

Psychological Medicine

MONOGRAPH SUPPLEMENT 8

Handedness, language
dominance and aphasia:
a genetic model
I. C. McManus

Cambridge University Press

Handedness, language dominance and aphasia: a genetic model

Right- and left-handedness are of interest intrinsically, and because of their relation to cerebral dominance for language. Previous studies have suggested a range of possible determinants, from purely environmental through to purely genetic. In the present monograph the predominant finding of evidence for familial transmission has been taken as the starting point for a novel genetic model of handedness, which is consistent with known biological constraints upon the manifestation of laterality and, in particular, upon the conceptual distinction between 'fluctuating' and 'directional' asymmetry. A maximum likelihood procedure is used to find the genetic model which best fits all the available family and twin data; an adequate fit is found for a two-allele model in which one homozygote produces only right-handed phenotypes, the other homozygote produces a racemic mixture of right- and left-handed phenotypes, and the heterozygote shows additivity. The model also allows an estimate of the true incidence of left-handedness in the population, irrespective of differences in incidence of manifest handedness between populations, and is estimated at 7.75%. The model is also compared with other existing genetic models of handedness.

By postulating pleiotropy of the alleles at the single locus, the genetic model is extended so that by increasing the number of independent functional asymmetries of language and other processes which may be controlled by the single gene system, the model can describe and predict the incidence of acute and permanent aphasias in right- and left-handers with right- or left-sided lesions in relation to familial history of sinistrality.

This new genetic model has the advantages of being conceptually simple, invoking only well-understood genetic and biological processes, and yet also being powerful enough to be readily extended to cover the complexities of individuals who appear to have separate directions of cerebral dominance for different functional systems.

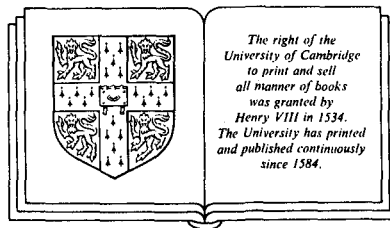
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CAMBRIDGE UNIVERSITY PRESS

CAMBRIDGE
LONDON NEW YORK NEW ROCHELLE
MELBOURNE SYDNEY

PUBLISHED BY
THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE

The Pitt Building, Trumpington Street, Cambridge CB2 1RP
32 East 57th Street, New York, N.Y. 10022, U.S.A.
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Cambridge University Press 1985

Printed in Great Britain by the University Press, Cambridge

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I am grateful to Professor M. J. Morgan and Dr C. G. N. Mascie-Taylor for their extensive discussion of the ideas contained in this paper. I also wish to thank the National Children's Bureau, and in particular Mr K. Fogelman who gave me permission to re-analyse the data obtained by the National Child Development Study, and the Survey Archive of the Social Science Research Council, and in particular Mr E. Roughley who provided those data. Drs Mascie-Taylor, Chaurasia and Goswami kindly gave me permission to quote from their unpublished data, for which I am very grateful. Finally, I am very grateful to Mrs J. Yap for her help in the preparation of the manuscript.

SYNOPSIS A simple two-allele Mendelian model of the genetics of handedness is described and fitted to data in the literature. The model proposes that there are two alleles, D (dextral) and C (chance), the homozygous DD genotype producing only right-handers (directional asymmetry), the homozygous CC genotype producing a racemic mixture of 50% right-handers and 50% left-handers (fluctuating asymmetry), and the heterozygote, DC, being intermediate between the homozygotes and producing 25% left-handers, and 75% right-handers. It is also suggested that the true population incidence of left-handedness is 7.75%, deviations from this figure being due to either criterion shifts or selection biases. The same model is then fitted, by means of a number of minor conceptual extensions, to data from the literature on the relationship of handedness to language dominance, acute and permanent aphasia, and visual processing dominance.

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