

ARAŞTIRMA MAKALESİ/RESEARCH ARTICLE

A COMPARISON RELATED TO THE LATERALITY OF THE VOLUNTARY MOTOR PERFORMANCE SUCH AS BASKETING, TARGETING AND PEG-MOVING (*)

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ABSTRACT

This study is intended to investigate the laterality in skills of the one side of the body. For this purpose, the performances of basketing, targeting and peg-moving task were carried out on 233 volunteer subjects. To assess the preferences, the Edinburg Handedness Inventory and a second Handedness Inventory developed by Yetkin were used collectively. 6 % of the subjects given the first set of questions (G1) were found to be left-handed, and remaining 94 % were appeared to be right handed. When the second set of questions (G2) were given, 8 % of the subjects were found to be left handed, and remaining 92 % were right handed. In basketing, there was a significant difference obtained between right- and left-hand preferences ($p<0.01$). In targeting, there were also the same notable differences between the performances of left-and right hand preferences ($p<0.01$). In the peg-moving task, there was an asymmetric difference between left-and right-hand preferences ($p<0.01$). However, the results remained unchanged when this test was separately applied to both males and females. In conclusion, there were notable differences between left-and right hand preferences in the tasks of basketing, targeting and peg-moving.

Key Words: Basketing, Targeting, Peg-moving, Laterality, Hand preferences, Motor performances, Human.

BASKET ATMA, NİŞAN ALMA VE ÇİVİ TAKMA GİBİ İSTEMLİ MOTOR BECERİLERİN LATERALİTESİ ÜZERİNE BİR KARŞILAŞTIRMA(*)

ÖZ

Bu çalışmada vücudun bir yanı ile gerçekleştirilen becerilerin lateralitesini araştırma amaçlandı. Bu amaç için, 233 gönüllü denekler üzerinde basket atma, nişan alma ve çivi takma işlevleri gerçekleştirildi. Vücudun bir yanının tercihlerini belirlemek için 10 sorulu Edinburg Handedness Inventory ve geliştirdiğimiz ikinci bir 10 sorudan oluşan birleştirilmiş 20 sorulu ortak bir anket formu kullanıldı. 1. Grup sorularına göre (G1) % 6 solak, % 94 sağlak, 2 grup sorularına göre % 8 solak, % 92 sağlaklık dereceleri saptandı. Basket atmadaki fark anlamlı bulundu ($p<0.01$). Bu eylemde sağ el performansı sol elden daha yüksek; aynı şekilde erkeklerin el performansları kızlardan daha üstün bulundu. Nişan alma eyleminde de aynı şekilde sağ ve sol performansı arasındaki fark önemli bulundu ($p<0.01$). Çivi takma eyleminde ise sağ ve sol tercihler arasında asimetric bir fark vardı ($p<0.01$); ancak bu sonuç erkeklerin ve kadınların sağ ve sol el tercihleri arasında bulunamadı. Sonuç olarak, basket atma, nişan alma ve çivi takma gibi istemli becerileri gerçekleştirilmede sağ ve sol el kullanımları arasında anlamlı bir farkın olduğu anlaşıldı.

Anahtar Kelimeler: Basket atma, Nişan alma, Çivi takma, Lateralite, El tercihleri, Motor işlevler, İnsan.

(*) In the memory of the 77th anniversary year of the Foundation of Turkish Republic (29.10.2000) and of it's founder Mustafa Kemal Atatürk.

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1. INTRODUCTION

The study you are holding is a meditation on the hand preference and the laterality of the one side of the human body, born of nearly years of professional experiences that caused me to want to learn more about the laterality. Every morning, even before we were out of bed, our hands came to life. Where would we be without our hands (Wilson, 1998). Every pair of hands has a set of fingerprints, which do not alter after five months prior of birth.

The studies related to motor performance and behaviours have been undertaken on different animal groups (Yetkin, 1993). The researches on hand preference and performance in humans have also been continuing (Oldfield, 1971; Yetkin, 1996). Hand preference can be defined as the ability to perform some tasks with one hand (right-hand) rather than the other (left-hand) or *visa versa*. A psychomotor organisation can probably play an important function in preferring one of the hands. The first argument suggested that, there are two groups in the population as right-and left-handed peoples (Annett, 1970). The continual arguments suggested that the hand preference should be regarded as continuous between right-and left-hand preference (Geschwind and Levitsky, 1968). There is not, however, yet any substantiated agreement among the authors with regard to the hand preference and hand performance or abilities.

Laterality, especially the one which includes functional asymmetry, has been studied in recent years as prevalent. We have also studied on the subject of the laterality by voluntary tasks of young males and females (Yetkin, 1995), and on the preferences related to the use of hand, foot and eye (Yetkin, 1993). We have come up with the conclusion that the hand preferences were rather different in left-, right-, handed and ambidexterity on the main of the first set of ten questions (G1) than on the main of the second set of ten questions (G2). We have also recently studied on the subject of the laterality of hand skills and performance during voluntary tasks by throwing a ball into a basket ring, and investigated the asymmetry of the hand preference together with eye and index finger by aiming at a target table on 22 subjects. We found out that there was an asymmetry in the hand preferences of the subjects for above mentioned behaviors.

Hand preferences have been observed as a single continuity, ranging from strong right preference-across ambidexterity to strong left preference in human population (Kilshaw, 1983). Human's hand preferences can be reflected as the affinity to perform some tasks with one particular hand rather than the other one. It is suggested that the motor asymmetry might have been developed as a result of cerebral influence on motor centers. Cerebral laterality (CL), with respect to manipulo-spa-

tial functions appears to be established. Each cerebral hemisphere (CH) is also responsible primarily for opposite side of the body (Hellige, 1990). It has also been reported that there is not any relationship between hand skills assessed by targeting, basketing and hand preferences in right- and left-handed subjects (Yetkin, 1995).

On the other hand, the female brain is more bilaterally organized than the male brain (Wada, 1975; Tan, 1989). However, the other asymmetries-physical asymmetries-have been reported to be similar between males and females (Annett, 1976). In agreement with the results of the researches, it has been reported that the scores in hand preferences for left - handers were less lateral than they were for right - handers.

In this study main interest is concentrated on laterality on the hand skill and especially on the voluntary tasks such as basketing, targeting, and peg-moving task and finally on the relations between these different performances mentioned above. Our purpose is to investigate the contribution of the cerebral asymmetry to both behavioral and voluntary tasks on left - and right - sides of the body including peg-moving task (PMT) together with basketing and targeting on the subjects, when they were much larger in number than those of previously undertaken studies (Tubiana, 1981). Hand preferences depend on a continuum of differences between the right and left hands in skill or ability. In this study the relationship of the lateral performance of the both hands was investigated.

As a researcher in the neuroscience, I have tried to learn how do the skills or abilities as a cognition and motor function, and I have began to see the subjects who were having differently using their hands as right - and left handed or mixed handed.

2. MATERIALS AND METHODS

The study was carried out with 233 volunteer students of Biology Department of Science Faculty. The subjects consisted of 110 females and 123 males aged 18 to 25 years (Mean 23). All were healthy. They had no disciplined sports training, no motor, mental, anatomic and visual abnormalities either. They were informed about the practice. The experiments were performed on the subjects in different positions by using different sets for the following skills.

2.1. Assessing the Hand Preferences

The degree of laterality of subjects by Geschwind scores (GSS) and Edinburgh Handedness Inventory (EHI) were assessed for the first group. To assess the hand preference, all subjects were given a Oldfield's questionnaire in Turkish translation. The survey comp-

rised ten questions designed to represent a range of uni-manual and bimanual activities with minimal redundancy (Oldfield, 1971). Respondents were asked to indicate which hand they would use in writing, drawing, throwing, or using scissors, toothbrush, knife, spoon, broom (upper hand), striking a match (hand holding the match) or removing a lid (hand holding the lid). And a second inventory containing 10 questions was used to assess the whole laterality degree of the body (see Yetkin, 1993). Respondents were also asked to indicate which hand, foot and eye they would use in looking through a microscope, passing a thread through a needle, kicking a ball, aiming at (with eye and finger), shaking hand and saluting, sewing (hand holding the needle), holding a saw, throwing out a hammer, carrying a suitcase, or playing hopscotch (foot carrying the body). The male and female subjects were classified as being right - handed, left - handed and mixed - hand (ambidexterity) according to their laterality degree. The questions were corresponding the preferences to pertain to which hand was used by the subjects for the voluntary skills. After the assessment of the hand preference, the Geschwind's scores were used for laterality degree.

2.2. Basketing Task (BT)

To investigate and observe the task of basketing, an available set of basketing was developed by us as applicable methods (Yetkin, 1995) and the action of basketing was repeated by subjects for ten times. The subjects performed the basketing actions at the basket set. They threw a special rubber ball from a distance toward the basket set. This process was repeated ten times per hand, separately. At the end of trials, the successful basketing actions were totaled.

The positive score of subjects was recorded in percentage.

2.3. Targeting Task (TT)

The action of targeting was also conducted by the subjects for ten times. The convenient methods were also developed by us and put into practice in the previous study. The subjects performed aiming at the eye and index finger together by using their hands and eyes one by one. The subjects touched their index fingers to a point at the target table with their right and left hands, respectively. The subjects repeated this process ten times with each hand, and the positive score was determined in percentage as well.

2.4. Inserting the Nails in a Hole Peg-Moving Task (PMT)

The set contained 100 holes on the surface of a table. The subjects used their right and left hands for inserting the nails in these holes. The time of inserting was measured by chronometer and recorded for each subject. Thus, the hand skill was measured by the PMT, which had been formerly developed and modified by Yetkin for his laboratory.

2.5. Data Obtaining

The data obtained from the males and females were analyzed separately. The subjects were required to insert 100 pegs into the holes which were holed within a board. The time spent on this procedure was measured by mechanical and electronic devices.

2.6. Statistical Analysis

After the assessment of the data, t-test was used separately to disclose the differences between left-right preferences and between male and female performances. In addition, the correlation value between the first (G1) and the second (G2) group questions was calculated. The distribution of the Geschwind scores was analyzed by frequency histogram. The distribution of GSs was also analyzed in percentage. The laterality degree was taken as the sum of all the scores.

3. RESULTS

3.1. Hand Preferences

The assessment of the hand preferences and the relationship between two groups symbolized G1 and G2. The first group deals with only hand preferences.

The present analysis showed that most of the subjects tend to use the right hand. The GSs and distribution between the answers given to first and second group questions are shown in Figures (Figures 1 and 2). The ratio for 6 % of the subjects in first group were found to be left handers, and the remaining 94 % of them were right handers in terms of hand preference. However, in the second group, 8 % of the subjects were found left handed and 92 % of them were right handed. In the right handers, the distribution was shaped between "J" and "S" letters for the first and second groups respectively, while it was found similar like a line in the left handers as it shows at the left sides of the Figures 1 and 2.

To assess the relationship between hand, eye and foot preferences the scores obtained from the first and second group was compared by statistical analysis of t-test ($t=1.8$; $p<0.05$). According to the correlation valu-

es ($r=0.80$), there was a close relation between preferences of the subjects in both groups. The relationship is shown in Figure 3. However, the line is not diagonal. Thus, the hand preferences indicated by Oldfield's questionnaire and other lateral preferences indicated by Yetkin's questionnaire were compared. The distribution of the hand and other preferences, such as eye, foot and finger preferences in the total sample ($n=233$) are illustrated by curve in Figure 1 and Figure 2. In these histograms approximately "J-" (for G1) and "S-shaped" (for G2) distribution are recognised. Whereas, the relationship between G1 and G2 scores is illustrated by a line which was superior-diagonal on the left side and inferior diagonal on the right side; i.e., the line was not completely diagonal (Figure 3). The second group contains the questions related to eye and foot preferences.

3.2. Motor Performances

3.2.1. Basketing Task (BT)

After the assessment of laterality, t-test was used to compare the average performance of the both sexes and their hand preferences during basketing. The difference

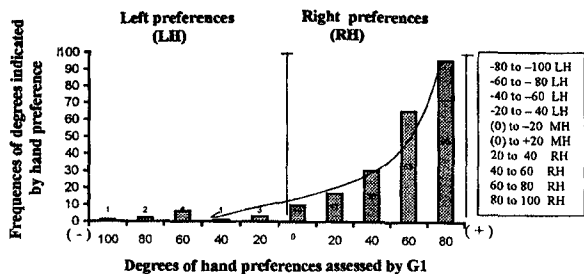


Figure 1. A Histogram of Distribution of GSs and Frequencies Assessed By Hand Preferences of G1 With Ten Questions For Total Sample ($n=233$). The Line Attached By Mean Point of Degree of Hand Preferences Were Nearly Shaped "J" Letter.

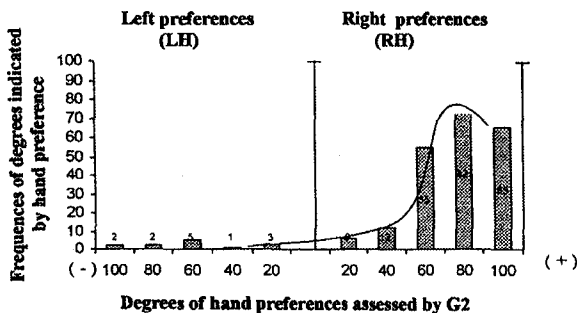
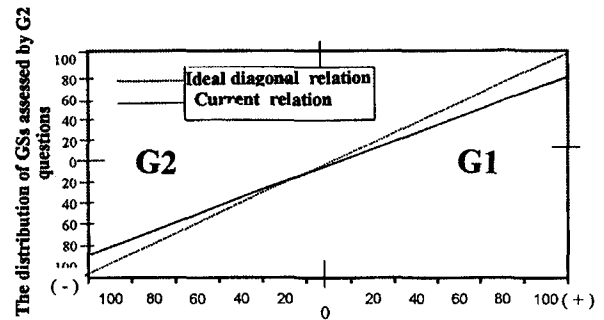


Figure 2. A Histogram of Distribution of GSs and Frequencies Assessed By Hand Preferences of G2 With Ten Questions For Total Sample ($n=233$). The Line Attached By Mean Point of Degree of Hand Preferences Were Also Shaped "S" Letter.



The distribution of GSs assessed by G1 questions

Figure 3. The Regression Curve Between The G1 and G2 Questions (1) Applied To Subjects ($n=233$). The Relation Between G1 and G2 Was Shown Rather Close To Diagonal Line.

between the scores of left and right hand basketing was found very significant ($t=7.6$; $p<0.01$). The mean value for males was 3.50 and for females 2.90; for left hand of the males and females, the difference was also found significant ($t=2.10$; $p<0.05$). After the application of the action of basketing, the mean scores were found 2.2 for male and 1.80 for female subjects. Both left and right performances of the males were superior to female subjects. The difference of the hand performance (right and left) of male and female subjects is 0.6 and 0.4 respectively. The mean values and differences between means were found higher than previous studies. Figure 4 shows the mean values of the scores observed basketing scores.

In the performance of the basketing, the difference was found to be significant ($t=5.90$; $p<0.01$), when the laterality degree of left and right in males was compared. Similarly, the difference was found to be important in the female subject's scores when the results were compared with those of males ($p<0.01$). The relationship between the mean values observed from male and female subjects are shown in Figure 6 as BT, TT and PMT, respectively.

3.2.2. Targeting Task (TT)

The results of targeting are shown in terms of right and left - hand performances. The mean success of the hand performances was 9.00 and 9.50 for left and right hand respectively. The difference was found to be significant ($p<0.01$). The means were found higher than those obtained in the previous study, while the difference between means was found to be less than the results of the previous study. Figure 5 shows the mean performance levels observed from of the targeting task.

3.2.3. Peg-moving Task (PMT)

The mean values of right and left hand performances in the PMT were 138.00 and 160.00 seconds respectively. The difference between left and right hand performances for PMT was found 22.00 seconds. This difference was statistically significant ($p < 0.01$). The differences between right - left hand performance of the male and female subjects were also insignificant for PMT ($p < 0.05$). It means that the PMT time was longer in females than those males.

The PMT was studied by a board with a hundred holes. In previous studies (Tan, 1989; Tan, 1990) a peg board with two parallel rows of 25 holes was used for PMT. It shows clearly that the 100 holes were better than 25 holes for elucidating the difference in performances between left and right hand. In a longer interval of hand usage, the hands could be tired more than they get in a short time. In the light of this hypothesis, the hand performance was assessed by a peg board (PMT) (Annett, 1972), which was modified in our study to observe an accurate measure of hand skill.

A difference from asymmetry between hands of the males was found to be significant ($p < 0.01$). The mean values were 138. and 160 seconds for right and left hand usage respectively. In the PMT, the right hand performance was better than those of left hand. In the same way, the difference between hands of females was found to be significant ($p < 0.01$; $t = -10.70$). The mean values of the PMT in the females were 137 and 162 seconds for right and left hand usage respectively. In both sexes, the right hand performance was better than left hand. The mean values are shown in Figure 6.

In order to understand the variation, the results have been summarized in three tables. The Table 1 shows the mean statistical results of the observation of the right and left hand usage for BT, TT and PMT, including the differences between left and right hand performance. The Table 2 also shows the mean statistical results indicating the sex factors in the hand preference for hand skills above mentioned BT, TT and PMT. The Table 3 shows the mean statistical result obtained from the comparison of the hands of male and female groups separately. The findings and observations were discussed on our hypothesis, and the conclusions were indicated for the comparisons.

The present study was performed in order to understand whether a population has an asymmetry in different skills using special experimental sets. The basketing and peg-moving tasks are related further to hand preference, whereas the targeting is related to the eye, finger preferences together with the hand.

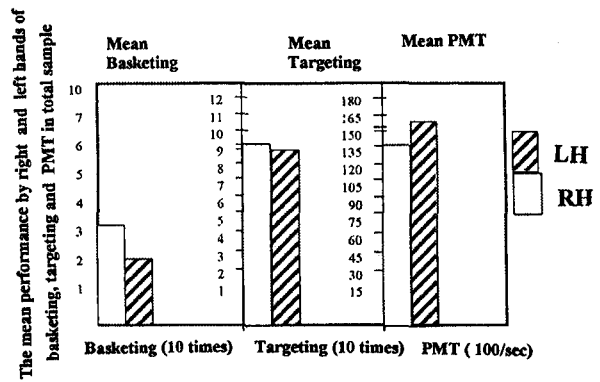


Figure 4. The Mean Results of The Observation of The Right and Left Hand Usage For Total Samples In The Performance of Basketing, Targeting, and Peg-moving.

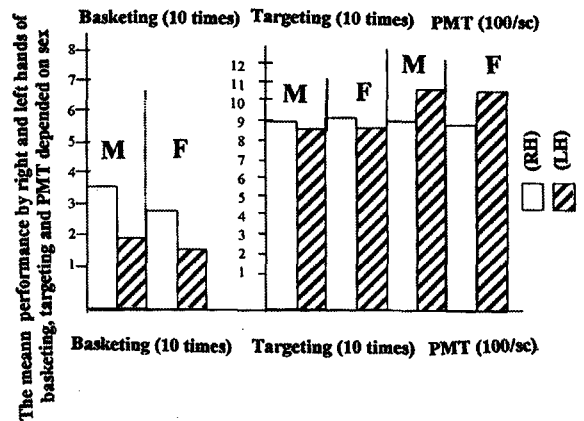


Figure 5. The Mean Results of The Observation of The Right and Left Hand Usage For Total Samples In The Performance of Basketing, Targeting, and Peg-moving.

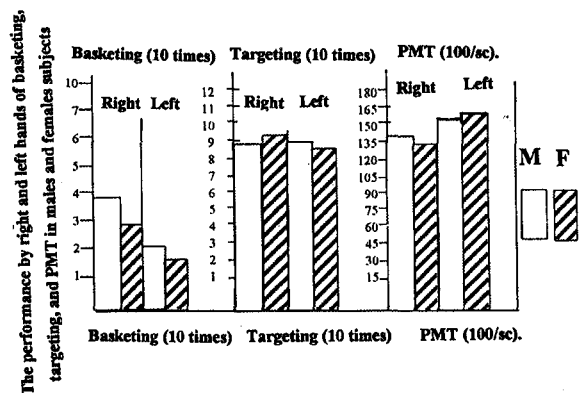


Figure 6. Figure 4. The Mean Results Obtained From Comparison of The Right and Left Hands In The Performance of Basketing, Targeting, and Peg-moving In Male and Female Subjects Separately.

Work on this subjects began at the beginning of 1991, as we starting a neuro-physiological study in department of at the Atatürk university of Erzurum.

4. DISCUSSION

In the light of the functional asymmetry, the purpose of present study was to determine the laterality as related to one side of the body for some voluntary tasks such as basketing, targeting, and peg-moving tasks. There is more and more evidence in biologic research that handedness may be nearly as old as influential as bipedalism was in shaping human development and orienting our subsequent history (Previc, 1991; Marzke, 1996; Wilson, 1998; Vogan and Tabin, 1999).

The hand is an organ of information as well as an organ of execution. The hand remarkably mobile and malleable, capable of conforming to the shape of objects to be grasped or studied or emphasizing an idea being expressed. The hand can co-ordinate an infinite variety of movements in relation to each of its elements (Annett and Kilshaw, 1983). This blending of movements of digits allows the hand to mould itself to the shape of the object for different abilities. The handedness, of course, is under the effect on the genetic and environmental factors (Annett, 1978) such as the others anatomical and functional features and characteristics in humankind.

The development of hand preference and other lateral behaviors has received a considerable amount of attention by a number of studies (Napier, 1993). The comparison of hand preference distributions of subjects of different tasks is essential in order to understand how asymmetries emerge in the course of life time. The changes or stability in hand preferences or other lateral behaviors in human are commonly explained in terms of genetic and environmental factors (Corballis, 1978; Tubiana, 1981). The culture, however, can serve to shape or modify behavioral development. There is more and more evidence in biological researches that handedness may be nearly as old and influential as bipedalism was in shaping human development and orientating our subsequent history (Marzke, 1996).

The focus of this work is to compare the studies which have examined the effects of chosen voluntary tasks for the expression of hand preference or counter arguments put forward in this field, and finally to discuss lateral behavioral measures. The mean values of data were shown in Table 1, 2 and 3.

As can be seen in the references, the results go parallel with some recent studies. There was, however, a correlation between G1 and G2 scores (Figure 3). Although the linear line is not diagonal, it was understood

that the second set of ten questions in G2 could be used in the assessment of the laterality of completely one side of the body.

In basketing, the mean values (Figure 4) were 3.2 and 2 for right and left hand performances respectively. In targeting, the mean values (Figure 5) were 9.50 and 9.00 for right and left hand performances respectively. But there are a few studies which show that left hand is better than the right hand performance for some actions (Tan, 1989; Parlow, 1990). The results of present study showed that the performance of the right hand in basketing and targeting was better than the left hand performance. The difference of the mean statistical results between right and left hand usage were 1.2 and 0.50 for basketing and targeting, respectively. The difference between hands was found to be important for basketing ($p < 0.01$) and targeting ($p < 0.01$). In this study, the differences between left and right hand basketing were found important in contrast to our previous study ($p < 0.01$) (Wilson, 1998). This may be due to the number of the subjects. In the present study, more subjects were employed than in the previous study (Yetkin, 1995).

In the PMT, the mean values were 138 and 137 seconds for right hand in males and females respectively and the mean values were 160 and 162 seconds for left hand in males and females respectively. The difference between right hands of males and females was one second, while it was two seconds between their left hands. However, the men were faster than women in the PMT. On other hand, the difference between male and female subjects however, was not statistically important for left and right hands ($t = 0.36$; $p > 0.8$). The results is illustrated in Figure 6.

To understand the development of manual skills and motor tasks in order, we must know something about the human groups and their abilities (Guiard, 1987).

As it was expressed at the beginning of this manuscript that we have developed and used a new peg board with 100 holes for hand conduction velocity during peg moving task, and we have added an inventory with ten questions to EHI since 1993 (Yetkin, 1993d). Of course, we have assessed the differences to discuss the laterality and functional asymmetry.

As a result, it was also found out that the differences between left and right hands were important in actions of basketing ($p < 0.01$), targeting ($p < 0.01$) and peg-moving tasks ($p < 0.01$). This results shows that the subjects on the laterality will be studied for a long time in future because there is not a certain common agreement on that subject. If the skills of the humans were compared with those of other animals in performing human activities of daily living, on might discern evidence of a

progression from primitive to advanced of an evolutionary process (Wilson, 1998) However the human fingers emerged as a compromise at one point in evolutionary time, a locomotion organ that has been transformed in to a manipulative organ by tool use (Marzke, 1997). The functions are facilitated and constrained by its links with the rest of the evolving hand and brain.

On the other hand, the right hand is dominant as depending on the left hemisphere dominance. Several recent attempts to determine the distribution of right -

and left - hand dominance as a function of brain (Tan, 1988; Davidson and Hugdahl, 1995) have started that we use more frequently the right hand than the left hand, as expected.

Finally, in left - and right-handed females, the given, skills of the right- and left-hands were found to be different. The difference was important ($p < 0.01$). In left- and right-handed males, the skills of the right- and left hands were in the same manner found different. The difference was significant ($p < 0.01$). In the total sample,

Table 1. The Mean Statistical Results of The Observation of The Right and Left Hand Performance.

Means of	Basketing (10 times)	Targeting (10 times)	Peg-moving task (as sec./100 nails)
RH	3.2	9.4	138.00
LH	2.0	9.1	161.00
df: RH	1.7	1.1	16.00
df: LH	1.6	1.5	20.00
t-values	7.61	2.50	13.60
p-values	0.0	<0.01	0.00

Abbreviations: RH: Right-hand; LH: Left-hand; df: Degrees of Freedom; D: Difference Between The Means of The Parameters.

Table 2. The Mean Statistical Results Indicating The Sex Factors In Hand Preferences As Related To Basketing, Targeting and Peg-moving.

Means of	Basketing (10 times)			Targeting (10 times)			Peg-moving task (as sec./100 nails)		
	RH	LH	D	RH	LH	D	RH	LH	D
M	3.50	2.20	1.30	9.40	9.20	0.20	138.00	160.00	22.00
F	2.90	1.80	0.90	9.50	9.00	0.50	137.00	162.00	25.00
df: RH	1.60	1.60	0.00	1.20	1.30	0.10	16.50	21.00	4.50
df: LH	1.80	1.50	0.30	1.00	1.70	0.70	16.00	20.00	4.00
t-values	2.70	2.10	0.60	-0.75	0.90	0.15	0.40	-0.75	-0.35
p-values	0.00	<0.05		0.50	0.40	-	0.70	0.50	-

Abbreviations: RH: Right-hand; LH: Left-hand; M: Male; F: Female; df: Degrees of Freedom; D: Difference Between The Means of The Parameters.

Table 3. The Mean Statistical Results Obtained From Comparison of The Hands of Male and Female Subject Groups, Separately.

Means of	Basketing (10 times)			Targeting (10 times)			Peg-moving task (as sec./100 nails)		
	M	F	D	M	F	D	M	F	D
RH	3.50	2.90	0.60	9.40	9.50	0.10	138.00	137.00	1.00
LH	2.20	1.80	0.40	9.20	9.00	0.20	160.00	162.00	2.00
df: RH	1.60	1.80	0.20	1.20	1.00	0.20	16.50	16.00	0.50
df: LH	1.60	1.50	0.10	1.30	1.70	0.40	21.00	20.00	1.00
t-values	5.90	5.00	0.90	0.90	2.50	1.60	-8.50	-10.70	-2.20
p-values	0.00	0.00	-	0.40	<0.01	-	0.00	0.00	-

Abbreviations: RH: Right-hand; LH= Left-hand; df= Degrees of Freedom; D= Difference Between The Means of The Parameters; M= Male; F= Female.

the skills of the right- and left-hands were also found different. The difference was important ($p < 0.05$).

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