GENETIC BASIS OF MORPHOLOGICAL VARIATION

RICHARD H. OSBORNE
FRANCES V. DE GEORGE

Foreword by Theodosius Dobzhansky

Genetic Basis of Morphological Variation

AN EVALUATION AND APPLICATION
OF THE TWIN STUDY METHOD

By Richard H. Osborne and
Frances V. De George

Published for THE COMMONWEALTH FUND
by HARVARD UNIVERSITY PRESS
Cambridge, Massachusetts, 1959

Published for The Commonwealth Fund
By Harvard University Press, Cambridge, Massachusetts

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Distributed in Great Britain by Oxford University Press, London

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To the Twins and Other Subjects
Who Made This Study Possible

Foreword

Nature-nurture polemics are no longer quite as rife as they used to be during the period between the two world wars. Nevertheless, the question of the relative contributions of heredity and environment to the causation of the differences between persons remains one of the outstanding unsettled problems of the Science of Man. The diversity of opinion continues to be as great and irreconcilable as ever. Only a few years ago Darlington was able to write: "Man is immensely adaptable, not through the plasticity of the individual but through the variability of the species. . . . Individual adaptability is indeed one of the great illusions of common sense observation." At the opposite extreme, Alfred Adler wrote: "But the concept that character and personality are inherited from one's parents is universally harmful because it hinders the educator in his task and cramps his confidence." And yet, is this so intractable an issue that it must remain outside the framework of scientific analysis? Obviously it need not be; but the only hope of arriving at an universally satisfactory settlement lies in acquisition of well authenticated evidence, not in declarations of personal opinions, however uncompromisingly or persuasively stated. Careful gathering of reliable data was the goal which Osborne and De George set for themselves, and their book reports the results so far obtained.

The naive hope that some day we shall know which human "traits" or "characters" are hereditary and

which are environmental is no longer entertained by any informed student of the problem. More sophisticated approaches had to be adapted. All traits and all characters are hereditary and all are environmental; there is no organism without heredity, and no heredity can produce an organism except by transforming a part of the environment into a living body; the path which the development of the body takes is necessarily within the norm of reaction of the organism, set by its genotype but realized within a given succession of environments. The nature-nurture problem takes, then, a different form. We must ask what portion of the variance in a given trait observable in a given population is ascribable to the existing diversity of genotypes and what part can be accounted for by the diversity of environments. This statistical approach is adopted by Osborne and De George. The critical value is everywhere the ratio of the variances observed between members of monozygotic twin pairs and between those of dizygotic twin pairs. These "intrapair" variances are, in turn, compared with the "interpair" variances, which measure the diversity of the forms which a given trait takes in the population from which the twins studied are a sample.

Some of the results obtained by Osborne and De George can be understood properly only in the light of the principle that what is inherited is the norm of reaction to the environment, and not this or that "character." Thus, Osborne and De George have found no appreciable genetic components in the variability of such traits as the body weight, the head length, and some measurements taken transversally to the long axis of the body. Other studies on twins, particularly the classic work of Newman, Freeman, and Holzinger, have found a strong genetic component in the same characters. And yet, there is no contradiction between these studies. It turns out that a considerable proportion of the twins studied by Newman, Freeman, and Holzinger were young people still in the process of growth, while Osborne and De George have dealt with adult twins. The most reasonable explanation is, consequently, that the genetic components in the determination of the growth rates and growth patterns are relatively greater than those in the conformation of the fully developed traits in the adult.

The work of Osborne and De George represents a great step forward in the studies on the nature-nurture problem. Surely, much further work is needed; the data which they have collected will however remain a part of the store of factual evidence, as well as an example of how such evidence should be gathered and analyzed.

Theodosius Dobzhansky
Columbia University, New York

Preface

The study reported here explores the possibilities of investigating the important question of genetic and environmental interaction by genetic methods utilizing the techniques of morphological description and measurement.

The complex nature of man's genetic variation and some of the problems which are unique to human studies are reviewed. The twin method is then evaluated, within the context of our understanding of the phenomenon of human twinning, for its usefulness in detecting genetic variability and analyzing genetic and environmental interaction. With this background, the twin method is then applied to the study of different descriptions and measurements of morphological variation.

Because this is a preliminary study, emphasis has been placed upon the methods of investigation and upon providing an empirical basis for the application of genetic and morphological studies to different human problems. It is hoped that the methods presented here and the results of this analysis will suggest further twin research and morphological studies in genetics, anthropology, and the medical sciences.

While the present study was designed for the analysis of genetic and environmental effects on what may be termed "normal" morphological variation, selection of the subjects on the basis of medical histories and examinations has made it possible to extend considerably the scope of the investigation. Most of the data relat-

ing to medical information have been reported elsewhere. Those aspects which have a bearing on the evaluation of the twin method or the analysis of morphological variables are reported here. Extensive data available from the records of the Columbia-Presbyterian Medical Center also have been incorporated.

The Twin Study Project was carried out under the auspices of the Institute for the Study of Human Variation in Columbia University, and was conducted within the facilities of the Columbia-Presbyterian Medical Center. The collection of the data was started in September 1952 with a poll of all new admissions to Vanderbilt Clinic, for twins; it was completed in March 1956.

R. H. O.

June, 1959 F. V. De G.

Acknowledgements

Throughout the course of this study, Drs. Theodosius Dobzhansky, L. C. Dunn, and Howard Levene at Columbia University, and Dr. Robert Loeb at the Columbia-Presbyterian Medical Center gave generously of their time and counsel, and all of them read the manuscript. Particular gratitude is due to Dr. Levene for his statistical guidance, and to Dr. Dobzhansky for writing the Foreword.

We are grateful to Dr. Harry L. Shapiro of the American Museum of Natural History for advising on anthropological aspects, for making available anthropometric instruments, and for reading the manuscript.

Dr. John Scudder and Miss Mary Sargent of the Presbyterian Hospital Blood Bank, together with their staff, were of the greatest assistance throughout the course of the study not only in performing blood grouping determinations, but also in providing laboratory equipment and facilities. Dr. Amos Cahan and Mr. James Jack of the Knickerbocker Foundation, Inc., and Dr. Phillip Levine of the Ortho Research Foundation also gave advice and assistance in obtaining the blood determinations so vital to the zygosity diagnosis.

The subjects were examined in the Constitution Laboratory in the Department of Medicine, College of Physicians and Surgeons, Columbia University. Dr. William Sheldon and his staff were helpful in executing procedures pertinent to this phase of the study. Dr. Sheldon assigned the somatotype ratings and made valuable control data available for the

analysis of body build. Dr. Sylvia Traube was particularly helpful in expediting various study procedures and in making arrangements for the study subjects. Miss Edith Seabury gave generously of her time in obtaining questionnaire information.

The medical aspects of this study profited greatly from the advice and assistance of Dr. Sylvia Traube, Dr. Albert Damon, and Dr. Warner Nash, who, in addition to other staff residents, conducted the medical examinations of all of the subjects studied. Clinical laboratory determinations were performed primarily by Miss Ellen Mikkelson and Miss Betty Nielson.

The juvenile series was obtained from the Fetal Life Study conducted in the Department of Pediatrics, Columbia University, College of Physicians and Surgeons, and Babies Hospital. This study was aided by grants from the Rockefeller Foundation, the Life Insurance Medical Research Fund, the New York State Department of Health, the New York Foundation, The Association for the Aid of Crippled Children, and the U.S. Public Health Service (Grant G-4194).

We thank Mrs. Janet Nichols for giving us access to her excellent records and to the Sloane Hospital statistics. To Mr. Robert Demarest we are indebted for illustrating the Masculinity-Femininity Ratings.

Acknowledgements are gratefully extended to the hospital registrars, record room personnel, x-ray technicians and aides, and to friends and colleagues who contributed so generously throughout the course of this study.

All aspects of this study—the collection of data, the analysis, and the preparation of the manuscript for publication—were supported by the Commonwealth Fund. We wish to express our deepest appreciation for this help and for the understanding and cooperation of the staff throughout this period.

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