

HANDEDNESS IN TWINS: A CRITICAL REVIEW

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Abstract—The incidence of left-handedness is the same in MZ twins, DZ twins, and singletons. The proportions of R-R, R-L and L-L pairs in MZ twins are not in a binomial distribution. Twins have not been shown to be subject to any special factors modifying their handedness and are thus suitable for genetic analysis.

TWINS, it is usually claimed, are more likely to be left-handed than are singletons, and monozygotic (MZ) twins are more likely to be left-handed than dizygotic (DZ) twins [1, 2]. It is also claimed that the distribution of concordant and discordant MZ handedness pairs approximates to that of a binomial distribution [3]. In this paper I would like to suggest that none of these assertions is supported by adequate evidence, the published evidence being unsatisfactory. I shall consider the items in the reverse order to that just given.

I. THE DISTRIBUTION OF PAIR-TYPES IN MZ AND DZ TWINS

Twin data have represented the Achilles' heel of genetic models of handedness, the lack of any difference in concordance between MZ and DZ twins forcing CORBALLIS and BEALE [1] to suggest, and COLLINS [3] to claim directly, that R-R, R-L and L-L pairs, in both MZ and DZ twins, were present in binomial proportions, and hence to infer that there could be no genetic control over handedness. Similar conclusions have been made for the genetic control of hand-clasping [4], and have been shown to be false, since some genetic models of asymmetry predict very low degrees of concordance [5-7].

COLLINS [3] added together the results of several large studies of twin handedness and concluded that the twin pairs were present in binomial proportions. NAGYLAKI and LEVY [1] demonstrated that Collins' results were invalid, but in so doing they made a further error, of adding together data which are not capable of addition. It is not statistically valid to combine data from different studies unless the incidence of left-handedness is similar in the individual studies. Table 1 shows data on twin pairs from 19 studies of MZ twins, and 18 studies of DZ twins. There are highly significant differences in the incidence of left-handedness between studies, both for MZ twins ($\chi^2 = 73.26$, 18 *df*, $P < 0.001$) and for DZ twins ($\chi^2 = 53.32$, 17 *df*, $P < 0.001$). The differing incidences of left-handedness in the separate studies imply that the criterion for left-handedness is different between studies; hence the data within a study cannot be regarded as strictly independent, and hence *data* from different studies may not be summated, although *significance levels* may be [8].

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Table 1.

Study	Year	Size designation	N_{Mz}	% L_{Mz}	N_{Dz}	% L_{Dz}	Difference	χ^2_{Mz-Dz}	Two-tailed	One-tailed	MZ	χ^2_{BINOM}	DZ
SIEMENS [39]	1924	Small	37	16.21	31	27.41	-	2.52	0.108	0.946	0.00	0.09	
WEITZ [9]	1924	Small	18	25.00							0.02	—	
LAUTERBACH [11]	1925	Large	75	5.33	126	12.69	-	5.69	0.016	0.991	0.24	0.00	
DAHLBERG [13]	1926	Large	69	14.49	128	7.03	+	5.72	0.015	0.992	6.14	0.25	
VERSCHUER [39]	1927	Large	244	20.28	278	14.04	+	5.51	0.018	0.009	0.14	7.77	
NEWMAN [12]	1928	Small	50	31.00	50	17.00	+	5.37	0.019	0.009	0.62	0.31	
HIRSCH [40]	1930	Small	43	20.93	58	6.03	+	2.90	0.084	0.042	3.01	0.24	
WILSON and JONES [17]	1932	Large	70	10.71	123	11.38	-	0.04	0.832	0.583	0.06	0.13	
STOCKS [41]	1933	Small	42	9.52	94	10.63	-	0.08	0.776	0.611	1.23	1.03	
NEWMAN <i>et al.</i> [18]	1937	Small	50	19.00	50	11.00	+	2.51	0.108	0.054	1.21	0.76	
BOUTERWEK [42]	1938	Small	122	18.85	35	17.14	+	0.10	0.744	0.372	0.04	1.50	
RIFE [43]	1940	Large	223	11.88	146	15.41	-	1.91	0.163	0.918	3.32	0.09	
THYSS [44]	1946	Large	103	18.44	86	16.27	+	0.30	0.587	0.293	5.24	0.05	
RIFE [6]	1950	Large	343	12.82	211	11.61	+	0.35	0.557	0.278	0.03	0.32	
DECHAUME [45]	1957	Small	33	24.24	33	19.69	+	0.39	0.535	0.267	0.00	0.44	
ZAZZO [17]	1960	Large	259	13.32	335	10.89	+	1.63	0.198	0.099	5.62	1.24	
SHIELDS [10]	1962	Small	88	10.23	25	12.00	-	0.12	0.720	0.639	—	—	
CARTER-SALTZMANN <i>et al.</i> [46]	1976	Large	187	17.11	176	19.31	+	0.59	0.552	0.723	3.30	0.04	
LOHRLIN and NICHOLS [19]	1976	Large	514	14.10	333	11.11	+	3.21	0.069	0.034	0.08	1.37	
Total			2570	15.09	2218	12.80							

Differences between studies are not only due to criterion problems or sampling problems in small studies, since even when one considers only the large studies ($N = 10$; defined as having both more than 60 MZ pairs and more than 60 DZ pairs) there are still differences in the proportions of left-handers in the different studies (MZ twins $\chi^2 = 35.0$, 9 *df*, $P < 0.001$; DZ twins $\chi^2 = 30.28$, 9 *df*, $P < 0.001$).

In order to test whether data are fitted by a binomial distribution it is therefore necessary to test each data set *separately*, and then to combine the χ^2 goodness of fit values. Figure 1 shows data from the 10 large MZ studies, showing the incidence of R-L and L-L pairs.

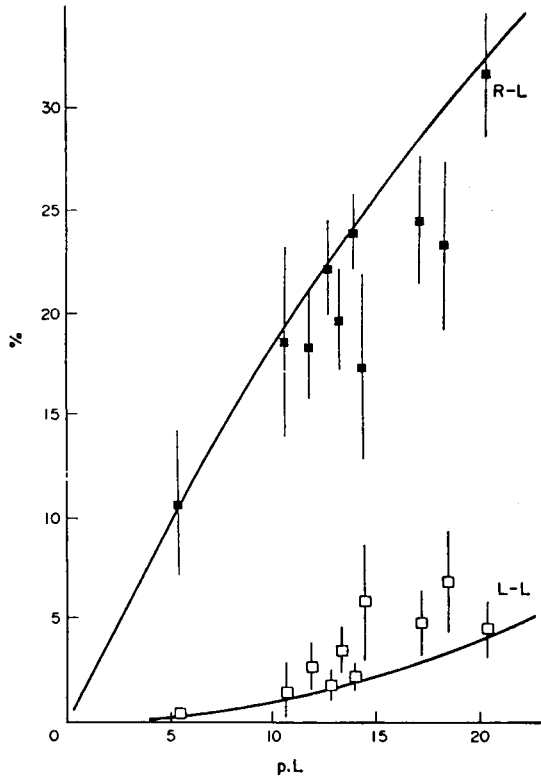


FIG. 1. Shows, for the ten large studies of monozygotic twins, the percentage of pairs that were L-L (open squares), and the percentage that were R-L (solid squares). All points are ± 1 standard error. The abscissa shows the overall proportion of left-handers in the sample. The solid lines indicate the expected values under a binomial hypothesis.

In 9 of the 10 cases there are less R-L pairs than would be expected by a binomial distribution, and in the same cases there are more L-L pairs than would be expected by a chance distribution (exact binomial probability = 0.0107). Table 1 shows, in the columns marked χ^2_{BINOM} , for both MZ and DZ twins, the individual χ^2 values for the goodness of fit of a binomial distribution. For MZ twins three of the studies are significantly different from a binomial distribution in their own right; together the 19 MZ studies have a χ^2 value of 30.30, which with 18 *df* gives $P < 0.05$ for a binomial fit; for just the large studies $\chi^2 = 24.27$, with 10 *df*, for which P is less than 0.001. We may therefore accept Nagylaki and Levy's conclusion that MZ

twin pairs do not occur in binomial proportions, even though their own evidence on this point was insufficient. Unlike MZ twins, the proportions of DZ pairs do not differ significantly from the predictions of a binomial distribution, the χ^2 value for all the studies being 15.63 (17 *df*), and for the large studies alone being 11.26 (10 *df*, n.s.). A genetic explanation of handedness should not be ruled out merely because the DZ pairs do not differ significantly from binomial distribution; any adequate genetic explanation merely has the constraint that for DZ twins its predictions should be close to those of a binomial distribution.

It might be argued that the small difference between MZ and DZ twins is not good evidence for a genetic component in handedness. Far stronger evidence would be the incidence of the three types of handedness pair in MZ and DZ twins from parents of known handedness. There are no adequate data of this form in the literature, the only approximation being that of RIFE [6], which are shown in Table 2. There is a far higher proportion of L-L pairs amongst those MZ twins with a family history of left-handedness than in those without a history of left-handedness.

Table 2. Data of RIFE [7], showing the effect of a family history of left-handedness upon the handedness pairs of MZ and DZ twins

Twin type	Family History	Per cent			N (pairs)
		R-R	R-L	L-L	
MZ	+	56.41	41.02	2.56	78
MZ	-	81.88	16.60	1.50	265
DZ	+	54.16	43.75	2.08	48
DZ	-	84.66	14.72	0.61	163

χ^2 MZ: $\chi^2 = 21.74$, 2 *df*, $P < 0.01$

DZ: $\chi^2 = 17.28$, 2 *df*, $P < 0.01$

II. THE DIFFERENCE IN INCIDENCE OF LEFT-HANDEDNESS BETWEEN MZ AND DZ TWINS

Nineteen studies in the literature have analysed the incidence of left-handedness in twins (including the study of WEITZ [9] who looked only at MZ twins). The study of SHIELDS [10], is difficult to interpret on account of his describing some twins as "ambidexters". I have used therefore only the overall incidence figures in the following analysis.

Overall 15.09% of 5140 MZ twins showed left-handedness as compared with 12.80% of 4436 DZ twins. It is not however permissible to combine data from studies in this way, since the incidence of left-handedness is clearly different between studies (see above). It is therefore necessary to look at each study separately, and to combine results only *after* analysis. Figure 2 shows the incidence of left-handedness in MZ and DZ twins in 18 studies. In only 11 of the 18 studies is the incidence greater in MZ twins than in DZ twins.

Table 1 shows, for each study, the incidence of left-handedness in MZ and DZ twins. In the column marked "Difference" there is a "+" if the incidence is higher in MZ twins than in DZ twins, and a "-" if the incidence is higher in DZ twins. Of the 18 studies, 7 found the MZ twins to have a *lower* incidence of left-handedness. The column marked " χ^2 " gives the χ^2 value for a homogeneity test for a difference between MZ and DZ pairs in either direction, the probabilities being given in the column marked "Two-tailed". Only four studies show

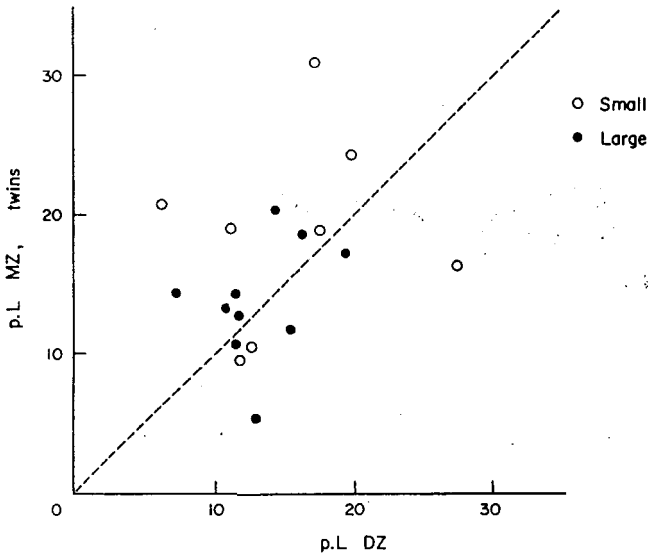


FIG. 2. Shows, for 18 separate studies, the percentage of left-handers in dizygotic twins (abscissa), and in monozygotic twins (ordinate). Solid circles are the 10 "large" studies, and open circles are the 8 "small" studies. The dotted line at 45° represents the point of equality for MZ and DZ twins.

significant differences, and one of these [11] shows the difference in the opposite direction to that expected. Note also that all of the significant results were obtained before 1930 when we may assume that determination of zygosity was rudimentary, and when we know that both NEWMAN [12, 13] and DAHLBERG [14] felt that symmetry reversal in twin pairs was actually pathognomic of monozygosity. The data of Table 1 may be combined to give an overall probability value for a difference between MZ and DZ twins. The column marked "One-tailed" gives the probability of a significant difference in the direction of MZ twins having a higher incidence of left-handedness than DZ twins (calculated by taking the two-tailed probability, P_2 , and calculating $P_1 = P_2/2$ if MZ greater than DZ, or $P_1 = 1 - (P_2/2)$ if DZ greater than MZ). These one-tailed probabilities may be combined using the method of KENDALL [15] (see also JONES and FISKE, [16] for further details). Overall the differences between MZ and DZ twins are significant ($\chi^2 = 70.28$, 36 *df*, $P < 0.001$). However if one divides the data according to date of publication, then for studies produced up to and including 1930, the difference between MZ and DZ is highly significant ($\chi^2 = 34.86$, 12 *df*, $P < 0.001$), whilst for the periods 1931–1945, 1946–1960, and 1961–1976, the differences are not significant, either separately ($\chi^2 = 14.86$, 10 *df*, n.s.; $\chi^2 = 12.26$, 8 *df*, n.s.; and $\chi^2 = 8.30$, 6 *df*, n.s. respectively) or combined ($\chi^2 = 35.42$, 24 *df*, n.s.).

In summary the only evidence in favour of MZ twins having a higher incidence of left-handedness than DZ twins was obtained prior to 1930, when we may assume that classification of laterality was not entirely independent of zygosity determination, due to theoretical prior conceptions about the nature of mirror-imaging.

It should be noticed that the demonstration of differences between pre- and post-1930 studies does not invalidate earlier conclusions about the non-binomiality of MZ twins. Thus, in the post-1930 studies there is a significant departure from binomiality ($\chi^2 = 17.65$, 7 *df*, $P < 0.02$).

III. HANDEDNESS IN TWINS AND SINGLETONS

NAGYLAKI and LEVY [1] claim that the incidence of left-handedness in twins is higher than it is in singletons. Their evidence for this consists of a comparison between published studies of twins and singletons. However in none of these cases is evidence quoted of twins and singletons assessed by the same criteria, in the same study, by the same investigators. In view of the wide differences in reported incidences of left-handedness in MZ twins, and also in DZ twins (see earlier) it is clearly fallacious to compare different studies in such a manner.

There are almost no studies in the literature in which twin and singleton handedness have been assessed by the same method. A notable exception is ZAZZO [17] who comments (p. 124) "Pour ma part, je n'ai jamais trouvé, dans mes multiple recherches sur les jumeaux, cet excès de gauchers dont parlent tous les auteurs", and he supports this statement with statistical evidence (his Table 8). WILSON and JONES [18] found no difference in usage of the left hand for *writing* in twins or singletons, but did find a small difference in ball throwing.

In summary, there is no adequate evidence for the claim of Nagylaki and Levy. It is perhaps worth suggesting that any further studies on this topic should be carried out either by questionnaire, or preferably, by personal examination, with the experimenter blind to the twin status of each child, who should be examined individually, not in pairs.

IV. HANDEDNESS IN TWINS: SECULAR TRENDS

Despite the problems of twin data, we might expect that the handedness of twins has been rather more accurately determined than that of singletons in large population surveys. Thus, the probability of a true left-handed twin being recorded as a right-hander would be low, although the probability of a right-hander being recorded as a left-hander would be concomitantly higher, due to a tendency towards over-inclusive definitions of left-handedness (e.g. NEWMAN *et al.* [19] sometimes relied entirely on asymmetry of finger-tapping as evidence of left-handedness). Figure 3 shows the incidence of left-handedness in the 18 studies (MZ

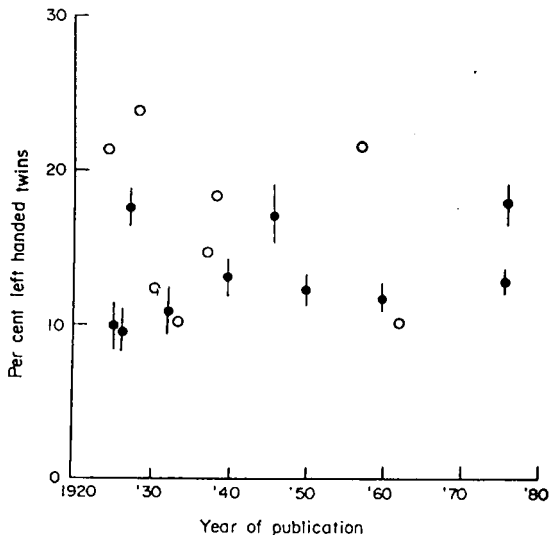


FIG. 3. Shows the overall incidence of left-handedness in 18 different twin studies (MZ and DZ twins combined), plotted against the date of publication of each study. Solid circles represent the 10 "large" studies, and open circles the 8 "small" studies. Only the large studies have bars, which represent \pm one standard error.

udies combined). Only the large studies have standard error bars. Note the tendency of small studies to have higher incidences of left-handedness than large studies (Mann-Whitney U test, $P < 0.05$). There is a hint that the incidence of left-handedness is increasing, although this trend is not significant. The relatively low value reported by LOEHLIN and NICHOL [20] might be a result of their use of a postal questionnaire rather than personal examination, as used by most of the other studies.

DISCUSSION

Evidence submitted here suggests that the incidence of left-handedness in both MZ and DZ twins is the same as that in singletons. This removes the objection of NAGYLAKI and LEVY [1] "that it is impossible to assess the heritability of a trait by using twin data if the frequency of the trait among twins differs from that among non-twins".

Nevertheless Nagylaki and Levy provide several other reasons why twins should have an increased incidence of left-handedness, and these must be considered, for if valid these reasons will put us in the awkward position of positing a true incidence of left-handedness which, if it were not for pathological factors, would be *lower* in twins than in singletons. Two main suggestions were made:

"... prenatal pathogenic factors are responsible for the high frequency of sinistrality in twins..." There seems little doubt that twins, both MZ and DZ, suffer an increased intra-uterine mortality and morbidity, as well as increased perinatal death-rates [21, *Passim*] and, as Nagylaki and Levy point out, this could be responsible for decreased IQ, and other mental subnormality. However these facts do not bear upon the main issue, since these associates have not been shown to relate *causally* to left-handedness, and until they have been, they need not concern us. The particular hypothesis of left-handedness being secondary to acute anaemia during delivery [22-24], has received little further support [25-27].

"... some cases of handedness discordance in one-egg twins derive from asymmetry reversal". Asymmetry reversal, or mirror-imaging, has been proposed to account for the discordance of handedness, hair-whorling and dermatoglyphics. It is a much quoted concept for which there is no adequate published evidence. There would be little problem in demonstrating its existence if, say, all singletons were of phenotype R, and all MZ pairs were of type R-R or R-L, with none of type L-L, for then mirror-imaging would be indisputable. In the presence of a high singleton incidence of type L, and relatively high frequencies of L-L twin pairs, to demonstrate true mirror-imaging is a statistical problem of some complexity, necessarily requiring rejection of a null hypothesis. This has never been done satisfactorily. NAGYLAKI and LEVY [1] quote NEWMAN's work, in 1917, [28] on the quadruplets of the nine-banded armadillo, as evidence of ectodermal mirror-imaging. However Newman himself said that his data were so complex that he did not know how to analyse them and he certainly gives no formal statistics [29]. In the absence of a statement of chance probabilities his assertions of apparent mirror-imaging are difficult to assess.

In the case of hair-whorling, MORGAN [30] has demonstrated that the work of BERNSTEIN [31] is dubious, and therefore Rife's observations of a binomial distribution of hair-whorling in twins actually refutes the possibility of mirror-imaging, since binomiality is surely the null hypothesis to be rejected in such a case.

There is no adequate evidence for mirror-imaging in dermatoglyphics [32, 33]; neither is there evidence for mirror-imaging in tooth cusps, another ectodermal derivative [34, 35].

NAGYLAKI and LEVY [1] accept that there is no evidence for mirror-imaging of the viscera, or other non-ectodermal structures.

With regard to mirror-imaging, one may only concur with BULMER [36] who commented that it "does not occur more frequently than would be expected by chance".

We may conclude, in the absence of other evidence, that MZ and DZ twins are suitable for testing genetic models of handedness, not being subject to any special influences which may be demonstrated statistically. An important consequence of this conclusion is that any genetic model has to explain a significant but non-binomial degree of discordance in MZ twins. As CORBALLIS and BEALE [2] have clearly shown, the model of NAGYLAKI and LEVY [37] cannot cope with such a possibility, and it must therefore be regarded as inadequate. The model of ANNETT [5] can account for the discordance in monozygotic twins, but only by suggesting that one parameter of the model is different in twins and singletons, which is perhaps an unreasonable suggestion.

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REFERENCES

1. NAGYLAKI, T. and LEVY, J. "The sound of one paw clapping" isn't sound, *Behav. Genet.* 3, 298–303, 1973.
2. CORBALLIS, M. C. and BEALE, I. L. *The Psychology of Left and Right*. Lawrence Erlbaum, Hillsdale, New Jersey, 1976.
3. COLLINS, R. L. The sound of one paw clapping: an inquiry into the origin of left-handedness. In *Contributions to Behaviour-Genetic Analysis—The Mouse as a Prototype*, G. LINDZEY and D. D. THIESSEN (Editors). Meredith Corporation, New York, 1970.
4. MARTIN, N. G. No evidence for a genetic basis of tongue rolling or hand clasping. *J. Hered.* 66, 179–180, 1975.
5. ANNETT, M. A single gene explanation of right and left handedness and brainedness. Lanchester Polytechnic, 1978.
6. RIFE, D. C. Application of gene frequency analysis to the interpretation of data from twins. *Hum. Biol.* 22, 136–145, 1950.
7. McMANUS, I. C. and MASCIE-TAYLOR, C. G. N. Hand-clasping and arm-folding: A review and a genetic model. *Ann. Hum. Biol.* 6, 527–558, 1979.
8. LEWIS, D. and BURKE, C. J. The use and mis-use of the Chi-square test. *Psychol. Bull.* 46, 433–489.
9. WEITZ, W. (1924). Cited by NAGYLAKI and LEVY (1973).
10. SHIELDS, J. *Monozygotic Twins: Brought Up Apart and Brought Up Together*. Oxford University Press, Oxford, 1962.
11. LAUTERBACH, C. E. Studies in twin resemblance. *Genetics* 10, 525–568, 1925.
12. NEWMAN, H. H. Asymmetry reversal or mirror imaging in identical twins. *Biol. Bull.* 55, 298–315, 1928.
13. NEWMAN, H. H. *Multiple Human Births*. Doubleday, Doran & Co., New York, 1940.
14. DAHLBERG, G. *Twin Births and Twins From a Hereditary Point of View*. Stockholm, Tidens, 1926.
15. KENDALL, M. G. *The Advanced Theory of Statistics*, Volume II, 3rd Edition. Griffin, London, 1951.
16. JONES, L. V. and FISKE, D. W. Models for testing the significance of combined results. *Psychol. Bull.* 50, 375–382.
17. ZAZZO, R. *Les Jumeaux: le Couple et la Personne*, Presses Universitaires de France, Paris, 1960.
18. WILSON, P. T. and JONES, H. E. Left-handedness in twins, *Genetics* 17, 560–572, 1932.
19. NEWMAN, H. H., FREEMAN, F. N. & HOLZINGER, K. H. *Twins, a Study of Heredity and Environment*. University of Chicago Press, Chicago, 1937.
20. LOEHLIN, J. C. and NICHOLS, R. C. *Heredity, Environment and Personality: A Study of 850 Sets of Twins*. University of Texas Press, Austin, 1976.
21. ANON, Preventing prematurity in twins, *Br. Med. J.* I, 1618, 1977.
22. BAKAN, P. Handedness and birth order. *Nature* 229, 195, 1971.
23. BAKAN, P. Left-handedness and birth order revisited, *Neuropsychologia* 15, 837–839, 1977.
24. BAKAN, P. Why left-handedness? *Behav. Brain Sci.* 1, 279–280, 1978.
25. HUBBARD, J. L. Handedness not a function of birth order. *Nature* 232, 276–277, 1971.
26. SCHWARTZ, M. Left-handedness and high-risk pregnancy. *Neuropsychologia* 15, 341–344, 1977.

27. HICKS, R. A., EVANS, E. A. and PELLEGRINI, R. J. Correlation between handedness and birth order: compilation of ~~five~~ studies. *Percept. Mot. Skills* 46, 53-54, 1978.
28. NEWMAN, H. *The Biology of Twins*. University of Chicago Press, Chicago, 1917.
29. NEWMAN, H. H. Heredity and organic symmetry in armadillo quadruplets: II. Mode of inheritance of double scutes and a discussion of organic symmetry. *Biol. Bull.* 30, 173-209, 1916.
30. MORGAN, M. J. Embryology and inheritance of asymmetry. In *Lateralization in the Nervous System*, S. R. HARNAD, R. W. DOTY, L. GOLDSTEIN, J. JAYNES and G. KRAUTHAMER (Editors). Academic Press, New York, 1976.
31. BERNSTEIN, F. Beitrage zur mendelistischen Anthropologie . . . , *Sitzungsberichte Physikalisch-mathematische Klasse der Preussische Akademie der Wissenschaften*, 1925. Cited by MORGAN (1976).
32. NEWMAN, H. Palmar dermatoglyphics of twins. *Am. J. Phys. Anthropol.* 14, 331-378, 1930.
33. RIFE, D. C. & CUMMINS, H. Dermatoglyphics and mirror imaging. *Hum. Biol.* 15, 55-64, 1943.
34. STALEY, R. N. and GREEN, L. J. Types of tooth cusp occurrence asymmetry in human monozygotic and dizygotic twins. *Am. J. Phys. Anthropol.* 40, 187-196, 1974.
35. POTTER, R. H. and NANCE, W. E. A twin study of dental dimension: I. Discordance, asymmetry and mirror-imaging. *Am. J. Phys. Anthropol.*, 44, 391-396, 1976.
36. BULMER, M. G. *The Biology in Twinning in Man*. Clarendon Press, Oxford, 1970.
37. NAGYLAKI, T. and LEVY, J. A model for the genetics of handedness. *Genetics* 72, 117-128, 1972.
38. SIEMENS, H. W. (1924). Cited by NAGYLAKI and LEVY (1973).
39. VERSCHUER, O. Von, (1927). Cited by NAGYLAKI and LEVY (1973).
40. HIRSCH, N. D. M. *Twins, Heredity and Environment*. Harvard University Press, Cambridge, Mass., 1930.
41. STOCKS, P. A biometric investigation of twins and their brothers and sisters. *Ann. Eugen* 5, 1-55, 1933.
42. BOUTERWEK, E. (1938). Cited by ZAZZO (1960).
43. RIFE, D. C. Handedness with special reference to twins. *Genetics* 25, 178-186.
44. THYSS, J. (1946). Étude bibliographique et critique du problème des gauchers, Paris MD thesis. Unpublished. Cited by ZAZZO (1960).
45. DECHAUME, M. P. (1957). Contribution à l'étude de la dominance laterale chez les jumeaux. Unpublished MD thesis, Paris. Cited by ZAZZO (1960).
46. CARTER-SALTZMANN, L., SCARR-SALATAPEK, S., BARKER, W. B., and KATZ, S. Left-handedness in twins: incidence and patterns of performance in an adolescent sample. *Behav. Genet.* 6, 189-203, 1976.

Résumé :

L'incidence de gaucherie manuelle est identique chez les jumeaux MZ, chez les jumeaux DZ et chez les non jumeaux. Les proportions des paires droitiers-droitiers, droitiers-gauchers et gauchers-droitiers chez les jumeaux MZ n'ont pas une distribution binomiale. Les jumeaux n'ont pas été soumis à quelques facteurs particuliers ayant pu modifier leur préférence manuelle; ils sont donc utilisables pour une analyse génétique.

Zusammenfassung

Die Häufigkeit der Linkshändigkeit ist bei monozygotischen Zwillingen, dizygotischen Zwillingen und bei Einzelkindern gleich. Das Verhältnis von R-R, R-L und L-L Paaren bei monozygotischen Zwillingen hat keine binomiale Verteilung. Zwillinge unterliegen keinen besonderen Faktoren, die ihre Händigkeit modifizieren und sind deshalb für genetische Analyse geeignet.