

Study on Seven Asymmetric Behavioral Traits in Three Mongolian Groups

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Abstract Three Mongolian groups (Elute, Bargud and Buriat) were investigated on seven asymmetric behavioral traits (handedness, hand clasping, arm folding, leg folding, foot preference, stride type and eye preference) in Hulun Buir League, Inner Mongolia, in September, 1997. The results were as follows: 1) In the Mongols of Hulun Buir League, handedness, leg folding, foot preference, stride type and eye preference showed obviously higher frequencies of right type than those of left type. 2) The seven traits except leg folding had no significant sexual difference. 3) The differences between Bargud and Elute were greater than those between Bargud and Buriat. 4) Compared with other groups, the Mongols in Hulun Buir League showed a lower frequency of right hand clasping, a higher frequency of right arm folding and a moderate frequency of right leg folding. 5) Statistically significant correlation was found between 12 pairs of the traits.

Keywords: handedness, hand clasping, arm folding, behavioral trait, Mongols

Introduction

Some human behavioral traits (handedness, hand clasping, arm folding, leg folding, foot preference, stride type, eye preference etc.) are asymmetric and show lateral functional dominance. Different groups have different frequency distribution of these traits. Many ethnic groups in foreign countries have been studied on these traits, such as Greeks (Pelecanos, 1969; Pentzos-Daponte, 1986), Americans (Downey, 1926; Hardyck et al., 1975; Plato et al., 1985), Spaniards (Pons, 1961), Japanese and Koreans (Yamaura, 1940), Brazilians (Freire-Maia et al., 1958), Whites in Australia and New Guineas (Lai and Wulsh, 1965). However, few data of Chinese population have been published.

China is a multinationality nation. Mongolian Nationality once exerted considerable influence on the world history. Now it has a total population of 4,800,000. The

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Inner Mongolia Autonomous Region where Mongols live compactly has a population of 3,380,000 according to the census in 1990 (Wang Zhen et al., 1997). Hulun Buir League in eastern Inner Mongolia is inhabited by three Mongolian groups: (1) Bargud, whose ancestors lived on the east of Lake Baikal and moved in Hulun Buir in 1700s, (2) Elute, who settled down in Hulun Buir from Xinjiang in 1700s, and (3) Buriat, who used to live around Lake Baikal in Russia and immigrated last century. To find out the frequency distribution of asymmetric behavioral traits and to make further research on genetics and morphology we made this investigation.

Material and Methods

In September 1997, a total of 947 subjects (439 males and 508 females), including 426 Elute (201 males and 225 females), 108 Buriat (42 males and 66 females) and 413 Bargud (196 males and 217 females), were investigated on seven indexes (handedness, hand clasping, arm folding, leg folding, foot preference, stride type and eye preference). All subjects were healthy middle school students aged 12 to 20, whose parents were both Mongols. The investigation was carried out in Ewenki Banner, Hulun Buir League, Inner Mongolia, China. The international standard methods discussed afterwards were adopted in the present study. First, we described the seven indexes to all subjects, then investigated them carefully one by one, and then noted down. Single person was employed to judge each index to reduce errors.

The method devised by Hardyck et al. (1975) was used to investigate handedness. Eye preference, leg folding were investigated using the method of Plato et al. (1985), and hand clasping and arm folding using that of Freire-Maia et al. (1958).

Handedness is studied mostly by finding out which one of two hands is more agile in action, i.e., which hand is predominantly used to work and play. Previously, scholars adopted a single-measure method to study this trait. For example, some scholars measured the power of gripping (Woo and Pearson, 1927). Some asked individuals to hang objects with same weight on each index to find out which hand felt more weight (Van Biervliet, 1897). Some measured the lengths of ulna and radius of individuals (Jones, 1911). Some scholars asked individuals to pick up objects (Wile, 1934). Later, scholars (Hardyck et al., 1975; Plato et al., 1984) advocated the use of a multiple-measure method to study handedness comprehensively and thought self-description as a simple trustable method. In this investigation, we followed the method of Hardyck et al. by using several methods (using scissors, pitching, writing and so on), and letting the subject decide cautiously which hand was predominant. If the right hand was more nimble, right handedness (R) was considered, otherwise left handedness (L).

Clasping the hands with the fingers interlocked, individuals were classified as right hand clasping (R) if they were comfortable to put the right thumb on the top of the left one. In the reversed condition, they were classified as left hand clasping (L).

We asked the individuals to stand on both feet and imagine there was a football in front of them. If an individual wanted to kick the football with his right foot, it was considered as right foot preference (R), otherwise as left foot preference (L).

To study stride type, we asked individuals to stand at attention and then stride. Individuals who strode their right feet first were considered to be of the right stride type (R), and the reverse to be left stride type (L).

An individual was asked to gaze fixedly at one point in the distance, then to hold out this thumb towards the exact line of vision, and then close his left eye. If that point was hidden from view by the thumb, right eye preference was recorded (R), otherwise left eye preference (L).

If an individual felt comfortable to overlap his right leg on the left one when sitting on a chair, he was considered as right leg folding (R), otherwise as left leg folding (L).

A similar phenomenon could be observed in hand clasping and arm folding. Some individuals put the right hand or right arm uppermost (R) while others did the contrary (L).

Results and Discussion

The results of seven asymmetric behavioral traits in three groups were listed in Table 1 and Table 2. The relation between the seven traits is presented for both sexes in Table 3 and Table 4, for males in Table 5 and Table 7, and for females in Table 6 and Table 8. The frequencies of R-types on some asymmetric behaviors in some ethnic groups were given in Table 9.

Handedness

Handedness is the most prominent manifestation of behavioral asymmetry in the human population. Most Mongols in Hulun Buir League were right handed (88.2%) (Table 1, Table 2). The frequencies of R-type in the 3 groups were in the following order: Elute-92.0%, Bargud-85.2% and Buriat-84.3%. The results showed significant difference between Elute and Bargud ($P < 0.05$) and extremely significant difference between Elute and Buriat ($P < 0.01$). There was no significant sex difference ($P > 0.05$) of right handedness not only in each groups but also in total. The results confirmed Hardyck et al. and Pelecanos's conclusion (Pelecanos, 1969) that handedness is not related to sex.

The frequency of right handedness in Mongols in Hulun Buir League was lower than that of Hans- 91.04% (Zheng Lianbin et al., 1998) in Huhhot City, Mongols (Zheng Lianbin et al., 1998) in Jirem League-90.69%, somewhat higher than that of Huis (Zheng Lianbin et al., 1998) in Huhhot City-87.74%.

The total frequency of 88.2% in Mongols in Hulun Buir League was lower than those in the following populations: American Negroes-90.5% (Hardyck, 1975), Central Indian Murias-95.75%, Bisonhorn Marias-96.40% and Halbas-99.28% (Datta et al.,

Table 1. Finding of seven behavioral traits of lateral functional dominance in three Mongolian groups (N%)

			Handed- ness	Hand clasping	Arm folding	Leg folding	Foot preference	Stride type	Eye preference
			R	R	R	R	R	R	R
Bargud	Male	196	163 (83.2)	104 (53.1)	116 (59.2)	136 (69.7)	167 (85.2)	137 (69.9)	128 (65.3)
	Female	217	189 (87.1)	117 (53.9)	110 (50.7)	166 (76.5)	196 (90.3)	158 (72.8)	150 (69.1)
	Total	413	352 (85.2)	221 (53.5)	226 (54.7)	302 (73.1)	363 (87.9)	295 (71.4)	278 (67.3)
Elute	Male	201	188 (93.5)	93 (46.3)	84 (41.8)	151 (75.1)	188 (93.5)	100 (49.8)	140 (69.7)
	Female	225	204 (90.7)	109 (48.4)	107 (47.6)	181 (80.4)	213 (94.7)	128 (56.9)	163 (72.4)
	Total	426	392 (92.0)	202 (47.4)	191 (44.8)	332 (77.9)	401 (94.1)	228 (53.5)	303 (71.1)
Buriat	Male	42	34 (81.0)	23 (54.8)	23 (54.8)	27 (64.3)	34 (81.0)	26 (61.9)	23 (54.8)
	Female	66	57 (86.4)	41 (62.1)	31 (47.0)	49 (74.2)	58 (87.9)	37 (56.1)	45 (68.1)
	Total	108	91 (84.3)	64 (59.3)	54 (50.0)	76 (70.4)	92 (85.2)	63 (58.3)	68 (63.0)
Total	Male	439	385 (87.7)	220 (50.1)	223 (50.8)	314 (71.5)	389 (88.6)	263 (59.9)	291 (66.3)
	Female	508	450 (88.6)	267 (52.6)	248 (48.8)	396 (78.0)	467 (91.9)	323 (63.6)	358 (70.5)
	Total	947	835 (88.2)	487 (51.4)	471 (49.7)	710* (75.0)	856 (90.4)	586 (61.9)	649 (68.5)

*: significant difference ($0.01 < P < 0.05$) (χ^2 between sexes)

The L-type frequency can be obtained by subtracting the R-type frequency from the total

Table 2. Inter-group difference of frequency of functional asymmetries for the seven behavioral traits

Ethnic groups	Handed- ness	Hand clasping	Arm folding	Leg folding	Foot preference	Stride type	Eye preference
(Bargud × Elute)	9.625**	3.114	8.198**	2.629	10.024**	28.642**	1.433
(Bargud × Buriat)	1.162	1.142	0.768	0.326	0.568	6.829**	0.726
(Elute × Buriat)	6.005*	4.832*	0.925	2.734	9.728**	0.805	2.708

* significant difference ($0.01 < P < 0.05$); * * extremely significant difference ($P < 0.01$)

Table 3. Interrelation between the seven traits (coincidence for each combination; both sexes included)

		Hand clasping		Arm folding		Leg folding		Foot preference		Stride type		Eye preference	
		R	L	R	L	R	L	R	L	R	L	R	L
Handedness	R	445	390	419	416	650	185	783	52	538	297	567	268
	L	42	70	52	60	60	52	73	39	48	64	82	30
Hand clasping	R			258	229	391	96	452	35	315	172	318	169
	L			213	247	319	141	404	56	271	189	331	129
Arm folding	R					368	103	432	39	302	169	319	152
	L					342	134	424	52	284	192	330	146
Leg folding	R							672	38	470	240	483	227
	L							184	53	116	121	166	71
Foot preference	R									560	296	591	265
	L									26	65	58	33
Stride type	R											405	181
	L											244	117

Table 4. ϕ interrelation analysis between the seven traits (based on the data in Table 3; $N = 947$)

	hand clasping	arm Folding	leg Folding	Foot preference	Stride type	Eye preference
Handedness	0.102**	0.024	0.181***	0.313***	0.143***	0.037
Hand clasping		0.067*	0.126***	0.085**	0.059	0.072*
Arm folding			0.073*	0.045	0.046	0.017
Leg folding				0.250***	0.153***	0.019
Foot preference					0.224***	0.034
Stride type						0.016

*significant correlation ($0.01 < P < 0.05$); **extremely significant correlation ($P < 0.01$); *** extremely significant correlation ($P < 0.001$)

Table 5. Interrelation between the seven traits in males (coincidence for each combination)

		Hand clasping		Handedness		Arm folding		Leg folding		Foot preference		Stride type	
		R	L	R	L	R	L	R	L	R	L	R	L
Handedness	R	204	181										
	L	16	38										
Arm folding	R	123	100	199	24								
	L	97	119	186	30								
Leg folding	R	173	141	292	22	177	137						
	L	47	78	93	32	46	79						
Foot preference	R	203	186	357	32	203	186	294	95				
	L	17	33	28	22	20	30	20	30				
Stride type	R	137	126	241	22	144	119	211	52	250	13		
	L	83	93	144	32	79	97	103	73	139	37		
Eye Preference	R	134	157	249	42	145	146	200	91	258	33	177	114
	L	86	62	136	12	78	70	114	34	131	17	86	62

Table 6. Interrelation between the seven traits in females (coincidence for each combination)

		Hand clasping		Handedness		Arm folding		Leg folding		Foot preference		Stride type	
		R	L	R	L	R	L	R	L	R	L	R	L
Handedness	R	241	209										
	L	26	32										
Arm folding	R	135	113	220	28								
	L	132	128	230	30								
Leg folding	R	218	178	358	38	191	205						
	L	49	63	92	20	57	55						
Foot preference	R	249	218	426	41	229	238	378	89				
	L	18	23	24	17	19	22	18	23				
Stride type	R	178	145	297	26	158	165	259	64	310	13		
	L	89	96	153	32	90	95	137	48	157	28		
Eye Preference	R	184	174	318	40	174	184	283	75	333	25	228	130
	L	83	67	132	18	74	76	113	37	134	16	95	55

Table 7. ϕ interrelation analysis between the seven traits in males (based on the data in Table 5; $N = 439$)

	Hand clasping	Handedness	Armfold-ing	Leg folding	Foot preference	Stride type
Handedness	0.153**					
Arm folding	0.102*	0.048				
Leg folding	0.158***	0.255*****	0.177*****			
Foot preference	0.116*	0.346***	0.077	0.250***		
Stride type	0.048	0.146**	0.097*	0.236***	0.248**	
Eye preference	0.114*	0.091	0.027	0.087	0.078	0.026

*significant correlation ($0.01 < P < 0.05$); **extremely significant correlation ($P < 0.01$); *** extremely significant correlation ($P < 0.001$)

Table 8. ϕ interrelation analysis between the seven traits in males (based on the data in Table 6; $N = 508$)

	Hand clasping	Handedness	Armfold-ing	Leg folding	Foot preference	Stride type
Handedness	0.056					
Arm folding	0.037	0.123**				
Leg folding	0.094*	0.108*	0.022			
Foot preference	0.051	0.280***	0.015	0.243***		
Stride type	0.067	0.140**	0.082	0.071	0.196***	
Eye preference	0.036	0.119**	0.007	0.041	0.062	0.106*

* significant correlation ($0.01 < P < 0.05$); ** extremely significant correlation ($P < 0.01$); *** extremely significant correlation ($P < 0.001$)

1989), 14 groups-91.4—100% in Sikkim of India (Bhasin et al., 1987), North Indian Pangwalas-98.3%, Thanshumant Gaddis-95.1% and Settled Gaddis-97.6% (Bhasin et al., 1986). However, it was higher than that of 80.95% in Jews (Rife and Schonfeld, 1944) and 86.5% in Indian Gujarat Thakurs (Pandey et al., 1982). In addition, it was close to that of 89.8% in American Whites (Hardyck, 1975) and 89.65% in students of north Greece (Pelecanos, 1969). All data show that the frequencies of right handedness are significantly higher than those of left one.

Up to now, most scholars have believed that handedness is autosomally inherited. Right handedness is a dominant character (Zhou Xicheng et al., 1991) while left handedness is a recessive character. The frequencies of dominant and recessive genes calculated under this assumption were $H = 0.6561$ and $h = 0.3439$ in Mongols in Hulun Buir League, respectively.

Hand clasping

Hand clasping is one of the human lateral functional traits studied by scholars on a large scale. At the beginning of the 20th century, according to his investigation on family data, Lutz (1908) believed that hand clasping was related to genetic factors, and the pattern of the behavioral trait could not be explained simply by Mendelian mechanism. His opinion was supported by Yamaura (1940), Kawabe (1949), Freire-Maia et al. (1958), Pons (1961) and Bhasin (1987). Kawabe believed that right hand clasping was a dominant character, but some recessive homozygote showed right hand clasping. Freire-Maia et al. thought that hand clasping was controlled by a pair of alleles, left hand clasping was dominant character, but some recessive homozygote showed left hand clasping. However, some scholars have different ideas. Having analyzed the hand clasping of mono- and dizygotic twins, Dahlberg (1926) declared that the evidence was not enough to confirm Lutz's hypothesis. Wiener (1932) and Lai and Walsh (1965) agreed that hand clasping had no relation to genetic factor.

The frequency of right hand clasping in Mongols in Hulun Buir League was 51.43%. The frequencies of R-type in the three groups were as follows: Buriat-59.26%, Bargud-53.51%, Elute-47.42%. The frequencies of right type showed significant difference between Elute and Buriat. No significant sex difference was shown between the three groups. The results were consistent with those of most scholars (Arrietta et al., 1985; Pandey et al., 1982).

Compared with other groups of Inner Mongolia, the frequency of right hand clasping in Mongols in Hulun Buir League was lower than that in Hans in Huhhot-53.02%, close to that in Mongols in Jirem League (50.09%), but higher than that in Huis in Huhhot City-46.59% and Daurs in Hulun Buir League-45.87% (Zheng Lianbin et al., 1999)

The Mongols in Hulun Buir League showed a lower frequency of right hand clasping than the following populations: Negroes in Brazil-68.71% (Freire-Maia et al., 1958), Japanese-55.7% (Lai and Walsh, 1965), Philippons-63.3% (Lai and Walsh, 1965).

New Guineas-62.7% (Lai and Walsh, 1965), Indians in Brazil-54.69% (Freire-Maia et al., 1958), Rajputs-59.78% and Pathans-55.20% in Pakistan (Mian et al., 1994), Sikkims in India-49.2~60.3%, However, they showed a higher frequency of right hand clasping than Bisonhorn Marias-34.00% and Murias-38.65% in Central India. In addition, they showed a close frequency to the following populations: Jats in Pakistan-53.35% (Mian et al., 1994), Basques in Spain-53.31% (Arriet et al., 1985), Central Indian Halbas-50.72% (Datta et al., 1989), Hongkongs-48.6%, Indian Gujarat Thakurs-48.50% (Pandey et al., 1982), Whites in Australia-49.3% (Lai and Walsh, 1965), Whites in America Mallian-49.98% (Piato et al., n1985), Greeks-49.61%. On the whole, the total frequency of 51.43% we observed in Mongols in Hulun Buir League is relatively low.

Arm folding

The frequency of right Arm folding in Mongols in Hulun Buir League was 49.72%. In the three groups, the frequencies of R-type were in the following order: Bargud-54.72%, Buriat-50.00%, Elute-44.84%. The frequencies of R-type showed significant difference between Bargud and Elute. It was indicated that there was no sex difference in the frequencies of right arm folding, which proved the opinions of Freire-Maia et al., Pelecanos, Randey, Arrieta and Plato.

The frequency of right arm folding in Mongols in Hulun Buir League was close to that of Huis in Huhhot City -50.68%, slightly higher than that of Hans in Huhhot City-47.74% and lower than that of Mongols in Jirem League-52.37%, Daurs in Hulun Buir League-55.94%.

In contrast to other populations in the world, Mongolian nationality in Hulun Buir League showed a lower frequency of right arm folding than Syeds in Pakistan-56.85% (Mian et al., 1994) and Negroes in Angola-56.74% ((Freire-Maia and Almeida, 1966). However, the frequency of R-type in Mongols in Hulun Buir League was higher than the followings: Whites in Mallian of America-44.65%, Shias in India-42.04% (Tyagi, 1974), Central Indian Halbas-41.30%, Bishonhorn Marias-40.80%, Murias-38.65% and Settled Gaddis-37.2%, 14 groups in Sikkim of Indian 35.4—46.9%, Brazilian Whites-41.37% (Freire-Maia et al., 1958), Negroes-41.82%, Indians-46.12% (Freire-Maia et al., 1958), Japanese-43.97%, Spaniard-41.31%, Basques-37.92%, students in Thessaloniki of Greece-45.48%. In addition, it was close to that of Thakurs in Gujarat of Indian-51.00%, Pathan-48.95% and Jats-50.17% in Pakistan. In short, Mongols in Hulun Buir League have a moderate-to-high frequency of right arm folding.

Leg folding

The frequency of right leg folding in Mongols (74.97%) in Hulun Buir league was significantly higher than that of left one (25.03%). The results were consistent with those of most scholars. The frequencies of R-type in the three groups were as follows: Elute-77.93%, Bargud-73.12%, Buriat-70.37%. Sex difference was found: the

frequency of R type in Mongolian females-77.95% was much higher than that in Mongolian males-71.53%. This result supported Plato's observation (1985) that leg folding has significant sex difference. Plato believed that the rate of left leg folding in males was twice as large as what was in females. In this investigation, however, it was not completely the case.

The frequency of R-type in Mongolian nationality in Hulun Buir League was higher than that of Daur-72.28%. Indian Settled Gaddis-61.7%, Bisonhorn Marias-56.00%, Murias-50.35%, Halbas-43.48%, but close to that of Whites in Mallian of America-75.41%, 14 groups in Sikkim-66.8—81.6%. Reiss (1994) argued that the pattern of leg folding was so complex that it could not be explained simply by Mendelian mechanism though it was controlled by genetic factors.

Foot preference

Mongols in this study showed a much higher frequency of right foot preference (90.39%) than that of left one (9.61%), which was consistent with the results of Plato (1985). The frequencies of R type in three groups were as following: Elute-94.13%, Bargud-87.89%, Buriat-85.19%. There was extremely significant difference between the frequency of R type in Elute and that in other two groups ($P < 0.01$). The frequency of foot preference showed no relation with sex, which was inconsistent with Plato's results.

The data on foot preference are rare. The frequency of 90.39% in Mongols in Hulun Buir League was somewhat lower than that of 92.76% in Whites in Mallian of America (Plato et al., 1985).

Stride type

Mongols in Hulun Buir League were significantly accustomed to stride their right legs first-61.88% more frequently than their left legs-38.12%. The frequencies of R type in the three groups were in following order: Bargud-71.43%, Buriat-58.33%, Elute-53.52%. The frequency in Bargud was significantly higher than that in other two groups. No sex difference was found, which was consistent with the results of Daur nationality. Mongols in Hulun Buir League showed a higher frequency of right stride type than Daur-55.12%.

No data on this trait have been found published on populations outside of China.

Eye preference

When people fix their eyes on an object, one eye is predominant, the other is subsidiary. The predominant eye is called preferential eye. Eye preference has nothing to do with the ability of eyes. Data on eye preference are rare. The data reported showed that the frequency of R-type was higher than that of L-type (Zheng Mingxia et al., 1999).

The frequency of right eye preference-68.53% in Mongols in Hulun Buir League was significantly higher than that of the left one-31.47%. In the three groups, the frequencies of R-type were as following: Elute-71.13%, Bargud-67.31%, Buriat-

62.96%. No relation with sex was found, which was inconsistent with the results of Plato.

The frequency of right type in this investigation, was close to that in the following populations: Whites in Mallian of America-68.84% (Plato et al., 1985), Huis-69.7% in Huhhot City and Mongols-68.7% in Alxa League of Inner Mongolia, but lower than that in Hans-78.1%, Korean-78.2%, Mongols-74.2%.

From physiological point of view, the action of limbs is controlled by the opposite hemisphere of the brain. People whose right cerebral cortex centers occupy a dominant position over his left ones have left dominance. However, some human behaviors are affected by the social environment. For example, left handed people are very often forced to write and take food with their right hands. Therefore, the formation of asymmetric behaviors is related not only to genetic factors, but to social factors as well.

Up to now, some scholars have tried to explain the causes of these asymmetric behavioral traits. However, little is known. A study examined the prenatal development of asymmetric behavior by observing the occurrence of left- and right-arm movements in 17 human fetuses at three week intervals from 12 to 27 weeks gestational age. Fetuses exhibited significantly more right-arm movements than left-arm movements at every gestational age. Throughout all periods of observation, 83.3% of fetuses showed more right-arm than left-arm movements. The occurrence of asymmetric behavior in early gestation indicates that it is probably under muscular or spinal, rather than cortical, control and points to a genetic origin for such behavior. The presence of asymmetric behavior in early gestation suggests it may have a potential causative role for subsequent asymmetric behavior and asymmetric brain development

Freire-Maia and Freire-Maia (1968) have suggested a correlation between the types of hand clasping and the occurrence of the sesamoid bones in the hands. The time of appearance and distribution of the sesamoid bones are hereditarily determined. After his accumulating adequate data of hand clasping, Reiss (1999) found that the following distribution of left hand clasping (LHC) in the families in relation to the R × R, R × L, L × L-parents is 32%, 47% and 59% ($\chi^2 = 467.78$, $P < 0.0005$), respectively. This result suggested a biological basis of hand clasping. Although the data are not compatible with any simple, conventional Mendelian model, they do not permit the exclusion of some kind of genetic factors on hand clasping.

Relations Between seven asymmetric behavioral traits

Many scholars have studied the relations between asymmetric behavioral traits. Most of them believed hand clasping, arm folding, foot preference and eye preference were not interrelated but independent of one another (Pons, 1961; Wiener, 1932). But Kobylansky et al (Kobylansky et al., 1977) and Arrieta et al. (1985) thought there was obvious interrelation between hand clasping and arm folding. Plato be-

Table 9. Frequencies of R-types on some asymmetric behaviors in some ethnic groups (%)

Ethnic groups	Number		Hand clasping		Arm folding		Handedness		Leg folding		Authors (Years)		
	M	F	M	F	M	F	M	F	M	F			
Basques (Spain)	286	455	741	56.29	51.43	53.31	35.31	39.56	37.92		Arrieta et al. (1985)		
Spanishes	251	235	486	49.40	54.89	52.06	41.28	41.33	41.31		Pons (1961)		
Greeks	1082	1062	2144	81.45	81.15	81.30	45.56	45.27	45.48	88.84	90.72	89.65	Pelecanos (1969)
Americans	272	326	598	63.97	56.75	60.03							Lutz (1908)
Americans	306	179	485	48.8	52.0	49.98	44.8	44.4	44.7	69.3	86.0	75.5	Plato et al. (1985)
White (America)	1040	541	1581	49.60	54.20	51.90							Downey (1926)
Japanese			1012			60.57			43.97				Freire-Maia et al. (1958, 1966)
Russians			58			56.90							Freire-Maia et al. (1958)
Negroes (Angola)	1357	74	1431	62.26	58.10	62.05	57.11	50.00	56.74				Freire-Maia et al. (1966)
Negroes (Brazil)			489			68.71							Freire-Maia et al. (1958)
Mongoloids (Brazil)			1012			60.57							Freire-Maia et al. (1958)
Indians (Brazil)			192			54.69							Freire-Maia et al. (1958)
White (Australia)	50	52	102	50.00	48.60	49.30							Freire-Maia et al. (1958)
New Guinea	127	174	301	62.60	62.80	62.70							Freire-Maia et al. (1958)
Settled Gaddis (India)			437			55.4			37.2			97.6	Lai and Walsh (1965)
Thakurs (India)	110	90	200	45.50	52.20	48.50	41.80	62.30	51.00	90.00	82.00	86.50	Lai and Walsh (1965)
Marias (India)	153	129	282	50.32	24.80	38.65	38.56	38.76	38.65	98.03	93.02	95.75	Bhasin et al. (1986)
Bisonhorn Marias (India)	155	95	250	43.87	17.89	34.00	39.36	43.16	40.80	96.13	96.85	96.40	Paudey et al. (1982)
Halbas (India)	82	56	138	56.09	42.85	50.72	37.80	46.43	41.30	98.78	100.00	99.28	Patta et al. (1989)
Shias (India)	171	93	264	52.63	51.61	52.27	42.10	41.93	42.04	56.13	55.79	56.00	Plato et al. (1985)
Sunnis (India)	132	54	186	54.54	55.55	54.83	50.00	38.88	46.23	36.58	53.57	43.48	Plato et al. (1985)
Rajput (Pakistan)			189			59.78			47.08				Tyagi (1974)
Jat (Pakistan)			283			53.35			50.17				Tyagi (1974)
Pathan (Pakistan)			96			55.20			48.95				Mian et al. (1994)
													Mian et al. (1994)
													Mian et al. (1994)
													Mian et al. (1994)

lieved leg folding and foot preference interrelated each other not only in males ($\chi^2 = 14.47$, $P < 0.01$) but also in females ($\chi^2 = 7.26$, $P < 0.01$), eye preference and foot preference interrelated each other only in females ($\chi^2 = 8.81$, $P < 0.01$), hand clasping and arm folding interrelated only in males ($\chi^2 = 6.26$, $P < 0.01$).

By means of ϕ interrelation analysis between the two traits, twelve interrelations in 21 pairs of traits were found to be significant (Table 4). Among them hand clasping, leg folding, handedness and foot preference had multiinterrelations with other traits. The interrelations between handedness and foot preference, arm folding and leg folding are what people are interested in. About 93.77% of 835 right handed subjects showed right foot preference, but only 65.18% of 112 left handed subjects showed right foot preference. That means right handedness and right foot preference, left handedness and left foot preference are closely related. So are right arm folding and right leg folding, left arm folding and left leg folding. Upper and lower limbs of the same side are controlled by the brain of the opposite side. That is probably why some pairs of traits have interrelations. In a word, there is relatively close influence between the seven asymmetric behavioral traits.

The difference between three groups

As far as the seven behavioral traits were concerned, four traits showed extremely significant difference between Bargud and Elute, three traits showed extremely or moderately significant difference between Elute and Buriat, but only one trait showed extremely significant difference between Bargud and Buriat (Table 2), which suggested that Bargud and Buriat have closer relations. Both of their forbears had lived near Lake Baikal. That may explain the similarity of the two groups. Although both Elute and Buriat live in Ewenki Banner now, they have greater difference. That is because they came from different places and seldom intermarried.

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