

Evidence for Genetic Similarity Detection in Human Marriage

R. J. H. Russell and P. A. Wells

Psychology Department, University of London Goldsmiths' College

J. P. Rushton

Psychology Department, University of Western Ontario

Previous theoretical and empirical studies have shown that individuals may act to the benefit of others of similar genotype. We argue that the ability to discriminate among individuals of varying degrees of relatedness is prevalent in many species, and that the tendency to favor relatives can be considered a special case of a tendency to favor those of similar genotype. The phenomenon of assortative mating can be explained in this way, but new evidence capable of disproving this conjecture is not easily obtained. We have reanalyzed three previously reported studies of heritability and assortative mating in humans, and show that there is a greater degree of assortative mating on more highly heritable traits, in accordance with the prediction.

Key Words: Assortative mating, Heritability, Genetic similarity, Humans, Kin recognition.

We have previously argued (Russell et al. 1984; Rushton et al. 1984) that humans and other animals are able to detect genetic similarity between themselves and others. Furthermore, we have suggested that this ability has important implications: it may be involved in processes such as kin recognition, and may also play a part in human relationships such as marriage and friendship.

Recent work on kin recognition has demonstrated that animals from a wide variety of species are indeed capable of distinguishing kin from nonkin and, in some instances, performing

fine discriminations among conspecifics of varying degrees of relatedness (see, for example, Greenberg 1979). Much of the relevant evidence is reviewed by Holmes and Sherman (1983). Although in many cases the mechanisms involved in kin recognition may be complex and its possible function in some species far from clear, there seems to be little doubt that the discriminatory ability exists.

What are the possible consequences of the ability to detect genetic similarity? According to kin selection theory, altruism should be directed towards those of similar genotype in order that an altruism gene succeed (Hamilton 1964). Theoretical models such as those developed by Boyd (1982) and Samuelson (1983) specify some of the conditions under which this can occur. The detection of genetic similarity may even be of advantage to reciprocal altruists, who *need* not share any genes (Trivers 1971), although the conditions for reciprocation are more easily fulfilled if the interactants are relatives (Axelrod and Hamilton 1981).

The ability to detect genetic similarity may influence more than just altruistic behavior. It may be used to avoid inbreeding, as reported in free-living populations of primates (Packer 1979; Pusey 1980), or to optimize mate choice by the selection of a partner of some intermediate degree of similarity (Bateson 1983).

In many species, the choice of sexual partner reflects the phenomenon known as homogamy or assortative mating. Assortative mating ensures the simultaneous reproduction of two individuals who are, by definition, more similar

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Address reprint requests to: P.A. Wells, Psychology Department, University of London Goldsmith's College, Lewisham Way, London SE14 6NW, UK.

than average with respect to the trait or traits in question. Guaranteeing the reproduction of a partner who might not otherwise have reproduced and who shares many of one's own genes helps to ensure that more shared genes will be propagated into the next generation than if a dissimilar mate had been chosen.

Reviews by Vandenberg (1972) and by Thiessen and Gregg (1980) provide evidence that assortative mating is widespread among humans and other species. For example, it is well known that human marriage partners tend to resemble each other on a variety of psychological and social characteristics. Less well known is the fact that spouses also show resemblances on a variety of physical characteristics (Roberts 1977; Spuhler 1968). We have aggregated the correlations across a wide range of studies reported by Spuhler (Rushton et al. 1984*b*). The correlations between spouses are low but positive on such measures as height, minimum neck circumference, chest breadth, middle finger length, the length of ear lobe, and many others. Assortative mating also occurs for schizophrenia (Kallman and Mickey 1946), affective disorders (Baron et al. 1981), and alcoholism (Rimmer and Winokur 1972). Guze, Goodwin, and Crane (1970) found that wives and sisters of criminals exhibited the same psychopathology as one another. Gershon et al. (1973) reported that wives of males suffering from affective disorders exhibited a high prevalence of the same problem, and their relatives did too. It appears that assortative mating is not confined to socially desirable characteristics. Alternative reasons can be proposed for this finding (see, for example, Burley 1983); but it raises the possibility that the tendency to seek a similar partner may sometimes override considerations such as mate quality and individual fitness.

If humans are capable of detecting genetic similarity and prefer those people who are similar, it should be possible to show that interpersonal relationships reflect genetic similarity rather than similarity attributable to a similar environment. Thus, assortative mating would be expected to occur on the basis of traits of high rather than low heritability.

Thiessen and Gregg (1980) point out that assortative mating increases genetic similarity between parent and offspring, and between the offspring themselves, and spell out the beneficial consequences for within-family altruism. (For

instance, parents are expected to direct greater care towards more similar offspring.) Nevertheless, their model assumes that, in order to avoid inbreeding depression, "mates assort strongly on traits low in additive genetic variance, thereby capitalizing on what gene homology does exist between the partners, yet still avoiding excessive homozygosity. Conversely, mates assort weakly on traits high in additive genetic variance, capitalizing on a smaller portion of the existing gene homology while still limiting homozygosity."

There seems to be very little evidence in support of this assumption. It may be the case, as they suggest, that assortment occurs initially on sociocultural traits such as propinquity, socioeconomic status, religion, and so on; subsequently on more specific traits such as intelligence and personality; and ultimately at an even more specific level on measures such as anthropometric traits (although a review by Huston and Levinger 1978, found little empirical support for such sequential filter models). It may even be the case that the general-to-specific sequence is correlated with differences in additive variance between traits, as they also suggest. It is, however, crucial that the relevant heritability estimates for each trait should be measured rather than merely assumed. Furthermore, the heritability estimates for all traits must be measured (and the assortative mating coefficients calculated) on the same population: to quote Falconer (1981), "It is important to realize that the heritability is a property not only of a character but also of the population and of the environmental circumstance to which the individuals are subjected . . . whenever a value is stated for the heritability of a given character it must be understood to refer to a particular population under particular conditions." In other words, it would not be legitimate to compare heritability estimates for different traits measured in different populations. Assortative mating coefficients and heritability estimates for different traits spanning the range of possibilities mentioned by Thiessen and Gregg, but measured in the same population, are not currently available. Even in they were, it could well be argued that the traits would be too discrepant in type to make the comparisons meaningful.

Nevertheless, it is possible to test the hypothesis that there is an association between heritability of traits and assortative mating coeffi-

cients, provided that heritability and assortative mating coefficients are simultaneously assessed on the same sample, using a set of traits that appear homogeneous in nature. Given the argument that individuals will associate with others who are genetically similar, we predict, in contrast to Thiessen and Gregg, that assortative mating will occur more on the basis of traits of high heritability.

A possible objection to this use of human assortative mating coefficients is that if husband-wife similarities are observed some time after marriage, the resemblance could have been developed as a result of mutual interaction over time. As we shall see, however, assortative mating can occur on the basis of measures obtained prospectively (Hill 1973). Guttman (1970) also obtained an indirect measure of the length of marriages by assuming that there was a relationship between length of marriage and the age of the first-born child. Partialing out this age variable produced no substantial difference in the between-mate correlation. Griffiths and Kunz (1973) studied the degree of physical resemblance between spouses, using photographs whose similarity had been rated by independent judges, and found no tendency for resemblance to increase as a function of the duration of the marriage. Finally, Eysenck and Wakefield (1981) found that similarity on a variety of psychological characteristics does not change as a function of the length of the marriage. All of these findings support the contention that people pick similar partners to marry, as opposed to the possibility that individuals in a marriage grow to resemble each other.

The three separate studies on humans discussed below fulfill the necessary criteria described above: that is, heritability estimates for comparable traits and assortative mating coefficients obtained from the same sample. In these studies, heritabilities were estimated on the basis either of parent-offspring or of midparent-offspring correlations.

The first two studies to which we refer (Guttman 1970; Susanne 1977) calculated heritabilities from parent-offspring correlations. Measured this way, the heritability is the observed correlation as a proportion of the correlation that would be found if the character were completely inherited, that is, if all the variance were additive genetic (Falconer 1981). To remove the inflating influence of assortative mating on the parent-

offspring correlation, these studies based estimates of heritability (h^2) on the formula $h^2 = 2r_{po}/(1 + r_{pp})$, where r_{po} is the parent-offspring correlation and r_{pp} is the correlation between the parents. Error variance in the assortative mating coefficients, therefore, would tend to produce negative correlations between h^2 and r_{pp} . The predicted effect has to be sufficiently robust to overcome this problem.

In the first of the studies to be considered, Guttman (1970) calculated heritabilities of five visual number judgments on a large human sample of Asian and North African origin. Between-mate correlations were also obtained for the same five tasks. Each person was asked to judge the number of marbles or ping-pong balls contained in a transparent plastic bag; the numbers of objects to be judged ranged between 5 and 34. Using Pearson's correlation coefficient, we found that the five heritability estimates given by Guttman correlate positively with the degree of assortative mating shown by parents on these tasks, but that the correlation just fails to attain significance ($r = 0.729$).

In the second study, Susanne (1977) obtained heritabilities of 36 anthropometric traits in a Belgian sample. Heritability estimates were calculated on the basis of parent-offspring correlations, as in the study by Guttman, on the grounds that this method provides a good estimate of the relative influence of additive genetic variance in the total phenotypic variance. Those body measurements based on the osseous part were found to have higher heritabilities than those based on the muscular or adipose part, as would be expected if the latter were more greatly influenced by environmental factors. Again, we calculated the correlation between estimates of h^2 and r_{pp} . The resulting coefficient is significant ($r = 0.358$, $p < 0.025$, one-tailed).

The third study (Hill and Hill 1973) estimated the heritabilities of the 11 scales of the Minnesota Multiphasic Personality Inventory from midparent-offspring correlations, avoiding the need to correct for assortative mating. Unusually, the personality scales were administered to parents and offspring at comparable points in their life cycle, thus correcting for possible developmental changes with age. This procedure also has the merit of avoiding the underestimation of phenotypic variance that may occur when individuals within a family are tested simultaneously (since they are at that time sharing a

common environment). Corresponding assortative mating coefficients based on test administration prior to marriage are separately reported (Hill 1973). We calculated the correlation between estimates of heritability and the assortative mating coefficients as before. Again, the correlation is significant ($r = 0.707$, $p < 0.01$, one-tailed).

Many behavioral scientists consider that humans are an atypical species in the degree to which cultural transmission occurs. They may object to the way in which parent-offspring correlations have been accepted here as a valid basis for the estimation of heritability. However, the argument that r_{PO} is a measure of the efficacy with which a parent produces environmental effects on offspring is hardly tenable. For example, the critic who uses this argument to object to the claims made here would have to argue that Susanne's measures of adipose tissue were less influenced by the parental environment than were the skeletal measures. More generally, such a critic would have to explain how a trait that was sensitive to environmental influences would produce close parent-offspring resemblance in the face of other, possibly contradictory, environmental pressures.

Another possible criticism of the interpretation we have placed on the data is that the correlations between heritability and assortative mating coefficients are due to an artifact. If, for example, one trait had a very low test-retest reliability, then a low heritability estimate would be expected, as well as a low assortative mating coefficient. Thus, heritability and assortative mating coefficients would be expected to covary positively, but as a spurious result stemming from variations in the reliability of measurement of the traits. In the case of the personality measures, test-retest reliabilities over a three year period are available, using the same subjects as did Hill (1973) and Hill and Hill (1973). We have aggregated across sex the figures reported by Hathaway and Monachesi (1963), and entered the resulting reliability coefficients into a multiple regression equation together with the heritability scores from Hill and Hill (1973), with the assortative mating coefficients from Hill (1973) as the dependent variable. The multiple R is 0.736. Entering the additional predictor variable, then, slightly improves the prediction of degree of assortative mating. However, the actual regression equation on standard scores is:

Assortative Mating = $0.689 \times$ Heritability - $0.206 \times$ Reliability. It can be seen that reliability correlates with the criterion in the "wrong" direction as far as this criticism is concerned. Thus, the positive correlation between heritability and assortative mating, far from being an artifact of test reliability occurs despite its potentially weakening effect.

The correlations we report are based on distinctly different measures, taken from three independent investigations. The first is concerned with cognitive or perceptual judgments, the second with physical characteristics, and the third with personality. Each of the correlations indicates that people tend to assort more on the basis of more heritable traits—in line with our prediction, but contrary to that of Thiessen and Gregg (1980). The idea that marriage partners select each other on the basis of genetic similarity may be considered to have received some counterintuitive empirical support.

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