor skills between the left and right hands. Handedness is regarded as an index of individual difference in cognitive performance. Determining the hand preference of a subject / patient is important to psychologists, clinical neurologists and research scientists because hand preference is considered as a marker of cerebral hemispheric dominance for speech and language. As recent attention has been focused on the studies of hemispheric asymmetries and cognitive functions, sex related lateral asymmetry has become an area of interest in the study of hemispheric specialization. It may address to the question of how cerebral organization influences behavior. In fact, one of the most obvious sources of individual variation in the behavior of humans is gender; males and females behave differently. The question is whether any disparity in the cognitive behavior between males and females can be attributed to biological differences between the brains of two sexes. There are several anecdotal and experimental evidences of such cognitive differences and there have been several attempts to relate these to differences in brain organization. Evidences of significant sex difference in cerebral organization are derived primarily from studies of normal subjects, laterality studies, cerebral blood flow measurements and neurological patients. However, current interest in hemispheric specialization coupled with the observation that: difference in patterns of cerebral organization in left and right-handers have led to considerable interest in the neuropsychology of handedness. As a result many investigators concerned with hemispheric asymmetries now routinely screen their subjects for handedness.

In a recent meta- analysis, Lalumiere, Blanchard and Zucker (2000) compiled evidence on association between handedness and sexual orientation in men and women. Data from 6,182 homosexual men and 14808 heterosexual men and 805 homosexual women and 1615 heterosexual women showed that the difference between the handedness of both sexes were

statistically significant. Richard A. lippa (2003) in his review related to handedness, sexual orientation and gender related personality traits in men and women noted that there are slightly higher rate of left-handedness in males than females.

Peters Michael (1991) has found that gender differences in brain are represented by factors such as handedness and environmental factors yield sex difference in mathematical performance. Ravinder Singh and Ajita R. Singh (2003) have observed significant difference in mental rotation tasks and handedness of both sexes.

Two early large scale lesion studies clarified the relation between the lateralization of speech & handedness. One study was of military personnel who suffered brain damage in World War II (Russel & Espir, 1961) and the other was of neurological patients who underwent unilateral excisions for the treatment of neurological disorders (Penfield & Roberts, 1959). In both the studies, approximately 60 % of dextral (right -handers) with left hemisphere lesions and 2 % of those with right hemisphere lesions were diagnosed as aphasic; the comparable figure for sinestrals (left -handers) were about 30 % and 24%, respectively. These results indicate that left hemisphere is dominant for language related abilities in almost all dextrals & in the majority of sinestrals (Benson, 1985); they also indicate that sinestrals are more variable than dextrals with respect to language lateralization (Hellige, 1990; Joannette, 1989).

Interest in the possibility that the brains of females & males differ in their degree of lateralization was stimulated by McGlones's (1977, 1980) studies of unilateral stroke victims. McGlone found that male victims of unilateral strokes were three times more likely to suffer from aphasia than female victims. She found that male victims of left hemisphere strokes had deficits on the WAIS verbal sub-tests. Whereas male victims of right hemisphere strokes had deficits on the WAIS performance subtest.

And she found that female victims of unilateral strokes had the same deficits on the WAIS regardless of the side of the stroke. Since researches have tried to prove that males and females differ in their patterns of cerebral organization, it is decided to find out if there is any significant difference in their pattern of handedness. Moreover, after more than half a century of research, the literature describing human handedness is plagued with ambiguities and inconsistencies to the extent that basic questions remain unresolved. Since, most of the tests of handedness are in the form of questionnaires or inventories; therefore, it is decided to study the difference in the pattern of handedness of males and females with the help of a performance test developed by Stott et al. (1972). Hence it was proposed that there will be a difference in the handedness of male & female subjects and females will be more right-handers than left-handers.

## II. METHOD

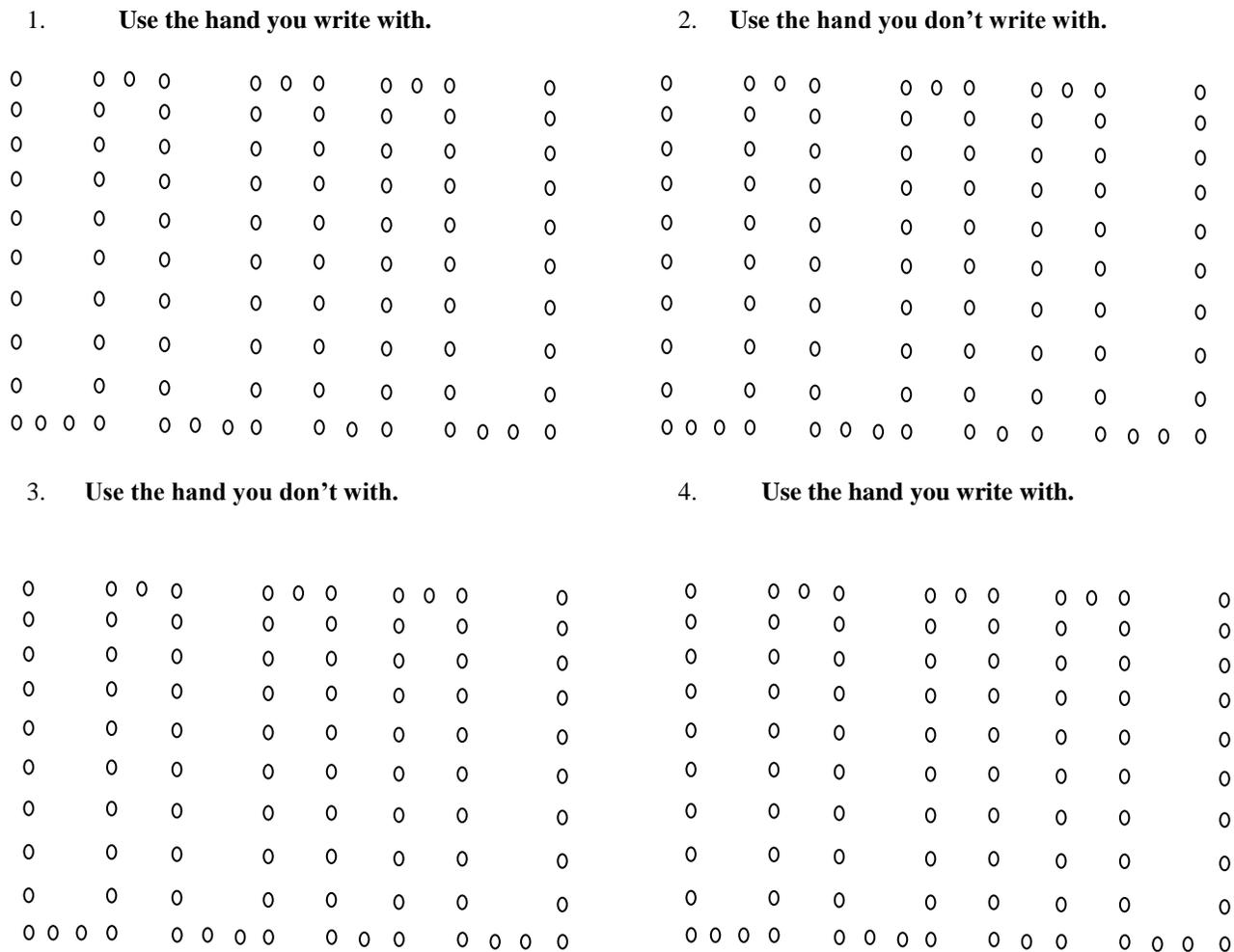
### 1. Participants

The subjects for this study were 1544 graduates out of which 704 subjects were male and 840 were female in the age group of 19 to 25 years.

Subjects were appearing before Services Selection Boards of the Army for Short Service Commission to join Indian Armed Forces. All of them belonged to the middle income group.

### 2. Material

Handedness was assessed with group version of a test employed by STOTT et al (1972). The test-retest reliability was  $r=.993$  and internal consistency was Cronbach's Alpha=.97. Handedness scores were found to have significant correlation with the finger tapping task.



**Figure1. : The Hand Performance Test (Group Version)**

### III. PROCEDURE

Subjects were told to “make a dot in each circle following the pattern as quickly as you can”. It was emphasized that the dot must be in the circle, not on the edge or outside of it, in order to be scored. Twenty seconds were allotted for each of four trials. Subjects used their preferred hands on the first and fourth trials and their non preferred hands on the second and third trials.

To score this test the number of circles properly filled was counted for each trial. Hand differences were then expressed as the difference between right and left hand scores divided by the total  $(R-L) / (R+L)$ . This measure represents the difference in rate expressed as a proportion of the overall rate. The right-handers were defined as those who obtained positive scores and left handers as those who obtained negative scores.

### IV. RESULTS

Data was analyzed as per the purpose of the research using t-test.

**Table-1 Difference in the handedness of male and female subjects**

Group	N	Mean	SD	't'
Males	704	0.194	0.162	<b>8.46*</b>
Females	840	0.216	0.160	
Male RH	625	0.242	0.092	<b>5.33*</b>
Female RH	759	0.261	0.084	
Males LH	79	-0.181	0.078	<b>0.048</b>
Female LH	81	-0.201	0.086	

\*P = < 0.01 RH = Right handers, LH = Left handers

Result indicates that there is a significant difference between the handedness of males and females. Females tended to be more strongly “handed” than males. The sex difference reached statistical significance for right-handers [t (1384) = 5.33, P< 0.01] but not for left- handers [t (160) = .048, P< 0.10].

Overall, left-handers comprised 10.36% of the total sample, with 11.22% of the males and 9.64% of the females being left-handed. This is consistent with a large-scale survey of handedness by Porac, C. and Coren S. (1981). However, sex difference was not statistically significant in case of left-handers.

#### V. DICUSSION

The Present data provides convincing evidence that males and females differ in their handedness. Females tend to be more strongly ‘handed’ than of males. This finding is consistent with findings of the study carried out by S.M. Tapley and M.P. Bryden (1985). The difference in handedness between males and females can be attributed to neurobiological differences found between the brains of the two sexes.

Maccoby and Jacklin (1974) found that girls have greater verbal ability than boys. They score higher on task involving both receptive and productive language and on high-level complex verbal task (analogies, comprehension, creative writing) as well as on lower level measures (Fluency).

Sommer IE, Aleman A, Somers M, Bokes MP, and Khan RS (2008) have concluded with the help of meta-analysis of studies, that, males are more frequently non-right handed than females.

However, in case of left-handedness males and females do not differ significantly. It is because cognitive functions are more bilaterally organized in left-handers than right-handers. Kenneth J. Zucker, Nicole Beaulieu, Susan J. Bradley and Anne Wilcox (2001) have found that boys with gender identity disorder were significantly more likely to be left handed than the

clinical control boys. Hence left-handedness appears to be a behavioral marker of an underlying neurological process associated with gender identity disorder.

The conclusion drawn from aphasia literature also shows that aphasia occurs more often in left handers than in right handers with comparable damage, but that recovery from aphasia is more rapid and complete in the left handers, hence it may be the component of bilaterality in the cognitive functions of left handers that makes them less dextral as compared to right handers. Similar observation was also made in handedness data collected by S.M. Tapley and M. P. Bryden (1985). Where it was found that right-handers were somewhat more right handed than left-handers were left handed. Witelson S.F. (1985) in her post mortem study found that the size of corpus callosum, the region that connects the two cerebral lobes, was 11% greater in left-handers than in right-handers. Similar results were found by Philips K A, (Hiram College) Sherwood CC and Lilak A L, (2008) that right-handed individuals have a smaller size of corpus callosum than left handed individuals. It imply that there is greater interaction between the both hemispheres of left handers, which intern, makes them bilateral and thus reducing the intensity of hemispheric dominance in left handers as compared to right handers.

It also explains the non-significant difference, found in handedness of left handed males and left handed females, as their hemispheric dominance may be equally reduced due to the larger size of their corpus callosum.

Some of the variation, in studies of changes in cerebral blood flow during cognitive activities, is apparently related to gender as well as to handedness. In 1982, Gur and his colleagues found that both sexes exhibited an increase in left hemisphere blood flow during verbal task and in right hemisphere blood flow during spatial task. Females and left handed males have a higher rate of cerebral blood flow and a greater percentage of fast per fusing tissue (rapid blood exchange) than do right handed males. This data suggest that cerebral blood flow patterns of left handed males are different than right handed males and it is similar to

females and hence no significant difference is noticed in the handedness of left handed males and females.

In a study on sex, handedness and sexual orientation as predictors of face perception ability, Paul W.H. Brewster et al (2008) have noted that, gender, handedness and sexual orientation play a role in face perception ability. On a battery of face perception task right-handed women were better than right-handed men. This again indicates strong hemispheric dominance in case of right-handed females.

## VI. CONCLUSION

It is evident from the study that there are significant differences in handedness of males and females. Right handed females are more strongly handed than right handed males and this may be the cause of significant difference in their cognitive functions e.g. verbal difference, visuospatial difference and difference in mathematical ability etc.

Harshman and his associates (1983), in a study of the interaction of sex and handedness in cognitive abilities report a significant interaction between sex and handedness; that sex related difference in verbal and visuospatial behavior varied as a function of handedness.

In fact, it is difficult to imagine how social or environmental factors alone could account for this type of result. It is thus very plausible to account for sex-related differences at least partly by neurological factors that may be modulated by environment.

## VII. IMPECATIONS

The appearance of sex difference in handedness has important implications for neurological assessment, since gender may be significant in predicting what normal performance level should be. The appearance of reliable sex difference on various clinical tests implies that separate norms are necessary for clinical assessment of males and females. Along with it, by studying gender specific variations in the pattern of handedness, we may be able to separate the cognitive processes that are lateralized and gain insight into the nature of cerebral asymmetry.

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## AUTHORS

**First Author** – Shakti Mehrotra, M.Phil in Medical & Social Psychology, Services Selection Centre East, Allahabad, India, 211001. [shaktipsych@gmail.com](mailto:shaktipsych@gmail.com)

**Second Author** – Mrs. Ambalika Sinha, Ph.D. Assistant Professor, MNNIT, Allahabad, India, 211001. [ambalika.mnnit@gmail.com](mailto:ambalika.mnnit@gmail.com)