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Hand Preference Patterns in Psychiatric Patients

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Summary. A brief survey, using a standardized questionnaire, has been made of hand preference patterns in a series of patients admitted to hospital with functional psychiatric disorders. A small but significant shift towards left hand preference has been observed, more marked in the young patients and virtually confined to the males. Psychotic patients show such a shift more clearly than neurotic or personality disordered patients. Simple genetic factors do not appear to be responsible for these sinistral tendencies. The findings are discussed in relation to possible acquired abnormalities of functional brain organization.

Introduction

Handedness is known to exist as a graded characteristic, ranging from pure right-handedness through various grades of mixed handedness or 'ambidexterity' to pure left-handedness. Several questionnaires have now been established for categorizing individuals along this continuum. It was therefore considered worthwhile to undertake a preliminary and rather cursory survey of hand preference patterns in a series of psychiatric patients admitted to the Maudsley Hospital, in order to explore whether the distribution is in any way unusual in the patients as a whole or in diagnostic sub-categories.

The idea is perhaps not as far-fetched as at first sight appears. Handedness is a crude but readily testable aspect of cerebral dominance, i.e. a reflection of the partition of functions between the two hemispheres of the brain, and certain strands of evidence have accumulated to suggest that unilateral cerebral dysfunction may exist in patients with certain forms of psychiatric disorder. Such evidence is admittedly often indirect, but seemed amenable to further testing by this means.

Thus, Flor-Henry (1969) has produced evidence that epileptic subjects who develop schizophrenia-like psychoses have foci more often in the dominant temporal lobe, and those who develop affective disorders more often in the non-dominant temporal lobe. Pursuing this further, he has attempted to argue, from psychometric and EEG data and from prevalence of illness data in males and females, that psychopathy and schizophrenia may in general be related to dysfunction in the left (dominant) hemisphere, whereas depression is related to dysfunction on the opposite side of the brain (Flor-Henry, 1974). Meanwhile, Gruzelier (1973) and Gruzelier and Venables (1974) have shown that skin conductance responses are often asymmetrical in schizophrenics and depressives in a manner which they also interpret as evidence of left hemisphere dysfunction in the former and right hemisphere dysfunction in the latter.

More directly from the point of view of handedness, Walker and Birch (1970) have observed poorly developed preferences for hand and eye usage, as well as impaired awareness of right-left spatial organization, in a high proportion of 'schizophrenic children'; and Oddy and Lobstein (1972) have reported an increased incidence of crossed dominance between hand and eye in adult schizophrenics. Finally, Zangwill (1960), reviewing the relationships between cerebral dominance and psychological function, has suggested that 'indeterminate cerebral dominance may be associated with temperamental instability and undue sensitivity to stress'. Insecure dominance was said to characterize 'some (though not all) of the persons commonly designated left-handed, to-

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gether with a considerable number of individuals who appear to lack strong and consistent lateral preferences'. Zangwill drew his conclusion from studies of children and adolescents with developmental dyslexia and kindred educational problems, but it now seems pertinent to inquire whether adults who display unusual patterns of handedness are also more vulnerable to stress and to psychiatric breakdown.

Method

Annett's (1970) hand preference questionnaire was used as the instrument for assessing handedness. This allows one to place an individual in one of a series of mutually exclusive classes, representing discrete parts of a spectrum from 'pure right-handedness' to 'pure left-handedness', with various degrees of inconsistency of hand preference between. This is done by noting which hand is the preferred hand for a variety of tasks. The classes obtained by Annett were established by testing a large number of healthy volunteer subjects and then further validating them against a test of relative manual speed. The re-test reliability of the questionnaire has recently been examined and found to be reasonably high (McMeekan and Lishman, 1975).

The questionnaire consists of twelve items, six of which are designated 'primary' (in brief, writing, throwing, using a racket, striking a match, hammering, and using a toothbrush), and six 'secondary' (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). The distinction between primary and secondary items was arrived at by Annett by a process of association analysis on data gathered from over 2,000 individuals, allowing an assessment of which items clustered most closely together in the normal population.

A large number of handedness categories can be derived from the questionnaire, but some of the finer groupings contain only a very small proportion of the population. A first division, of course, may be made into subjects who write with the right and those who write with the left hand. A further subdivision recommended by Annett involves distinctions based on the primary questions alone: subjects who state right preference for all six of the primary questions ('strong right-handers' in the tables which follow) are separated from subjects who consistently state left preference for all six of the primary questions ('strong left-handers'); subjects who show any admixture of preferences for the six primary questions are designated 'mixed handers'. For inclusion in the last group it is necessary for the subject to have shown a clear anomalous preference for one (or more) of the primary actions; claims to equal facility with either hand on individual items do not suffice for such a categorization. The mixed-handed group can then be subdivided according to the hand used for writing, yielding 'right mixed' and 'left mixed' subcategories.

The 'strong right' and 'strong left' groups can be further subdivided on the basis of responses to the secondary questions. Strong right-handers who show left preference for one (or more) of the secondary questions are designated 'inconsistent right-handers', and strong left-handers who show right preference for secondary questions are 'inconsistent left-handers'. These finer subdivisions are rarely shown below on account of the small numbers of subjects usually involved.

The questionnaire was administered by one of us (E.R.L.M.) during a personal interview with each of a consecutive series of adult patients admitted to the Maudsley Hospital. Care was taken to ensure as far as possible that responses were accurate, checking when necessary by asking the patient to demonstrate by mime his habitual pattern of hand preference on each of the items. Any patient known to be suffering from a psychiatric illness associated with cerebral pathology (for example epilepsy, dementia or an acute organic reaction) was excluded from the series; similarly any patient with a history of brain damage at any time in the past, or presently showing abnormal neurological signs.

Eye dominance was briefly assessed by asking which was the preferred eye when using only one, for example when peeping through a hole in a piece of paper, and foot dominance by asking which foot would be used for kicking a ball towards a target. Finally, systematic

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inquiry was made from the patient about any known left-handedness or ambidexterity among his family members. Scoring of the results was completed without knowledge of the patient's diagnostic category.

Results are available for 130 patients with the diagnoses shown in Table I. The diagnoses were those obtained from the eighth revision of the International Statistical Classification of Diseases, Injuries and Causes of Death (1965), and recorded when each patient left hospital by the doctor in charge of the case. Each diagnosis was checked (and very occasionally amended or added to) by one of us (W.A.L.) after perusal of the case notes, without knowledge of the handedness category already allotted.

Results

The patients comprised 65 males and 65 females, ranging in age from 16–62 with a mean of 35·3 years (36·8 for males, 33·7 for females). In Table II the distribution of handedness categories is shown for comparison with Annett's findings in the normal population. Annett's 'sample 1' consists of her total normative data, published in 1970, on which the hand preference questionnaire was standardized. Annett's 'sample 2' consists of more recent (unpublished) data on a group of open university students, closer in age to the patient population (mean for males 36·7 years, females 35·8 years), and with data available for males and females separately. 'Young patients' are shown separately at the bottom of the table, consisting of

Table I

Distribution of diagnoses among the 130 patients

Diagnosis	M	F	Total
Neurosis	8	12	20
Personality disorder	8	11	19
Psychosis	31	26	57
Neurosis and personality disorder	6	9	15
Psychosis and personality disorder	7	5	12
Neurosis and psychosis	0	1	1
Other diagnoses*	5	1	6
	65	65	130
All neurotics	14	22	36
All personality disorders	21	25	46
All psychotics	38	32	70

* 3 alcoholics, 1 Gilles de la Tourette syndrome, 1 marital disturbance, 1 patient with oversleeping and diagnosed 'no psychiatric abnormality'.

Table II

Distribution of hand preference categories among patients and comparison with normal samples

	No.	Hand used for writing		Strong right handers		Mixed handers		Strong left handers	
		R	L	Consistent	Inconsistent	R mixed	L mixed	Inconsistent	Consistent
Annett's normal sample 1	2,321	89	11	67	19	3	3½	3	4½
				86		6½		7½	
Annett's normal sample 2	807	92½	7½	64	23½	5	2	2	3½
				87½		7		5½	
All patients	130	85	15	59	17	9	5½	4	5½
				76		14½		9½	
Young patients	73	79½	20½	52	22	5½	5½	7	8
				74		11		15	

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males younger than the mean for males (up to and including 36 years of age—mean 25·9 years) and females younger than the mean for females (up to and including 33 years of age—mean 25·6 years). Young patients have been examined separately in this way because, if we are to infer that abnormalities in the distribution of hand preference are in any way related to vulnerability to psychiatric illness, we may expect to find that patients who have come to attention at a young age would show an especially abnormal distribution.

It can be seen that the patients show a small excess of left-handed writers when compared to Annett's normal samples (15 per cent, compared to 11 per cent or 7½ per cent). The finer subdivisions on the right of the table show a dearth of strong right-handers, an excess of mixed-handers and an excess of strong left-handers among the patients. The 'shift to the left' becomes more marked when attention is restricted to young patients.

The findings in Table II may be subjected to statistical analysis by taking Annett's normal samples as population measures for the proportions in each handedness category, and applying a goodness of fit test (Chi-squared) to see whether the patient sample has the same population parameter values.* On a simple two-way division into right-handers and left-handers the patients differ from Annett's normal sample 2 ($\chi^2 = 8{\cdot}8$, $P < 0{\cdot}01$) but not from sample 1 ($\chi^2 = 2{\cdot}1$), whereas in the tripartite division into strong right, mixed and strong left-handers the patients differ markedly from both normal samples (χ^2 for sample 1 comparison $= 14{\cdot}1$, $P < 0{\cdot}001$, χ^2 for sample 2 comparison $= 14{\cdot}7$, $P < 0{\cdot}001$). The young patients differ significantly from Annett's normal samples on all such comparisons (two-way division of handedness—χ^2 for sample 1 comparison $= 7{\cdot}4$, $P < 0{\cdot}01$, for sample 2 comparison $= 17{\cdot}0$, $P < 0{\cdot}001$: tripartite division of handedness—χ^2 for sample 1 comparison $= 9{\cdot}5$, $P < 0{\cdot}01$, for sample 2 $= 15{\cdot}2$, $P < 0{\cdot}001$).

Males and females are shown separately in Table III, for comparison with the males and females of Annett's Open University sample. The male patients show a marked excess of left-handed writers, which in the young males amounts to a quarter of subjects. The tripartite division on the right shows a dearth of strong right-handers and an excess of strong left-handers in the male patients, more marked in the young, i.e. an overall shift towards strong left-hand preference.

Female patients show a less impressive excess of sinistral writers, and this proves to be due not to an increase in strong left-handers but to an increase in mixed-handers.

Chi-squared comparisons uphold the significance of the differences between the male patients and the male controls (χ^2 for two-way division of handedness $= 9{\cdot}9$, $P < 0{\cdot}01$, for tripartite division $= 13{\cdot}8$, $P < 0{\cdot}001$). The differences are considerably greater when the

* Annett's two normal samples differ significantly from each other on the simple two-way division into left-handers and right-handers ($\chi^2 = 6{\cdot}20$, $P < 0{\cdot}05$), but not on the tripartite division into strong right, mixed and strong left-handers ($\chi^2 = 2{\cdot}92$). The latter types of comparison with the patient groups are therefore likely to be of principal interest.

TABLE III

Distribution of hand preference categories among male and female patients

	No.	Hand used for writing		Strong right handers	Mixed handers	Strong left handers
		R	L			
Annett's normal males ..	399	93	7	89	6	5
Male patients	65	82	18	72½	14	13½
Young male patients	34	73½	26½	70½	6	23½
Annett's normal females ..	408	91½	8½	85½	8½	6
Female patients	65	89	11	80	15½	4½
Young female patients ..	39	84½	15½	77	15½	7½

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young male patients are compared to the male controls (χ^2 for two-way division = 16·0, $P < 0·001$, for tripartite division = 18·8, $P < 0·001$), and indeed there is a significant difference within the patients themselves when young male patients are compared to old male patients (χ^2 for tripartite division of handedness = 8·1, $P < 0·025$). Among the females, however, it is only the comparison between young female patients and the female controls that yields noteworthy differences, and only on the two-way division into right-handers and left-handers ($\chi^2 = 4·4$, $P < 0·05$).

Diagnostic categories

It is obviously important to try to discern which diagnostic categories have been mainly responsible for these findings. The task is difficult because of the relatively small numbers and the overlaps that occur between one diagnostic category and another, as shown in Table I. Some of the principal findings are shown in Table IV.

Neurotic patients show no excess of left-handedness for writing when attention is restricted to 'pure neurotics', i.e. when neurotics with other concurrent diagnoses are excluded. There are no strong left-handers among the pure neurotics. Thus the neurotic patients have contributed only to the excess of mixed-handers in the patient sample. Male and female neurotics followed similar patterns (data not shown).

The personality disordered patients do not emerge as noteworthy when attention is restricted to pure personality disorders (i.e. when those with concurrent neuroses or psychoses are excluded). They have perhaps contributed somewhat to the excess of mixed-handers, but not to the excess of left-handers in the patient sample. Male and female personality disordered patients followed similar patterns.

The patients with purely psychotic disorders show a considerable number of left-handers, and this becomes more pronounced among the young psychotics. Thus one-fifth of the young psychotics were sinistral writers, and all of these were strong left-handers. The sexes are shown separately in the table; male psychotics are seen to account for this excess, the distribution among females being unremarkable.

The psychotic patients consisted of 30 manic-depressives, 14 schizoaffectives and 26 schizophrenics. Detailed analyses showed that the excess sinistrality among the psychotics was largely due to manic-depressive and schizo-affective psychoses rather than schizophrenic psychosis.

Not surprisingly in view of the small number involved, the findings in Table IV do not reach

TABLE IV

Distribution of hand preference categories among principal diagnostic groupings

	No.	Hand used for writing		Strong right handers	Mixed handers	Strong left handers
		R	L			
All neurotics	36	83½	16½	75	19½	5½
Pure neurotics	20	90	10	75	25	0
Young neurotics	10	90	10	90	10	0
All personality disorders ..	46	82½	17½	76	13	11
Pure personality disorders ..	19	94½	5½	79	16	5
Young personality disorders ..	16	94	6	81½	12½	6
All psychotics	70	85½	14½	78½	10	11½
Pure psychotics	57	87½	12½	79	10½	10½
Young psychotics	29	79½	20½	72½	7	20½
Male psychotics	31	80½	19½	71	13	16
Female psychotics	26	96	4	88½	7½	4

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statistical significance, either when the 'pure' diagnostic categories are compared one with another or when patients in any given diagnostic category are compared with the remainder. The sole exception is that the young psychotic patients (N = 29) are significantly different to the remainder (N = 101) on the tripartite division of handedness categories ($\chi^2 = 6{\cdot}9$, $P < 0{\cdot}05$).

Certain symptoms among the psychotic patients perhaps deserve comment. A crude symptom inventory showed that delusion formation was rather strongly associated with left-handedness. There were 52 patients with delusions and 18 without; the former contained 19 per cent left-handed individuals and the latter none. Among the young psychotics, 34 per cent of those with delusions were left-handed, but none of those without delusions. Hallucinations, by contrast, showed rather the reverse, 8½ per cent of hallucinated psychotics being left-handed compared to 20½ per cent of non-hallucinated psychotics. The figures for young hallucinated and non-hallucinated psychotics were 11½ per cent and 46 per cent respectively.

Family history of sinistrality

The abnormal distributions of hand preference among the patients could rest on genetic factors, common genes having contributed towards hand preference patterns and vulnerability to particular forms of psychiatric illness; or alternatively there might be factors acquired during development contributing to vulnerability to psychiatric illness and at the same time influencing the pattern of hand preference.

Table V shows the incidence of known left-handedness (or 'ambidexterity') in the relatives of the male and female patients, also in the relatives of right- and left-handed patients. Males and females show an identical pattern of familial sinistrality, providing no indication that the excess of left-handedness in male patients was due to genetic influences. Moreover the proportion of patients with a parent, sibling or child left-handed was very similar to that in Annett's normal sample of Open University students (28·3 per cent males and 28·9 per cent females). It can be seen that the proportion of left-handed patients with sinistral first degree relatives is *reduced* in comparison to right-handed patients; this is the reverse of what would have been expected if the majority of left-handed patients had inherited their sinistral tendencies.

Table VI shows the situation in different diagnostic groups. The neurotics show no striking differences from the patients as a whole. The personality disordered patients have an excess of sinistral first-degree relatives, so their slight excess of mixed-handers may have a genetic basis. The psychotics, however, have no excess of left-handed relatives (if anything the reverse), so their excess of left-handedness does not appear to rest on genetic factors. Thus the evidence for an *acquired* abnormality in hand preference is most strong among the psychotics. These conclusions are upheld and mostly strengthened when attention is restricted to young patients (data not demonstrated here).

TABLE V

Familial sinistrality in male and female patients, and in right-handed and left-handed patients

	Number	% with parent sib or child left handed	% with other relative left handed*	% with no known relative left handed
Male patients	65	27½	9½	63
Female patients	65	27½	9½	63
Right-handed patients	111	31½	6½	62
Left-handed patients	19	5½	26	68½

* i.e. Grandparents, aunts, uncles, cousins, nephews, nieces.

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TABLE VI

Familial sinistrality in different diagnostic groups

	Number	% with parent sib or child left handed	% with other relative left handed	% with no known relative left handed
All patients	130	27½	9½	63
All neurotics	36	28	14	58
Pure neurotics	20	20	15	65
All personality disorders	46	32½	11	56½
Pure personality disorders	19	37	10½	52½
All psychotics	70	24	6	70
Pure psychotics	57	23	5	72

Inconsistency of foot or eye preference

Finally, the consistency or otherwise of foot and eye preference with hand preference was analysed in the various patient groups. The only striking result to emerge was a higher incidence of inconsistent preferences among left-handers than among right-handers (inconsistent foot preferences 33 per cent and 7 per cent respectively, inconsistent eye preferences 33 per cent and 24 per cent respectively). Male and female patients showed equivalent inconsistencies, similarly patients in the different diagnostic groups. In particular, the psychotic patients and the small group of 26 schizophrenics showed no excess of crossed laterality for foot or eye.

DISCUSSION

The distribution of hand preference patterns has emerged as abnormal in this group of patients suffering from 'functional' psychiatric illnesses when compared to two large series of healthy individuals. The patients as a group show an overall shift towards left-hand preference, manifest both in an increased incidence of left-handedness and mixed-handedness and in a diminution in the degree of right-handedness among dextrals. Although reaching statistical significance, these findings must be viewed with some caution in view of the relatively small number of patients tested and the fact that the normal controls have of necessity been obtained from elsewhere.

Nevertheless, the findings raise the strong possibility that subjects who come to psychiatric attention are unusually liable to show sinistral tendencies. Moreover, those patients who are younger than the mean of the group show such tendencies in a more decisive fashion. This makes it tempting to postulate that the abnormal distribution of handedness is in some way related to vulnerability to psychiatric disorder, rather than a purely chance finding.

It is the male rather than the female patients who appear to account for the increased sinistrality. And the analysis of diagnostic categories, though often relying on very small numbers of patients, indicates that the psychotic patients in the sample have been especially prone to left-handedness. There are further indications that delusion formation among the psychotics may bear some special relationship to left-handedness.

It is probably premature to speculate too closely about the nature of these relationships, but three main possibilities may be considered: left-handedness may impose psychosocial problems which contribute to psychiatric illness; or it may be inherited coincidentally with vulnerability to illness; or it may reflect acquired abnormalities of cerebral dominance (i.e. of functional relationships between the hemispheres) which have contributed to vulnerability to illness.

It would seem unlikely that psychosocial effects alone could account for the present

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findings. Neurotic disorders or abnormalities of personality could conceivably be so engendered, but these have shown little relationship to left-handedness in the present sample. It is hard to conceive of psychotic illnesses arising from the frustrations of being left-handed in a right-handed world. Nor does the present evidence support a simple genetic hypothesis: the male patients have shown no greater incidence of sinistrality among their relatives than the females, nor the psychotics than the non-psychotics. Moreover the left-handers among the patients have shown a *reduced* incidence of familial sinistrality compared to the right-handers. Altogether this suggests that in some at least of the left-handed patients their sinistrality has been acquired rather than inherited.

The concept of acquired or 'pathological' left-handedness has traditionally been linked to ideas of covert left hemisphere damage at birth or during early development. This is almost certainly too restricted a view of a complex situation. Asymmetries of function need not imply pathology, especially when, as with left-handedness or mixed-handedness, they lie within a well established normal range. The genesis of hand preference is very incompletely understood, but appears to be linked in some way with the mechanisms underlying the development of cerebral dominance for language. A multitude of influences could stand to disturb this complex process, including brain damage certainly, but perhaps also patterns of learning or patterns of interaction with the environment during sensitive periods of early development. It may even be that disturbing emotional relationships may disrupt the orderly establishment of cerebral dominance for language and other functions. Thus the increased left-handedness among the patients, and more specifically among the psychotics, may be linked to covert early left hemisphere damage, or alternatively to less tangible influences of the kind just mentioned which have operated on the individual during early development. The issue, irrespective of these theoretical possibilities, is that subjects vulnerable to mental illness appear to show evidence of some disturbance of cerebral dominance, and this disturbance appears to have been acquired rather than inherited. This evidence has emerged in patients suffering from 'functional' mental illnesses in whom there was no indication, in the history or on examination, of cerebral pathology.

That the abnormalities of hand preference are more marked in male than in female patients accords with the observation that cerebral dominance for language appears to be slower to become established in boys than in girls (Kimura, 1967; Knox and Kimura, 1970; Buffery and Gray, 1972). Males may therefore be more prone than females to display abnormalities of dominance (and of handedness) in the face of influences such as those outlined above. The excess of left-handedness in psychotic patients may be viewed in relation to Flor-Henry's (1974) suggestion that schizophrenia may be related to 'dysfunction' within the left temporo-limbic system. Among the present psychotic patients, however, left-handedness was more prevalent in manic-depressives and schizoaffectives than in the purely schizophrenic patients. The finding that delusion formation in the psychotics was specially related to left preferent tendencies, whereas hallucinations were not, perhaps deserves further examination in a more comprehensive sample of patients. It may be noted, however, that Davison and Bagley (1969) found a significant correlation between primary delusion formation and lesions of the left cerebral hemisphere in their analysis of a large series of patients from the literature who showed schizophrenia-like psychoses in association with a variety of cerebral pathologies.

Flor-Henry's additional proposition of dysfunction in the right (non-dominant) hemisphere in persons showing depressive symptomatology would be hard to examine by the present means, since dysfunction within the right hemisphere would have no impact on the normal tendency to develop a right-hand preference. Where manic-depressive psychotics are concerned, however, the present findings are directly inconsistent with the proposition, for they indicate left rather than right hemisphere dysfunction as discussed above.

The analyses of foot and eye preferences in the present patients has failed to reveal a special

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incidence of 'crossed-dominance' in any diagnostic group. Specifically, Oddy and Lobstein's (1972) findings of increased crossed dominance for hand and eye in schizophrenic patients is not confirmed, though the number of schizophrenics in the present sample was relatively very small.

Finally, in addition to the cautions already expressed concerning the present data, one must also bear in mind that hand preference patterns are merely a crude and readily testable aspect of 'cerebral dominance'. To equate sinistral tendencies with abnormalities of cerebral functional organization is justifiable only in very general terms. Other non-traumatic procedures for assessing cerebral dominance, such as dichotic or tachistoscopic techniques, might be more informative when applied to patients with functional psychiatric disorders, to see whether disturbance of functional cerebral organization can be confirmed.

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