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Differences between Two Studies of Hand Preference in Psychiatric Patients

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Summary: Significant differences in handedness patterns between groups of psychiatric patients and normal controls were identified in two recent British studies, with substantial disagreement in some important findings. Most of the discrepancies were attributable to the different application of a simple classification of handedness data, and the remainder to differences in sample size. Diagnosis, sex and age were then found to have a similar effect on handedness in both studies. Neurotic patients were similar to controls regardless of classification, whereas mixed handedness in personality disorder depended on it. There was no overall excess of left-handedness among schizophrenics, but trends towards excess sinistrality in men and full dextrality in women approached significance.

There has been a steady development of interest in the investigation of lateral asymmetry of cerebral function since it was firmly established as a phenomenon a little over 100 years ago. In the last 10 to 15 years this interest has extended to psychiatric patients. Estimation of handedness continues to be a key measurement in most studies. In many, because of the strong relationship between right-handedness and left hemisphere specialization for the mediation of speech, handedness has been taken as the sole indicator of cerebral organization. In others it is used as a reference point; groups, to whom more sophisticated testing of asymmetrical function is to be applied, are first defined by their handedness. Handedness is thus to a considerable extent being used as a standard against which other measures of laterality are judged. It is therefore a source for concern that results of handedness studies have frequently been contradictory.

When consideration is confined to samples of psychiatric patients there are many potential explanations for the differences in results. The most important is that the samples of psychiatric patients do truly differ in their patterns of laterality, but before this can be accepted other possibilities must be excluded. Some of these, such as differences in attitude to handedness both in investigator and subject, different selection of items measured, different techniques of observation and use of different control groups, were discussed in a recent study of handedness in schizophrenia (Taylor *et al*, 1980). The differences between any two studies are generally so numerous that the level of influence of the individual factors has had to remain largely a matter for speculation.

A detailed comparison of two recent studies of hand preference in psychiatric patients (Lishman and McMeekan, 1976; Fleminger *et al*, 1977a) offers the opportunity to evaluate the importance of some of these issues. There appeared to be marked variation between the studies in the laterality of the total patient groups in relation to their controls (see Table I) and also of the diagnostic subgroups. In brief, the Lishman and McMeekan (1976) (Maudsley) study showed a general trend towards increased sinistrality among the patients, but this was almost exclusively among males who were younger than the mean age of the sample, and who were psychotic. Owing to the small numbers concerned it was scarcely possible to subdivide them into the conventional schizophrenic, schizo-affective and manic-depressive categories. Patients with neurotic illnesses or personality disorders showed no noteworthy departures from the norm.

The Fleminger *et al* (1977a) (Guy's) series, by contrast, showed an excess of fully *right*-handed members among the psychotic patients. A small excess of sinistrality was evident among the male schizophrenics, but did not reach the 5 per cent level of statistical significance. Male schizophrenics, however, emerged as significantly more often left-handed than female schizophrenics, a sex difference which was not found in the other patient groups nor among the controls. Another finding in the Guy's series was a

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TABLE I

Handedness distribution among psychiatric patients and controls

Sex	Handedness	Fleminger, Dalton and Standage (1977): Guy's				Lishman and McMeekan (1976): Maudsley			
		Patients		Controls		Patients		Controls—Annett Open University sample	
		n	%	n	%	n	%	n	%
M	Right	189	(53)	165	(46)	47	(72)	355	(89)
	Mixed	131	(37)	162	(45)	9	(14)	24	(6)
	Left	37	(10)	30	(8)	9	(14)	20	(5)
		357		357		65		399	
F	Right	239	(54)	231	(52)	52	(80)	349	(86)
	Mixed	167	(38)	172	(39)	10	(15)	35	(9)
	Left	37	(8)	40	(9)	3	(5)	24	(6)
		443		443		65		408	

significant excess of mixed handedness among the female personality-disordered group.

There were differences in methodology and treatment of the data between the studies, but there were also many features which they had in common. This made it possible to isolate and examine some aspects of experimental technique as potential sources of variation.

(a) Important similarities in methodology

Both studies used the Annett Hand Preference Questionnaire (Annett, 1970) for defining handedness. Subjects were asked to rate their individual hand preference as 'right', 'left' or 'either' on each of 12 items. There was a small difference between the studies in the administration of the questionnaire. The Guy's study relied wholly on the self-report of subjects while in the Maudsley study the questionnaire was presented during the course of an interview and doubtful responses controlled by asking the patient to mime the activity in question. The latter method is probably more reliable, particularly among psychotic groups who have been found to show some confusion about hand preference (Wahl, 1976). Annett's data, however, which provided the control group for the Maudsley study, was collected only by self-report.

Differences between the studies in assignment of diagnosis were likely to have been very small. The British Glossary to the International Statistical Classification of Diseases (General Register Office, 1968) was used as the basis of psychiatric labelling. In both of the studies this information was taken from case note material and then each diagnosis checked from details in the patient's record. In each study one author, who was blind to the handedness category assigned to the patients, completed this part of the work.

Other characteristics of the patients were also similar. Both samples included substantial numbers of subjects of both sexes. The age range of the Maudsley sample was 16 to 62 and at Guy's 15 to 64, with comparable proportions of patients falling into the under 40 and over 40 age groups. In both, patients were excluded when there was reason to suspect organic cerebral dysfunction.

(b) Important differences

The control groups were drawn from different sources. The Maudsley study used Annett's normal samples. The Guy's study collected their own control group which was the same size as the patient group and consisted of non-psychiatric patients attending the dental hospital out-patient department. This difference might be expected to affect results for two reasons. Firstly, Annett's normal samples were not wholly representative of the general population, but consisted of 1692 university undergraduates and 630 new male servicemen recruits, and then of Open University students. Highly intelligent subjects were thus over-represented in both samples. There is an extensive literature on the relationship between intelligence and handedness which, although inconclusive, suggests the possibility of a statistical association between lower intelligence and left-handedness.

The Maudsley patients, however, were not selected in a way that would favour the collection of a highly

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intelligent group. Secondly, it has been shown that age is an important factor in handedness (Fleminger *et al*, 1977b) and Annett's first sample was undoubtedly biased towards a younger age group, although the second sample probably covered a wider age range. Recognizing this difficulty, the Maudsley study relied more heavily on the second sample.

The patient groups also differed in the sources from which they were collected. All the Maudsley sample were hospital in-patients while the Guy's group included out-patients as well. The Maudsley group may thus, in general, have had more severe psychiatric disturbance than the Guy's group which might have had a bearing on handedness results (Boklage, 1977). However, the final sample size was very different. Maudsley had only 130 patients while Guy's had a total of 800 patients.

There were major differences in the treatment of the handedness data. Although both studies used a simple classification into 'right', 'mixed' and 'left', allocation diverged in two important ways: in the criteria for grouping, and in the handling of 'either' responses on any individual item.

Annett divided the 12 items in her questionnaire into 6 primary items which were the ones occurring together with greatest frequency on her association analysis (writing, throwing, using a racket, striking a match, hammering and using a toothbrush), and 6 secondary items which were the remainder (use of scissors, threading a needle, hand at top of a broom, at top of a shovel, dealing cards and unscrewing the lid of a jar). In the Maudsley study patients were classified as right-handed providing that they showed no left-handed preferences on any primary activity (see Fig). Left-handedness for secondary activities did not in itself deflect classification into a mixed or left-handed category. By contrast, the Guy's study accepted as right-handed only those subjects who showed no deviation of any kind from right-handedness.

Because of relatively small numbers of left-handers the Guy's study was not so rigorous in designation of left-handedness. Left-handed preference for writing alone was sufficient for allocation to the left group. The Maudsley study on the other hand employed the same approach as they had used for their right-handers, insisting on a 'left' or 'either' preference on all primary items for acceptance into the left group.

Inevitably the criteria for mixed-handedness also differed. Mixed-handers in the Guy's study were all right-handed writers who shared a variety of types and numbers of deviations from right-handedness on any of the other 11 activities. The Maudsley study insisted on a mixture of 'left' and 'right' responses on the primary items.

Subjects were free in both studies to express an 'either' response on any item of the questionnaire when they felt approximately equal preference for the use of either hand for the activity. The two studies differed in their handling of such responses. Maudsley adhered to Annett's (1970) recommendations in effectively ignoring 'either' responses, i.e., treating them as right responses for right-handed writers and left responses for left-handed writers. This was necessary in their study because they were using Annett's normative data for control purposes. At Guy's, by contrast, 'either' responses were recognized as a deviation from a left or right preference. There is no doubt that most subjects making an either response are clearly stating they do not feel distinct lateral preference. Annett attempted to introduce a questionnaire imposing forced choice between left and right preference and found that subjects continued to

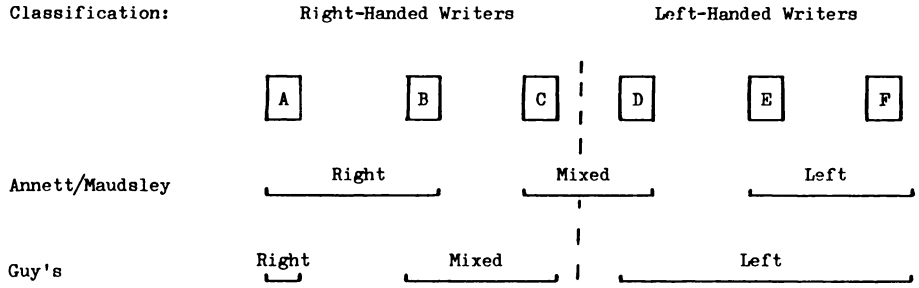


FIG.—Allocations to handedness groups.

Key: A = Right preference for all items.
B = Right preference for all primary items, but 'left' or 'either' for one or more secondary items.
C = Right preference for writing but 'left' or 'either' for one or more secondary items.
D = Left preference for writing but right preference for one or more other primary items.
E = Left preference for all primary items but right preference for one or more secondary items.
F = Left preference for all items.

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indicate either responses (Annett, 1970). Furthermore in McMeekan and Lishman's study (1975) examining the retest reliability of the questionnaire, it was found that either responses changed at retest to left twice as frequently as they did to right. The effect of the Guy's treatment of either responses, however, meant that right-handed writers who expressed an either response on any item would be placed within the mixed-handedness category.

There is as yet no work which convincingly demonstrates that one style of classification is a better predictor of cerebral organization than the other. On the basis of current knowledge either is justifiable.

Method

The raw data were collected from both studies. All the Guy's data were re-classified fully into Annett's groupings as used in the Maudsley study. All the previous comparisons were made by fitting hierarchical log linear models with Poisson errors (Everitt, 1977) using generalized linear interactive modelling (GLIM) (Baker and Nelder, 1978); this was repeated with the data after re-classification. A more detailed account of the use of this statistical method for the assessment of handedness is given elsewhere (Taylor *et al*, 1980). Where changes in handedness patterns seemed to follow re-classification, for interest Maudsley data were classified in Guy's terms as a further check on the similarity of the samples.

An attempt was then made to explore the relative importance of each of the two major differences of classification. The Guy's sample alone was selected for these analyses because of its larger size. The classification was adjusted in stages. Thus the differences established between patients and controls using the original Guy's classification could be seen in relation to any differences remaining (a) when the Guy's technique of grouping was applied but the Maudsley/Annett recommendation for dealing with either responses was used, (b) when the Guy's method of treating either responses was retained but in conjunction with Annett grouping, and (c) a full Annett classification was employed.

Results

Table II shows the effect of re-classification for the Guy's control group. The Annett classification is effectively broader in its criteria for right-handedness and more stringent for left-handedness. Consequently, as expected, the right-handed groups appear very much larger throughout and the left-handed groups slightly smaller. A substantial number of the mixed-handers (who were all right-handed writers) became redefined as right-handed, whereas relatively small numbers of the left-handers became shifted into the mixed group; in consequence the proportion of mixed-handers appears much reduced. The intermediate stages of re-classification are also presented. It can be seen that for each sex group the handedness patterns of the Guy's controls and those used in the Maudsley study are remarkably similar when Annett's method of classification is used for both. Differences between the studies in atypical handedness patterns reported for groups of psychiatric patients were not, therefore, attributable to differences in their control groups.

The result of changing one part of the classification at a time is shown only for the controls (Table II). It can be seen that the practice of disregarding either

TABLE II

Re-classification of the handedness of the Guy's control group in partial or complete Annett terms

			Guy's sample				Maudsley sample
Sex	Age	Handedness	Original Guy's classification	Classification by Guy's grouping plus Annett use of 'either'	Classification by Annett grouping plus Guy's use of 'either'	Annett classification	Annett classification
Male	All	Right	165 (46)	256 (72)	259 (73)	309 (87)	355 (89)
		Mixed	162 (45)	71 (20)	87 (24)	30 (8)	24 (6)
		Left	30 (8)	30 (8)	11 (3)	18 (5)	20 (5)
		Total	357 (99)	357 (100)	357 (100)	357 (100)	399 (100)
Female	All	Right	231 (52)	310 (70)	331 (75)	384 (87)	349 (85)
		Mixed	172 (39)	93 (21)	94 (21)	37 (8)	35 (9)
		Left	40 (9)	40 (9)	18 (4)	22 (5)	24 (6)
		Total	443 (100)	443 (100)	443 (100)	443 (100)	408 (100)

For all tables percentages are given in brackets.

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TABLE III

Re-classification of handedness: all psychiatric patients and controls

Sex	Age	Handedness	Guy's sample: Guy's classification: Patients	Guy's sample: Guy's classification: Controls	Guy's sample: Annett classification: Patients	Guy's sample: Annett classification: Controls	Maudsley patient sample: Annett classification
Male	Under 40	Right	79 (44)	72 (40)	152 (85)	151 (84)	27 (71)
		Mixed	76 (43)	89 (50)	10 (6)	16 (9)	3 (8)
		Left	24 (13)	18 (10)	17 (9)	12 (7)	8 (21)
		Total	179 (100)	179 (100)	179 (100)	179 (100)	38 (100)
	40 and over	Right	110 (62)	93 (52)	157 (88)	158 (89)	20 (74)
		Mixed	55 (31)	73 (41)	10 (6)	14 (8)	6 (22)
		Left	13 (7)	12 (7)	11 (6)	6 (3)	1 (4)
		Total	178 (100)	178 (100)	178 (100)	178 (100)	127 (100)
Female	Under 40	Right	120 (48)	117 (47)	214 (86)	216 (87)	36 (78)
		Mixed	103 (41)	106 (43)	14 (6)	20 (8)	7 (15)
		Left	26 (10)	26 (10)	21 (8)	13 (5)	3 (7)
		Total	249 (99)	249 (100)	249 (100)	249 (100)	46 (100)
	40 and over	Right	119 (61)	114 (59)	170 (88)	168 (87)	16 (84)
		Mixed	64 (33)	66 (34)	14 (7)	17 (9)	3 (16)
		Left	11 (6)	14 (7)	10 (5)	9 (4)	0 (0)
		Total	194 (100)	194 (100)	194 (100)	194 (100)	19 (100)

responses, while continuing to use the Guy's method of grouping, had a substantial effect on the form of the data in increasing the proportion of right-handers. Obviously sustantial numbers of subjects had elected to make use of recording equally strong hand preferences. When the possibility was allowed that the either response represented a deviation but the Annett technique of grouping was employed, a similar increase in the proportion of right-handers was noted, but there was also a decrease in the proportion of left-handers. Combining the two components of the re-classification had little further modifying effect on the data. This suggested that for the right-handers the majority of the either responses were on secondary items in the questionnaire; this was probably less true for the left-handers. The effect was almost identical in all patient groups and sub-groups.

Table III shows that the grouping of the Guy's data for the total patient sample has changed considerably after re-classification. The changes were, however, very similar in direction to those for the control group. Thus the laterality of the total patient sample from Guy's did not differ significantly from that of their controls, no matter how data were classified. In this the Guy's sample differs from the Maudsley sample in which there was a significant shift towards left-handedness for the patient group. A statistical comparison between the patient groups from each study is limited by the extremely small numbers of patients falling into some of the sub-groups but it can be seen from Table III that the excess left-handedness in the Maudsley series is almost entirely accounted for by the young males.

When patients with functional psychoses were considered (Table IV) the excess dextrality apparent with the original Guy's classification was still evident among the females, but was no longer statistically significant; among the male psychotics the trend towards excess dextrality had disappeared. The small excess of left-handedness among the males was likewise non-significant. In this they differed from the Maudsley sample where a significant excess of left-handedness among young males had been evident. Re-classification, then, abolished most apparent differences in handedness patterns between the two samples of psychotics but, if anything, exaggerated the discrepancy between them in the one finding of young male left-handedness. It can be seen that this depended on 6 young male sinistral psychotic patients in the Maudsley sample.

With regard to psychotic sub-groups, the most important finding was the strong similarity now apparent between the schizophrenics of the Guy's and Maudsley series (Table IV). In both series the schizo-

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TABLE IV

Re-classification of handedness for all psychotic patients and the schizophrenic subgroup

			Guy's sample				Maudsley sample	
			Guy's classification		Full Annett classification		Full Annett classification	
Sex	Age	Handedness	Psychotic patients	Schizophrenics	Psychotic patients	Schizophrenics	Psychotic patients	Schizophrenics
Male	Under 40	Right	21 (54)	15 (56)	32 (82)	21 (78)	16 (70)	13 (81)
		Mixed	13 (33)	7 (26)	3 (8)	2 (7)	1 (4)	1 (6)
		Left	5 (13)	5 (18)	4 (10)	4 (15)	6 (26)	2 (13)
		Total	39 (100)	27 (100)	39 (100)	27 (100)	23 (100)	16 (100)
	40 and over	Right	40 (62)	16 (67)	55 (85)	20 (83)	12 (80)	1 (100)
		Mixed	19 (29)	5 (21)	6 (9)	2 (8)	2 (20)	0 (0)
		Left	6 (9)	3 (12)	4 (6)	2 (8)	0 (0)	0 (0)
		Total	65 (100)	24 (100)	65 (100)	24 (99)	15 (100)	1 (100)
Female	Under 40	Right	28 (67)	16 (64)	41 (98)	24 (96)	15 (78)	8 (89)
		Mixed	13 (31)	8 (32)	0 (0)	0 (0)	2 (11)	1 (11)
		Left	1 (2)	1 (4)	1 (2)	1 (4)	2 (11)	0 (0)
		Total	42 (100)	25 (100)	42 (100)	25 (100)	19 (100)	9 (100)
	40 and over	Right	59 (70)	22 (85)	77 (92)	25 (96)	12 (92)	0 (0)
		Mixed	22 (26)	3 (11)	4 (5)	0 (0)	1 (8)	0 (0)
		Left	3 (4)	1 (4)	3 (3)	1 (4)	0 (0)	0 (0)
		Total	84 (100)	26 (100)	84 (100)	26 (100)	13 (100)	0 (0)

phrenics show a trend towards excess sinistrality among the males and in the opposite direction, towards full dextrality, for the females. Although the difference in the occurrence of left-handedness between the male and female schizophrenics had been significant in the original Guy's study ($P = 0.039$), the difference failed to reach significance after re-classification ($P = 0.13$). The Maudsley group was too small to allow statistical testing. Given the ever present problem of small sample sizes, but the similarity in diagnostic techniques between the studies, the Maudsley and Guy's groups were combined to examine further the effect of sex on the relationship between handedness and diagnosis. For this larger group of schizophrenics the difference between the handedness patterns of the males and females was bordering on significance ($P = 0.066$) using Annett's classification.

With regard to the non-schizophrenic psychotic patients, differences between the studies persisted even after re-classification, but were probably attributable to small sample sizes. In the Maudsley material the male manic depressives showed an apparent marked excess of left-handedness (18 per cent) by the Annett classification) whereas no such trend emerged in the Guy's sample. The Maudsley findings, however, derived from only 3 of 17 subjects. Similarly the excess sinistrality among the Maudsley male schizo-affectives (25 per cent) represented in real terms only 1 of 4 patients. It could therefore be argued that the apparently high prevalence of left-handedness in these Maudsley sub-groups was an artefact created by small numbers.

The other main area of disagreement had concerned females with personality disorder who in the Guy's sample had shown a significant excess of mixed handedness. No such differences were present in the Maudsley sample. This discrepancy disappeared after re-classification.

Discussion

This re-examination of two handedness studies highlights the difficulties inherent in the definition of a lateralized phenomenon—even when it is relatively as gross and fixed as hand preference. The importance of such problems is revealed by the demonstration that when data classified according to one set of criteria are re-classified in terms of another, the results appear substantially different—in other words classification can apparently determine outcome. The difficulties are emphasized by the fact that in both studies the classification used was, in theory, the simplest possible—that is into 'right', 'mixed' and 'left' handedness types. Comparison between the studies

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serves as a striking reminder that leftness and rightness are not absolute phenomena, and that any attempt to classify data in such terms must depend on arbitrary cut-off points on a continuum. In consequence important differences in their definition are bound to arise.

Until more studies are performed which make attempts to relate details of one type of lateral measure to details of other modes, classification will remain largely a matter of personal choice. Since it is not clear whether patterns of cerebral lateralization vary with degree of handedness, we can only continue to make the observation that handedness is a matter of degree. If a choice is to be made between the classifications used in the original studies discussed here, it has to rest on arguments about face validity rather than on empirical data. Thus some would argue that the full Annett classification is preferable because it gives expected results, i.e., that the over-whelming majority of people are right-handed. The opposing argument is that a classification which fails to demonstrate differences which nevertheless do exist between samples is not adequate, and that the Fleminger modification of the classification is preferable on the grounds of greater sensitivity.

When the differences in classification patterns between these two studies were identified and resolved it was possible, after re-examination of the data, to make a better evaluation of apparent associations between handedness patterns and patient/subject characteristics. The control groups were very similar in their handedness patterns, providing the same classification was used, so that differences between the different control groups could be ruled out as the source of apparent discrepancies. Re-classification of handedness for the Guy's patient sample confirmed that the discrepancies were more seeming than real. In both studies each of the principal variables—diagnosis, sex and age of subject, had a marked effect on handedness patterns. Furthermore, providing the size of the sub-groups under study rose above single figures, there was virtually no disagreement on the nature of the influence of such factors.

Given the high level of agreement established after return to the raw data, it is worth emphasizing the major findings—first in the diagnostic categories:

(1) The neurotic patients represented the one diagnostic group that was unaffected by classification, and which did not differ significantly from controls in either study.

(2) A major discrepancy between the original studies concerning the personality-disordered patients proved to be an artefact of classification.

(3) For the schizophrenics too, such differences as the original studies had suggested were also seen to be artefacts of classification. The samples were in fact remarkably similar. There was no significant excess of left-handed subjects among schizophrenics in either sample by either classification. Neither patient sample showed significant difference from controls in their dextrality, unless this was defined as an exclusive right-handed preference.

(4) The only between-study differences for diagnostic sub-groups which remained after re-classification were for the manic-depressives and the schizo-affectives. The small sample sizes in the Maudsley study, however, make it possible that these differences were artefactual.

(5) The differences between studies for the overall patient versus non-patient comparison are mentioned last because they are probably the least important. The total patient groups were so heterogeneous that logically a unifying difference from control handedness patterns would seem unlikely. In the larger Guy's sample of 800 patients, regardless of method of classification there was no suggestion of distinctive handedness patterns for the total patient group. When the Maudsley sample, which did suggest this possibility, was examined more closely it seemed likely that the explanation was simply in the size and constitution of the sample. Although excessive left-handedness did emerge for the whole patient group when compared with controls, the excess almost exclusively derived from young male psychotics. They represented 23 of 130 subjects in the Maudsley sample (i.e. 17.7 per cent), but only 39 of 800 subjects (4.9 per cent) in the Guy's sample. Distortion for the whole group by one small unusual group was thus a problem for the Maudsley sample.

The re-classification of the Guy's data in Annett terms reduced the importance of the age effect, although the trend remained in all but a few of the female groups. In the original study both patients and controls had shown a highly significant shift towards dextrality with increasing age. The Maudsley sample showed a very similar shift, although it has to be said that some of the older groups were very small indeed.

The interesting effect of sex of subject was highlighted by both samples. It did not appear to influence handedness in the control groups of either study but, in both, a male/female difference emerged in some of the patient groups. It was most obvious and consistent in the schizophrenic group where males showed more left-handedness than females. Many workers (for example, Flor-Henry, 1976; Wexler, 1980) have linked left temporal lobe pathology and schizophrenia. Taylor (1969) showed that the left temporal lobes were more vulnerable for longer in males than in females. Forrest and Hay (1971; 1972) have demonstrated that there are sex differences in the present-

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ation, particularly in the age of presentation, of schizophrenia. On this background these studies taken together give considerable weight to the idea that there does exist an important sub-group of schizophrenics, namely males with early presentation and possible pathological left-handedness, who may indeed have lateralized cerebral damage or dysfunction.

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