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Handedness and depression: evidence from a large population survey

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Abstract:

There is a considerable body of research arguing for an association between psychotic disorders and atypical brain lateralization – the latter usually being indicated by non-righthandedness. By contrast, there has been less attention given to a possible link between handedness and affective disorders and, unlike the case of psychosis, there is no obvious a priori biological reason for such a link. There are very studies of this in normal populations. This paper uses a new large population survey from twelve European countries to measure the association between handedness and depression. It is found that, using three different measures, left-handers are significantly more likely to have depressive symptoms that right-handers. For example left-handers are about 5% more likely to have reported having ever experienced symptoms of depression compared to about 27% of the total sample. There is no evidence that this effects differs between men and women.

Introduction

There is a considerable body of research arguing for an association between psychotic disorders and atypical brain lateralization – the latter usually being indicated by non-righthandedness. Early papers in this literature include Flor-Henry (1969,1979). This theme has been taken up by Crow (1997) who provides theoretical arguments for an association between schizophrenia and atypical handedness. Other studies who consider this connection include Klar (1999), and Sommer, Aleman, Ramsey, Bouma and Kahn (2001). These arguments have been extended to make the case for an association between bipolar disorder and atypical handedness although this has been less well studied, see Savitz et al (2007) for example.

By contrast, there has been less attention given to a possible link between handedness and affective disorders and, unlike the case of psychosis, there is no obvious a priori biological reason for such a link. However it is common knowledge that in most societies there are negative connotations in popular culture with being left-handed though the nature and extent of these vary across societies, see McManus(2002) or Coren (1992) for overviews of the phenomenon. There is a considerable amount of evidence pointing to a higher incidence of certain chronic illnesses (notably auto-immune diseases) amongst left-handers, see Bryden, Bruyn and Fletcher (2005) for example. There is also a claim that the life expectancy of left-handers is significantly shorter than right-handers (Coren & Halpern 1991) although the evidence in general seems weak, see Peto (1994) for example. Given all these negative connotations with handedness (even if some of them are not true) it seems at least possible that being left-handed could be, literally, depressing.

It is striking that all the existing studies are from either small clinical samples (some with normal controls) or somewhat larger, but still small, datasets, based on students.

There are no studies (that I aware of) which consider the general population and hence it is difficult to infer anything about the relationship in general. In particular if the effect sizes of interest are small then statistical tests may be highly underpowered- a point made by Coren (1993) with regard to handedness and Gelman & Weakliem (2007) more generally. Hence it is necessary to examine this relationship using larger and more representative datasets. This paper utilises a new large cross-country dataset, SHARE, to revisit the question.

Biederman, Lapey, Milberger, Faraone, Reed, and Seidman (1994) find a positive association between left-handedness and depression in a sample of 260 boys between the age of 6 and 17. Bruder, Sutton, Berger-Gross, Quitkin and Davies (1981), who also find a positive effect, analyse a sample of 48. Amongst papers which find a negative association are Merrin (1984) using a sample of 52 individuals with schizophrenia, Muscovitch, Strauss and Olds (1981) who use a sample of patients with unipolar endogenous depression and Abrams and Taylor (1987) who analyse a sample of 67 depressive patients (with 42 normal controls). Overby (1994) and Elias, Saucier and Guylee (2001) are two non-clinical studies using samples of university students, with sample sizes of 110 and 541 respectively. Interestingly, they find opposite results. The former paper finds a higher incidence of depression for females only and no effect for men whereas the latter finds a positive effect for men only and no effect for women.

Data and Methods

The dataset used is SHARE: the Survey of Ageing, Health and Retirement in Europe. It collects data from nationally representative samples of the non-institutional population aged 50 years and older. The primary sampling unit is a household and all individuals in the household who are in the target age category are interviewed. This paper used release 2 of the dataset which includes 12 countries[i]. The sampling plan follows a complex probabilistic multistage design. Hence probability weights (calibrated by age and sex) are used to ensure that the sample is representative. For estimation purposes, each country is treated as a stratum and estimated standard errors allow for clustering within households. The size of the sample used in the estimation is 27,482.

Three measures of depression are used. Euro-D is a 12 item scale developed by the EURODEP Consortium (Prince *et al* 1999b, Copeland 1999). The items are a subset of those on the Geriatric Mental State-AGECAT (Copeland et al, 1986). The scale was created to provide a simple measure of the extent of depressive symptoms that could be used for comparing across European countries. The questions refer to the presence of these symptoms in the last month. Studies using Euro-D include Prince et al (1999a) and Castro-Costa et al (2007) the latter of which analyses the SHARE data used here.

The first measure to be modelled is simply the Euro-D scale itself. The second measure is a binary indicator equal to 1 if the Euro-D scale was greater than or equal to 4 (& equal to 0 otherwise) as Prince *et al* (1999b) found that this was the optimal cut-off for prediction of GMS depression and SHORT-CARE pervasive depression. The third measure was a binary variable indicating the yes/no response to the question "Has there been a time or times in your life when you suffered from symptoms of depression which lasted at least two weeks?" Handedness was measured simply by asking the respondents what their dominant hand was. This was asked prior to a test of grip strength. Descriptive statistics for the data are in Table 1. **<Table 1 about here>** The proportion of left-handers is about 7%, somewhat lower than many population estimates. However given that the average age is 64 and that the observed frequency of left-handedness is much lower amongst older populations this is not exceptionally low (see McManus (2002) Figure 9.1, for example).

To see how the mean of Euro-D varied with handedness we use least squares regression with main effects for handedness and sex and an interaction between the two. The latter is allowed for as some of the papers described above find sex-handedness interactions and such interactions are common in the laterality literature generally[ii]. Since the other outcomes of interest are binary we estimate logit model which predicts the probability that an individual will have ever experienced depressive symptoms using the same explanatory variables as the first model. The table of results reports marginal effects for the logit models: how the probability of being depressed varies with the explanatory variables. The Appendix provides details on how these are computed.

One could estimate a much richer model with additional covariates that will predict depression (including marital status, age, chronic illness for example). However this paper is not a general inquiry into the patterns of depression in the population, see Castro-Costa (2007) for one study using this data. Moreover including such variables in the model – while they may be of interest in their own right- has little effect on the results of interest here although I have not investigated this thoroughly. This is not surprising since there is no *a priori* reason to expect these variables to be correlated with handedness (with the possible exception of chronic illness) so one would not expect the coefficients to be biased by their omission. The question of how handedness effects might interact with (or be explained by) a wider set of covariates is left to further work.

Results and discussion

The results of the data analysis are in Table 2. **<Table 2 about here>** Column 1 shows how the mean of the Euro-D scale varies with sex and handedness. As is found in many datasets, the scale is higher for women then men and this effect is very precisely determined. It is also the case being left-handed is associated with a higher score on the Euro-D scale with left-handers being higher than right-handers, on average, by 0.291. This effect is statistically significant. To put it in comparative context, the effect is almost one third (29%) that associated with being female. The interaction term is not statistically significant at the 10% level (p=.089). In the second column, the outcome is based on the definition of a depression case from Prince et al (1999b): a Euro-D score of 4 or higher. The first parameter shows that females are 15.8% more likely to be depressed than males. One could also have seen this from simply comparing the means for males and females in Table 1: 0.1687 and 0.3346 respectively. The second parameter in the model shows that being left-handed is associated with a 5.2% higher probability of being depressed. This 5.2% difference is relative to an average for the overall sample of 26.9% (see Table 1). As with model 1, the effect of handedness is about one-third that due to sex. Again, as with model 1, one can reject the hypothesis that there is a sex-handedness interaction. The final column uses the self-reported measure of depression. The results are very similar to the preceding model: left-handedness is associated with around a 5% higher probability of being depressed and there is no evidence of a sex-handedness interaction. The marginal effect of being female is somewhat lower.

The results here show a clear pattern that being left-handed is associated with a higher level of depressive symptoms. While there are several small studies based on clinical populations, there are only two studies that look at normal populations, Merrin (1984) and Elias et al (2001). Their sample sizes, which consist of students, are comparatively small. The results here are not surprising in the (weak) sense that what little evidence exists tends to point to depression being higher amongst left-handers.

Why such an effect exists is far from clear. One possibility is environmental: that both the practical disadvantages (including stigma) associated being left-handed have a depressive effect. The population surveyed in SHARE is relatively old so one might conjecture that these effects would be smaller or non-existent in younger cohorts who in general have experienced fewer problems as left-handedness is more widely accepted.

A second possibility is both biological and environmental. Since there is evidence that some chronic illnesses are more common in left-handers this might contribute to higher depression. This possibility is testable in principle. On would not expect this effect to differ between cohorts. A third possibility, also biological and akin to the arguments made about schizophrenia and handedness, is that there are common genetic factors to affective disorders and atypical lateralization. These explanations are neither mutually exclusive nor exhaustive and a great deal of further work will be required to clarify matters.

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Table 1: Descriptive statistics

	Males	Females	Total
Euro-D depression scale	1.830 (0.025)	2.817 (0.028)	2.381 (0.021)
Euro-D≥ 4	0.169 (.005)	0.335 (0.005)	0.261 (0.004)
Ever depressed	0.194 (0.005)	0.327 (0.006)	0.269 (0.004)
Right handed	0.931 (0.003)	0.938 (0.003)	0.935 (0.002)
	44.1%	55.9%	

Notes: Coefficients are weighted means. Estimated standard errors are in parentheses.

Table 2: Depressive symptoms as a function of sex and handedness

	1 Euro-D	2 Euro-D≥ 4	3 Ever Depressed
Female	0.983	0.158	0.132
	(26.81)	(22.51)	(17.50)
Left-handed	0.291	0.052	0.051
	(2.84)	(2.56)	(2.09)
Female * left-handed	-0.252	-0.029	-0.019
	(1.70)	(1.65)	(0.68)
Constant	1.241		
	(22.54)		
R^2	0.087		
N	27,482	27,482	27,482

Notes: Model 1 is a linear regression with the Euro-D scale as dependent variable. Model 2 is a logit model of the probability of an individual being depressed: the cut-off being a Euro-D score of 4 or higher. Model 3 is a logit model of the individual self-reporting having ever experienced depressive symptoms for more than two weeks. The coefficients in Models 2 and 3 are marginal effects: the change in the probability of the outcome due to a unit change in the covariate, see the Appendix for details. All models included a full set of country dummies, details available on request. Estimation uses the regression and probit commands for survey data in Stata 9. T statistics are in parentheses.

Appendix: Marginal effects

Models of binary outcomes can be written as Pr(y=1)=F(**b**X+e) where the dependent variable takes on the value of 0 or 1 and y=1 is commonly denoted a "success". Common choices for the F function are the logistic or the normal distribution function giving rise to the logit and probit estimators respectively. The estimates of the parameters, the **b** vector, are not easily interpreted. However it is helpful to consider the marginal effects: the estimated effect of a unit change in one of the X variables, say X_1 , on the probability of a "success":

$\frac{\partial \Pr(y=1)}{\partial X_1} = f(bX)b_1$ where f(bx) is the corresponding probability density function.

Where X_1 is a dummy variable an equivalent expression is easily derived. Clearly the expression above will be different for each observation (unlike linear models). Two solutions possible are to evaluate it at some point such as the mean of the X's (the "marginal effect at the mean" or MEM). Alternatively one can evaluate at each observation and take the mean (the "average marginal effect" or AME). Respectively these are:

$MEM = f(b\bar{X})b_1$ and $AME = \overline{f(bX)}b_1$

While these two approaches often give similar results there is no guarantee that they will do so. It can be argued that AME makes more intuitive sense as often the mean of the X variables has no obvious interpretation where the X's are dummy variables like sex, or handedness for example. This paper uses AME as implemented in the *margeff* routine for Stata due to Bartus (2005). However using MEM, as implemented in Stata's built-in *mfx* routine gives very similar results.

Given advances in software and hardware marginal effects are now easy to calculate for most non-linear models and allow a simple intuitive interpretation of the results more so than, say, the odds-ratios produced by logit models for example.

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END NOTES

[i] They are Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, Switzerland and Israel. The first release of the data which was collected in 2004 consists of the first 11 countries listed. Preliminary data from Israel, collected in 2005-2006, was included in release 2. Visit http://www.share-project.org/ for more information.

[ii] Numerous sex-handedness interactions have been found including brain morphology (Witelson and Kigar 1992), divergent thinking (Coren 1993), novelty seeking (Goldberg, Lovell, Podell, and Riggio 1994), school performance (Faurie, Vianey-Liaud and Raymond 2006) and earnings (Denny and O'Sullivan 2007).