

## Left-handers have a lower prevalence of arthritis and ulcer

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In a very large study ( $N = 1,247,344$ ), left-handedness showed no association with allergies overall (and an inconsistent association with individual allergies), but there was strong evidence that left-handers had *lower* rates of arthritis and ulcer—Arthritis: Odds-ratio (OR) = 0.942, 95% CI 0.922–0.962; Ulcer: OR = 0.920, 95% CI 0.896–0.944.

Left-handers have been claimed by Geschwind and his colleagues to have a higher prevalence of a wide range of illnesses and conditions, particularly allergic problems (Geschwind & Behan, 1982; Geschwind & Galaburda, 1987; McManus & Bryden, 1991), although a meta-analysis has failed to find convincing evidence for this in a range of immune disorders (Bryden, McManus, & Bulman-Fleming, 1994). Here we examine data from a large survey, which not only finds no consistent association of handedness with allergy, but also does find substantial evidence that left-handers have a lower rate of arthritis and ulcers.

### METHOD

The data were collected as part of a postal survey of olfaction in which scratch-and-sniff cards were distributed with approximately ten million copies of *National Geographic* magazine (Wysocki & Gilbert, 1989). As well as asking about the odours presented on the card, a brief questionnaire asked about food, drug, pollen, and animal allergies, and about a history of hypertension, ulcer,

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arthritis, or diabetes. Respondents also described their age, sex, ethnic group, smoking, and handedness (Gilbert & Wysocki, 1992).

## RESULTS

Altogether 1,421,062 replies were received, meaning that the response rate was of the order of 14%, which is very high for a questionnaire distributed with a magazine. 103,631 respondents were aged under 20 (and would have had very low disease incidences), and 930 were aged 90 or over (and hence standard errors would have been high due to the small sample size). Of the remaining 1,309,391 respondents, 50,633 did not give their ethnic origin (or were in the small "other" group) and were excluded. A further 3820 did not specify their writing hand, and another 7046 had other missing variables. The analysis was therefore restricted to 1,247,344 respondents.

A total of 9.2% of respondents used the left hand for writing, left-handedness being more common in males, younger respondents, and smokers, and less common in Asian and Hispanic respondents (see Table 1). Logistic regression was used to assess the relationship of left-handedness to each of the allergies and disease, after taking into account effects of age (cubic polynomial), sex, ethnic origin, and smoking. Logistic regression is similar to multiple regression in that the effect of each predictor (dependent) variable is considered after taking all others into account, so that confounding cannot explain the effects found. Effect sizes are expressed in the conventional way as the odds ratio. If a measure occurs in a proportion  $p$  in group A, and  $q$  in group B, then the odds ratio is  $p.(1-q)/[q.(1-p)]$ . A value of 1 means that there is no difference in the rate of the measure in the two groups. Logistic regression typically calculates the log of the odds ratio, which can then be converted back to an odds ratio proper.

A total of 8.8% of respondents said they were allergic to food, and 22.5% to pollen, although neither condition was associated with left-handedness [Food: OR = 1.007, 95% CI 0.985–1.030,  $p = .520$ ; Pollen: OR = 1.008, 95% CI 0.994–1.023,  $p = .279$ ]. A total of 9.7% of respondents were allergic to animals, with a marginally higher rate in left-handers [OR = 1.023, 95% CI 1.002–1.043,  $p = .0291$ ], whereas 12.7% of respondents were allergic to drugs, with a marginally *lower* rate in left-handers [OR = 0.978, 95% CI 0.959–0.997,  $p = .021$ ]. Overall 35.6% of respondents reported having at least one of the four allergies, although there was no association with handedness [OR = 1.007, 95% CI 0.994–1.020,  $p = .289$ ]. Overall these data provide strong evidence against Geschwind's suggestion that allergies are more common in left-handers.

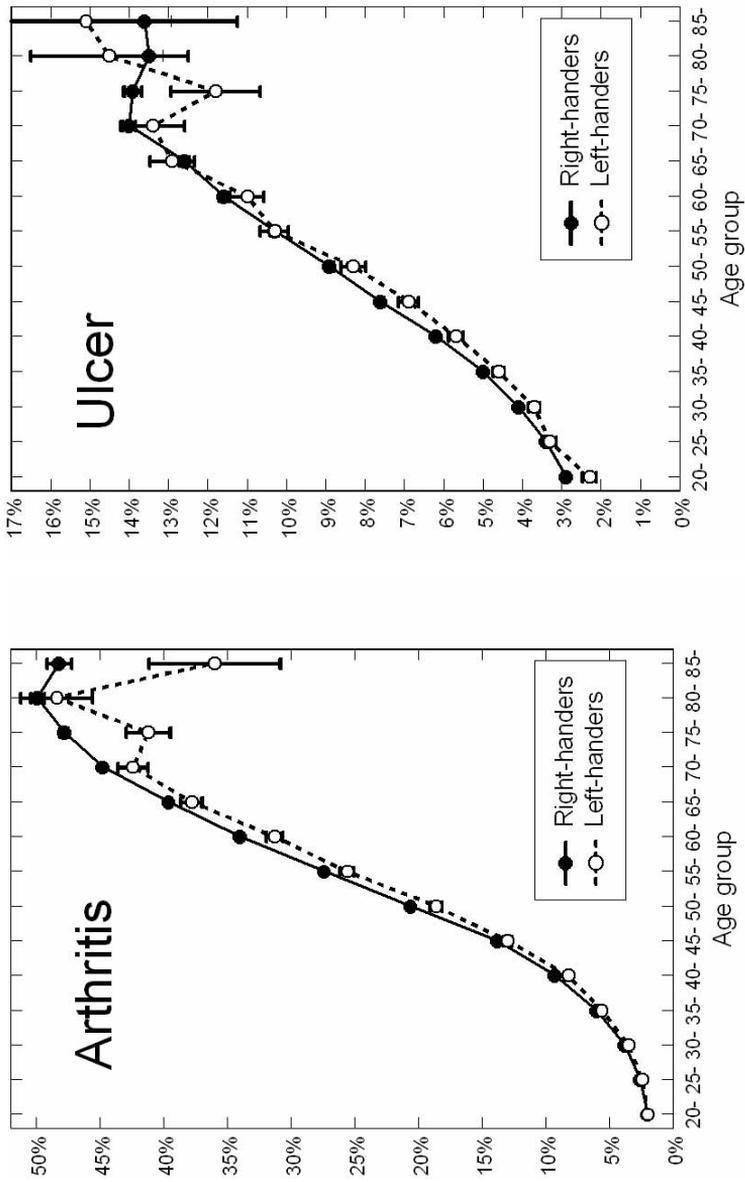
A total of 12.7% of respondents reported a history of hypertension, and 2.7% reported a history of diabetes, neither being associated with left-handedness [Hypertension: OR = 0.998, 95% CI 0.977–1.019,  $p = .817$ ; Diabetes: OR = 0.965, 95% CI 0.924–1.009,  $p = .116$ ]. However both arthritis and ulcer were each *less* common in left-handers [Arthritis: OR = 0.942, 95% CI 0.922–0.962,

TABLE 1  
Results of the logistic regressions (odds ratios)

	Female (relative to male)	Current smoker (relative to non-smokers)	Ethnic group (odds ratio relative to White)					Left writing hand (relative to right)
			Black (N = 8361)	Asian (N = 11,221)	American Indian (N = 2336)	Hispanic (N = 12,963)		
Descriptive statistics	55.6% (696,948)	18.8% (235,525)	0.7% (N = 8361)	0.9% (N = 11,221)	0.2% (N = 2336)	1.0% (N = 12,963)	9.2% (115,768)	
<i>Have you been diagnosed by a physician as having any of the following types of allergies</i>								
Animals	9.7% 1.396***	7.47***	.776***	.889***	1.048 NS	.844***	1.023*	
Foods	8.7% 1.759***	8.04***	1.094*	1.387***	1.364***	1.024 NS	1.007 NS	
Drugs	12.7% 2.298***	1.034***	.896**	.915**	1.477***	.773***	.978*	
Pollen	22.5% 1.160***	.752***	1.015 NS	1.163***	1.075 NS	.9315**	1.008 NS	
Any of the above allergies	35.6% 1.434***	.826***	.986 NS	1.146***	1.148**	.899***	1.007 NS	
<i>Have you ever been diagnosed as having any of the following</i>								
Ulcer	7.2% .803***	1.419***	1.069 NS	.970 NS	1.744***	1.040 NS	.920***	
Arthritis	15.8% 2.082***	1.079***	1.106**	.629***	1.472***	.874***	.942***	
Diabetes	2.7% .802***	1.023 NS	1.844***	1.488***	2.421***	1.430***	.965 NS	
Hypertension	12.7% .888***	.977**	1.763***	.917*	1.343***	.937 NS	.998 NS	
<i>Other</i>								
Current smoker	18.8% .907***	—	1.240***	.641***	1.955***	.857***	1.033***	
Left writing hand	9.2% .789***	—	.934 NS	.443***	.935 NS	.617***	—	

The rows show the various dependent variables, and the columns show the independent variables included in the model (Except age, which was included in every case, and in each case showed highly significant curvilinear effects, the linear trends being positive for food, drugs, ulcer, arthritis, diabetes, and hypertension, and negative for writing hand, smoking, allergies to animals and pollen, and the overall allergy measure).

Significance levels are indicated by NS: Not significant; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ .  
Total  $N = 1,247,344$ .



**Figure 1.** The percentage of right-handers (solid circles) and left-handers (open circles) reporting a diagnosis of arthritis (left-hand panel) or ulcer (right-hand panel). Total sample sizes vary from a maximum of 193,139 at ages 35–39, to minima of 58,757 at ages 20–24, and 2768 at ages 85–89. Left-handers are most common in the youngest age groups (~11%) and least common in the oldest age group (~3%). Error bars represent one standard error, and in many cases are substantially smaller than the size of the plotted symbol.

$p < 10^{-7}$ ; Ulcer: OR = 0.920, 95% CI 0.896–0.944,  $p < 10^{-9}$ ]. Figure 1 shows that left-handers have a lower rate of arthritis and ulcer across the entire age range.

## DISCUSSION

Although not necessarily representative of the population as a whole, the size of the present data set and the presence of several relevant background variables mean that these data are of exceptional interest. Although the survey sample was to a degree self-selected (Wysocki & Gilbert, 1989), and smokers are known to be somewhat under-represented (Cain, Gent, & Cometto-Muñiz, 1993), the associations found are nevertheless likely to be valid, since the sex and ethnic differences are much as might be expected from studies designed to characterise the general population. In particular, it is important that the primary purpose of the study was connected neither with handedness nor with allergy or disease, making associations between those measures particularly likely to be valid.

The absence of an association of left-handedness with hypertension, diabetes, and allergies overall (and small, inconsistent, and only just statistically significant associations with individual allergies), despite a vast sample size, suggests that the two very significant associations, of handedness with arthritis and ulcer, are not merely type I errors, but might instead be real effects, particularly given their stability across the age range and after controlling for confounders. Although the effect sizes are not large (only being useful for group rather than individual prediction), they are nevertheless substantively meaningful, are large compared with many epidemiological findings (Rosenthal, 1990) and require explanation. For 100 right-handers with an ulcer or arthritis, the data suggest the condition will be found in only 92 or 93 matched left-handers, an effect that should be apparent to a clinician with a reasonably sized clinic population. The mechanisms of the effects are very unclear, but seem unlikely to be due to immune factors, and merit further replication and investigation.

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