Mean mortality among Brazilian left- and right-handers: Modification or selective elimination?

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Many surveys report a higher incidence of left-handedness in younger than in older cohorts, and explanations for this phenomenon have centred around two rival hypotheses. The modification hypothesis attributes this trend to secular differences in the social tolerance of left-handed preferences, whereas the elimination hypothesis contends that left-handers have a shorter life-span than right-handers do, and hence are infrequent in the population above age 70. In order to evaluate these two hypotheses, data were collected on 513 decedents from kin informants. There were 465 right- and 48 left-handed decedents, including 18 switched sinistral. Females lived significantly longer than males, and there was a non-significant survival advantage for left-handers. Switched left-handers were disproportionately represented among older compared to younger decedents, indicating an historical reduction of sanctions against left-handed writing. These results contradict the survival advantage for right-handers reported by Coren and Halpern (1991), providing evidence more favourable to a cultural conditioning explanation, rather than one emphasising selective mortality.

Data from family studies of handedness consistently reveal a lower incidence of left-handedness in the parental than in the offspring generation (Annett, 1985; McManus & Bryden, 1992; Tan, 1983). In addition, most large-scale surveys of handedness distributions across the life-span have reported a systematic decline in left-handedness with increasing age, to such an extent that few sinistrals were located in the older (age > 70) cohorts (Brito, Brito, & Paumgarten, 1985; Brito, Brito, Paumgarten, & Lins, 1989; Castresana, Pery, & Dellatolas, 1989; Coren, 1994a; Davis & Annett, 1994; Ellis, Ellis, & Marshall, 1988; Lansky, Feinstein, ...
& Peterson, 1988; Newcombe et al., 1975; Porac, Coren, & Duncan, 1980). Of those hypotheses originally offered by Porac and Coren (1981) to account for these age-related patterns of handedness, two in particular have been singled out: cultural conditioning, or the modification hypothesis, and differential mortality, or the elimination hypothesis.

The modification hypothesis recognises the potent role played by social directives against left-handedness in causing a large proportion of sinistrals to shift left-preferent behaviours to the right side. Given the circumstances, pressures may exert no discernible handedness effects, affect only those behaviours targeted, such as eating and writing (Porac, 1996; Shimuzo & Endo, 1983), or become so generalised (especially if begun at a very early age) that most primary left-handed tendencies become reversed (Harris, 1990; Lauterbach, 1933). In countries such as the United States and Canada, where strictures against use of the left hand have receded in recent decades, left-handed preferences previously suppressed would be expected to increase in the population coming of age during the period of abatement. In liberalised countries then, specifically for writing, the modification hypothesis would predict an elevated proportion of switched left-handers (SLH) among older rather than younger cohorts, and combining SLH with non-switched left-handers (NSLH) should obviate any decrease in sinistrality as a function of increasing age.

Some cross-generation analyses have shown a uniform increase in left-handed writing in specific liberalised countries (Beukelaar & Kroonenberg, 1986; Brackenridge, 1981; Levy, 1974; Smart, Jeffrey, & Richards, 1980), although these studies did not report the number of SLH. Two surveys, in line with predictions, found right-hand writing predominantly among older sinistrals (Dellatolas et al., 1988; Dellatolas et al., 1991). Furthermore, a cross-sectional study conducted in Japan (a non-liberalised country) by Iwasaki, Kaiho, and Iseki (1995) confirmed that proscriptions against left-handed eating and writing continue unabated; most importantly, when handedness was classified by self-description, or by throwing or hammering, sinistrality among males occurred more frequently in the oldest (age > 70) than in the preceding age intervals. In comparison, females manifested a relatively stable pattern of right-handedness across the life-span. Results from other studies revealed an increase in SLH with age, but not sufficient to offset the total decrease in left-handedness among the older age groups (Castrésana et al., 1989; Gilbert & Wysocki, 1992; Hugdahl, Satz, Mitrushina, & Miller, 1993). Also, in a large-sample longitudinal study conducted in a community in northern England by Ellis et al. (1998a), over 6000 individuals completed the Edinburgh Inventory, and a uniform decline in the prevalence of left-handedness was observed across the 15–65 age-span. Furthermore, results from regression analyses revealed that information on writing and drawing preference accounted for only 18% of the variation in the overall age-related decrease in left-handedness. Such findings, especially from
liberalised countries, suggest that, by itself, the modification hypothesis does not provide an adequate explanation for the proportional reduction of left-handedness, frequently encountered among the older age cohorts.

As an alternative hypothesis to cultural conditioning, Porac and Coren (1981) speculated that left-handers might be infrequent among the elderly, because, in comparison with right-handers, their life expectancy may be reduced. The “elimination hypothesis”, as developed by Coren (1992) and associates (Coren & Halpern, 1991; Halpern & Coren, 1990, 1991) assumes that right-handedness, given its historical pre-eminence (Corballis, 1991; Coren & Porac, 1977), has become a bioevolutionary fixture in the human species. According to Coren (1994a,b, 1995), left-handedness constitutes a deviation from the dextral genotypic norm, is not a hereditary trait, and arises mainly from a confluence of traumatic events, which usually occur during prenatal development. These pathological antecedents in turn are held to alter neuromotor development in a covert fashion, leading to a leftward shift in manual dominance without paralysing the right hand. Consequently, left-handedness in general is considered to be a phenotypic “marker” for a variety of abnormal or “alnormal” syndromes which eventually take a toll on the organism, resulting in premature death (Coren & Searleman, 1990). In addition, left-handers at work and play in physical environments designed for right-handers are viewed as more “accident-prone”, and thereby more susceptible than dextrals to accident-related injury and death (Coren, 1992). Although the elimination hypothesis is premised on the notion of “pathological left-handedness”, it does not adhere to the more extreme “unilateral” position (cf. Harris and Carlson, 1988), favoured by Bakan (1975), and Bakan, Dibb, and Reed (1973), which assumes that all left-handedness stems from pathological antecedents. In this regard, Coren and Halpern (1991, p. 97) acknowledged the presence of “natural left-handedness” that “could be caused by factors ... associated with the intrauterine environment, such as fetal position during gestation”. Coren and Halpern (1991) did not, however, make projections as to what the probable proportional distribution of the “natural” and “pathological” subgroups might be in the general population of left-handers.

There are two principal sources of evidence for differential mortality. First, in an archival study of major league baseball players, Halpern and Coren (1988) reported an 8-month longevity advantage for right-handers. Second, in a next-of-kin community survey, Coren and Halpern (1991) found that on the average, females outlived males by about 6 years, and right-handers outlived left-handers by nearly 9 years. In terms of causality, only accidental aetiology was cited, with additional analyses indicating that left-handers were four times more likely to have perished in vehicular accidents than right-handers were.

The baseball study has been replicated by independent investigators, with the majority not finding any significant relationship between handedness and longevity (Anderson, 1989; Fudin, Renninger, Lembessis, & Hirshon, 1993;
Hicks et al., 1994; Wood, 1988). In contrast, the next-of-kin study, which provides the strongest support for the elimination hypothesis, has not been directly replicated, even though it has been amply criticised on a number of methodological grounds (Annett, 1993; Beaton, 1994; Bryden, 1993; Harris, 1993). Among other drawbacks, Coren and Halpern (1991) did not provide certain statistical information, such as subgroup sample sizes and measures of variation, and aside from accidents, did not delineate other possible predisposing causes of mortality. Another criticism was directed towards the exclusive use of mean age at death as the dependent variable, rather than survival functions which require the presence of non-decedents, or censored data (Peto, 1994; Rothman, 1991; Salive, Guralnic and Glynn, 1993). To date, results from five longitudinal community studies, using research strategies appropriate to survival analysis, have been reported (Ellis et al., 1998b; Kuhlemeier, 1991; Marks & Williamson, 1991; Salive et al., 1993; Wolf, D’Agostino, & Cobb, 1991), and none found left-handers to be at higher risk for premature death than right-handers.

Nevertheless, an adequate evaluation of this hypothesis would be more convincing if conducted independently, using Coren and Halpern’s original design. Also, data from dececdents alone may be used to test the validity of both hypotheses, provided that, in the society under study, sanctions against manifest left-handedness were strongly enforced during past generations, because such an antecedent condition would increase the possibility of locating an adequate number of switched left-handers (at least for writing) in the obtained samples. Moreover, mean mortality would need to be supplemented by analyses focusing on the handedness distribution of dececdents across each age level, with special attention to the pattern for SLH and NSLH.

With regard to the social context, in Brazil left-handedness was strongly censured in the past, and left-handers were routinely pressured by parents and teachers to write and eat right-handed (Morais, 1965). An anonymous author, writing during the early 1940s, reported a widespread parental concern in Brazil with both the “cure” and prevention of left-handedness, where it was popularly characterised as “a teratological phenomenon, analogous to a monstrosity” (F.A.L., 1945, p. 278). Although social pressure has relaxed during the past 20 years, as late as 1990, about 58% of the left-handed elementary students interviewed in Belem reported having suffered attempts to switch their writing hand, and approximately 2% had successfully converted (Martin, 1991).

This study was designed to replicate as closely as possible, within a different sociocultural setting, Halpern and Coren’s community survey, in order to test the validity of the two hypotheses. To this end, aside from mean mortality, analyses were focused on the distribution of SLH and NSLH across the age spectrum, based on the following rationale. (1) If the modification hypothesis were valid, then, together with non-significant differences in mean mortality, a larger proportion of SLH should be present among left-handed dececdents in the upper
than in the lower age intervals. (2) Conversely, if the elimination hypothesis were tenable, a significant mean longevity advantage should emerge for right-handers, with fewer left-handers of either phenotype appearing in the older age intervals. The issue of causality was addressed by examining the data for accident-related and other aetiological conditions, which might differentiate left-from right-handers.

**METHOD**

**Sampling procedure**

Over a period of 13 months, the names and addresses of each decedent’s next of kin were obtained from all death certificates filed in 10 funeral homes, located in the central *barrios* of Belem, Para State, Brazil. Next of kin were interviewed directly, either at home or by telephone, and a brief questionnaire composed of items dealing with cause of death, health problems, and handedness was completed. Next of kin were advised that the survey was intended to document specific physical and medical problems related to mortality, with an additional interest in collecting data on hand preference. To ensure accuracy in identifying handedness, no data were collected on decedents below the age of 10. For ethical reasons, contacts with next of kin were initiated after a period of at least 4 weeks had elapsed since the date of death. It was not possible to exclude, beforehand, deaths by homicide or suicide as Coren and Halpern (1991) did, because medical diagnoses on the certificates did not use these terms. Whenever such cases arose, interviewers recorded only the information given, and took care not to elicit further details.

A total of 556 death certificates were consulted, and from the 530 next of kin contacted, 513 complete questionnaires were obtained. Nine relatives refused to be interviewed, and eight cases were omitted because the decedents had suffered from long-term physical impairments affecting the hands.

**Handedness**

The hand preference of each decedent was classified nominally, and then by reference to selected unimanual tasks. Next of kin were asked whether the deceased would best be categorised as right-handed, left-handed, ambidextrous, left-handed/switched, or “other” (including hand change due to injury). Respondents then rated the deceased as right-, left-, or ambi-handed on the following five items, which a pilot study, conducted with university students and their relatives, revealed to be the easiest to identify and non-redundant: writing, eating with a spoon, cutting with scissors, using a tooth brush, and using a hammer. In order to index the degree of hand preference, a handedness score (HS) was determined for each decedent by means of the following formula:

$$HS = \frac{\text{number of right-handed ratings} - \text{number of left-handed ratings}}{\text{total number of ratings}}$$
(number of right-handed ratings + number of left-handed ratings), yielding values ranging from +1.0 (strongly right-handed) to −1.0 (strongly left-handed). The decision rule used to allocate individuals to handedness groups relied primarily on nominal classification with the HS providing verification. That is, if next of kin classified the deceased as a “‘left-handed’, then that designation was accepted unless the HS proved to be in obvious contradiction, which did not occur in any case. Furthermore non-switched left-handers (NSLH, defined previously) referred to those who wrote left-handed, whereas switched left-handers (SLH) referred to designated left-handers, who wrote right-handed because they were compelled to do so at an earlier age.

Data analyses

By means of a computer program, the difference between birth and death dates was converted to total days of life, including leap years. This total was then divided by 365 in order to present mean age values in the more familiar “years and days” unit. The SPSS program for microcomputers (version 8.0) was used for descriptive and inferential analyses.

RESULTS

Sample characteristics

Males were more prevalent than females (56% vs 44%), indicating a higher frequency of mortality during the sampling period, in agreement with the male/female differential (57% vs 43%) calculated from mortality data available for Belem from the official census (Fundação Brasileiro de Geografia e Estatística, 1994). Of the 513 cases, 48 (9.4%) were classified as left-handed, 465 (90.6%) as right-handed, and none as ambidextrous. Relative to totals for each sex, the percent incidence of left-handedness was slightly higher among females than males (10.1% vs 8.7%; 95% confidence intervals ± 3.9% and ± 3.2%), and the overall percentage was somewhat higher than the 6–8% prevalence rate reported for larger samples of Brazilian adults (Brito et al., 1989). The sex differential was most likely a spurious result, because all published surveys of handedness among Brazilian adults (Brito et al., 1985, 1989; Cosenza & Mingotti, 1993), and children (Brito, Lins, Paumgartten, & Brito, 1992; Martin & Gadotti, 1985) have reported a higher incidence of left-handedness among males than females. Furthermore, of the 48 left-handers, 18 were identified by kin as having been switched to right-handed writing by parents or teachers. Among this subgroup, males predominated over females (61% vs 39%), a non-significant difference ($p = .38$).

Results from analyses of the handedness scores (HS) supported nominal classification. When apportioning items based on preference, next of kin were quite strict in following the global assessment. No task was rated
‘ambimanual’, and only six of the 465 right-handers received a left-preferent rating on one of the five items, leading to reduced variation around the group HS mean (M = .99, SD = .045). Increased variability occurred among left-handers as a group (M = −.78, SD = .30), and among SLH (M = −.44, SD = .20), more than NSLH (M = −.97, SD = .10). The HS clearly differentiated left-handers from right-handers, \( F(1,511)=13715, \ p<.001 \), and switched from non-switched left-handers, \( F(1,46)=147.24, \ p<.001 \). There were no significant sex differences in the mean HS within each handedness sample. Next of kin also tended to adhere strictly to nominal classification when evaluating left-handers on individual items: none were rated as right-preferent on more than two tasks. Seven SLH were right-handed for eating with a spoon and writing, whereas the remaining 11 were adjudged right-handed for writing alone. The absence of overlapping scores between handedness groups was somewhat surprising for left-handers, given their characteristic response variability on measures of lateral preference (Peters & Murphy, 1992), and may reflect an information bias peculiar to kin informants. In addition, an analysis of mean hand scores across nine age intervals (ages 10 to ≥ 90) revealed a uniform, nonlinear trend: \( F(8,504)=1.06, \ NS \).

Mean mortality

Despite the large discrepancy between the two sample sizes of right- and left-handers, the shapes of the two distributions were similar, as verified by the Kolgomorov-Smirnov test (\( Z = .60, \ p = .86 \)), thereby justifying the use of parametric tests for these analyses.

A 2 × 2 analysis of variance was performed, with mean longevity as the dependent variable, and sex and handedness as the independent variables. As shown in Table 1, females evinced a 3-year longevity advantage, and left-handers outlived right-handers by about 25 months. Whereas the main effect of sex was significant, \( F(1,509)=3.97, \ p<.05 \), the effect for handedness was not, \( F(1,509)=.58, \ NS \), and the sex by handedness interaction was also non-significant.

Because Halpern and Coren’s (1991) samples excluded deaths due to homicide and suicide, these cases (\( N = 15 \)) were removed and the data reanalysed. Mean longevity increased slightly for females (M = 69.17, SD = 16.70), males (M = 65.81, SD = 17.23), left-handers (M = 69.27, SD = 15.67), and right-handers (M = 67.11, SD = 17.20), but did not change the outcome of the previous analyses. Females still differed significantly from males, \( F(1,496)=4.81, \ p<.03 \), and left-handers evinced a non-significant 2-year survival advantage over right-handers, \( F(1,496)=.68, \ NS \).

Reverting to the original data and mean values in Table 1, female left-handers lived, on the average, 4 years longer than right-handed females, and over 7 years
longer than left- and right-handed males, who, in terms of mean mortality, ranked last with a mean mortality of about 66 years.

Furthermore, despite an 8-year disparity in mean longevity between switched and non-switched left-handers (M = 73.56, SD = 13.85 vs M = 65.30, SD = 17.61), this difference only approached significance, $F(1,44)=2.88$, $p=.096$. Nevertheless, a $2 \times 2$ ANOVA with sex and subgroup (i.e. Table 1, “Left-handed Subgroup”) as independent variables, yielded marginal significance for the sex-by-subgroup interaction: $F(1,44)=3.73$, $p=.06$, and for the effect of left-handed phenotype (SLH vs NSLH), $F(1,44)=3.27$, $p=.08$, prompting further analyses. Due to the small sample sizes, age of death data for female and male switched left-handers were pooled again to form the total SLH subgroup. A univariate ANOVA was then conducted on mean age of death across five samples: female right-handers, male right-handers, female NSLH, male NSLH, and total SLH, yielding a significant difference: $F(4,508)=3.18$, $p<.02$. Fisher’s LSD test was used for post hoc comparisons, and the lower mean age of death recorded for the male NSLH (M = 57.15) differed significantly ($p<.05$ per comparison) from the longer-lived total SLH (M = 73.56), female NSLH (M = 72.44), and right-handed females (M = 68.13). Also, male right-handers (M = 64.91) differed significantly from the total SLH group (+8.65 year difference), and from right-handed females (+3.22 year difference), but not from the other groups.

### Table 1

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>286</td>
<td>64.90</td>
<td>17.68</td>
</tr>
<tr>
<td>Females</td>
<td>227</td>
<td>68.55</td>
<td>17.43</td>
</tr>
<tr>
<td><strong>Handedness</strong></td>
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<tr>
<td>Right-hander</td>
<td>465</td>
<td>66.32</td>
<td>17.75</td>
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<tr>
<td>Left-hander</td>
<td>48</td>
<td>68.40</td>
<td>16.64</td>
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<td><strong>Handedness by sex</strong></td>
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<td></td>
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<tr>
<td>Male right-hander</td>
<td>261</td>
<td>64.91</td>
<td>17.66</td>
</tr>
<tr>
<td>Female right-hander</td>
<td>204</td>
<td>68.13</td>
<td>17.74</td>
</tr>
<tr>
<td>Male left-hander</td>
<td>25</td>
<td>64.85</td>
<td>18.21</td>
</tr>
<tr>
<td>Female left-hander</td>
<td>23</td>
<td>72.26</td>
<td>14.15</td>
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<td><strong>Left-handed subgroup</strong></td>
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<td></td>
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<tr>
<td>Male non-switched</td>
<td>14</td>
<td>57.15</td>
<td>16.89</td>
</tr>
<tr>
<td>Male switched</td>
<td>11</td>
<td>74.65</td>
<td>15.37</td>
</tr>
<tr>
<td>Female non-switched</td>
<td>16</td>
<td>72.44</td>
<td>15.36</td>
</tr>
<tr>
<td>Female switched</td>
<td>07</td>
<td>71.86</td>
<td>12.03</td>
</tr>
</tbody>
</table>
Age distribution

Among right-handers, the mortality spread was wide, extending from age 11 to age 107. Left-handers, as a group, showed a more truncated range, with the earliest deaths occurring at age 27, and the oldest surviving until age 93.52. As Table 2, shows, the spread for switched left-handers is especially attenuated, with the earliest deaths occurring in the 45–59 age interval.

When compared to right-handers, the relative incidence of left-handers showed no systematic decline with increasing age, $\chi^2(5)=7.90$, NS. When compared to the combined incidence rate for previous age levels, the frequency of sinistrals increased significantly among the oldest ($\geq 90$) decedents (23% vs 8.6%): $\chi^2(1)=6.08$, $p<.02$. This increase was due to an elevated number of switched left-handers among this oldest set (4/6); furthermore, 61% of the SLH survived beyond age 70, in contrast to 37% of the NSLH, a non-significant difference ($p=.18$).

That these age trends represent a generation effect was attested by examining the decade-by-decade birth dates: in contrast to 77% of the NSLH sample, all 18 of the switched left-handers were born prior to 1940; also, of the oldest left-handed cohorts born prior to 1920 (N=23), 52% wrote right-handed. Decedents from these two generations, then, came of age during a period in which strong sanctions against left-handed behaviours were, according to the historical evidence, extensively practised by parents, relatives, and teachers in Brazil (Morais, 1965).

Cause of death

Based on diagnoses derived from the death certificates, decedents were grouped into 12 disease and accident-related categories (coronary infarct, cardiac, respiratory, cerebral and gastrointestinal illnesses, cancer, old age, homicide, suicide, accident, other, and unknown). Overall there was no significant

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>The percentage of left-handers by sex and subgroup in each age interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age interval</td>
<td>≤ 29</td>
</tr>
<tr>
<td>N = 23</td>
<td>N = 47</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male left-handers</td>
<td>4.3</td>
</tr>
<tr>
<td>Female left-handers</td>
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<tr>
<td><strong>Subgroup</strong></td>
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<tr>
<td>Non-switched</td>
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</tr>
<tr>
<td>Switched</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>4.3</td>
</tr>
</tbody>
</table>
association between handedness and aetiology: \( \chi^2(11) = 17.25, p = .10 \). Odds ratios (OR) and 95% confidence intervals (CI, using Woolf’s approximation) were calculated for each aetiological class, and only a few trends, albeit non-significant, were identified. Right-handers were nearly three times more likely than left-handers to have died from coronary infarct (OR = 2.53, CI,95 = .89 – 7.24), and respiratory illnesses (OR = 2.77, CI,95 = .65 – 11.77), whereas left-handers died about twice as frequently than right-handers from heart disease (OR = .45, CI,95 = .18 – 1.15), and cerebral dysfunctions (OR = .55, CI,95 = .28 – 1.07). Coren (1992) stressed the increased probability of accidents among left-handers, but our data revealed about a twofold higher susceptibility for right-handers (OR = 2.00, CI,95 = .26 – 15.30). Furthermore, vehicular accidents claimed the lives of 10 decedents, all right-handers. This latter finding was not unexpected, because the majority of the adult population in Brazil (at least in the northern states) do not drive motor vehicles (R. Rozenstratten: Personal Communication).

**DISCUSSION**

Taken together, these findings provide no support for the elimination hypothesis. Although sex differences are in line with Coren and Halpern’s (1991) findings, the pattern for handedness effects were in the opposite direction, indicating a slight, albeit non-significant, survival advantage for left-handers. In addition, female left-handers evinced the highest average age at death, with male right- and left-handers dying about 6 years sooner; a finding at odds with Coren and Halpern’s data, which located female right-handers at the highest end of the longevity spectrum, and male left-handers at the lowest, separated by a 12-year difference. Moreover, contrary to Coren and Halpern’s report, our results indicated that dextrals, and not sinistrals, manifested an increased vulnerability to accidental death.

Overall, our evidence is congruent with a hypothesis emphasising the effects of cultural conditioning. The modification hypothesis would predict that in a society where intense sanctions against left-handed writing have diminished during recent generations, the number of dextralised sinistrals would be more frequent in the older than in the younger age groups. On the average, switched left-handers lived longer, and were disproportionalately represented among the more elderly decedents. The obtained distributional pattern is similar to results from cross-sectional data for non-decedent SLH presented by Hugdahl et al. (1993), and in particular to those reported by Iwasaki et al. (1995), showing an increase in the number of right-handed writing left-handers among the older respondents. At the same time, this cross-age trend, together with the non-linear relationship observed between age and degree of handedness, lends no support to the suggestion that dextrality may be a developmental phenomenon,
increasing over the course of the life-span because of the cumulative effects of living in a right-biased world (cf. Porac, 1993).

The only outcome that might be construed as a tendency towards premature death among left-handers, was the 17-year difference in mean mortality that emerged between male NSLH and SLH in general. There is, however, no logical reason why conversion to right-handed writing should endow switched left-handers with a survival advantage. This finding can be more plausibly viewed as a vestige of secular variations; had the older left-handers not been subjected to such strong conformity pressures during the first three decades of this century, virtually all of them would have written right-handed, thereby erasing the longevity advantage observed between the two left-handed phenotypes.

Finally, in comparison to Coren and Halpern’s (1991) mail survey, the direct interview procedure employed in this study had the advantage of controlling for sources of information bias, including recall effects and ambiguous responses (cf. Dorthe, Blumenthal, Lantz, & Jason, 1995). On the other hand, the procedure was time-consuming and resulted in a smaller sample size than that obtained by Coren and Halpern (513 vs 949 cases). In view of our reduced sample of left-handers, and considering the complementary relationship between sample size and statistical power, findings from this study provide strong, but not conclusive support for the postulated effect of generation differences on handedness phenotype. At the same time the results constitute another source of evidence against the argument that left-handers are at greater risk for early mortality, and further question the validity of the premise that left-handedness in itself is a symptom of pathology and increased liability.

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