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Handedness Inventories: Edinburgh Versus Annett

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Abstract: *Two handedness inventories were compared. The Edinburgh Handedness Inventory yielded more either-hand and fewer left-hand responses than does the Annett questionnaire. Both questionnaires showed high internal consistency. Ear preference in telephone usage seemed to be related more to bimanual coordination than to hemispheric asymmetry for speech. No sex difference was found in the incidence of left-handedness.*

Keywords: Handedness, telephone, ear preference, sex difference.

It is universally recognized that the handedness of the patient has great significance for clinical neuropsychology. This recognition prompted attempts to understand and to measure handedness more thoroughly. Though there may be a place for performance measures of handedness, research and clinical workers in large numbers have turned to questionnaire instruments. These are highly correlated with behavioral measures (Chapman & Chapman, 1987). That the questionnaires add further information to a simple self-classification as right- or left-handed is shown by a further finding of Chapman & Chapman (1987): Little more than half of self-classified left-handers were determined to be left-handed by the questionnaires. Self-classified strong right-handers on the other hand were rarely determined to be left-handed by the questionnaires.

A number of American instruments (Briggs & Nebes, 1975; Crovitz & Zener, 1962; Healey, Liederman, & Geschwind, 1986; Raczkowski, Kalat & Nebes, 1974) have been standardized on samples from the United States, which raises questions about their utility for European work relative to European instruments. The dominant European questionnaires have been the British ones of Annett (1970) and Oldfield (1971). For example, Dellatolas et al. (1988), when constructing a questionnaire for use in French contexts, reported that their initial item pool was made up of items drawn mainly from Annett's and Oldfield's questionnaires. In an unpublished citation analysis of a bibliography of 456 articles relevant to dichotic listening, I found Oldfield's Edinburgh Handedness Inventory had the most impact, with 50 citations in a single year.

The choice of a questionnaire is made less critical by the fact that there is considerable overlap of items (see Chapman & Chapman, 1987). The Edinburgh inventory has two forms: a 20-item and a 10-item version. Six of the items are the

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same in the 10-item Edinburgh inventory and the 12-item Annett questionnaire. Nevertheless, the context of the whole questionnaire may influence the way in which identical items are answered.

A comparison of the two questionnaires was conducted by McMeekan and Lishman (1975). They used the 10-item rather than the 20-item Edinburgh questionnaire, in line with most other researchers. McMeekan and Lishman gave both questionnaires to each subject in a within-subjects design. It seems clear that there are drawbacks to this procedure. Answering one questionnaire might well affect responses to the second. Moreover, the two possible orders of questionnaires do not appear to have been equalized throughout the sample. There was a further major problem: Sampling was not random. A special effort was made to recruit left-handers, and for most analyses, a preponderance of twins from the Institute of Psychiatry (London) twin register was used. The main focus of McMeekan and Lishman's study was the test–retest reliability of the questionnaires: These reliabilities were found to be about .80, which is rather disappointing relative to some other popular questionnaires. In particular, during retesting with the Edinburgh inventory, subjects often changed classification of their preference for a function as strong (two ticks in the appropriate box) or weak (one tick). Nonetheless, McMeekan and Lishman (1975) concluded that "neither questionnaire has appeared from the present study to be greatly superior to the other where stability over time is concerned" (p. 58).

One major problem with the Edinburgh inventory is the procedure for deriving a laterality quotient (LQ). This is calculated by totalling the number of ticks in the *right* column (R) and the number of ticks in the *left* column (L) and computing the following statistic: $(R - L)/(R + L)$. But this makes it possible to score an LQ of 100 in more than one way—by putting anywhere between 10 and 20 ticks in the *right* column as long as there are none in the *left*—so that there is no discrimination between degrees of strong right-handedness (the bulk of any random sample is strong right-handers). Also, there is no real justification for weighting a strong preference as twice the magnitude of a weak preference just because it is recorded as two ticks rather than one. Nor can one justify the equal weighting of the different items used to derive the LQ (cf. Williams, 1986). Annett (1970) divided items into primary and secondary ones, making a more refined statistical discrimination possible. Other refinements could also be implemented.

A surface reading of the Edinburgh Handedness Inventory suggests the possibility of another major problem with it: The instructions seem to encourage an *either-hand* response, for they state "if in any case you are really indifferent *put a tick in both columns.*" If it is important to measure the handedness of patients accurately, it is critical to investigate whether this wording does have a biasing effect.

One aspect of handedness has come to the fore since the construction of these questionnaires: which hand is used to pick up a telephone and put it to the ear. Surwillo (1981) suggested that the right-ear advantage for speech (Kimura, 1961), long thought to reflect left-hemisphere specialization for speech, might be due to a bias toward right-ear telephone usage. It has since been confirmed that the experimental right-ear advantage is correlated with right-ear telephone use (Williams, 1982) and that telephone handedness tends to correspond with the more conventional aspects of handedness, such as writing (Williams, 1987, 1989). In the present research, I investigated this issue by adding questions on telephone use to Annett's (1970) questionnaire.

There have been persistent reports of sex differences in the incidence of left-handedness. Gender is paradigmatically an easy variable to record and analyze irrespective of the main purpose of a project; for this reason, reports of sex differences in handedness may be Type I errors, with perhaps more numerous rejections of a difference not being reported (as negative results). Nevertheless, Porac and Coren (1977) suggested there is a sex difference and that the findings of no sex difference that do exist probably reflect restricted sample sizes. Chapman and Chapman (1987), with a large sample, still found no sex difference in their main test but did find differences with subsidiary analyses. Such subsidiary analyses, not reported as such, would also increase the probability of Type I error. In the present research, this issue was also investigated.

The main purpose of this study, then, was to investigate whether the Edinburgh Handedness Inventory and Annett's (1970) questionnaire differ in the incidence of either-hand responses elicited. Subsidiary purposes were to investigate the relationship between telephone use and other aspects of handedness and to consider the relevance of gender to handedness.

Method

Subjects

All subjects were undergraduate volunteers between 18 and 21 years old. The Edinburgh Handedness Inventory (10-item version) was completed by 161 students at the University of Sussex, and Annett's (1970) questionnaire was completed by 111 students at the University of Ulster. Recruitment procedures were equivalent for the two samples, and there is no reason to suppose that they differ systematically in any respect, such as school of study.

Apparatus

The Edinburgh inventory included questions about writing, drawing, throwing, using scissors, using a toothbrush, using a knife (without a fork), using a spoon, using a broom (upper hand), striking a match, and opening a box. Three supplementary questions were added: "Please write down any relatives known to be left-handed or partly left-handed"; "To your knowledge, has the pattern of your handedness changed at all over the years?" (used to exclude subjects with unnatural handedness); and "Please describe your ear preference when listening to someone on the telephone (Which ear do you usually use? Is it a strong or weak preference? Do you change over when you have to write down a message?)."

Annett's (1970) questionnaire contains 12 main items, which are about writing, throwing, using a racket, striking a match, using scissors, using thread, using a broom, using a shovel, dealing cards, hammering, using a toothbrush, and unscrewing a jar lid. Consistent right-handers are asked to name any left-handed actions, and consistent left-handers are asked about right-handed actions. I added questions about telephone ear preference; the questions were set out more systematically and were separated for making and for receiving calls.

Procedure

Subjects filled out the questionnaires in the company of the experimenter, but in their own time. They were told the experimenter was a psychologist. No one invited declined to participate.

Results and Discussion

The frequencies of either-hand responses for each item in each questionnaire are given in Table 1. The items are numbered in the table according to the order in which they are listed in the Method section. The difference between either-hand responses to Annett's (1970) questionnaire (6%) and the Edinburgh inventory (13%) is significant, $t(20) = 2.10$, $p < .05$. The frequencies of either-hand or left-hand responses to items identical in the two questionnaires are given in Table 2. An either-minus-left score was derived for each item. This score was significantly greater for the Edinburgh items, $t(5) = 4.40$, $p < .01$, partly because there were fewer left-hand responses to the Edinburgh items (6% as opposed to 12% for Annett's questionnaire).

Particularly for the Edinburgh inventory, items that appeared later in the questionnaire were more likely to yield either-hand responses. Moreover, the raw data also show more weak-preference responses for these items.

Regarding telephone use, one query was whether it is indeed important to ask for ear preference both in making and in receiving a call. This was confirmed by these data; the correlation between the two was only .66 (.68 when strength of preference was taken into account in deriving the ear-preference index).

Another query was whether telephone ear-preference correlates significantly with general handedness (LQ). This was also confirmed. For the group that responded to Annett's (1970) questionnaire, the correlation was .41 for making a call and .38 for receiving a call. With this group's data, stepwise regressions were conducted of the effect of telephone ear preference on the main items of the questionnaire. The items reaching the criterion for entry to the regression equation were those concerning the use of scissors and thread; the same items were selected for entry when ear preference for receiving a call was the dependent variable, but the items about dealing cards and hammering were selected when ear preference for making a call was the dependent variable. The latter two actions especially are basically bimanual actions in which the two hands play very different roles; in this respect, they are perhaps not dissimilar from dialing the telephone and holding the receiver. These results give some indication therefore that telephone ear preference may reflect general manual coordination rather than (as assumed in the past) hemispheric asymmetry for speech.

The other major query was the role of gender. To assemble a substantial sample, I combined the present data with data from two earlier studies (Williams, 1981, 1987) and with unpublished data (including some subjects selected for signs of sinistrality but not for sex). In a total sample of 691, there were 49 left-handers

Table 1
Frequency (% of Subjects) of Either-Hand Responses to Each Item of Each Questionnaire

	Item number												
Questionnaire	1	2	3	4	5	6	7	8	9	10	11	12	*M*
Annett	0	4	9	3	3	5	11	9	7	0	7	11	6
Edinburgh	0	1	8	9	12	6	14	27	17	35	—	—	13

Note. The Edinburgh Handedness Inventory contained only 10 items.

Table 2
Frequency (% of Subjects) of Either-Hand and Left-Hand Responses to Items Identical in the Two Questionnaires

	Edinburgh Handedness Inventory		Annett	
Item	Either	Left	Either	Left
Writing	0	6	0	13
Throwing	9	7	4	10
Using a match	17	6	4	4
Using scissors	9	4	3	12
Using a broom	27	11	11	21
Using a toothbrush	12	5	7	15

among 359 males and 53 left-handers among 332 females. The chi-square for this contingency was 0.74, which is not significant.

The internal consistency (coefficient alpha) of both questionnaires was calculated. For the Edinburgh inventory, alpha was .93, and for Annett's (1970) questionnaire, it was .87. Ceteris paribus, a high alpha is a desirable quality. However, alpha will increase with the size of the sample, and the sample responding to the Edinburgh inventory was larger in this study, so there is no real ground here for preferring the Edinburgh inventory to Annett's questionnaire. Both alphas are comparable to those (around .96) calculated by Chapman and Chapman (1987) with sample sizes an order of magnitude higher. Item–total correlations suggest that the items detracting most from consistency were the item about unscrewing jars in Annett's questionnaire ($r = .39$) and the items about opening boxes (.49) and using brooms (.54) in the Edinburgh inventory.

Further incidental observations in this study were that (a) no member of the sample showed any difficulty in answering any part of either questionnaire, (b) distributions of handedness were the standard continuous J-shaped distribution, that is, with a marked tail of strong left-handers (who were, however, many fewer than the strong right-handers) and with few mixed-handers, and (c) some subjects put 10 single ticks in the *right* column for the Edinburgh inventory, which suggests that they may not have understood the instructions on reporting strength of preference.

The results suggest that the instructions of the Edinburgh inventory succeed in generating more either-hand responses when left hand would otherwise be the response. Therefore, neuropsychological researchers who need to detect any trace of sinistrality may, for this and other reasons mentioned previously, prefer to use Annett's (1970) questionnaire. It could be argued that the difference found between the questionnaires is an artifact of using a between-subjects rather than a within-subjects design. The two samples were both random and large, however, and an artifactual explanation seems unlikely. McMeekan and Lishman (1975) pointed out defects of within-subjects designs. Even a properly counterbalanced within-subjects design would tend in this research to diminish real differences between the questionnaires because subjects would wish to be consistent in their responding. Moreover, transfer from Annett's questionnaire to the Edinburgh inventory might

be greater or less than transfer from the Edinburgh inventory to Annett's questionnaire, a problem that counterbalancing cannot solve. There seems to be a place for both types of evidence, both between- and within-subjects designs.

The results provide further evidence for an environmental rather than a neurological explanation of the right-ear advantage for speech. No influence of gender on handedness, of the kind predicted by some work on hemispheric asymmetry and gender, was detected.

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