

Relations of Hand Clasping and Arm Folding to Handedness in Hungarian Children

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Introduction

If somebody clasps his hands alternating the fingers of both hands, it can be observed that either the right, or the left fingers remain above those of the other hand. The phenomenon, well-known for many years, is called "hand clasping" (HC) and people fall into two groups recorded as "R" and "L" individuals according to which of their hands lies in the upper position. A similar action, performed by the arms, is called "arm folding" (AF). It may also occur with the right, or with the left arm uppermost ("R" and "L" type of action). Both phenomena, repeated in a natural way, are carried out consistently, with only very rare exceptions.

The question was put in rather early papers (Lutz, 1908; Downey, 1926, 1933; Weiner, 1932), whether the two phenomena were genetically determined, or mainly submitted to the effects of environmental factors. Concerning HC, a greater part of authors are of the opinion of maintaining the primary role of heredity (Lutz, 1908; Downey, 1926; Yamaura, 1940; Kawabe, 1949; Freire-Maia et al, 1958; Pons, 1961) and what is more, Malhotra (1968), after having studied 8 endogamous groups of Maharasthrian Brahmins, emphasizes the probable utility of this trait in inter-population studies, while Dahlberg (1926), Weiner (1932), Lai and Walsh (1965) are proclaiming the hypothesis of environmental influences on the character. Referring to AF, a much greater uncertainty about its development can be found in the literature. No connection between HC and AF could be proved up to the present.

According to population data, the proportion of "R" individuals is about 50% in young individuals. Pons (1961), reporting examinations on a series of Spaniards aged from 6 to 80 years, found an increasing percentage of "R" individuals with age; Lai and Walsh (1965), after having tested white Australians and New Guinea natives, failed to find the same phenomenon. In respect of AF, there are higher proportions of "L" individuals reported in the majority of publications, but opposite data are also obtained: Freire-Maia and De Almeida (1966) noticed a predominance of "R" individuals among African Negroes.

Looking for data on the frequency of left-handedness in European populations, very differing numbers (from 1 to 50%) can be registered (Kramer, 1961).

We asked the following question: may any connection be between the manner of HC and AF on the one hand, handedness on the other hand? To get an answer, we tried:

1) to examine the manner of clasping the hands and folding the arms in school children;

2) to compare these characters to a series of tests — chosen by us — for handedness. By this way a further problem arose: are HC and/or AF suitable to be enlisted into the tests for laterality?

Mathematical procedures have already been earlier employed for the analysis of the tests for handedness. It was pointed out that, satisfying the expectations, the values of the tests for the diagnosis of laterality differ from each other to a very great extent. Bloede (1946) and Wegener (1949) stressed the significant role of the anamnesis relating to the childhood, but they did not support their statements mathematically. In the reports of Nutzhorn (1953), Leiser-Eggert (1954) and Černaček (1964) an effort of analysing the values of the tests by a points system can be found.

Material and Methods

We have not intended to form a detailed series of tests from every possible respect, only using the tests for the sake of a comparison of handedness to the frequency distributions of HC and AF. Our results, as shown in Tabs. I, II and III, are consisted of the data of 415 unrelated pupils of the Budapest school “Horváth Imre”, aged from 9 to 15 years, including 212 boys and 203 girls.

The following tests were employed:

- a) Does the pupil believe himself / herself to be right or left-handed?
- b) The child draws a profile: does it look to the right, or to the left?
- c) HC: right, or left hand above?
- d) AF: right, or left arm above?
- e) A test of taking out a coin from a purse. Right or left hand used?
- f) A test of drawing one of five playing cards. Right or left hand used?
- g, h, i) Two parallelograms are put on the table. One of them is vertically lined. The other must be lined askew.
- g) From which direction in which direction are the lines drawn?
- h) In which direction are the lines leaning?
- i) Is the ruling begun from above or from below?
- l) Which hand is used for drawing?

Each question could be answered in two different ways: they were signed as “1” or “0”. (Answers suspicious for right-handedness were signed as “1”).

In analysing our data mathematically, those pupils were treated as “left-handed” in a first approximation, who professed themselves to be left-handed. In this way the distribution of 415 children was the following: 389 right-handed, 17 left-handed and 9 uncertain. (The last group was left out from the further analysis). This mate-

rial contained a relative low number of left-handed children; in order to increase their number, we chose out of 456 further pupils of the school those persons, who professed themselves to be left-handed. Those children were also submitted to our tests and so the number in the left-handed group increased to 32.

Analysis of Results

The results are summarized in Tables I, II and III. Our data show a slight deviation from those of other European populations (Pons, 1961), i. e. the percentage of "L" individuals is somewhat higher both in respect of the manner of clasping the hands and folding the arms. HC and AF look independent from each other, our observations being in accordance with the data of literature. There was no significant difference found between the two sexes.

Tab. I. Distribution of both types of hand clasping and arm folding of Hungarian children

HC	AF		
	"R" individuals	"L" individuals	Total examined
"R" individuals	73	117	190
"L" individuals	81	144	225
Total examined	154	261	415

Tab. II. Distribution of both types of hand clasping of Hungarian children grouped according to sex

	N. of pupils classified	"R" individuals		"L" individuals	
		N.	%	N.	%
Boys	212	95	44.8	117	55.2
Girls	203	95	46.8	108	53.2
Total examined	415	190	45.8	225	54.2

Tab. III. Distribution of both types of arm folding of Hungarian children grouped according to sex

	N. of pupils classified	"R" individuals		"L" individuals	
		N.	%	N.	%
Boys	212	84	39.6	128	60.4
Girls	203	70	34.5	133	65.5
Total examined	415	154	37.1	261	62.9

HC and AF are generally not regarded as tests for handedness, hence it must be supposed that a simple and easily recognizable connection does not exist between HC, AF and laterality. By a mathematical treatment of the problem, we tried to elucidate an eventual latent connection.

Original tests were transformed to a new test-system, consisting of the following tests:

- T₁: the original (b);
- T₂: the combination of (e) and (f);
- T₃: the combination of (h) and (i).

Some original tests were excluded from the new system as a result of a preliminary analysis of the data.

In the case of T₂ and T₃ three outcomes were possible: 0-0, 1-1 and mixed (1-0 or 0-1). Consequently, the number of all possible outcomes for the whole system was 2. 3. 3 = 18. A "point number for left-handedness" (PNLH), defined by the sum of PNLH-s belonging to the single tests, were attached to every pupil.

The PNLH was determined as a function of the frequencies of the outcomes both in the group of right-handed and left-handed children. In a more exact formulation the PNLH belonging to the outcomes "l", "m" and "n"¹ is defined by

$$\text{PNLH}_{(l, m, n)} = P_{1l} + P_{2m} + P_{3n} + K$$

where

$$P_{1l} \approx c \log \frac{X_{1l}}{Y_{1l}} \quad (l = 0, 1)$$

$$P_{2m} \approx c \log \frac{X_{2m}}{Y_{2m}} \quad (m = 0, 1, 2)$$

$$P_{3n} \approx c \log \frac{X_{3n}}{Y_{3n}} \quad (n = 0, 1, 2)$$

where X_{1l}, X_{2m}, X_{3n} and Y_{1l}, Y_{2m}, Y_{3n} denote frequencies of the answers "l", "m" and "n" given for T₁, T₂ and T₃, in the left-handed and right handed groups, respectively. The values of K and c, determining the origin and the range of the point scale, can be established arbitrarily (in our computations K = 80, c = 100 and the logarithm of base 10 were used). The PNLH-s were rounded to integers (this is denoted by the symbol ≈). In our case the least and largest PNLH-s were equal to 0 and 288, respectively. In Tab. IV the PNLH-s belonging to every possible combination (l, m, n) are represented.

Right-handed children were divided into 8 categories based on the following 3 factors (each having 2 levels): (1) sex; (2) HC and (3) AF. Tab. V contains the

¹ Possible values of "l" in T₁ are 0 or 1, while "m" and "n" take on 0, 1 or 2 (corresponding to the combinations 0-0, 1-1 or "mixed" of possible answers for the original tests) in T₂ and T₃, respectively.

Tab. IV. Different point numbers for left handedness (PNLH-s) belonging to the outcomes "1", "m" and "n"

Test			PNLH-s
1.	2.	3.	
0	0	0	229
0	0	1	200
0	0	2	288
0	1	0	85
0	1	1	56
0	1	2	144
0	2	0	132
0	2	1	103
0	2	2	191
1	0	0	173
1	0	1	144
1	0	2	232
1	1	0	29
1	1	1	0
1	1	2	88
1	2	0	76
1	2	1	47
1	2	2	135

Tab. V. PNLH-s of "right-handed" children grouped according to sex, HC and AF

Sex	HC	AF	N. of pupils belonging to the group	PNLH-s	
				Sum	Average
Boy	0	0	67	2690	40.1
Boy	0	1	43	1254	29.1
Boy	1	0	52	2035	39.1
Boy	1	1	33	1257	38.1
Girl	0	0	68	2725	40.1
Girl	0	1	37	1215	32.8
Girl	1	0	59	1265	21.4
Girl	1	1	30	843	28.1
Boy	0+1	0+1	195	7236	37.1
Girl	0+1	0+1	194	6048	31.2
B+G	0	0+1	215	7884	36.7
B+G	1	0+1	174	5400	31.0
B+G	0+1	0	246	8715	35.4
B+G	0+1	1	143	4569	32.0
B+G	0+1	0+1	389	13284	34.15

averages of PNLH-s belonging to each combination and to different groupings. It shows that:

- 1) Average of PNLH-s is higher in boys than in girls;
- 2) Average of PNLH-s in the group "0" is greater than that in the group "1" for HC;

Tab. VI. Distribution of "right-handed" children into "absolutely right-handed" and not "absolutely right-handed", grouped according to HC and AF

Sex	HC	AF	"Absolutely right-handed" belonging to the group (PNLH = 0)		Not "absolutely right-handed" belonging to the group (PNLH > 0)	
			N.	%	N.	Average of PNLH-s
Boy	0	0	35	52.4	32	84.1
Boy	0	1	21	48.8	22	57.0
Boy	1	0	23	44.2	29	70.2
Boy	1	1	16	48.5	17	73.9
Girl	0	0	34	50.0	34	80.1
Girl	0	1	19	51.3	18	67.5
Gr1	1	0	40	67.8	19	66.6
Girl	1	1	22	73.3	8	105.4
B+G	0+1	0+1	210	54.0	179	74.21

Tab. VII. PNLH-s of left-handed children

	N. of individuals	PNLH-s	
		Sum	Average
Left hand used for writing	20	3217	160.9
Right hand used for writing	12	1272	106
Total "left-handed" group	32	4489	140.3

3) Average of PNLH-s in the group "0" is greater than that in the group "1" also for AF.

It is difficult to judge the significance of the results owing to the relatively small number of the test persons and the strange distribution of the PNLH-s (i. e. the frequency of the "0" PNLH is greater than 50% of the cases).

Another fact indicated by Tab. V is that the average of PNLH-s of the group "1" for HC is much higher in boys than in girls. On the basis of a further analysis this phenomenon may be interpreted as a consequence of a significantly higher proportion of "absolutely right-handed persons"¹ in the group HC-"1" among girls than among boys, as it is represented in Tab. VI.

The PNLH-s of the left-handed pupils were also computed. Their group was divided into two parts, according to the observation: which hand was used for writ-

¹ "Absolutely right-handed person" is called a child giving an answer "1" for each of the tests T₁, T₂ and T₃. (This is the case corresponding to the value "0" PNLH).

ing (children using the right were called "left-handed in the wider sense"). The data of the left-handed children are demonstrated in Tab. VII. Only one child (a "left-handed in the wider sense") out of 32 gave an answer looked as "absolutely right-handed"; such an answer had a frequency of 54% in the right-handed group.

Summary

The authors examined the manner of clasping the hands (HC) and folding the arms (AF) in 415 unrelated pupils, aged from 9 to 15, of the Budapest school "Horváth Imre". As refers to HC, 54.2% of the total material was found to be "L" (55.2% in ♂ and 53.2% in ♀), while concerning AF, 62.9% of the total material was found to be "L" (60.4% in ♂ and 65.5% in ♀). No significant difference between sexes could be observed. On the basis of a test constructed by the authors and supposed to be connected with handedness, every pupil examined was marked by a "point number for left-handedness" (PNLH). New observations drawn from our data are: (1) the PNLH average of right-handed pupils is somewhat higher in ♂ than in ♀; (2) a higher PNLH average is found, both for HC and AF, in the group of "L" individuals; (3) as the most striking phenomenon, the group of "R" type girls for HC (marked as "1") contains a significantly high number of "absolutely right-handed". This observation suggests that there may be a latent connection between HC, AF and laterality, but the lack of a simple and manifest coherence between these characteristics makes it inadequate to apply HC and AF as tests for handedness.

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RIASSUNTO

Gli autori hanno esaminato il modo di giungere le mani (HC) e incrociare le braccia (AF) di 415 alunni, non imparentati, dai 9 ai 15 anni, della scuola « Horváth Imre » di Budapest. Per quanto riguarda l'HC, di tutto il materiale esaminato, il 54.2% si dimostrò « L » (55.2% dei ♂ e 53.2% delle ♀). Per quanto riguarda l'AF, di tutto il materiale, il 62.9% si dimostrò « L » (60.4% dei ♂ e 65.5% delle ♀). Non furono riscontrate differenze significative tra i due sessi. Sulla base di un test costruito dagli autori e che si supponeva correlato con la manualità, ogni alunno esaminato fu segnato con un « numero indice per il mancinità » (PNLH). Le osservazioni ricavate dai nostri dati sono: (1) la media del PNLH dei non mancini è alquanto più elevata nei ♂ che nelle ♀; (2) una più alta media del PNLH viene riscontrata per quanto riguarda sia l'HC che l'AF nel gruppo degli individui « L »; (3) come fenomeno più sorprendente, il gruppo delle ragazze « R » per l'HC (indicate come « 1 ») ne comprende molte decisamente non mancine. Questa osservazione suggerisce la possibilità di una relazione latente tra HC, AF e lateralità, ma la mancanza di una semplice e manifesta coerenza tra queste caratteristiche contraddice l'applicazione dell'HC e dell'AF come tests per la manualità.

RÉSUMÉ

Les auteurs ont examiné la façon de joindre les mains (HC) et de croiser les bras (AF) de 415 élèves non consanguins, âgés de 9 à 15 ans, de l'école « Horváth Imre » de Budapest. Ils ont trouvé, pour tout le matériel examiné, 54.2% « L » en ce qui concerne l'HC (55.2% des ♂ et 53.2% des ♀), et, en ce qui concerne l'AF, 62.9% « L » (60.4% des ♂ et 65.5% des ♀). Des différences significatives parmi les deux sexes n'ont pas été observées. Sur la base d'un test construit par les auteurs mêmes, concernant le caractère manuel, chaque élève examiné fut indiqué avec un « nombre index pour la disposition à se servir de la main gauche » (PNLH). Il a été observé que: (1) la moyenne de PNLH de garçons avec disposition à se servir de la main gauche est parfois plus élevée de celle des jeunes-filles; (2) une moyenne plus élevée de PNLH est trouvée en ce qui concerne l'HC et l'AF chez le groupe des individus « L »; (3) phénomène le plus surprenant, le groupe des jeunes-filles « R » pour l'HC (indiquées comme « 1 ») en comprend plusieurs qui se servent exclusivement de la main droite. Cette observation suggère que probablement il y a une relation latente entre HC, AF et latéralité, mais l'absence d'une simple et manifeste cohérence entre ces caractéristiques contredit l'application de l'HC et de l'AF comme tests pour le caractère manuel.

ZUSAMMENFASSUNG

Verf. untersuchten bei 415 Schülern der « Horváth Imre »-Schule Budapest im Alter zwischen 9 und 15 Jahren, deren Art und Weise, die Hände zu falten (HC) und die Arme zu kreuzen (AF). Beim HC erwiesen sich 54.2% des ganzen untersuchten Materials als « L » (55.2% der ♂ und 53.2% der ♀); beim AF hingegen betrug dieser Prozentsatz 62.9% (60.4% der ♂ und 65.5% der ♀). Wesentliche Unterschiede zwischen den beiden Geschlechtern waren nicht ersichtlich. Einem von den Verf. konstruierten Test gemäss, der mit der Händigkeit in Zusammenhang stehen soll, wurde jedem Schüler eine « Indexnummer für Linkshändigkeit » (PNLH) verliehen. Die sich aus unseren Erhebungen ergebenden Beobachtungen sind folgende: 1) der Durchschnitt der PNLH der Nichtlinkshänder ist bei ♂ erheblich höher als bei ♀; 2) bei den « L »-Kindern ist der Durchschnitt der PNLH sowohl in Bezug auf HC als auf AF höher als bei den anderen; 3) am meisten überraschte die Beobachtung, dass in der Gruppe der « R » für HC bei Mädchen (die als « 1 » bezeichnet wurden) viele ganz deutlich nicht-linkshändige inbegriffen waren. Diese Beobachtung lässt vermuten, dass eine latente Beziehung zwischen HC, AF und Händigkeit besteht; da jedoch diese Merkmale keine einfache und deutliche Kohärenz aufweisen, so lassen sich HC und AF nicht für Händigkeitstests anwenden.

Acknowledgement. The authors are pleased to acknowledge the helpful suggestions of Prof. Dr. G. Lenárt and express their gratitude for the possibility of examination of school children to Mrs. Dr. L. Kántor, director of the school.

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