

Analysis of Hand Usage Behavior According to the Dominant Hand in Normal Person

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Abstract

In this study, 1,933 Korean male and female subjects ranging in age from 10 to 82 were selected to investigate the various statistics about hand dominance and employment characteristics of preferred hand in handling diverse products and facilities. The statistics show that 5.6% are left-handed and 7.6% are ambidextrous. The average left-hander has a strong tendency to use his or her left hand more often when taking a forceful action than one that requires accuracy. On the contrary, the average ambidextrous or right-handed person generally uses his or her right hand more with action that requires accuracy than force. Derived from such results, the conclusion is that depending on which hand is the dominant one, people seem to use their hands differently when they handle objects and is a point that should be considered in designing hand control devices.

Key Words: Dominant hand; Hand dominance handedness; Left-handed ambidextrous.

Introduction

The human brain, along with hands, legs, eyes and ears, are all body parts that are symmetrically the same on the left and right sides, but each side carries out a different role. Including Corballis (1980), many scientists, doctors and psychiatrists find that the human brain is divided into left and right domains and function accordingly. The left brain covers logic, analysis and command of language while the right brain is creative, artistic and processes visual and spatial information. Studies report human hands (Falek, 1959; Hardyck and Petrinovich, 1977), legs (Augustyn and Peters, 1986; Brown and Taylor, 1988), eyes (Bourassa et al, 1996; Brown and Taylor, 1988), and ears (Jung and Jung, 2003; Tolleth, 1978)

differ in size between left and right ones and one is preferred or used more often over the other. Therefore, the 2 symmetrical body parts may look the same but their roles seem to be different.

The most indicative action that displays the asymmetrical function of the human brain is handedness. As hand dominance affects how the cerebrum, which is mainly in charge of speech and language, functions, psychiatrists, specialists in neurology and scientists have conducted various researches on hand dominance. With allowance of slight racial differences, about 90% of the general population is right-handed (Previc and Saucedo, 1992). however, 4.5~6.2% (average 5%) of the adult population and 17% of the child population in Korea are left-handed, which in total exceeds 2 million people.

A majority of the people may not realize it, but we live in a right hand-oriented world. Various kitchen supplies are also made for the right-handed as well as shirt pocket, button position, computer keyboard and mouse and door handle are all sources of little inconveniences for the left-handed. At the table during mealtime, a left-handed person has to sit at the far left end. If he or she chose to sit at the middle or seat on the right, arms would be bumping together with the person seated on the left. Social and cultural prejudice toward the left-handed is far more than little and just not enough specialized products and social consideration around. The simple reality is that the left-handed are highly inconvenienced in carrying out their daily tasks and routines.

The left-hander in question would experience inconveniences and at the same time become a potential risk factor to the public's health and security. Moreover, assuming that work flow or distribution of work space is passively designed to fit the average right-handed worker, an unaccustomed left-handed worker would bring down work efficiency and run a higher risk of accidents and injuries (Coren, 1989; Winder et al, 2002). Consequently, promotion may be hindered and could end up either way: turning in one's job resignation or receiving a termination notice.

On the other hand, Hoffmann and Halliday (1997) find that hand dominance is irrelevant in regards to performance and learning ability in assembly lines. Recently, products to make life more convenient for the left-handed are manufactured locally and sold in

specialty stores. In particular, the US and England carry many specially designed products for left-handed users. Nevertheless, demand and supply of these products are not in balance and makes mass production difficult. Either prices are very high or products are not easy to obtain as most of them are imported. The level of consideration for the social minority is an important yardstick of how advanced a society is. It is time to take better care of the left-handed in a more realistic way. They should be able to utilize everyday products more easily and be provided with appropriate tools.

In this study, 1,933 Koreans were randomly selected and surveyed to gather various statistics on hand dominance and observe characteristics of the hand that was used to handle objects according to the dominant hand. In addition, left-handed subjects were asked about any daily inconveniences and injury incidents that they experienced from using right-handed products.

Methods

Subjects

This study was conducted on a total of 1,933 Koreans ranging in age from 10 to 82 with male and female compositions being 1,086 (56.2%) and 847 (43.8%) respectively. Places of survey were junior high and high schools for subjects in their 10s, college campuses for those in their 20s, and churches, bus

Table 1. Age and gender distribution by age stratification

(N=1,933)

Age	Mean age (SD)	Gender		Total
		Male	Female	
10s	15.1 (2.4)	306	246	552 (28.6%)
20s	23.8 (2.7)	425	303	728 (37.7%)
30s	33.6 (2.8)	118	92	210 (10.9%)
40s	44.0 (2.9)	98	92	190 (9.8%)
50s	53.5 (2.8)	84	46	130 (6.7%)
Over 60	67.2 (5.1)	55	68	123 (6.4%)
Total	29.1 (15.2)	1,086 (56.2%)	847 (43.8%)	1,933 (100%)

terminals and train stations for various age groups. Parks and retirement homes were visited as well to survey elderly subjects. Table 1 shows age and gender distribution of subjects by age stratification.

Survey Methods

The subjects were asked to write their age and gender and fill out answers to questions about whichever hand they used the most when handling objects. In order to appropriately investigate hand usage according to the dominant hand, questions related to the dominant hand were asked afterwards as prior thoughts about it would affect how they answered questions about hand usage.

Statistical Analysis

According to the dominant hand, technical statistics using SPSS 10.0 for windows on integrated data, gender, and age characteristics by each item were analyzed. Chi-squared verification and two-way ANOVA were conducted to ascertain differences in characteristics according to the dominant hand. Level of significance was 5% for all statistics.

Results

Overall statistics of the dominant hand

The reality is that right-handedness is preferred

to left-handedness and many groundless prejudices about the latter do exist. Percentage of left-handers vary by country from 5~30%, and there is no scientific evidence that indicates the percentage to be particularly small in Korea.

Percentage of dominant hand is shown in Table 2. Out of a total of 1,933 subjects, 1,677 (86.8%) were right-handed, 109 (5.6%) left-handed and 147 (7.6%) ambidextrous. More subjects answered that they were ambidextrous than left-handed and if the ambidextrous were to be counted as left-handed, the total number of left-handed subjects would be 256 (13.2%). Meanwhile, Gilbert and Wysocki (1992) found that left-handed figures of whites, blacks and North American Indians were slightly higher compared to those of Asians (9.3%) or Hispanics (9.1%). To explain, gaps may exist due to differing assessment tools or ways of deciding the dominant hand (that is, whether to consider the ambidextrous as left-handed or not) and incoherent age stratification.

In particular, some that answered to be left-handed may have been forced to use their left hand in daily routines because their right hand was injured in a traffic or industrial accident or daily activity. At the same time, some that were originally left-handed may now have naturally become right-handed or ambidextrous to ease the stress caused by social or parental pressure and make work adjustment and living in general easier.

Table 2. Distribution of dominant hand by gender and age stratification

	Dominant hand									χ^2
	Left-handed			Ambidextrous			Right-handed			
	Male	Female	Sub-total	Male	Female	Sub-total	Male	Female	Sub-total	
10s	19	15	34	28	33	61	259	198	457	
20s	29	18	47	32	29	61	364	256	620	*40.117
30s	8	8	16	7	5	12	103	79	182	(.000)
40s	4	4	8	5	2	7	89	86	175	**1.789
50s	3	1	4	1	0	1	80	45	125	(.409)
Over 60	0	0	0	2	3	5	53	65	118	
Total	63	46	109	75	72	147	948	729	1,677	

*Age: $\chi^2(p)$.

**Gender: $\chi^2(p)$.

Comparative Analysis by Gender and Age Stratification

It has already been established that gender and age backgrounds affect how a person becomes left-handed or not. Gilbert and Wysocki (1992)'s study of 1,177,507 subjects found that more males (12.6%) were left-handed than females (9.9%) and likewise, more in younger age stratifications of 10s and 20s (males 14%, females 12%) than older stratification (both gender around 6%).

More closely to home, according to Min et al (1996), a total of 2,852 elementary school students

from grade 1 to 3 were surveyed. Results showed 17.3% of the total count to be left-handed and by gender, boys (18.6%) had a higher percentage of left-handedness than girls (15.8%). This percentage declined as grades became higher with 19.1% of 1st graders, 18.1% of 2nd graders and 14.8% of 3rd graders being left-handed. Reasons to why there are less left-handed kids as they become older are that an increasing percentage of kids use their right hand pressured by society's preference to the right hand (Porac et al, 1986) and the left-handed have a higher death rate due to accidents (Halpern and Coren,

Table 3. Percentage of left-handedness by gender and age stratification

	Male			Female		
	Constituent	Left-handed	Percentage	Constituent	Left-handed	Percentage
10s	306	19	6.2	246	15	6.1
20s	425	29	6.8	303	18	5.9
30s	118	8	6.8	92	8	8.7
40s	98	4	4.1	92	4	4.3
50s	84	3	3.6	46	1	2.2
Over 60	55	0	0	68	0	0
Total	1,086	63	5.8	847	46	5.4

Table 4. Analysis of preferred hand usage by dominant hand and required motion

Performing motion	Dominant hand						p
	Left-handed		Ambidextrous		Right-handed		
	Left	Right	Left	Right	Left	Right	
Exercising	89	20	52	95	23	1,654	.000
Hammering	87	22	52	95	24	1,653	.007
Inserting subway pass	60	49	47	100	55	1,622	.006
Kicking ball	71	38	55	92	55	1,622	.001
Pressing buttons	58	51	58	89	147	1,530	.302
Pushing/pulling door	77	32	75	72	259	1,418	.758
Throwing ball	86	23	60	87	27	1,650	.000
Triggering gun	62	47	46	101	44	1,633	.254
Using knife	90	19	58	89	22	1,655	.056
Using scissors	79	30	50	97	13	1,664	.843
Using spoon/chopsticks	67	42	40	107	11	1,666	.112
Writing	57	52	11	136	4	1,673	.001
Zippering/unzippering	63	46	57	90	122	1,555	.003
Total	946 (66.8%)	471 (33.2%)	661 (34.6%)	1,250 (65.4%)	806 (3.7%)	20,995 (96.3%)	

1990). But a clear explanation is yet to be provided.

With the survey data, distribution of the dominant hand by gender and age stratification has been calculated as in Table 2. When the left hand was the dominant one, male and female percentages were 58% and 42% respectively and those under the age of 30 accounted for 90% of all left-handed subjects. These findings are similar to those of Gilbert and Wysocki (1992), Gotestam (1990), and Min et al (1996).

Chi-squared verification showed that the distribution by age stratification fell within the significant level of $p < .001$ whereas that by gender did not ($p = .409$). With less and less sample count further up the age range, the absolute percentage of left-handed subjects was low over the age of 30. However, a look at Table 3, which displays the relative percentage of left-handedness by gender and age stratification, finds more male (5.8%) than female (5.4%) subjects to be left-handed.

Analysis of Hand Usage Behavior According to Dominant Hand

In order to analyze hand usage behavior according to the dominant hand, observations were made respectively for various motions shown in Table 4. Results show that overall left-handed subjects had a strong tendency to use their left hand, but when it came to writing, there was not much difference between left-hand and right-hand percentages (1:91). It may be assumed that as books, notebooks and desks are geared for the right-handed user, it would have been quite difficult to write with the left hand. It could also be that teachers or parents forced the use of right hand when young and while still being left-handed, right-handed writing habits were formed. Ambidextrous subjects tended to use their right hand more than their left hand, except when pushing and pulling entrance doors. And as expected, right-handed subjects had a high tendency to use their right hand.

As dominant hand percentages differ between male and female, two-way ANOVA was conducted by

setting gender and dominant hand as independent variables. Significant differences between the two variables did not exist in regards to using scissors ($p = .843$), pressing telephone or cash machine buttons ($p = .302$), pulling gun trigger ($p = .254$), using spoon or chopsticks ($p = .112$) and pushing and pulling entrance door ($p = .758$), but did exist ($p < .05$) as for the rest of the motions. In addition, subjects were asked on which side of the street or sidewalk they pass (left or right). Results were respectively, 57% and 41% of the left-handed and right-handed subjects passed on the left side while the ambidextrous did not show preference to either side.

Min et al (1996) did a study on 2,852 elementary school students (grades 1~3) in regards to writing, using spoon, using scissors, throwing and kicking ball. In total, 82.7% answered that they did all 5 motions with their right hand and 18.6% of boys and 15.8% of girls did at least one motion with their left hand. Frequency of left hand usage for every 100 subjects was 1 for writing, 4 for using spoon, 4.4 for throwing ball, 5.4 for using scissors and 3.8 for kicking ball. The results of this study were higher than those of Min et al (1996) with the lowest count being 3.7 subjects for writing, 6.1 for using spoon, 8.9 for throwing ball, 7.3 for using scissors and 9.4 for kicking ball. Particularly high figures were recorded using the left hand for pushing and pulling entrance door (21.3), pressing telephone or cash machine buttons (13.6) and zipping up pants (12.5).

Meanwhile, Kang (1994) reported that Korean and American college students have incoherent standards for differentiating the dominant hand. In the US, the decision is based on which hand is used to write or eat with but in Korea, it's the hand that throws ball or uses knife or scissors. Therefore, social and cultural factors can affect which hand becomes the dominant one.

Table 5 displays the percentages of hand usage behavior according to the dominant hand and type of motion. In order to analyze hand usage behavior according to the dominant hand, observations were

Table 5. Percentage of preferred hand usage by dominant hand and characteristics of motion

Preferred hand usage	Dominant hand					
	Left-handed		Ambidextrous		Right-handed	
	Left	Right	Left	Right	Left	Right
Force required motion	75.2	24.8	40.0	60.0	4.6	95.4
Accuracy required motion	61.5	38.5	31.2	68.8	3.0	97.0
Mean percentage	68.3	31.7	35.6	64.4	3.8	96.2

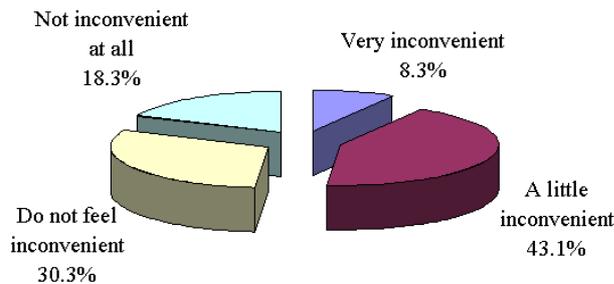


Figure 1. Degree of convenience living as a left-handed person.

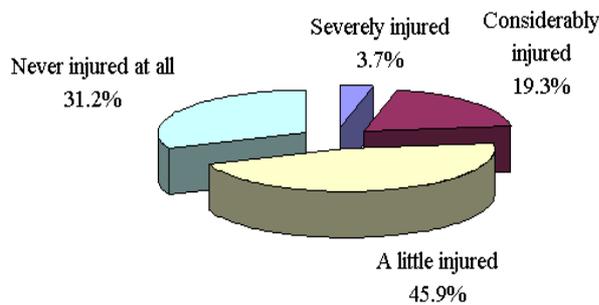


Figure 2. Degree of injury experience as a left-handed person.

made respectively for accuracy required motion and force required motion. Accuracy required motion mainly exercise fingers to move the hand and call for relatively precise movements, such as writing, using scissors, using spoon and chopsticks, pressing telephone or cash machine buttons, pulling gun trigger, inserting subway pass, zipping up pants and cutting with knife. Force required motion generally require forearm strength to move the hand and includes throwing ball, hammering, pushing and pulling entrance door, exercising and kicking ball.

Left-handed subjects tended to use their left hands more with force required motions than accuracy required motions while ambidextrous and right-handed subjects used their right hands more with accuracy required motions. However, ambidextrous subjects in general showed a stronger tendency to use their right hands with force required motions than accuracy required motions. Of course, the both hands usage of the right hand is weaker than that of the right-handed, but the general opinion that the ambidextrous be considered as right-handed cannot be fully supported.

In regards to the level of inconvenience experienced in everyday activities as a left-handed person, Figure 1 shows that 51.4% were troubled to some degree from 'very inconvenient (9)' to 'a little inconvenient (47)' and 48.6 % answered positively as 'do not feel inconvenient (33)' or 'not inconvenient at all (20)'. In particular, the elder subjects answered more positively, that is as 'do not feel inconvenient' or 'not inconvenient at all' than the younger subjects. It is thus assumed that as one gets older, he or she becomes more accustomed and feels less inconvenienced by daily activities.

Graham and Cleveland (1995), Hicks et al (1993), Taras et al (1995) and Winder et al (2002) reported that the left-handed have an extremely higher probability of being in accidents and getting injured from using systems and equipment designed for the right-handed. With slight differences in actual figures, on average, the probability of automobile accidents was 55%, tool related accidents 54% and household accidents 49%. In this study as shown in Figure 2, in regards to injury experience from using products or facilities designed for the right-handed,

61.3% of the left-handed subjects answered in the positive. In detail, 4 subjects were 'severely injured,' 21 'considerably injured' and 50 felt only 'a little injured', and in total, accounted for 68.8% of all left-handed constituents. The remaining 34 (31.2%) were 'never injured at all'.

Discussion

Almost every kind of daily activity, work and exercise that we engage in require hand usage. There is an endless amount of hand related hardware in the world today. From hand protection products to hand-operated industrial, household, medical and sports equipment, instruments and machine operations, numerous devices and facilities exist. This study found over 10% of the population to be left-handed. In light of this result, it seems necessary to consider how a left-handed user would use the diverse types of hardware in the designing process.

Brown and Taylor(1988) noted that left-handedness is hereditary and decided by the brain, so one should not try to become right-handed deliberately. "If the left brain is dominant, you are right-handed and if the right brain is dominant, you are left-handed." Therefore, "One cannot change, as if an unwanted habit, the nervous system that has each side of the brain controlling the opposite side of the body." Instead of trying to make the left-handed adjust by becoming right-handed, social consideration should be taken so that left-handers can use their left hand freely and without hesitation.

At present, in western countries such as the US, Canada and England, teachers give special counsel to left-handed students so that they may comfortably use their left hand in daily routines. Many school and daily supplies are now produced for the left-handed and are easily purchased in general as well as specialty stores. The local environment is comparatively poor, but specialty stores for the left-handed are newly opening and The Left

Hander's Association of Korea along with 5 to 6 left-hander web sites are already up and running. Not only do they work to protect and enhance their rights and interests, but also move society on a national level to correctly understand and recognize the left-handed in a positive manner.

The first and more urgent measure to be taken is to institutionalize a law that enforces a certain percentage of all manufactured products to be additionally made for the left-handed. And if possible, designs should be geared toward both right-handed and left-handed users (for example, modifying handle direction of fishing reel or electric drill). Furthermore, public and private sectors together have to set up a system to produce and distribute left-handed products and consider designing public locations and facilities in a way that left-handers and right-handers can commonly use.

Conclusion

As there are hardly any reference data on the current status of left-handers and hand usage behavior according to the dominant hand in Korea, this study should prove useful to designers of left hander related products and equipment and thereby enhance the safety and efficiency of left-handed users. Meanwhile, future studies should be made to investigate the accurate status of accidents and injuries that took place due to a dominant left hand and cases in which a left-handed person naturally became ambidextrous or right-handed because it was easier to conform to the demands of society, parents or colleagues or simply a matter of having to adjust after an accident or injury.

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