

Left-Handedness and Its Inheritance

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ABSTRACT Hands perform myriads of functions. 90 per cent of the people are right-handed and the remaining ten per cent left-handed. The handedness is under the influence of both nature and nurture. The incidence varies from population to population. Twins, psychologically disturbed and mentally retarded exhibit high incidence. Right-handedness is inherited as an autosomal dominant trait. When both parents are left-handed, some children contrary to the expectation, exhibit right-handedness. Rife (1940) propounded a convincing explanation for this phenomenon. The problems, safe gaurds and the advantages of the left-handers are explained.

As the man acquired the bipedal mode of locomotion, his hands became free and got involved to perform myriads of functions. Although all the functions of the body are synchronised by the central nervous system, yet most of the physical actions are carried through by the hands and as such the hands, next to brains, are the most important organs of the body. Each human hand has in total 27 bones and the articulation of these bones with themselves and with the other bones of the lower arm- namely radius and Ulna have made the hands so amazingly perfect in the co-ordination of the movements, flexibility, manoeuvrability and adjustability as to carry out many simple and intricate jobs with a remarkable precision unknown to the other living creatures. The greatest boon to the hand is that of the opposable thumb, which helps in grasping the objects from both the sides. The importance and the need of the opposable thumb can only be felt when a person has lost his thumb in an accident or the thumb is malfunctioning. Such a person feels miserable while taking a grip of the objects. He desperately struggles to have the grasp of the objects but they continue to slip away. The only alternative for him is to use both of his hands from both the sides of the objects.

IMPORTANCE OF THE OPPOSABLE THUMB

The importance of the opposable thumb can very well be understood from a legend of Mahabharata. Rajguru Dronacharya - a wizard in archery and other warfare affairs was requested by the King to give the training to Pandavas and Kauravas. During the time of his training, Eklavya who was the son of a Charioter also approached him for the same training; but he was dissuaded, discouraged and denied and was told that the training was meant for the children of the Royal families and not for the low caste. Eklavya though discouraged had determined to have such a training. In this pursuit he made an idol of Dronacharya and started practicing with a devotion and thus excelled in archery. When Dronacharya came to know of it, he met Eklavya who narrated to him about his practice and achievements through the inspiration of idol of Rajguru. Dronacharya never wanted that anyone other than his favourite Arjun to excel in archery. The Guru asked Eklavya for *Gurudakshina* and which Eklavya readily agreed to give anything. Knowing Eklavya was right hander, the Guru very cleverly asked for the right hand thumb. A true devotee and Votary of Dronacharya, Eklavya instantaneously chopped off his thumb and presented it as *Gurudakshina*. Dronacharya was aware that without the thumb of right hand Eklavya would not be able to shoot the arrow with precision. Thus Arjun continued to be matchless in archery.

HANDEDNESS

Ojemann (1930), Wile (1934) have reported the studies in handedness. According to Mosby's Medical Dictionary (1992) handedness is voluntary and involuntary preference for use of either the left or right hand. The preference is related to cerebral dominance, with

left-handedness corresponding to the dominance of the right side of the brain and *vice versa*. Also called chirality, laterality.

The normal hand is able to perform many simple and sophisticated functions. The prehistoric man had a few simple activities to perform, *viz.* grasping, shooting the arrow, throwing, killing, eating. With the increase of size of brain and the development of his faculties, the man with his ingenuity and the technical skill was able to perform many specialised jobs with his hands. Besides there were gradual changes in the social activities and also the changes in the climate, which impelled and compelled the man to utilise the material as well as the technical knowledge acquired for his survival. During the adverse times of climes he needed the protection to his body and he used the skin of the hunted animals for clothing. He thus learnt other skills and host of other activities through his hands, *viz.*, stitching, putting thread in the needle, swinging, striking stones to make fire, and then progressively holding the pen, making the sketch, holding the spoon, distributing the cards, putting the key in the keyhole, striking the match (Falek 1958). Writing is considered to be the most important activity of the hand. It is the important activity of the hand. It is said that the normal adult brain has 16 lakhs cells. By speaking we use only three lakhs of cells, while writing we use more than 13 lakhs of cells.

When a person is able to carry out most of the above activities with his right hand, he is termed to be right-handed, irrespective of the sex and age. Almost 90 per cent of the population is right-handed.

Left-Handedness

Left handedness may be described as a natural tendency by some persons to favour the use of the left hand in performing most of the activities mentioned above. It is also called sinistrality. In general 10 per cent of the population is left-hander. Stuttering the disturbance of speech is very much closely linked with handedness. The boys suffer four times more than girls, when the stuttering is observed in left-handed children, who have been pestered or pressurised to shift to right-handedness. Switching back to left-handedness makes a great improvement. Par-

son (1924), Siemens (1924) have made some observations of left-handedness.

Right Handedness

It maybe described as a natural tendency to favour the use of right hand (Collan 1881). Also called dextrality. The use of right or left organ of the body is not restricted to hands only and there may be other organs also *e.g.*, eyes (Kuroda, 1927; Woo, 1927; Walls, 1951; Marrell, 1957). In 1994 it was reported that most people are right eyed, just as most people are right-handers. Almost every one prefers one eye when peeping the universe through telescope. This study reveals that people have a dominant eye, when either of the two could be used.

Since most of the animals walk on all four, the preference for right-or left handedness in animals has not been reported. However, this observation can be made, say in cats, dogs or cattle, when after the sleep or rest or other being in stationary position, whether they put their right or left paw forward while initiating the walk. The apes and specially the Chimpanze is in terms of organic evolution, more closer to human being. Thus it will be interesting to observe this phenomenon if they are right or left-handers. Some observations have been made in some of the animals. Eg. All Australian Glossy Black Cockatoos are left footed. There are elephants who are either right or left tusked, and the tusk most used is shorter. Looking at the pictures or idols of Lord Ganesh, some of them show their tusk on the right side, whereas some exhibit it to be on the left side. While in some the tusk takes a little curvature and comes to stand on the centre.

However, there are a few, who are ambidextrous and are so versatile that they are able to carry out the activities with either of their hands with equal ease.

Incidence of Left Handedness

The presence of left-handedness may vary according to age (Jones 1931), sex (Wilson and Dolan 1930), and race (Matthews 1997). In general population 10 per cent of population exhibit the left-handedness. In Asian countries it is 10 per cent and in European countries it is three to eight per cent. A century ago only two per cent of the population in North America was

left-handed and presently it has gone high to 12 per cent. In Taiwan the incidence is less than one per cent. Twins have significantly higher frequency and the gene responsible for this trait has a high degree of penetrance than among the single borns. Clinically or psychologically disturbed group exhibit a high incidence and in mentally retarded population it is as high as 18 per cent. Some believe that the maternal age beyond 30 years enhances the incidence of left-handed children. The left-handedness is not the phenomenon of the present as its evidence has been reported on fossils and paintings of the prehistoric times. A team of research workers at the University of California observed that the incidence of left-handed was greater in prehistoric times. In individuals with brain injuries the incidence is more than in the groups of normal individuals.

As mentioned earlier in this paper, 90 per cent of people are right-handed and only 10 per cent are left handers. The question arises as to why are the left handers in such a minority. Many theories were ascribed to this phenomenon. One of them could be a Darwinian theory of natural selection. In primitive warfare the right hander wielded a spear or sword in the right hand, while the left hand carried the shield to protect the heart-the vital organ which pumped the blood in the body. Those who hold the shield in the right hand and fought with his left hand could not protect themselves and the heart was exposed to injury and fatal wounds. In a few thousands years of warfare the left handers were reduced in frequency due to natural selection.

Is Left-handedness Inherited?

Kelvin Laland (cited by Matthew, 1997) at the University of Cambridge carried out the investigations and reported that it is under the influence of both nature and nurture. He and his co-workers found that having both parents right-handed boosted the chances of right handed offspring by an extra 14 per cent. While having two left-handed parents cuts the chances by similar per cent. This team tested this observation to predict the expected ratio for handedness among monozygotic and dizygotic twins. The predicted ratio are impressive good fit for the handedness in twins. There are some other fac-

tors, social and cultural, which influence and could be the cause, specially the mothers who would oftenly encourage their left-handed children to use right hands and may sometimes punish them for defying. It is an accepted fact that every one had the genes that makes right-handedness more than left-handedness. Although monozygotic twins (Wilson and Jones, 1932) are endowed with the same genetic constitution, yet they do not have always identical handedness and this can be attributed to the social and cultural pressures. Jordan (1911, 1914), Kamaley (1913), and Chamberlan (1928), have also made their respective observations on the inheritance of the left-handedness.

As already reported the right-handedness depends on the dominance of the right hemisphere (Annett, 1964) leads to the left-handedness and *vice-versa*. When the left cerebral hemisphere is injured, the right-hander switches to left handedness. The injury can be at the time of delivery or when the children born is premature. Such children are bound to be about five times more left-handers or ambidextrous as compared to the children born normally. In one of the recent report by Mohinder Singh (1995). If your mother was left-handed, your chances of being left-handed was approximately double. Can it be attributed to the extranuclear inheritance?, where the mitochondria which are present in the mothers only, play the role. Father's handedness does not seem to matter that much. If both the mother and father are left-handed, your chances of being left-handed, rises between three to four out of ten, and when both the parents are endowed with right-handedness, the odds are about one in ten.

Genetics of Left-handedness

Ramaley (1913) showed left-handedness is inherited as an autosomal recessive trait. His observations were based on two families, in which both the parents were left-handers and in one of these families, not all the children showed left-handedness as would be expected from the autosomal recessive trait.

If we go by the hypothesis that right-handedness is an autosomal dominant (R) and left-handedness to be inherited as an autosomal recessive (r), the following would be the

genotypes RR and Rr both dominant and rr as recessive.

- (A) When both the parents are right-handers, there could possibly be three types of parental combinations and their respective genotypes could be (i) $RR \times RR$, (ii) $RR \times Rr$ or $Rr \times RR$, and (iii) $Rr \times Rr$. Let us examine each combination.
- When both the parents are phenotypically right-handers and genotypically homozygous dominant $RR \times RR$. All the children would be phenotypically right-handers and genotypically RR .
 - When both the parents are phenotypically right-handers but genotypically one is homozygous dominant (RR) and the other is genotypically heterozygous (Rr). All the children expected would be phenotypically right-handers but genotypically 50 per cent RR and the other 50 per cent Rr .
 - The third possible parental combination could be when both of them are phenotypically right-handers but genotypically heterozygous dominant Rr . The children expected in such a combining are phenotypically right-handers and left-handers in the ratio of 3:1, while genotypically 1: RR :2: Rr :1: rr .
- (B) Exploring yet other combinations, when one of the parent is right-hander, while the other is left hander, there could possibly be the following genotypes (i) $RR \times rr$ and (ii) $Rr \times rr$.
- When one of the right-hander parent is genotypically homozygous RR , while the other is left hander and genotypically homozygous rr . All the children expected are phenotypically right-handers and genotypically heterozygous Rr .
 - The other parental combination could possibly be genotypically heterozygous Rr , while the other left-hander genotypically rr . The progeny expected in such cases would be right-handers and left-handers in the ratio of 50:50 but with Rr and rr genotypes.
- (C) Finally when both the spouses are left handers with rr genotypes. In such cases,

all the children expected would be left-handers with rr genotype.

In actual observations it has been found that in the combination when both the parents are left-handers, considering the left-handedness to be autosomal recessive, some children exhibit the right-handedness contrary to the expectation. Inevitably there has to be some such other factor playing its role and need some explanation. The explanation to such a phenomenon has been convincingly depicted by Rife (1940, 1951) in his pioneer work. He stated that when both the parents are right-handers ($R \times R$). Only about six per cent of children are left-handers, and when one parent is left-hander ($R \times L$), this per centage goes up to 17 per cent, but when both parents are left-handers ($L \times L$), 50 per cent of these children are left handers. The RR individuals are strongly right-handers and are not easily influenced to change their preferences. People with rr genotype are thought to be strongly left-handers and are not influenced to prefer right-hand. In contrast the heterozygotes (Rr) are thought to be more variable. They are potentially ambidextrous and a thought to be easily influenced by the environment and social training. The left-handed person of the ambidextrous variety, may have this gene R and transmit it to a child who may then be right-handed. This is how one can explain two left-handed parents have right-handed children. Same explanation is valid when in monozygotic twins-one is left-hander, while the other is a right-hander. If both the parents are heterozygotes (Rr), gene R may express its phenotype in one twin, and the gene r in the other twin.

Amar J.S. Klar (1997), a geneticist from Maryland U.S.A., reported that a singly gene may separate most right-handers from left-handers. He studied three generations and observed that the people endowed with the gene are right-handers and those without it have 50-50 chances of being either right or left-hander.

Eminent Left-Handed Personalities

Many of the left-handers are talented and have made an excellent contribution in science and other fields. 20 per cent of mathematical genius with high I.Q. are left-handers. Of the last five American Presidents, four namely Ford,

Reagan, Bush and Clinton - have been left-handers. Also in the last two American elections, all the front runners were left-handers. The others belonging to the club of left-handers are Albert Einstein, Prince William of Royal family of U.K., Charlie Chaplin, Julius Ceasar, the famous Artist Leonard-da-Vinci, Napoleon, Paul-de-Carten, Joan of arc. In sports e.g. Martina Navaratilova, Monica Sales, John Mc-Enore, Pcter Korda, Marcelo Rios are left-handers. In cricket the Australians had as many as six batsmen in the team who were left-handers and made many runs. Robert Graeme Pollack was a left handed batsman. Among Indians Saurav Ganguly a front line player, former Indian test cricket Captain Bishan Singh Bedi was the best left arm spinner, Vinod Kambli is yet another left hand player. From Sri Lanka Jaya Suraya made the highest record of runs in cricket, Lara who made a record of 365 runs is also a left-hander. Among the Hollywood stars was Marilyn Monroe and the Indian matinee idol Amitabh Bachchan are bestowed with left-handed. There has been some left-handers who lived long, e.g. Pablo Picasso (92), Charle Chaplin (88), Benjamin Franklin (84), Queen Victoria (82), Regan who has crosed 85 years.

Ambidextrous

Besides right and left-handers, there are a few who can use both of their hands with equal case and are termed as ambidextrous. Mahatma Gandhi could use both of his hands for writing with equal case, and so was Leonardo-da-Vinci the great Italian painter was gifted of writing with both of his hands. Darren Wernet of California can pitch Basket Ball with 76 mph with his left hand and with 74 mph with his right hands. Swiss artist Paul Klee wrote with his right hand and painted with his left had.

Problems of Left-Handers

It is a great inconvenience to the left-handers. They are always at a great-risk of accidents as compared to the right-handers. The left hander is comparatively clumsy in playing games, handling tools in industries, mills, shops and almost every where, for they are all designed by right handers. Many controls in machinery, electric gadgets, kitchen utensils are designed

on the right side. Even the seating arrangements in theater, schools, offices and working places accommodate right-handers. The left-handers are left to mend and fend for themselves. The most common example is the use of scissors in which the blades are tapered for the right hand use. Moreover the holding of such scissors in which the thumb is inserted in the hole and the other fingers in the other hole, the left-hander cannot hold it, what to talk of use of the scissors.

This minority group of left-handers struggle hard to avoid collision during meal times. The left-handers is comparatively clumsy in playing games, handling tools. As such he is exposed to more accidents and injuries specially during the times of hazards like fires when the reflexes have to be quick and impulsive. Besides the use of the left hand is considered to be bad and impure and out of etiquette, since it is used to perform the excremental tasks and continues to be impure even after washing. Specially in India the people look down the person who eats with his left-hand. It is considered to be a sin to offer anything with the left hand. On the common dinning table when the left-hander takes out any eatable with his left hand, the common plate with eatable becomes polute and others would avoid taking out anything out of that plate. In ancient Japan the man would not marry a girl who was left-hander and if married the man could divorce his wife if she was left-hander. Militants who are left handers have complied the list of things which either they cannot operate or can do without an accuracy.

Shunned by the peers, bycotted by the society, ridiculed by the seers and dislinked by most of the people, the left-handers develop some sort of inferiority complex and many-atimes avoid social gatherings and many of them become isolated and depressed. Will someone take up the course of the minority group and make them feel at ease?

In 1978 a group of more than 75 left-handers took to agitation to Toronto. They marched through the town in support of their rights. They demonstrated and said the most of the office tools, sports equipment are designed for the right-handers only. While the remaining 10 per cent of left-handers were discriminated. Words like 'Sinister' and 'gauche', which both meant

'left', expressed the attitude of right-handers towards left-handers. The demonstrators carried the playcards reading, 'Gauche Power'. After the bomb only the best will be 'left' and abolish 'Leftovers'. These marchers were restricted to the right-hand side of the street and had to obey no left-turn signs, which they said resented.

Safeguards for the Left-Handers

Of all the groups of people, children are the most sensitive and the left-handed specially feel more slighted by the classmates in the school. The school teachers of such childrens have a great role to play by encouraging them. The parents also at home and the other normal sibs should not pester or ridicule them to switch to right-handedness. The society should go soft and encourage such children lest they become drop-outs. Such children be given free books, free education and even stipends and scholar- ships.

As mentioned earlier, 10 per cent of the population is of left-handers and naturally they cannot be ignored or left out. The tool making industry and heavy machine making industry, even the vehicle making industry, should design the tools in such a way that this minority group can carry out, handle and operate with ease, with maximum degree of precision and avoid the accidents and injuries to self and others. Left handers should help themselves by forming clubs where they can regularly meet, to understand, discuss, formulate and find solutions to their problems from time to time. Above all some sort of incentive should be provided to them by the state to keep the left-handers in good spirits.

The tool making industry should see that the tools and gadgets are designed in such a way as they can conveniently be used by the left handers. Even the vehicles should be made in such a way that the left-handers can easily drive and avoid the accidents.

In every town there should be some shopping centres where the necessary things for the left-handers be made available. A very few and handful of the right-handers have given a serious thought to make these left-handers stigma free and accordingly design such equipment to make their life activities more productive, easier and full with efficiency.

Keith Milson in Central London is the director of the shop 'Any thing left-handed' running from the last 30 years, offers the refund if any customer is not satisfied to what has been purchased. This shop also offers the specially designed scissors for every function of embroidery to hair cut. For left-handed children this shop offers the excellent books on the subject helping children to enjoy handwriting. 'A friend in need is a friend indeed' and this shop is a boon to the left-handers indeed.

Recently an interesting and welcome innovation has been made by a bank. This bank has brought out a cheque book for the left-handers. No doubt this bank has given a good and a serious consideration, and has perhaps invoked other to follow the suit. Some insurance organisations are considering for the special insurance covers to the left-handers.

Advantages of being the Left-Hander

Although the left-handers are shunned by the society and considered impure, nonetheless they have many other advantages. As mentioned earlier, all the office equipments, machines and other electronic gadgets, computers are designed for the right-handers, and as such they are very much exposed to accidents and other professional hazards. The left-handers are certainly at an advantageous position as they can carry out these operations with their left-hands. Imagine the misery of right-hander when his right hand is injured in accident, he feels handicapped. He cannot eat properly, nor can be put his signatures on the document or even bank cheques. Most of the activities of life requiring action cannot be carried out. Hands are so important that in some unfortunate times of accidents the people are anxious to know if it is right or left. In such situations even the ambidextrous individuals are certainly in most advantageous position but unfortunately there are only a very few persons who can carry out all the activities of life with equal ease and efficiency with both of their hands.

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