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Evaluation of Relationships Between Postural and Functional Lateral Preferences and Chewing Side Among Students In Eastern Turkey

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ABSTRACT

This study aims to evaluate the relationships between postural and functional lateral preferences and the preferred chewing side among young subjects. Functional lateral preferences, postural lateral preferences and the preferred chewing side were assessed in 376 young individuals (178 men, 198 women, mean age: 20.07). Of the 376 individuals, 31.1 % were strong right-handers, 58.8 % were weak right-handers, 2.9% were ambidextrous, 5.9% were weak left-handers, 1.3% was strong left-handers. There was a right-side preference for handedness (89.9%), footedness (75.8%), earedness (59.2%), eyedness (paper tube test, 70.0%), eyedness (Rosenbach dominant eye test, 62.9%), hand clapping (78.4%), leg-crossing (64.4%), preferred chewing side (60.9%) and a left-side preference for hand-clasping (55.2%), and arm-folding (55.3%). Only eyedness (paper tube test) differed between the genders; women mostly preferred the left eye when looking through the paper tube. Handedness, footedness, earedness, and eyedness (paper tube) were each related with hand-clapping, however not with hand clasping and arm folding. In addition, hand clapping and leg crossing (but not hand clasping and arm folding) were each related to preferred chewing side. In general, individuals who preferred the right side were right sided in all of the variables, while individuals who preferred the left side were closely related to individuals who preferred both sides. Thus, it can be concluded that individuals who preferred the left side tended to be mostly bilateral, compared with individuals who preferred only the right side. These results may bring insight into the relationships between functional and postural lateral preferences and the preferred chewing side for the young population.

Key Words: Brain lateralization, handedness, lateral preferences, preferred chewing side.

Introduction

Cerebral lateralization is described as anatomical and functional differentiation between the right and left hemispheres of the brain (1). Since the left and the right hemispheres perform different tasks, the link between cerebral lateralization and handedness needs further research (2). Lateral preference is defined as the asymmetric usage of extremities or sensory organs (3). People have different preferences for preferring one hand, one foot, one ear, or one eye over the other one, as well as preferring one way for leg crossing (LC), hand clasping (HC), and arm folding (AF) (4).

Although there is a similar asymmetric usage defined for paired organs (such as ears), the most commonly investigated lateral preference is handedness (3). Handedness is defined as a best performance or personal preference for using a hand (5). To understand handedness can provide precious signs for understanding the organization of the brain (6). Due to footedness, earedness, and eyedness are less affected by social learning than by handedness, they are considered to be better markers for evaluate laterality (7). In addition, the preferred chewing side (PCS), was suggested as a functional cerebral lateralization sign in addition to the other functional lateral preferences (8).

Some lateral preferences show geographical variations, especially HC (4). In addition, age differences were reported for some lateral preferences; handedness, eyedness, earedness, AF and LC (4). Therefore, the aim of the present study was to investigate the relationships between four postural lateral preferences (hand-clapping, HC, AF, LC) and four functional lateral preferences (handedness, footedness, earedness, eyedness), and PCS among university students in Van. There is no work similar to the present study done in this part of the country. In addition, in our knowledge there was no previous study on the relationship between the hand-clapping

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Table 1. Percentages of right-side, left-side, and mixed lateralities, and preferred chewing side

Laterality	N	Right (%)	Left (%)	Ambidextrous(%)
Handedness	376	89.9	7.2	2.9
Footedness	376	75.8	9.3	14.9
Earedness	375*	59.2	11.7	29.1
Eyedness (Paper tube test)	367*	70.0	27.2	2.7
Eyedness (Rosenbach test)	372*	62.9	35.5	1.6
Hand-clasping	375*	44.3	55.2	0.5
Hand-clapping	375*	78.4	17.1	4.5
Arm-folding	376	44.1	55.3	0.5
Leg-crossing	374*	64.4	20.6	15.0
Preferred chewing-side	371*	60.9	21.6	17.5

*Subjects who reported that they had problems with hearing, vision, teeth, or joints were out of measurement

and other investigated traits (handedness, footedness, earedness, eyedness, LC, PCS, AF, HC).

Materials and Methods

The present study was conducted with 376 young individuals (178 male, 198 females, mean age: 20.07). All of the subjects were students of the Van Yuzuncu Yil University, Van, Turkey. Handedness was assessed using the Edinburgh handedness inventory (9) and the Geschwind scores (GS) (10) were calculated (11). Depending on the GS, the hand preference was evaluated within 5 groups: strong right hand (+80 <GS<+100), weak right hand (+20<GS<+75), ambidextrous (–15<GS<+15), weak left hand (–75<GS< -20), and strong left hand (–100<GS< -80) (12, 13). Footedness was determined by 4 criteria: foot preference; (I) when kicking a ball, (II) (first foot forward) when climbing the first step of a staircase, (III) (first foot off) when stepping off an escalator, (IV) when stepping on the pedal of a trash can (14). Two different tests were used to determine eyedness: (I) the Rosenbach (15) test: According to the Rosenbach test, subjects were asked to aim at a target with their index finger with both eyes open. When the index finger and the far point were over the top, they were asked to close one of their eyes, without moving their arm or head. If the index finger and target were not located on the horizontal plane, the opened eye was dominant. When looking with the other eye, the index finger was sliding away from the target (16, 17). (II) In the other test, the subjects were asked to look through a paper tube (we called it the paper tube test). The subjects were observed and the eye that was preferred when looking through the tube was noted (18). Earedness was determined by 2 criteria: ear preference (I) when listening to a call (when the hands are not holding anything else) and (II) when listening to a person who is whispering (14) while standing in front of them.

Lateral preferences were determined by observing the subjects: which thumb was on top for HC and the fingers of which hand were on top for AF; For AF, the left hand answer was indicated by right AF (RAF) and the right hand answer was indicated by left AF (LAF) (19). The preferred hand for clapping was determined by observing subjects as they clapped their hands, (the hand in the upper position when the hands are fist clapped) (20). The subjects were asked to cross their legs and the LC preference was determined by observing which leg was positioned uppermost (21). The PCS was assessed by asking the subjects which side they preferred when chewing (22) a gum.

Statistical Analysis: Descriptive statistics for the continuous variables were presented as mean and standard deviation; minimum and maximum values of the counts and percentages for the categorical variables. The chi-square test was performed to determine the relationships between the categorical variables. In addition, a multiple correspondence analysis was carried out to analyze the pattern of relationships of several categorical variables. Statistical significance was considered as 5% and Statistical Package for the Social Sciences (SPSS) (ver. 24) statistical program was used for all of the statistical computations.

Results

Of 376 individuals, 89.9% were right-handed, 7.2% were left-handed, and 2.9% were ambidextrous; 117 were strong right-handers, 221 were weak right-handers, 11 were ambidextrous, 22 were weak left-handers, and 5 were strong

Table 2. Chi-square values for relationships among the traits

	1	2	3	4	5	6	7	8	9	10
1.Handedness	-									
2. Footedness	86.278	-								
	p<0.001									
3. Earedness	89.976	88.898	-							
	p<0.001	p<0.001								
4. Eyedness	33.442	26.546	24.705	-						
(Paper tube test)	p<0.001	p<0.001	p<0.001							
5. Eyedness	10.685	21.056	7.757	49.372	-					
(Rosenbach test)	p<0.05	p<0.001	p=0.101	p<0.001						
6. Hand-clasping	0.877	1.152	4.518	2.161	0.375	-				
	p=0.928	p=0.886	p=0.340	p=0.706	p=0.984					
7. Hand-clapping	117.073	58.098	64.992	23.335	7.226	2.018	-			
	p<0.001	p<0.001	p<0.001	p<0.001	p=0.124	p=0.732				
8. Arm-folding	0.835	0.930	2.839	5.139	3.491	2.269	3.133	-		
	p=0.934	p=0.920	p=0.585	p=0.273	p=0.479	p=0.686	p=0.536			
9. Leg-crossing	12.551	14.695	16.130	3.572	4.369	2.179	24.691	5.282	-	
	p<0.05	p<0.01	p<0.01	p=0.467	p=0.358	p=0.703	p<0.001	p=0.260		
10. Preferred chewing-side	32.699	31.117	28.115	4.953	11.915	4.120	11.064	3.957	16.201	-
	p<0.001	p<0.001	p<0.001	p=0.292	p<0.05	p=0.390	p<0.05	p=0.412	p<0.01	

left-handers.

We found a right-side preference for handedness (89.9%), footedness (75.8%), earedness (59.2%), eyedness (paper tube test, 70.0%), eyedness (Rosenbach dominant eye test, 62.9%), hand clapping (78.4%), LC (64.4%), PCS (60.9%), and a left-side preference for HC (55.2%) and AF (55.3%) (Table 1).

No significant relationship was found between gender and functional and postural lateral preferences or PCS. Only eyedness (paper tube test) differed between genders (p= 0.039); women mostly preferred the left eye while looking through the paper tube.

No significant relationship was found between handedness and HC, or handedness and AF. As well, there were no significant relationships between handedness and footedness (p<0.001), handedness and earedness (p< 0.001), handedness and eyedness (paper tube) (p< 0.001), handedness and eyedness (Rosenbach test) (p<0.05), handedness and hand clapping (p<0.001), handedness and LC (p < 0.05, or handedness and PCS (p < 0.001) (Table 2)

No significant relationship was found between footedness and HC or footedness and AF. However, significant relationships were found between footedness and earedness (p<0.001), footedness and eyedness (paper tube) (p<0.001), footedness and eyedness (Rosenbach test) (p<0.001), footedness and hand clapping (p<0.001), footedness and LC (p<0.01), and footedness and PCS (p<0.001). There were significant relationships between earedness and eyedness (paper tube) (p<0.001), earedness and hand clapping (p<0.001, earedness and LC (p<0.01), and earedness and PCS (p<0.001). Significant relationships were found between earedness and eyedness (Rosenbach test), earedness and HC, and earedness and AF.

Significant relationships were found between eyedness (paper tube) and eyedness (Rosenbach test) (p<0.001), and eyedness (paper tube) and hand clapping (p<0.001). No significant relationships were found between eyedness (paper tube) and AF, eyedness (paper tube) and LC, eyedness (paper tube) and PCS, or eyedness (paper tube) and HC.

No significant relationships were found between eyedness (Rosenbach test) and HC, eyedness (Rosenbach test) and hand clapping, eyedness (Rosenbach test) and AF, eyedness (Rosenbach test) and LC. There was a significant relationship between eyedness (Rosenbach test) and PCS (p < 0.05).

Significant relationships were not found between HC and hand clapping, HC and arm AF, HC and LC, HC and PCS. A significant relationship was found between hand clapping and AF. There were significant relationships between hand clapping and LC (p<0.001), and hand clapping and PCS (p<0.05). No significant relationship was found between AF and LC, as well as AF and PCS. There was a significant relationship between LC and PCS (p<0.01). In this study, the relationships

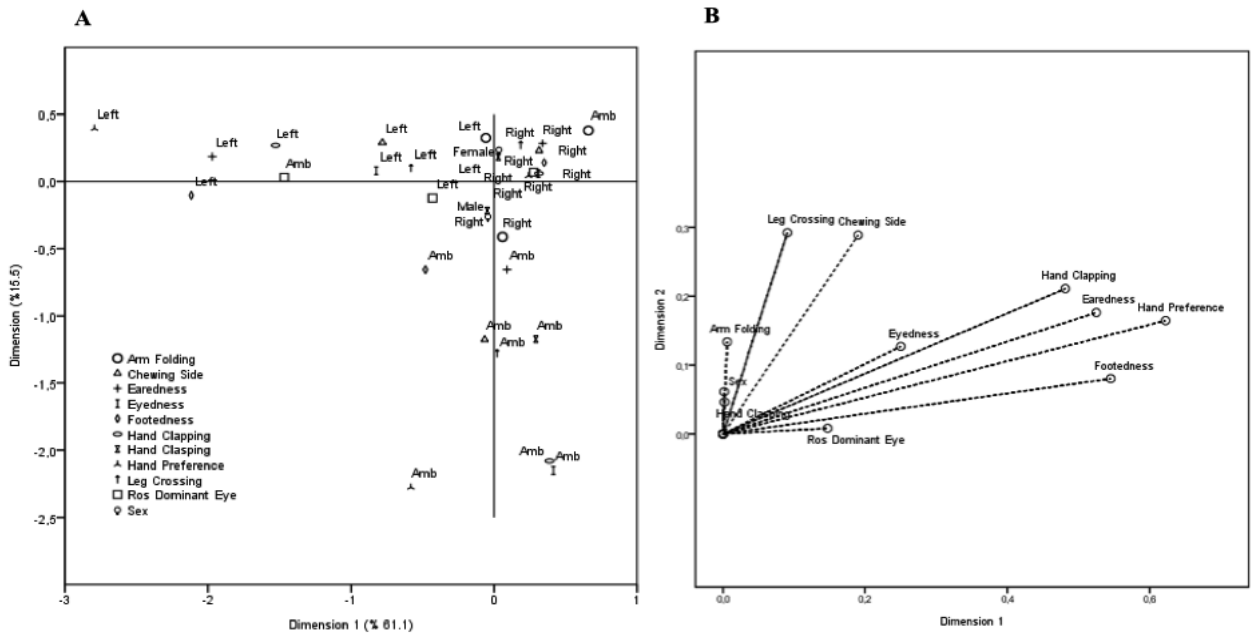

Fig.1. A. Configuration of the relationship between the categories of the variables in two dimension
Fig. 1.B. The pattern of the relationships among the variables

among the PCS, hand-clapping, LC, HC, AF, and gender, as well as hand preference degree, footedness, earedness, and eyedness were also examined. To investigate relationships among the mentioned properties, a multiple correspondence analysis was performed and the relationships among the categories of the variables are graphically shown in the 2-D space (Figure 1).

As seen in Figure 1(A), the 1*st* and 2*nd* dimensions accounted for 61.1% and 15.5% of the total variance, respectively. Of the 76.6%, the total variance was explained by reduction to the 2 dimensions.

When the relationships among the categories of the variables was considered by the 1*st* dimension, it was found that the individuals who weakly used their right hand were closely related to the individuals who preferred the left side and both sides in terms of hand preference degree. Similarly, it was also found that left-handed individuals were highly correlated with 2-handed individuals in terms of footedness, hand-clapping, eyedness (paper tube), earedness, and PCS. In other words, it can be stated that individuals who mostly preferred the left side tended to use both sides.

According to the 1*st* dimension, although there was no significant relationship between the men and women, it was concluded that the men mostly preferred the right while women mostly preferred the left for AF.

It was observed that individuals who preferred the left side were positively correlated with individuals who preferred both sides for footedness, eyedness (paper tube), hand clapping, LC, and PCS. On the other hand, both were negatively correlated with individuals who preferred only the right side.

According to the 2*nd* dimension, for the HC, it was observed that individuals who preferred the left side were positively correlated with those who were bilateral. However, both were negatively correlated with individuals who preferred only the right side.

In general, individuals who preferred the right side were right sided for all of the variables, while the individuals who preferred the left side were closely related with individuals who preferred both sides. Thus, it can be concluded that individuals who preferred the left side mostly tended to be bilateral, when compared with individuals who preferred only the right side.

Furthermore, the pattern of the relationships among the variables is presented in Figure 1(B), showing strong relationships between eyedness (paper tube), hand clapping, earedness hand preference, footedness, and eyedness (Rosenbach test). Similarly, AF, LC, and PCS were also positively correlated with each other. However, these 3 variables were not correlated with the other variables.

Discussion

The functional lateral preferences (handedness, eyedness, footedness, and earedness), postural lateral preferences (arm-folding, hand-clapping, hand-clasping, leg-crossing), and PCS were investigated among university students in Van, Turkey.

In the present study, a right-side preference for handedness (89.9%), footedness (75.8%), earedness (59.2%), eyedness (paper tube test, 70.0%), eyedness (Rosenbach dominant eye test, 62.9%), hand clapping (78.4%), LC (64.4%), PCS (60.9%), and a left-side preference for HC (55.2%) and AF (55.3%) were found. A right-side preference for handedness, footedness, earedness, eyedness, and leg-crossing and a left-side preference for HC and AF were reported in older adults (4). Our results also confirm the results of Rovira-Lastra et al., (21), demonstrating a right-side preference for handedness, footedness, earedness, eyedness, and LC, and a left-side preference for HC. Contrary to our findings, Rovira-Lastra et al., (21) reported that there was no lateral predominance for AF. Consistent with our findings, Ogah et al., (23) reported a left-side preference for HC and AF. Similar to our results, a right-side preference for the preferred chewing side was reported in previous studies (7, 8). Arslan et al., (8) studied relationships between functional lateral preferences and PCS, consistent with our results, and they reported significant correlations between the chewing side preference and hand, eye, foot, and ear side preference.

Barut et al., (12) studied relationships between hand and foot preferences and reported that of 633 individuals, the greatest value for handedness was 61.30% for weak right-handers, and the smallest value was 4.9 % for strong left-handers. In the present study, we found that the greatest value was with weak right-handers and the smallest value was found with strong left-handers, consistent with the results reported by Barut et al., (12).

Our data demonstrated significant relationships between handedness, footedness, eyedness (paper tuber test), and earedness in young individuals. Consistent with our results, Dittmar (4) reported a significant association between functional lateral preferences and suggested that the 4 functional lateralities were associated with each other in older adults.

Dittmar (4) reported that the 4 functional lateralities were related to LC. In the present study, we found that handedness, footedness, and earedness were each related with LC but the relation between eyedness and LC was found non-significant. The discrepancies may be associated with the differences between the tests that were used to determine the eye preference or the differences in the age of subject population. We also found that handedness, footedness, earedness, and eyedness (paper tube) were each related with hand-clapping, but not with HC and AF in young individuals.

In the present study, handedness, footedness, earedness, and eyedness (Rosenbach test) each seemed to be related to the PCS. In addition, hand clapping and LC (but not HC and AF) were each related to PCS. We also found that individuals with right earedness tended to prefer the right chewing side. Similarly, Rovira-Lastra et al., (21) demonstrated that the right-side chewers tended to more frequently use the right ear.

In conclusion, it can be stated that handedness, footedness, earedness, and eyedness are considerably related with each other in young individuals. Similarly, AF, LC, chewing side and hand clapping are highly correlated with each other. However, it should be noted that these 2 group variables are slightly correlated in the young population of Van, Turkey.

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