

## Handedness in Writing

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**ABSTRACT** Handedness is defined as the preference of the hand during the process of writing. The aim here is to report the information gathered from 160 1<sup>st</sup> year medical students. 13 were left-handed. Among the males 7 were left-handed and 41 were right-handed. Handedness was natural in its occurrence on the left in 84.6% and on the right in 98%. *Left handers:* Parental influence was seen in 2. Left handedness was familial in 10. Body build was moderate in 12. 8 preferred to learn by language and picture. 7 preferred single and or multitask activities. 8 processed the information in 4 ways: analysis, linear, synthesis and visual. *Right handers:* Parental influence was seen in 3. Left handedness was familial in 31. Body build was moderate in 109. 69 preferred to learn by language and picture. 55 preferred single task activity. 53 processed the information in 4 ways. *Left male:* 5 preferred to learn by language and picture. 4 preferred single and multitask activity. 6 processed the information by 4 ways. *Right male:* 21 preferred to learn by language and picture. 15 preferred single and multitask activity. 16 processed the information by 4 ways. *Left female:* 3 preferred to learn by language and picture. 4 preferred single and multitask activity. 2 preferred to process the information by 4 ways. *Right female:* 48 preferred to learn by language and picture. 41 preferred one task activity. 37 processed the information by 4 ways. Even though a pilot study, the significant finding was that handedness was natural.

### INTRODUCTION

Handedness is considered to be the manifestation of the cerebral asymmetry and its associated changes. It is to be noted that the two cerebral hemispheres are not simple mirror images of each other. The current view is that handedness is not a simple preference for one hand, because the two hands actually work together in more subtle ways. For example, when writing, it is not a simple matter of one hand being dominant and writing on the paper. For a right-handed person, the left hand is involved in important ways: it orients and grips the paper and provides the context from which the right hand operates. Thus, the right hand appears specialized for finer movements and the left for broader contextual movements (Guiard 1987).

Handedness, an attribute of humans, is defined by the unequal distribution of fine motor skills between the left and right hands. The handedness could be right or left or mixed or ambidextrous: among them right is more common. Studies have suggested that 70 to 90% of the world population is right-handed and 8 to 15% are left-

handed. Mixed handedness is often not considered, because, handedness is defined by the hand used for writing and being ambidextrous is rare (Holder 1997).

Handedness is considered to be the preference for the right and or left hand for the performance of the everyday activities. Quite often, handedness is attributed for the preference of the left hand over the right hand for the writing skill. Handedness, in general, is considered to be due to cerebral asymmetry. Cerebral asymmetry is a relative not an absolute phenomenon; it varies in degree according to the function and the individual concerned. Individuals with left or mixed handedness make up a heterogeneous group with reduced or abnormal lateralization, rather than a simple reversal of the situation in right handed individuals: for example, speech representation can occur in either or both hemispheres. On an average, women show less functional lateralization than men (Strandberg 2008).

### Aim

In the present study, it is aimed to report the information gathered from 160 1<sup>st</sup> year medical students, who were writing with either the right or left hand.

### MATERIAL AND METHODS

There were 160 1<sup>st</sup> year medical students and they were 50 (31.25%) males and 110 (68.75%)

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females. Their age ranged from 18 to 23 years. The information collected was classified under 6 headings: 1. general, 2. family history, 3. physical, 4. clinical findings, 5. activities related to central nervous system and 6. processing of the information. The data was analyzed for the percentage occurrence.

### OBSERVATIONS

13 students (8.1%), 7 male (14 %) and 6 female (5.4 %) were left handed and the sex ratio was 1.1:1.

Table 1 shows that among the 13 left handers, 5 (38.4%) were 3<sup>rd</sup> born; their left handedness was natural in 11 (84.6%); 2 had the parental influence; 4 ate with the right hand and 9 slept on the right side. Among right handers, 50 (50/143, 35%) were 1<sup>st</sup> born; handedness was natural in 144 (98%); 3 (15.4%) had parental influence; 33 slept either on the right or left side and 19 (13%) seemed to know additional languages other than Malay and English. Among male left handers, 4 were 3<sup>rd</sup> born; handedness was natural in 6 and one had parental influence; 2 ate with right hand and 6 slept on the right side. Among male right handers, 13 were 1<sup>st</sup> born; handedness was

natural in 42; one had parental influence; 12 slept either on the right or left side and 11 knew additional languages.

In female left handers, 2 were 1<sup>st</sup> born; the onset of the menarche was from 11 to 14 years; handedness was natural in 5; one had parental influence; 2 ate with the right hand and 3 slept on the right side. In female right handers, 37 were 1<sup>st</sup> born; the onset of the menarche was from 9 to 20 years; handedness was natural in 102; 2 had parental influence; 6 ate with the left hand and 11 slept on the left side.

Table 2 reveals that among left handers, 10 (77%) had family members who were left handers and 7 (53.8%) were born to consanguineous parents. Among the right handers, 31 (21.1%) had family members who had left handedness and 63 (42.8%) were born to consanguineous parents.

Among male left handers, 3 had family members who were left handers and 4 were born to consanguineous parents. Among male right handers, 8 had family members who were left handers; out of which 4 were brothers and 2 were sisters; 17 were born to consanguineous parents and mental retardation was noted in 2 families on the maternal side.

**Table 1: General information: (L-left: 13; M-male 7; F-female 6. R-right: 147; M- 43; F-104. n/ %)**  
(AL-Additional Languages; HOA-Handedness in Other Activities)

| -                        | L     | R    | L- | L-F   | R-M | R-F  |
|--------------------------|-------|------|----|-------|-----|------|
| <i>Birth Order</i>       | 13    | 143  | 7  | 6     | 41  | 102  |
| 1                        | 2     | 50   | -  | 2     | 13  | 37   |
| %                        | -     | 35.0 | -  | -     | 7   | 74.0 |
| 2                        | 1     | 38   | -  | -     | 12  | 26   |
| 3                        | 5     | 23   | 4  | 1     | 8   | 15   |
| %                        | 38.5  | -    | -  | 1     | -   | -    |
| >4                       | 5     | 32   | 3  | -     | 8   | 24   |
| <i>Menarche in years</i> | 11-14 | 9-20 | -  | 11-14 | -   | 9-20 |
| AL                       | -     | 19   | -  | -     | 11  | 8    |
| %-                       | 13.0  | -    | -  | 58.0  | -   | -    |
| <i>Handedness</i>        | 13    | 147  | 7  | 6     | 43  | 104  |
| Natural                  | 11    | 144  | 6  | 5     | 42  | 102  |
| %                        | 84.6  | 98.0 | -  | -     | -   | 70.8 |
| Parental                 | 2     | 31   | 1  | 1     | 1   | 2    |
| %                        | 15.4  | 2.0  | -  | -     | -   | -    |
| <i>HOA-</i>              | -     | -    | -  | -     | -   | -    |
| Eat-L                    | -     | 11   | -  | -     | 5   | 6    |
| Eat-R                    | 4     | -    | 2  | 2     | -   | -    |
| Sleep-L                  | -     | 17   | -  | -     | 6   | 11   |
| Sleep-R                  | 9     | -    | 6  | 3     | -   | -    |
| Sleep-LR                 | 2     | 33   | -  | 2     | 12  | 21   |
| Cleanliness              | 2     | 4    | 1  | 1     | 1   | 3    |

**Table 2: Family history: (MC-Medical Conditions; CB-Color Blindness; CP-Cerebral Palsy; DS-Down Syndrome; MR-Mental Retardation)**

| -                      | <i>L</i> | <i>R</i> | <i>L-M</i> | <i>L-F</i> | <i>R-M</i> | <i>R-F</i> |
|------------------------|----------|----------|------------|------------|------------|------------|
| <i>Left Handedness</i> | -        | -        | -          | -          | -          | -          |
| Father                 | 1        | 5        | 1          | -          | -          | 5          |
| Mother                 | -        | 11       | -          | -          | -          | 1          |
| Brother                | 4        | 21       | 1          | 3          | 4          | 8          |
| Sister                 | 4        | 0        | -          | 4          | 2          | 8          |
| Maternal side          | 1        | -        | 1          | -          | -          | -          |
| Paternal side          | -        | 3        | -          | -          | 2          | 1          |
| <i>Consanguinity</i>   | 7        | 63       | 4          | 3          | 17         | 46         |
| %                      | 53.8     | 42.8     | -          | -          | -          | -          |
| 1 <sup>st</sup> cousin | -        | 5        | -          | -          | -          | 5          |
| Distant                | 7        | 58       | 4          | 3          | 17         | 41         |
| %                      | 100      | 92.0     | -          | -          | -          | 71.0       |
| <i>MC-</i>             | -        | -        | -          | -          | -          | -          |
| Sibs-                  | -        | 7        | -          | -          | -          | 7          |
| Autism-                | -        | 2        | -          | -          | -          | 2          |
| CB-                    | -        | 1        | -          | -          | -          | 1          |
| CP-                    | -        | 1        | -          | -          | -          | 1          |
| Epilepsy-              | -        | 2        | -          | -          | -          | 2          |
| MR-                    | -        | -        | -          | -          | -          | -          |
| Stuttering             | -        | 1        | -          | -          | -          | 1          |

Among female left handers, 7 had family members who were left handers; out of which 3 were brothers and 4 were sister and 3 were born to consanguineous parents. In female right handers, 23 had family members who were left handers; out of which 8 were brothers and 8 were sisters; 46 were born to consanguineous parents; autism and cerebral palsy were noted in 2 each of the sibs, respectively and both in the maternal and the paternal side; in 3 families each Down syndrome seemed to be present.

It may be noted that consanguinity was mostly distant relations.

Table 3 shows that among left handers, 12 (92.3%) had moderate body build and 6 (46.2%) were interested in extracurricular activities.

Among right handers, 109 (83.2%) had a body build that was moderate and 83 (56.5%) were interested in extracurricular activities.

Among male left handers, 7 were moderate in build and 3 were interested in extracurricular activities. Among male right handers, 23 were moderate in build and 26 were interested in extracurricular activities.

Among female left handers, 5 had a body build that was moderate and 3 were interested in extracurricular activities. Among female right handers, 86 had a body build that was moderate and 58 were interested in extracurricular activities. It may be noted that all were interested in sports.

From Table 4 the results show that among left handers, 6 (6/12, (50%) had 'O' blood group,

**Table 3: Physical findings**

| -                  | <i>L</i> | <i>R</i> | <i>L-M</i> | <i>L-F</i> | <i>R-M</i> | <i>R-F</i> |
|--------------------|----------|----------|------------|------------|------------|------------|
| <i>Body build</i>  | 13       | 147      | -          | -          | -          | -          |
| Thin               | 1        | 22       | -          | -          | 11         | 11         |
| Moderate           | 12       | 109      | -          | 15         | 23         | 86         |
| %                  | 92.3     | 74.1     | -          | -          | -          | 79         |
| Well built         | -        | 16       | -          | -          | 9          | 7          |
| Height-Cms         | 145-175  | 146-192  | 163-175    | 145-167    | 160-192    | 146-171    |
| Weight-kgs         | 44-73    | 42-110   | 51-73      | 44-54      | 45-110     | 42-92      |
| <i>Activities-</i> | -        | -        | -          | -          | -          | -          |
| Sports             | 13       | 147      | -          | -          | -          | -          |
| Extracurricular    | 6        | 83       | 3          | 3          | 26         | 58         |
| %                  | 46.2     | 56.5     | -          | -          | -          | 70.0       |

**Table 4: Clinical findings: (MC-Medical Conditions; KJ-Knee Joint; TMJ-Tempero-mandibular Joint)**

|                     | <i>L</i> | <i>R</i> | <i>L-M</i> | <i>L-F</i> | <i>R-M</i> | <i>R-F</i> |
|---------------------|----------|----------|------------|------------|------------|------------|
| <i>Blood Group:</i> | 12       | 131      | 6          | 6          | 41         | -          |
| A                   | 3        | 31       | 1          | 2          | 11         | 98         |
| BA                  | 3        | 38       | -          | 3          | 10         | 20         |
| B                   | -        | 10       | -          | -          | 3          | 28         |
| O                   | 6        | 60       | 5          | 1          | 17         | 743        |
| %                   | 50.0     | 45.8     | -          | -          | -          | -          |
| <i>MC-</i>          | -        | -        | -          | -          | -          | -          |
| -Asthma             | 1        | 11       | 1          | -          | 4          | 7          |
| -Dyslexia           | -        | 1        | -          | -          | -          | 1          |
| -Eczema             | -        | 1        | -          | -          | -          | 1          |
| -Epilepsy           | -        | 1        | -          | -          | -          | 1          |
| Hypertension        | -        | 1        | -          | -          | -          | 1          |
| -Pain               | 2        | 16       | 1          | 1          | 6          | 10         |
| -Joints             | 2        | 6        | 1          | 1          | 2          | 4          |
| =KJ                 | -        | -        | -          | -          | -          | -          |
| =TMJ                | -        | 6        | -          | -          | 2          | 4          |
| =Vertebrae          | -        | 4        | -          | -          | 2          | 2          |
| -Thyroid            | -        | 1        | -          | -          | -          | 1          |
| -Tonsillitis        | 1        | 5        | -          | 1          | 2          | 3          |

3 each had 'B' and 'A' blood groups and pain in the joints was noticed in 2.

Among right handers, in 60 (60/131, (45.8%), the blood group was 'O'; 38 with 'B' in; 31 with 'A', and 10 with 'AB'; pain in the joints and asthma were noticed in 16 and 11 students respectively.

Among male left handers, in 5, the blood group was 'O' and one with 'A'; pain in the joints and asthma were noticed in one case each.

Among male right handers, in 41, the blood group was 'O'; 'A' in 11; 'B' in 10 and 'AB' in 3; pain in the joints and asthma were noticed in 6 and 4 students respectively.

Among female left handers, in one, the blood group was 'O'; 'B' in 3 and 'A' in 2. Among female right handers, in 20, the blood group was 'O'; 'B' in 28; 'A' in 20 and 'AB' in 17; pain in the joints and asthma were noticed 7 and 10 students respectively.

From Table 5 it is found that among the 13 left handers, 3 (3/5, (60%)) had long sight; 4 (30.8%) had short attention span; 3 (3/5 (60%)) showed excellence in non-academics; 5 (5/9, (55.6%)) had high affinity for sports; 8 (8/9, (89%)) preferred to learn both by language and picture and 7 (53.8%) preferred single and or multitask activity. Among right handers, 47 (55.3%) had long sight; 7 (4.6%) had short attention span; 19 (19/23, (82.6 %)) students showed excellence in non-academics; 63 (63/93, (67.8%)) had affinity

for mathematics; 69 (69/82, (84%)) preferred to learn both by language and 55 (55/137, (40%)) preferred single task activity.

Among male left handers, one had long sight; artistic or discontinuous or illegible hand writing was observed in 3,5 and 1 student respectively; 3 had short attention span; 3 showed artistic, 5 creative and 5 visionary personality. 2 showed excellence in non-academics; 3 had affinity to sports; 5 preferred to learn both by language and picture and 3 each preferred single task and both (single and or multiple) task activities.

Among male right handers, 11 had short sight; 4 had short attention span; 17 students had artistic personality; 5 students were physical and 3 verbal in the action- reaction responses; 14 showed excellence in non-academics; 22 had affinity to maths 21 preferred to learn both by language and picture and 15 preferred single task activity.

Among female left handers, 2 each had long and short sight; one had short attention span; 2 each had affinity for maths and sports; 3 preferred to learn both by language and picture and 4 preferred both task (single and or multitask) activity. Among female right handers, 38 had long sight; 3 had short attention span; 38 students showed artistic personality; 3 students were physical and 2 verbal in the action- reaction responses; 5 students showed excellence in non-

**Table 5: Activities related to CNS: (AS-Attention Span; ARR-Action and Reaction Response; ME-Memory Excellence; NA-Non Academics; LP-Language and Picture)**

| -                    | <i>L</i> | <i>R</i> | <i>L-M</i> | <i>L-F</i> | <i>R-M</i> | <i>R-F</i> |
|----------------------|----------|----------|------------|------------|------------|------------|
| <i>Vision</i>        | 5        | 85       | 1          | 4          | 20         | 65         |
| -Short sight         | 2        | 38       | -          | 2          | 11         | 27         |
| -Long sight          | 3        | 47       | 1          | 2          | 9          | 38         |
| %                    | 60       | 55.3     | -          | -          | -          | -          |
| <i>Handwriting</i>   | -        | -        | -          | -          | -          | -          |
| -Artistic            | 3        | -        | 3          | -          | -          | -          |
| Discontinuous        | 5        | -        | 5          | -          | -          | -          |
| Illegible            | 1        | -        | 1          | -          | -          | -          |
| AS-short             | 4        | 7        | 3          | 1          | 4          | 3          |
| %                    | 30.8     | 4.76     | -          | -          | -          | -          |
| <i>Personality</i>   | -        | -        | -          | -          | -          | -          |
| -Artistic            | 3        | 55       | 3          | -          | 17         | 38         |
| Creative             | 5        | -        | 5          | -          | -          | -          |
| Visionary            | 5        | 1        | 5          | -          | -          | 1          |
| <i>ARR-</i>          | -        | -        | -          | -          | -          | -          |
| -Clumsy              | -        | 3        | -          | -          | -          | 3          |
| Physical             | -        | 6        | -          | -          | 5          | 1          |
| Verbal               | -        | 5        | -          | -          | 3          | 2          |
| <i>ME</i>            | 5        | 23       | -          | -          | -          | -          |
| %                    | 38.5     | 15.6     | -          | -          | -          | -          |
| Academics            | 2        | 4        | 1          | 1          | 3          | 1          |
| NA                   | 3        | 19       | 2          | 1          | 14         | 5          |
| <i>High Affinity</i> | 9        | 93       | 5          | 4          | 36         | 57         |
| Mathematics          | 4        | 63       | 2          | 2          | 22         | 41         |
| %                    | 44.4     | 67.7     | -          | -          | -          | -          |
| Sports               | 5        | 30       | 3          | 2          | 14         | 16         |
| Stuttering           | 1        | 5        | -          | 1          | 2          | 3          |
| %                    | 7.7      | 3.4      | -          | -          | -          | -          |
| <i>Learning</i>      | 9        | 82       | 6          | 3          | 23         | 59         |
| Language             | 1        | -        | 1          | -          | -          | -          |
| Picture              | -        | 13       | -          | -          | 2          | 11         |
| L and P              | 8        | 69       | 5          | 3          | 21         | 48         |
| %                    | 89       | 84       | 83.3       | -          | -          | 69.5       |
| <i>Activities</i>    | 13       | 137      | 7          | 6          | 43         | 94         |
| One task             | 4        | 55       | 3          | 1          | 14         | 41         |
| %                    | -        | 40       | -          | -          | 32.5       | 43.6       |
| Multitask            | 2        | 30       | 1          | 1          | 14         | 16         |
| Both                 | 7        | 52       | 3          | 4          | 15         | 37         |
| %                    | 53.8     | 37.9     | -          | 57.1       | 35         | 39.4       |

academics; 41 had affinity to maths and 16 to sports; 48 preferred to learn both by language and picture and 41 preferred single task activity. It may be noted that hearing was normal in all 160. Attitude, aptitude, behaviour, cordiality, perception and performance were normal in all 160.

Among left handers, 8 (61.5%) processed the information with the combination of all 4 ways: analysis, linear, synthesis, visual. In right handers, 53 (38.7%) processed the information with the combination of all 4 ways: analysis, linear, synthesis, visual (Table 6). In male left handers; 6 (6/8, (75%) processed the information by all 4 ways.

Among male right handers, 16 (16/53, (30.2%) processed the information by all 4 ways; from the percentage point of view, it is seen that 6 (6/

11, (54.5%) processed the information by one way; 2 each for linear or synthesis or visual. In female left handers, 2 (2/8, (25%) processed the information by all 4 ways.

Among female right handers; 37 (37/53, (69.8%) processed the information by all 4 ways and from the percentage point of view, it is seen that 23 (23/29, (79.3%) processed the information by 3 ways and that too 15 for the analysis, synthesis and visual; 33 (33/44, (75%) processed by 2 ways; out of which 16 were for analysis and visual.

## DISCUSSION

The finding of asymmetric functions in the human cerebral cortex led to the introduction of

**Table 6: Processing the information**

| <i>Hand Number</i> | <i>L</i><br>13 | <i>R</i><br>137 | <i>L-M</i><br>07 | <i>L-F</i><br>06 | <i>R-M</i><br>39 | <i>R-F</i><br>88 |
|--------------------|----------------|-----------------|------------------|------------------|------------------|------------------|
| <i>One Way</i>     | 1              | 11              | -                | 1                | 6                | 5                |
| %                  | 7.7            | 8.0             | -                | -                | 54.5             | -                |
| Analysis-A         | -              | 2               | -                | -                | -                | 2                |
| Linear-L           | -              | 2               | -                | -                | 2                | -                |
| Synthesis-S        | -              | 5               | -                | -                | 2                | 3                |
| Visual-V           | -              | 2               | -                | 1                | 2                | -                |
| <i>2 Ways</i>      | 2              | 44              | -                | 2                | 11               | 33               |
| %                  | 15.4           | 32.1            | -                | -                | -                | 75               |
| A and L            | -              | 8               | -                | -                | 5                | 3                |
| A and S            | 1              | 5               | -                | 1                | -                | 5                |
| A and V            | 1              | 17              | -                | 1                | 1                | 16               |
| L and S            | -              | -               | -                | -                | -                | -                |
| L and V            | -              | -               | -                | -                | -                | -                |
| S and V            | -              | 13              | -                | -                | 5                | 8                |
| S and L            | -              | 1               | -                | -                | -                | 1                |
| <i>3 Ways</i>      | 2              | 29              | 1                | 1                | 6                | 23               |
| %                  | 15.4           | 21.7            | -                | -                | -                | 79.3             |
| A, L and S         | -              | 4               | -                | -                | -                | 4                |
| A, L and V         | 1              | 4               | -                | 1                | 1                | 3                |
| A, S and V         | 1              | 19              | 1                | -                | 4                | 15               |
| L, S and V         | -              | -               | -                | -                | -                | -                |
| S, L and V         | -              | 1               | -                | -                | 1                | 1                |
| <i>4 Ways</i>      | 8              | 53              | 6                | 2                | 16               | 37               |
| A, L, S and V      | -              | -               | -                | -                | -                | -                |
| %                  | 61.5           | 38.7            | 75               | 25               | 30.2             | 69.8             |

the term hemispheric dominance. In right handers, over 95% have left hemisphere dominance. In left handers, dominance is more complex and language skills are more often shared between the hemispheres, although the left hemisphere is relatively dominant in about 70% of the individuals. While the left hemisphere usually specializes in language, the non-dominant hemisphere plays an important role in spatial cognition and particularly in face processing (Warrel et al. 2004).

Hemispheric specialization is related to handedness. Handedness appears to be genetically determined. Right handed individuals constitute 91% of the human population and in 96% of them, the left hemisphere is the dominant or the categorical hemisphere and in the remaining 4% the right hemisphere is dominant. Among the 4% of the left handed individuals, in approximately 15%, the right hemisphere is the categorical hemisphere; in another 15% there is no clear lateralization and in the remaining 70% the left hemisphere is the categorical hemisphere. It is interesting to note, that the learning disability dyslexia is 12 times as common in left handers as they are in right handers, possibly because some fundamental abnormality in the left hemisphere leads to a switch in handedness, early in devel-

opment. However, the spatial talents of left handers may be well above average; a disproportionately large number of artists, musicians, mathematicians are left handed. For unknown reasons, left handers have slightly but significantly shorter life spans than right handers. In addition to the anatomical differences in the brain, chemical differences also exist between the two sides of the brain; the concentration of dopamine is higher in the nigrostriatal pathway on the left side in right handed humans, but higher on the right in the left handers. The physiological significance of these differences is unknown (Ganong 2005).

Usually, the left hemisphere deals with verbal and linguistic functions, mathematical skills and analytical thinking. The right hemisphere is non-verbal and involved in spatial and holistic thinking, appreciation of music and some emotions. Lateralization is also seen for memory; verbal memory primarily is the function of left hemisphere and non-verbal is represented in the right hemisphere. The neuropsychological functions of execution (perception, spatial analysis, learned skilled movement, language, memory, problem solving) and emotion are organized within the cerebral hemisphere. The organization of the neuropsychological functions is highly lo-

calized and involves the association area of the neocortex and the limbic system. Cerebral anatomical asymmetries are reported to be apparent at both the macroscopic and microscopic levels; a large cortical sulcus surrounds the central sulcus in left hemisphere especially in the areas containing the primary somatosensory and motor maps of the arm, which suggests that the cerebral manifestation of hand preference is a larger amount of neural circuitry in the relevant parts of the cortex. It is reasonably assumed that these differences underlie some of the functional asymmetry for the representation of the language (Strandring 2008).

A number of theories are proposed for the handedness from the biological, environmental, sociological and genetic aspects (Hardyck and Petrionovich 1977). Biological aspects are the role of prenatal testosterone (Elkadi et al. 1999) and the possibility of handedness occurring as early as in the womb (Santrock 2008). Environmental aspects are birth stress (Coren 1990; Dayton 1991; Domellöf et al. 2011), prenatal vestibular asymmetry (Dieterich et al. 2004; Previc 1991) and maternal exposure to ultrasound during pregnancy (Salvesen et al. 1993; Kieler et al. 1998). Sociological aspects are the division of labor in the cerebral hemispheres; the most commonly accepted theory for the handedness. For the left handers, the advantages in general and in sports and combat as well as the disadvantages in the learning process are also proposed (Santrock 2008).

**Genetic Aspects:** i) In 2007, researchers discovered LRRTM1, the first gene linked to increased odds of being left-handed. However, handedness is not inherited from parents in a simple way. Even when both parents are left-handed, there is a 26% chance only of their child being left-handed. (Francks et al. 2007) ii) The Right Shift (RS) theory (Annett 2009) of handedness postulates a gene (RS) responsible for left cerebral hemisphere dominance. People with RS+ genotype would have left hemisphere dominance and it would increase the probability of right-handedness, while RS- would have both hemisphere dominance and handedness independently determined at random. The 2<sup>nd</sup> type of left-hander is the natural or genetic left-hander. Such persons function normally but are more likely to process language (at least in part) in the right hemisphere. The 3<sup>rd</sup> type of left hander is the learned left-hander. iii) Different modes of in-

formation-processing were studied; handedness and facility with intuitive and rationalistic modes of information processing was compared and no correlation was found (Giannini et al. 1984).

**Parental and Societal Pressure:** The offered explanation is that since most of the population is right-handed, parental pressure essentially teaches the behavior and the right-handed dominance continues. Social stigma and repression of left-handedness for many tools and procedures are often not realized. In many South Asian countries it is encouraged to use the right hand for acts like eating and drinking. (Santrock 2008).

### General Information

It is reported in literature, that, 70 to 90% of the world population is right-handed and 8 to 15% are left-handed. (Holder 1997; Ganong 2005) The proposed reason for the more number of males being left-handed is attributed to the role of prenatal testosterone; but there are studies which have not shown any difference in the handedness between the male and the female (Elkadi et al. 1999).

In the present study, the occurrence of the left handedness in 13 (8.1%) is within the reported percentage in the literature and the observed sex ratio in the study sample was 1.1 male to 1 female.

Studies have shown problems in language development in left-handers (Santrock 2008). The left cerebrum is for language and the right for spatial cognition and face processing (Strandring 2008). In the present study, it is the right handers (9 (12.9%)) and the male right handers (11) who seemed to know additional languages rather than the left handers.

Most of the population is right-handed; hence, parental pressure essentially teaches right-handedness as normal and the right-handed dominance continues (Santrock 2008). These preferences for the right or the left may be linked with handedness, later in development (Santrock 2008). In the present study, whether, left (11 (84.6%)) or right (144 (98%)); male or female; handedness was mostly natural and the parental influence was seen for 2 left handers (15.4%). Other activities, such as eating and sleeping with the opposite side other than by the left or the right handedness in writing, was seen in 13 left and 28 right handers.

### Family History

It is reported that handedness is not inherited from parents in a simple way. Even when both parents are left-handed, there is only a 26% chance of their child being left-handed. The rate of incidence is high enough, so that when members of the same family exhibit left-handedness by chance, it can look as though the trait is inherited (Francks et al. 2007). In the present study, members in the family of 3 male and 7 female left handers, had left handedness. Left handedness was found in the families of 8 male and 23 female right handers. Whether left or right handers or male or female, among the family members, left handedness was present in the brothers (16) and sisters (14). In this study, parental left handedness may not be correlated to the left handedness in the children; since, left handedness was seen in 5 fathers of the female right handers

### Physical Findings

It is to be noted, that 10% of the left handers in the population have to play 90% of the games against right-handed opponents (Santrock 2008). In the present study, among right handers, 147 were interested in sports; whereas 83 out of 147 were interested in extracurricular activities. Among left handers all 13 were interested in sports and only 6 were interested in extracurricular activities.

### Clinical Findings

In the present study, the percentages of the 'O' blood group in 46.1% (6) of the left handers and 40.8% (60) of the right handers, reflected the population occurrence of the 'O' blood group.

### Activities Related to CNS

It is opined, that right hand appears specialized for finer movements and the left for broader, contextual movements (Guiard 1987). In the present study, handwriting was artistic (3) or discontinuous (5) or Illegible (1) in 7 male left handers and in the rest (153), it was normal. The spatial talents of left handers may be well above average; a disproportionately large number of artists, musicians, mathematicians are left handed (Ganong 2005). Studies have shown that left-handers tend to have unusually good visual-

spatial skills and the ability to imagine spatial layouts; mathematicians, musicians, architects and artists are more commonly left-handers than would be expected. It is also reported that among the students who have undertaken the Scholastic Aptitude Test, 20% of the top-scoring group was left-handed, twice the rate of left-handedness found in the general population (10%) (Santrock 2008). In the present study, the findings were: i) 4 (30.8%) left handers showed short attention span; ii) personality was artistic (3) or creative (5) or visionary (5) in male left handers and artistic in 17 male right handers; iii) excellence in academics and non-academics was of 38.5% (5) in left and 15.6% (23) in the right handers; iv) out of 13 left handers 4 showed high affinity for mathematics and 5 towards sports and among 147 right handers 63 to maths and 30 to sports; v) in 8 left handers, learning was preferred by language and picture and it was 69 in right handers; vi) Single and multitask activities was preferred by 7 left and 52 right handers. All 160 were interested in music and the attitude, aptitude, behaviour and personality were normal. The significance is that between the left and right handedness, differences could not be observed. Stuttering is found to be associated with right cerebral dominance and widespread over activity in the cerebral cortex and cerebellum, including increased activity of the supplementary motor area (Ganong 2005). Right cerebral dominance indicates left handedness. In the present study, the number of students stuttering in the left or the right hander groups was too small to comment further. Action and reaction responses were normal in the 13 left handers and clumsy or verbal or physical in the right handers (13, 8.8).

### Processing the Information

Men have larger brains than women and are said to have superior spatial skills and ability to navigate and it is suggested that the greater brain weight of men is due to more neuronal components (Ganong 2005). Usually, the left hemisphere is for the verbal and linguistic functions, mathematical skills and analytical thinking. The right hemisphere is non-verbal and involved in spatial and holistic thinking, appreciation of music and some emotions. Lateralization is also seen for memory; verbal memory primarily is the function of left hemisphere and non-verbal is represented in the right hemisphere (Standing 2008).



In the present study, the processing the information was analyzed for analysis or linear or synthesis or visual by one way or by the combinations of 2 or 3 or 4. It appeared that left and right handers have preferred the 4 way processing of the information; but from the percentage calculation, it is seen that left handers have showed a high percentage (61.5%) when compared to the right handers (38.7%). Among the 4 types of the processing of the information, male left handers have preferred the 4 ways (75%); male right handers for the one way (54.5%); female left handers have shown the same percentage of 25% for the 2 and 4 ways and female right handers for the 3 ways (79.3%).

From literature, it is seen, that left cerebrum is for the verbal, linguistic, mathematics and analytical aspects of learning. In the present study, right handers, male and female were interested in maths; male right handers seemed to know more languages and were more analytical. On the other hand, right cerebrum is for the non-verbal, spatial and holistic aspects of learning. In the present study, male left handers preferred to learn by analysis, linear, synthesis and visual.

In view of the paucity of the information, some of the observations from the present study, such as, birth order, menarche, consanguinity, medical conditions in the family and the students, body build and asymmetry, vision and hearing, types of tasks undertaken and the difference between the male and female left or right handers, could not be discussed.

### Inference

The findings that were common for both the male and female and the left and right handers were: 1) Handedness was natural. 2) Parents were distantly related. 3) Most of them were moderately built. 4) All were interested in sports. 5) Attitude, aptitude, behaviour, cordiality, perception, and performance were normal. 6) Learning was preferred both by language and picture. From the observations any findings that were above 50 % and findings noted in a particular group were related to the handedness:

In left handers: i) blood group was found to be 'O'; ii) at any given time it was either single and or multitask activities; iii) processing the information was by applying the ways of analysis, synthesis, linear and visual.

In right handers: i) 1<sup>st</sup> born; ii) most of them appeared to be tall; iii) they only had 'AB' blood group; iii) affinity to mathematics was noted; iv) action and reaction responses were clumsy or verbal or physical.

In male left handers: i) blood group was 'O'; ii) handwriting was found to be artistic, discontinuous and illegible; iii) personality was artistic/ creative/ visionary; iv) learning was preferred both by language and picture; v) activities at any given time was single and or multitask; vi) processing the information was by applying the ways of analysis, synthesis, linear and visual.

In male right handers: i) personality was artistic; ii) they were interested in non-academic activities; iii) they had affinity to mathematics; iv) activities at any given time could be single and or multitask; v) processing the information was by applying analysis or synthesis or linear or visual.

In female left handers: i) left handedness was present in the family; ii) activities at any given time could be single and or multitask.

In female right handers: i) personality was artistic; ii) they had high affinity to mathematics; iii) learning was preferred both by language and picture; iv) activities at any given time was single task; iv) processing the information was by applying the ways of analysis, synthesis and visual.

This information may possibly are being reported for the first time. Moreover, even in left handers 70% of the times, there exists the dominance of the right cerebrum. The observations and the differences may also be because of the known as well as the not yet known asymmetry in the nervous system.

### CONCLUSION

Being a pilot study, the findings were found to be interesting. It is seen that whether right or left handedness; the handedness was natural rather than due to parental or societal pressure; all were interested in sports; attitude, aptitude, behaviour, cordiality, perception, and performance were normal and the process of the learning was preferred both by language and picture.

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