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Genetics of Human Behaviour

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ABSTRACT How an individual's genes influence its behaviour is an exciting and challenging study of genetics. The application of molecular biology technique to identify DNA sequences which is responsible for behavioural variation, is open a new frontier of behaviour genetics. However, the quantitative genetic research determines the sum of heritable genetic influence on behaviour. The present article provide an overview on the magnitude of multigenic control of human behaviour and how inheritance plays a major role in behaviour as shown by twin, adoption and inbreeding studies.

INTRODUCTION

Behaviour is the new frontier of molecular biology. The connection of genetics and behaviour is the most complex phenomenon which reflects a dynamic changes in organism in response to the environment, therefore, it is not easy to envisage. The genetic analysis of human behaviour and disorder is more complicated for couples of reasons (Plomin, 1990). First, Mendel studied characters like smooth versus wrinkled seeds in the pea plant but human not either smooth or wrinkled. Second, mostly Mendelian disorder is caused by single gene with little effect of other genes or environment. Lastly, behaviour is essentially influenced by non-genetic factors.

The present article will provide an overview on the magnitude control of human behaviour and the findings of quantitative genetics research with the help of application of molecular biology. The behavioural differences between individuals are caused by differences in the genetic information that they possess. Therefore, the behavioural development involves an interaction between an individual's genotype (genetic makeup) and the environment in which it exists to produce that individual's phenotype (observable characters). However, how genes influences the development of human behaviour is rather controversial. Because, it is also responsible for health, illness, abilities, disabilities, drug abuse, mental retardation, sex and work of personal life. However, the quantitative genetic research determines the sum of heritable genetic influence on behaviour (Plomin et al., 1994).

Inbreeding

The mostly human behavioural genetic research relies on the studies of inbreeding, pair of relatives, adoption and twin designs. In human population marriage largely regulates mating (Mukherjee, 1971) and consanguineous marriage thus leads to inbreeding. Individuals who are related through one or more common biological ancestors are called consanguineous relatives. Consanguineous marriage are practised to a greater or lesser extent among most of the religious and ethnic groups of the world. Parental consanguinity increases the frequency of homozygotes in the offspring at the expense of heterozygotes, recessive and additive phenotypes would thus increase in frequency in the inbred individuals. This is true for single gene traits as well as multifactorial traits. Inbreeding brings out previously hidden recessive and additive alleles contributing to the phenotypic variance (Crow and Kimura, 1970) and hence it adds to the genetic variability (Jensen, 1983). Thus, phenotypic manifestation of complex and quantitative biological variations contributes significantly to the understanding of the genetics of those character (traits).

There are differences between racial groups in the gene frequencies for certain traits like blood groups, rhesus blood group factors and PTC testing. Bernstein (1931) worked out a formula that to estimate the relative proportions of genes from the original groups that went into hybrid group. The admixture from the larger ethnic group into the hybrid gene pool is:

$$I = \frac{f_x - F_2}{f_1 - F_2}$$

where f_x is the gene frequency in the hybrid group, f_1 the gene frequency in the smaller group, and F_2 that in the larger group. Freire-Maia (1982) estimated that the average gene flow per generation is to be between 3-6%. Such manifestation on the role of inheritance in human behaviour of congnitive abilities and disabilities, physiometric, personality and psychopathology are also considered here.

Cognitive Abilities and Disabilities

The most studied traits in human behavioural genetics is cognitive ability (IQ). The cognitive ability of an individual to learn something is called intelligence (IQ) (Burt, 1955). It contains a number of factors like verbal ability, word fluency, spatial visualization, number ability, reasoning and memory (Thurstone, 1941). Terman and Merril (1960) have divided IQ into various process like perception, conception, attention, memory, judgement, reasoning and inventiveness. Jencks (1972) has found the relative contributions of heredity, environment and their interaction of variation in IQ to be 45%, 33% and 20% respectively.

Lowering of IQ after inbreeding is perhaps among the best lines of evidence we have for hereditary control of IQ. The IQ correlation for first degree relative living together is about 0.40 (Badaruddoza and Afzal, 1993, 1997) for adopted apart first degree relative, the correlation is about 0.20. The correlation of identical and fraternal twin averaged 0.85 and 0.60 respectively. The correlations for IQ between spouses are generally around 0.50. The studies are summarized in table 1.

The question of whether and how genes influence the development of human behaviour is controversial. However, studies of human twins have confirmed that certain behavioural differences are caused by genetic differences. The model fitting analysis of IQ data showed (Plomin, 1990) that heritability of IQ scores is between 30 and 70%. Plomin et al. (1994) suggest that genetic effects on IQ during childhood highly correlated with genetic effects on IQ in adulthood. The multivariate research suggests that the genetic effects on academic achievement is highly correlated with the genetic effects on cognitive abilities.

Table 1: Familial correlations for IQ scores (After, Willoughby, 1927).

Category	*N*	*r*
Between spouses	90	0.44
	105	0.60
	274	0.47
Identical twins reared together	34	0.85
Identical twins reared apart	3	0.67
Fraternal twins reared together	41	0.58
Siblings reared apart	69	0.45

Personality

Table 2 summarized the correlations of personality test among the couples. It have been shown that all correlations are positive except two studies of dominance, where they are -0.05 and -0.07.

Table 2: Familial correlations for personality test scores

Variables studied	*Authors*	*N*	*r*
Neurotic tendency	Hoffeditz (1934)	100	0.16
	Willobughby (1927)	100	0.27
Introversion extraversion	Schiller (1932)	46	0.02
Dominance	Crook (1937)	79	-0.05
	Crook and Thomas (1934)	66	-0.07

Behavioual development is influenced not only by the genes an individual inherits but also environment and experience. The shared environmental influence could be the reason why identical twins are so similar behaviourally. A comprehensive study of identical twin reared apart (after birth) demonstrates that genetic differences are responsible for a significant part of the differences among humans in personality, temperament and social attitudes. From twin study, one can also calculates the proportion of variance (variation among individuals) due to genetic differences among individuals in the personality test. Heritabilities can range 0 (no variance is due to genetic differences) to 1 (all of the variance in phenotypes is due to genetic variation). For example, identical and fraternal twin correlations are about 0.50 and 0.30 respectively. It has been suggested the hypothesis of nonadditive genetic variance for personality and

lower heritability scores of this trait (Plomin et al., 1994).

Psychopathology

The study of psychopathology is another major area of behavioural genetic research. Previously, most research focused in this area on schizophrenia. Kallman and Mickey (1946) estimated the expectancy of schizophrenia in spouses of schizophrenics to be 2% in the population. The data from different sources (Gottesman and Shields, 1982) suggest that inheritance plays a significant role in schizophrenia as well as nongenetic factors have also a equal importance for the determination of the trait. Drewery and Rae (1969) studied 22 male alcoholics and their wives and 26 control couples. They asked each subject in three ways: myself as I am; my spouse as I see him or her; myself as I think my spouse sees me. They were categorised A, A_1 and A_2 for husbands and B, B_1 and B_2 for the wives. They calculated following correlations: $B \times A$, $B_1 \times A_2$, $A \times A_2$, $A \times B_1$, $A_1 \times B_2$, $B \times B_2$ and $A \times B$. The interesting findings are: (i) the control husbands expect to be understood by their wives while the patients except to be misunderstood (ii) the alcoholics are characterized by sociosexual role and a dependence-independence conflict.

The family study (Vandenberg et al., 1986) for major manic-depressive disorders diagnosed for 13% of the male relative and for 30% of the female relatives, which exceeds the base rate in the population although affective disorders were diagnosed in only 5.2% of biological relatives. This disorder was reported to be linked to a dominant gene on the short are of chromosome. From the available data of different sources, it has to be suggested that the children of a schizophrenic, manic-depressive or alcoholic parent have half that parent's genotype and are at much greater risk of developing the condition than are children of parents who do not have these disease (Vandenberg et al., 1986).

Molecular Biology

The application of molecular biology techniques open a new area of interest in behavioural genetic research. The genetics of human behaviour involves multiple genes that consisting of a series of genes interact in a cumulative fashion rather than one or two major genes. An individuals who inherits the right combination of these genes passes beyond a threshold of risk at this point an environmental component determines whether and to what extent that person is clinically affected. This suggest the use of molecular biology techniques for detection of DNA maker which accounts for small amounts of behavioural variation.

An important observation of recent years is that of certain alleles at the HLA loci predispose to certain specific diseases. For example the individual having B27 allele at the HLA-B locus has a 121 fold greater chance of developing ankylosing-spondylitis than an individual who lacks this allele. A blood marker (HLA-A9) has been found to be associated with schizophrenia. The linkage study with restriction fragment length polymorphisms (RFLP) marker provide recently the best evidence of human behaviour and behavioural disorders. However, this approach is greatly enhanced by the use of quantitative trait loci (QTL) internal mapping. Therefore, application of molecular biology techniques to identify genes for a small amount of variance of human behaviour require well strategies and planning which is not too complex for molecular biology.

CONCLUSIONS

Behavioural differences among individuals may be the result of genetic and/or environmental differences among them. The human genome is extraordinarily polymorphic so that the DNA of each individual (except identical twin) varies in millions of ways from the DNA of another. The molecular heterogeneity of individuals has an important implication for understanding of human behaviour. The vast majority of variations in DNA presumably have little or phenotypic effect although they provide DNA markers for detection behavioural disorders. The another type of genetic variation contributes to racial, ethnic and individual differences but that have no affect on health and susceptibility of disease. Nongenetic sources of variance are equally important because genetic variance rarely accounts for as much as half of the variance of

behavioural traits. Finally, the use of molecular biology techniques will revolutionize human behavioural genetics and quantitative genetic research for exploring the actual role of inheritance in the most complex phenotype.

REFERENCES

Badaruddoza and Afzal, M.: Inbreeding depression and intelligence quotient among North Indian Children. *Behaviour Genetics*, **23**: 343-347 (1993).

Badaruddoza and Afzal, M.: Inbreeding effects on variability of blood pressure among North Indian Children. *Indian Biologist*, **29**: 8-15 (1997).

Bernstein, F.: *Die Geographische Verteilung der Blutgruppen and ihre anthropologische Bedeutung*. Comitato Italiano per lo studio dei problemi della populazione, Instituto Poligraphico dello State, Rome, pp 227-243 (1931).

Burt, C.: The evidence for the concept of intelligence. *British Journal of Education Psychology*, **25**: 158-177 (1955).

Crook, M.M.: Intra-family relationships in personality test performance. *Psychological Record*, **1**: 479-502 (1937).

Crook, M.M. and Thomas, M.: Family relationships in ascendance submission. Publication University of California Education. *Philosophy and Psychology*, **1**: 189-192 (1934).

Crow, J.F. and Kimura, M.: In *Introduction to Population Genetic theory*. Harper and Row Publishers, New York, pp 591 (1970).

Drewery, J. and Rae, J.B.: A group comparison of alcoholic and non-alcoholic marriage using the interpersonal perception technique. *British Journal of Psychiatric*, **115**: 287-300 (1969).

Freire-Maia, M.: Inbreeding levels in different countries. *Social Biology*, **29**: 69-81 (1982).

Gottesman, I.I. and Shields, J.: *Schizophrenia: The Epigenetic Puzzle*, Cambridge University Press, Cambridge (1982).

Hoffeditz, E.L.: Family resemblanees in personality traits. *Journal of Social Psychology*, **5**: 214-227 (1934).

Jencks, C.: Inequality: A reassessment of the effect of family and schooling in America, New York (1972).

Jensen, A.R.: Effects of inbreeding on mental-ability factors. *Person. Indiv. Diff.*, **4**: 71-87 (1983).

Kallman, F.J. and Mickey, J.S.: Genetic Concepts and folie a deux. *Journal of Heredity*, **37**: 298-305 (1946).

Mukherjee, D.P.: Patterns of marriage and family formation in rural India and genetic implications of family planning. *Journal of Indian Anthropological Society*, **8**: 131-145 (1971).

Plomin, R.: The role of inheritance in behaviour. *Science*, **248**: 183-188 (1990).

Plomin, R., Owen, M.J. and Mc Guflin, P.: The genetic basis of complex human behaviours. *Science*, **264**: 1733-1746 (1994).

Schiller, B.: A quantitative analysis of marriage selection in a small group. *Journal of Social Psychology*, **3**: 297-319 (1932).

Terman, L.M. and Merrill, M.A.: *The Standard Binet Intelligence Scale:* Houghten. Miffin. London (1960).

Thurstone, L.L.: *The Primary Mental Ability Test*. Chicago Science Research Associates (1941).

Vandenberg, S.G.: Singer, S.M. and Pauls, D.L.: *The Heredity of Behavioural Disorders in Adults and Children*, Plenum, New York (1986).

Willoughby, R.R.: *Family similarities in mental test abilities*. Genetics Psychological Monogramme, **2**: 235-275 (1927).