Left-handedness: its disadvantages and hidden advantage

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What does it mean to be left-handed? Dr Iain Mathewson, a leftie himself, discovers that the relationship between left-handedness and other conditions is decidedly curious, and proposes an evolutionary advantage to benefit a few.

Are you one of the left-handers who constitute 10% of the population? A more precise term would be nonright-handed, rather than left-handed, but the two are used synonymously here. Left-handedness carries a slightly greater risk of a range of aberrations of neurological development, one of which this sinistral writer must admit to. There may well be other associations in areas where no-one has thought to look.

Conditions reportedly associated with left-handedness

Language and behaviour

Conditions reportedly associated with left-handedness range from ADHD[1] to language disorders such as stuttering, dyslexia or delayed language acquisition.[2,3] There are also associations with Rett syndrome, the autistic spectrum of disorders (including some forms of schizophrenia),[4,5] and a strange condition known as developmental prosopagnosia[6] in which sufferers have a lifelong difficulty in recognising the faces of people they know well.

Sexuality

A range of aberrations of sexual orientation associated with left-handedness can be regarded as neurodevelopmental anomalies. The chances of being left-handed in homosexual men and women are greater than those of their heterosexual counterparts by 34 and 91%, respectively.[7] As a group, left-handers tend to have a thicker corpus callosum,[8] as do lesbians of either handedness.[8] Canadian neuropathologist Professor Sandra Witelson, who was recently engaged in a study of Albert Einstein's brain, suggests that the additional thickness is due to increased bihemispheric functioning requiring greater interhemispheric connectivity.[8,9]

Transexuals, both male-to-female and female-to-male, show a significant increase in left-handedness.[7] The daughters of women treated with diethylstilboestrol, in misguided attempts to prevent abortion, and female patients with hereditary adrenogenital syndrome show a markedly increased tendency to be left-handed; both of these situations involve intrauterine virilisation.[7] In another study, nonright-handed women rated themselves to be less feminine and as having a greater degree of masculine sex-role identification than strongly right-handed women.[10] Who would believe that Marilyn Monroe was left-handed?

Personality and psychology

Left-handed people are more likely to suffer personality disorders. Various reports in the psychology literature have mentioned 'explosive', 'histrionic' and 'antisocial' personalities, as well as a tendency to gullibility.[5] People who are left-handed are more likely to become alcohol dependent[11] or addicted to recreational drugs. They have a tendency to clumsiness (even when sober), and they are over-represented in prison populations. These conditions probably reflect differences in cerebral layout or neuroreceptor populations, and can be categorised as neurodevelopmental anomalies.

The authors of a report published in 1985 claimed, on the basis of EEG evidence, that left-handers are more susceptible to the effects of psychoactive drugs.[12] It was suggested that in hunter–gatherer days right-handed people may have been less susceptible to the effects of toxic plants and berries, thus having an evolutionary edge over left-handed individuals. Another report concerned tardive dyskinesia resulting from treatment of psychoses with first generation antipsychotics available in the late 1980s: 68% of left-handers developed this condition compared with 29% of right-handers.[13]

Immunity

Disorders of immunity, such as asthma, eczema and allergies, as well as certain autoimmune diseases and some infections, are more common in left-handed people.[2,3,14] A significant association has been shown between left-handedness and certain alleles of the major histocompatibility complex.[15]

Life expectancy

Lastly, it seems that we lefties don't live so long. Canadian psychologist Professor Stanley Coren has found that the proportion of left-handers decreases with age: in a cross-section of 80-year-old individuals, less than 1% were left-handed.[16] Coren says this decrease is not due to some people being forced to change handedness at school because the decline is almost linear from adolescence onwards. That grand old left-handed lady, the Queen Mother, must have been approaching unique status when she died.

What is the explanation for the reduced longevity? Left-handers have been accused of having reduced Darwinian fitness, as evidenced by having fewer offspring and more

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It has often been claimed that Albert Einstein was left-handed, but this photograph shows that he wrote with his right. A recent examination of his long-pickled brain has shown a unique and major abnormality of the Sylvian fissures that is speculated to have facilitated his thought experiments.

miscarriages, and more serious accidents and serious diseases.[17] And if we lefties are indeed a bunch of clumsy alcoholics, is it any wonder that there are not too many of us around at 80 years of age? So, fellow lefties, you had better load up on life insurance before the companies try to load your policies.

Cerebral laterality and genetics

There is no doubt that a relationship exists between handedness and laterality but the relationship is indistinct. About 97% of right-handers have their language centres in the left hemisphere, but so do 70% of left-handers.[18] Of the remainder, a group that comprises equal numbers of right- and left-handers, two-fifths have right hemisphere language and three-fifths have bilateral or diffuse language representation.

There does appear to be a hereditary factor underlying handedness, and four single gene theories have been proposed – the latest only three years ago.[1-4] However, none of these theories is entirely satisfactory, and it is difficult to think of a plausible reason why nature should ever have found it necessary to put handedness under direct genetic control. After all, handedness *per se* is of little consequence and would barely have been noticeable before writing became common. So it seems preferable to regard handedness as the fuzzy phenotypic expression of the genotypes controlling cerebral laterality.

Mention should be made of two fascinating nonpathological conditions associated with nonright-handedness, namely mirror-writing and synaesthesia, both of which are more common in women and both of which appear to be genetic.[19] The ability to mirror-write and read appears to require bilateral language centres (for speech, language, reading and writing) with an active communicating pathway via the corpus callosum. People with synaesthesia hear in colour and even smell, taste, touch and feel in colour – it has been proposed that unusual pathways link the auditory and other areas with the visual area or, alternatively, that the synaesthesia originates in the limbic system.

Other influences on handedness

Testosterone has been shown to influence intrauterine brain development and lateralisation in some mammals, and this seems to be true for humans.[20] The fact that left-handedness is significantly more common in males than females may be due to differences in intrauterine testosterone levels – note that females, *in utero* and later, still produce some testosterone from the adrenal glands. Testosterone influences development of the thymus gland (a gland that plays a major role in the early development of the immune system),[21] and is known to have an immunosuppressant effect in children and adults.

A child's chance of being left-handed increases with the age of the mother at the time of the birth – the chance is more than doubled at a maternal age of 40 years.[22] The chance of being left-handed is greater in extremely low birthweight babies and in babies born after difficult pregnancies and labours.[23] There are also reports of associations between left-handedness and mental retardation, cerebral palsy, low Apgar scores and epilepsy.[7,14] So-called pathological left-handers have sustained damage to the left hemisphere of the brain that forced a change in dominance from the left hemisphere to the right. Lucy, the associate professor described in Dr Harold Klawans' recent book, *Defending the cavewoman*,[24] and Julius Caesar both fall into this category of pathological left-handers (one in twenty left-handers are thought to be pathological). Note that the window of opportunity to change laterality closes around puberty. Severe damage to the dominant hemisphere after this age will have lasting consequences as the brain loses its plasticity and becomes 'hard wired'.

A recent report linking ultrasonography in pregnancy to an increased incidence of left-handedness and 'subtle brain damage' has been given wide publicity and done nothing to lessen the public perception that sinistrality is something sinister.[25] This was actually the third report claiming a similar connection – the first, published in 1993,[26] and the second, in 1998[27], attracted little attention.

Handedness in identical twins is interesting. The majority of identical twins are the result of embryo splitting in the first week after conception; these are carbon copy twins and usually have the same handedness.[28] A minority are the result of splitting in the second week; these are mirror twins of opposite handedness. However, a split occurring at the end of the second week may be incomplete, resulting in conjoined twins of opposite handedness. The fact that mirror and conjoined twins are of opposite handedness and laterality shows that the mirroring process takes precedence over genetics, and it can be inferred that cerebral lateralisation is laid down as early as the end of the first week after conception. The fact that even conjoined twins can have very different personalities confirms the difference in cerebral organisation. Of the original Siamese twins, Chang was bad tempered and alcohol dependent but more intelligent; Eng did not drink (cynics would say he did not need to).

A note on the statistical studies

Quite a few studies attempting to show an association between left-handedness and another condition have only just reached statistical significance; other attempts to replicate findings have failed. Professor Dorothy Bishop has emphasised the pitfalls of the null hypothesis, pointing out that reports showing a positive association have a much greater chance of being published than those showing no association.[29] Taking this and other factors into account, she has concluded that there is no connection between, for example, language disorders and left-handedness.

If handedness is indeed a fuzzy phenotypic reflection of the underlying genotypes of cerebral laterality then it should be no great surprise that there are problems connecting left-handedness with other conditions – particularly as it is known that 70% of left-handers are left-brained, not right-brained. If left-handers were to be separated into two groups and studied separately (that is, the left-lateralised and the anomalously lateralised), then perhaps one group would show a more statistically significant correlation with these conditions.

An evolutionary advantage?

Even though we regard handedness as being under indirect rather than direct genetic control, it is still valid to apply evolutionary theory to the trait. Considering all the negative correlates of left-handedness, one would expect it to have been eliminated quickly by survival of the fittest. But the left-handed trait is thought to have existed for the past 100,000 years.[30] Why is it still around?

There is only one tenable reason: left-handedness must have an evolutionary advantage to counterbalance the disadvantages. The situation is analogous to that of the recessive diseases sickle cell anaemia and thalassaemia, in which the prevalence is greater than expected due to the fact that the heterozygous state confers some immunity to malaria.

It is known that there is a correlation between left-handedness and architectural design ability and artistic ability generally – that is to say, visiospatial ability (and thus also tracking ability), which is a right hemisphere function. But would this be a sufficient advantage to prevent the demise of left-handedness? Perhaps not, but combined with a capacity for lateral thinking it would. Professor Coren cites a study of the top 1% of 10,000 students who sat the Scholastic Aptitude Test that showed an unusually large proportion of left-handers. He also noted an increased representation of left-handers among chess grandmasters, male mathematicians and science students, as well as artists and architects. In 1995 he carried out a study that demonstrated a significant correlation between left-handedness in males and divergent thinking in two of three testing methods; the same subjects did not score more highly on tests of convergent thinking.[31]

How the advantage might have worked

Imagine a scene in south-eastern Europe 33,000 years ago. A group of Cro-Magnon are trying to shelter under an overhanging rock by the side of a river. Snow flurries herald the onset of winter. The group is intently watching a piece of prime real estate, a deep cave in the limestone mountain on the other side of the river. The problem is that the cave is occupied by Neanderthals. These strange beings, with much stronger limbs and bigger brains, must have been regarded with respect and fear. Any lateral-thinking Cro-Magnon male able to devise a strategy for taking possession of the cave would have had a good chance of establishing himself as the alpha male. If he was then able to decorate the walls of their new home with murals depicting the local fauna and perhaps some rituals or ceremonies, he would have been regarded with mystical reverence. The rapid spread of his genes would be assured. Could this fellow have been an ancestor of the individuals highlighted by Coren? Human evolution may have come to a standstill now, but back then it was on fire, fuelled by a high infant mortality rate and much smaller population.

Thus there appears to be an advantage for some left-handers that has been tested in the crucible of evolution and found to balance the more obvious disadvantages to which we less-gifted lefties are subject. There is still much to be uncovered about handedness and its relationship to brain architecture and neuronal functioning. MT

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A list of references is available on request to the editorial office.

Consultant's comment

From time to time we need to be jolted out of comfortable beliefs and opinions that we have adopted, inherited, or had thrust upon us, within and beyond our undergraduate years. Dr Mathewson has had good reason, it seems, to undergo such an experience and he has taken the sensible approach to an analysis of his own genetic (?) and environmental background by finding out what dogma, evidence or speculation contribute to an interesting area of anthropology. Just how valid is the perspective he has acquired can and will be debated, but the topic is fascinating and certainly deserves consideration by most of us – even the apparently ambidextrous. Did your parents tell you that you went through a mirror-writing phase? I did, as did our son and one grandson. Hmmm.

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Forum – Viewpoint
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