

Handedness, anxiety and sex differences

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Anxiety scores of 35 male and 35 female students (28 right-handers, 23 left-handers and 19 mixed-handers) were assessed in relation to the handedness classification of each individual. Females were found to show higher anxiety scores than were males; but in contradiction to previous findings, left-handers and mixed-handers were not found to be more anxious than right-handers. Extremes of handedness, however, were closely related to anxiety scores, with the strongly right-handed and the strongly left-handed both showing higher anxiety scores than those whose hand preferences were less extreme.

It has recently been suggested that non-right-handed individuals may be more anxious than right-handers (Orme, 1970; Hicks & Pellegrini, 1978*a*). However, the generality of Orme's findings must be questioned as his sample was composed of girls passing through an approved school classifying centre, and because of a number of additional problems concerning the methodology of his study which Hicks & Pellegrini raise in their own report. Nevertheless, although their study incorporates several improvements such as the inclusion of a mixed-handed group, Hicks & Pellegrini fail to state the number of males and females in their sample of college students.

There are several reasons for supposing that this may be an unfortunate omission. Firstly, a number of studies report a higher incidence of sinistrality among males (Oldfield, 1971; Annett, 1972; Hardyck *et al.*, 1976). Whilst there is also evidence to the contrary (Hecaen & Ajuriaguerra, 1964; Briggs & Nebes, 1975), there is at least a possibility that where the sex of subjects is not taken into account males may accordingly be overrepresented in the left-handed group. The discrepancy amongst reports on the incidence of non-right-handedness may also arise at least partly from the considerable variation in criteria employed in measuring handedness. This may lead not only to differing estimates of left-handedness in the population but also to disagreement concerning the membership of left-, mixed- and right-handed categories. With reference to sex differences in particular, this point is highlighted by Bryden (1977), who accounts for the greater number of male left-handers in his sample in terms of responses to the handedness questionnaire which he employed. Males were found to make fewer responses in the extreme categories (for example, they were more likely to claim that a task was 'usually' rather than 'always' performed with a given hand), which, in the case of a departure from an 'always right-handed' response, effectively increased the likelihood of their being classified as left-handers.

Secondly, it appears that self-report scales such as the Manifest Anxiety Scale (Taylor, 1953) and other similar questionnaires result in higher anxiety scores for females, in so far as differences are found at all (Maccoby & Jacklin, 1975). In addition, there is some evidence that females volunteer more readily for psychological experiments than do males, and that females who volunteer are more anxious than those who do not (Rosenthal, 1965), while no such differences are reported for males.

Finally, there is evidence for the existence of sex differences from studies in other areas, such as that of cognitive functioning; and some workers have found these differences to be manifested in interaction with differences between handedness groups (McGlone & Davidson, 1973; Tucker, 1976; McKeever & VanDeventer, 1977; Davis & Wada, 1978).

The research reported here, which was carried out as part of a larger study incorporating

a number of other variables, therefore investigates the possibility that a personality variable such as anxiety level may be affected both by sex differences and by handedness classification.

Methods and results

Subjects were initially selected according to their self-avowed hand preference and family history of handedness from 380 questionnaires which were distributed to students of two colleges and of which 316 were returned: 130 by males, 177 by females and 9 with sex unclassified. Handedness was then confirmed by subjects' responses to the Briggs & Nebes (1975) modification of Annett's handedness inventory (1967), using the scoring criteria adopted by Briggs & Nebes (1975) and a manual check procedure. On this basis, 70 subjects were selected in the following proportions: 35 males (14 right-handers, 10 mixed-handers, 11 left-handers) and 35 females (14 right-handers, 9 mixed-handers, 12 left-handers). These subjects were asked to participate in a further series of tests including the Taylor Manifest Anxiety Scale (TMAS).

The anxiety scores obtained on the TMAS were initially subjected to a square-root transformation since the data appeared to be in the form of a Poisson-type distribution. An analysis of variance with handedness as a main factor was then performed, using a hierarchical regression method, significance levels being determined with respect to the error sum of squares at that particular step. Results from this analysis are summarized in Table 1.

Table 1. Analysis of variance of anxiety scores by handedness (hierarchical regression approach) after transformation $x' = \sqrt{(x+1)}$

Variable	Order of entry	SS	d.f.	<i>F</i>	<i>P</i>
Sex	1	1.949	1, 68	4.617	0.035
Handedness (linear)	2	0.247	1, 67	0.582	0.448
Handedness (quadratic)	3	4.891	1, 66	13.690	< 0.0001
Handedness (linear) by sex	4	0.552	1, 65	1.557	0.217
Handedness (quadratic) by sex	5	0.406	1, 64	1.147	0.288

These results clearly demonstrate that anxiety scores were affected by the factor of sex, with females achieving significantly higher scores than males ($F = 4.62$, d.f. = 1, 68, $P < 0.05$). The factor of handedness reveals an even more interesting aspect of the data. Firstly, there was no significant linear effect of handedness on anxiety scores. The implication of this finding is that it is not possible to assert that left-handers are more anxious than are right-handers (or conversely). However, there was a highly significant quadratic effect of handedness on anxiety scores, indicating that those who were either strongly right-handed or strongly left-handed had higher anxiety scores than those whose strength of handedness ratings tended towards zero (indicating mixed-handedness). The sex \times handedness interactions, whether linear or quadratic, failed to attain significance: thus there is no support for the notion that, for example, female left-handers might be more anxious than other subgroups. Individual scores are depicted in Fig. 1, where the quadratic trend for both males and females is also illustrated.

The significantly higher anxiety scores obtained by females are in agreement with findings cited previously. However, there is no evidence in this study of a linear effect of handedness upon anxiety scores, either after taking the factor of sex into account or

without removing the effects of sex differences. This contrasts with the findings reported by Hicks & Pellegrini (1978*a*). In fact, it would appear that extremes of handedness, in either direction, are more likely to be associated with high anxiety scores. It may be possible to explain this phenomenon in terms of a tendency in mixed-handers to select less extreme responses on questionnaires, either by choosing more 'moderate' responses, or by choosing

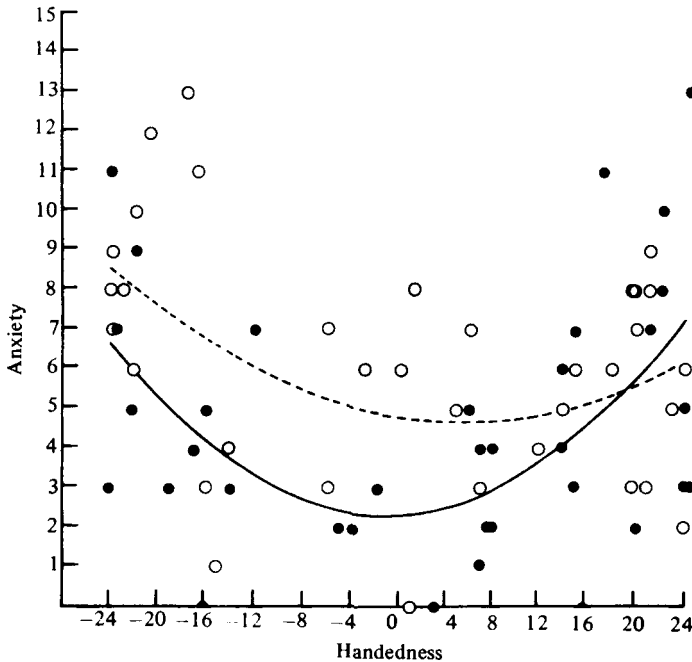


Figure 1. Anxiety and handedness scores for males and females with best fitting quadratic regression curves. ○—○, females; ●—●, males.

negative (e.g. 'False') responses to questionnaire items using 'extreme' wordings (e.g. never, always, very). Such a tendency would lead both to low anxiety scores and to the inclusion of such individuals in the mixed-handed group in the first instance, but might require further investigation.

There is already some evidence to support the notion that mixed-handers can be differentiated in this way. For example, Hicks & Pellegrini (1978*b*) have found that mixed-handers tend to score lowest on a 'locus of control' measure, believed to be an index of emotional stability. A similar quadratic function relating sleep and handedness has been reported by Hicks *et al.* (1979); and a study by Thomas & Campos (1978), which investigated handedness and performance on a cross-modal task involving the matching of parts to wholes, also found a relationship of this form.

Taken together, these results strongly suggest that the variables of sex differences and mixed-handedness should be taken into account in any future research in this area, particularly since their omission may have affected the interpretation of previously published findings.

References

- Annett, M. (1967). The binomial distribution of right, mixed and left handedness. *Quarterly Journal of Experimental Psychology*, **19**, 327-333.
- Annett, M. (1972). The distribution of manual asymmetry. *British Journal of Psychology*, **63**, 343-358.
- Briggs, G. G. & Nebes, R. D. (1975). Patterns of hand preference in a student population. *Cortex*, **11**, 230-238.

- Bryden, M. P. (1977). Measuring handedness with questionnaires. *Neuropsychologia*, **15**, 617-624.
- Davis, A. E. & Wada, J. A. (1978). Speech dominance and handedness in the normal human. *Brain and Language*, **5**, 42-55.
- Hardyck, C., Petrinovich, L. F. & Goldman, R. D. (1976). Left-handedness and cognitive deficit. *Cortex*, **12**, 266-279.
- Hecaen, H. & Ajuriaguerra, J. (1964). *Left-handedness: Manual Superiority and Cerebral Dominance*. New York: Grune & Stratton.
- Hicks, R. A. & Pellegrini, R. J. (1978a). Handedness and anxiety. *Cortex*, **14**, 119-121.
- Hicks, R. A. & Pellegrini, R. J. (1978b). Handedness and locus of control. *Perceptual and Motor Skills*, **46**, 369-370.
- Hicks, R. A., Pellegrini, R. J. & Hawkins, J. (1979). Handedness and sleep duration. *Cortex*, **15**, 327-329.
- Maccoby, E. E. & Jacklin, C. N. (1975). *The Psychology of Sex Differences*. London: Oxford University Press.
- McGlone, J. & Davidson, W. (1973). The relationship between cerebral speech laterality and spatial ability with special references to sex and hand preferences. *Neuropsychologia*, **11**, 105-113.
- McKeever, W. F. & VanDeventer, A. D. (1977). Visual and auditory language processing asymmetries: Influence of handedness, familial sinistrality, and sex. *Cortex*, **13**, 225-241.
- Oldfield, R. C. (1971). The assessment and analysis of handedness. The Edinburgh Inventory. *Neuropsychologia*, **9**, 94-113.
- Orme, J. E. (1970). Left-handedness, ability and emotional instability. *British Journal of Social and Clinical Psychology*, **9**, 87-88.
- Rosenthal, R. (1965). The volunteer subject. *Human Relations*, **18**, 389-406.
- Taylor, J. A. (1953). A personality scale of manifest anxiety. *Journal of Abnormal and Social Psychology*, **48**, 285-290.
- Thomas, D. G. & Campos, J. J. (1978). The relationship of handedness to a 'lateralized' task. *Neuropsychologia*, **16**, 511-515.
- Tucker, D. M. (1976). Sex differences in hemispheric specialization for synthetic visuospatial functions. *Neuropsychologia*, **14**, 447-454.

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