A note on regression to the mean

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Galton's (1869) law of filial regression to the mean is as misunderstood today as it was fifty years ago when Fisher (1924, p. 198) felt impelled to "allude to one result which has been entirely misunderstood, even in otherwise important works." The misunderstanding was, as it is today, that regression to the mean will counter the effect of selection. However, it would appear that the misunderstanding is now even deeper. To comprehend the nature and extent of misunderstanding, it is necessary to quote rather extensively from some well-known researchers.

Discussing IQ and fertility, Falek (1972, p. 14) says:

A closer examination of the material, however, presents some new problems which require evaluation. Knowledge of a slight positive correlation between parental intelligence and differential reproduction is not informative with regard to the measured intelligence of siblings in each of the subdivisions. Application of the Galton law of filial regression should dampen the I.Q. scores for children of parents in the highest I.Q. category and increase the scores to those parents in the lowest I.Q. range. It would seem that the effect of the law of filial regression to the mean will only serve to modify the positive effect of differential fertility. Furthermore, as the largest number of persons measured by standardized I.Q. tests are within the narrow band of just normal intelligence as designated by the normal distribution curve, it would appear that the vast numbers of children born to persons in this relatively narrow middle range would overwhelm the reproductive advantage for parents at the highest I.Q. levels.

Garrison, Anderson, and Reed (1968, p. 126) say:

If assortative mating for the opposite ends of the distribution of a trait such as intelligence were accompanied by a strong differential fertility, then we would expect the curve for people's intelligence to become sharply bimodal. However, there is no evidence of any strong differential fertility. Even if there were, we should remember that Galton's law of filial regression is a strong counterforce which constantly restores the frequency of persons at the middle of the distribution, thus preserving the normality of the curve from generation to generation.

This statement is rather surprising because one had the impression that Reed, at least, knew the reasons for Galton's law. In Reed and Reed (1965, p. 66) we find, "Thus, Galton's law provides a paradox of a sort, in that children born in the worst environment and to parents with poorest heredity, average better than their parents. Conversely, the children born into the best environments and to parents with the best heredity average below their parents. For-
tunately, the resolution of this paradox has been understood for many years."

Eysenck (1971, pp. 67-68), discussing Burt's data (1961) on social mobility, remarks:

The regression to the mean is a phenomenon well known in genetics, and characteristics of traits markedly influenced by genetic causes, environment would favour the children of the higher professional fathers and disfavour those of unskilled working class fathers, tending to make the difference between them even greater than that observed between their fathers. Clearly, this is not what happens; regression presents strong evidence for genetic determination of IQ differences. Regression also implies that if the next generation [that is, the children in the sample studied by Burt] take occupations which correlate with their IQ in the same way that their father's did, then considerable change in social class must occur.

It would therefore appear that the situation is now worse than that which confronted Fisher (1924). We are told that Galton's law of filial regression will not only counter the effect of selection but also that of assortative mating. Moreover, if regression to the mean is noticed in any trait, it is evidence of the genetic determination of that trait.

The true significance of filial regression to the mean can be comprehended by considering a trait, with no dominance, which breeds true. In a random mating population, a group of fathers whose average value on the trait in question is $x$, measured from the population mean, will have offspring whose average value on the trait is $x/2$. The reason for this regression is obvious. Both sexes are involved in the production of children, but we selected fathers only. Mothers are unselected. Their average value on the trait is therefore 0. The average value of the offspring is the average of parental values, or $(x + 0)/2 = x/2$. However, if we select both sexes in such a way that the average of mothers as well as fathers is $x$, then the average of the offspring will be $(x + x)/2 = x$, and there will be no regression toward the mean. That is, regression to the mean does not of itself imply genetic determination and genetic determination does not imply regression to the mean when both parents are taken into account.

It is well known that with traits like height and IQ, there is some regression to the mean even when both parents have been selected, because these traits are imperfectly inherited. Fisher (1924, p. 199) explains:

This effect finds its explanation in the fact that the actual stature is not quite a perfect measure of genetic potentiality for begetting or bearing tall children. If environmental effects, for example, were of any importance in determining stature, in selecting tall parents we should be selecting not only those of high genetic potentiality, but to some extent also those who had experienced an environment favourable to tall stature. The average of the next generation, reared in an average environment, would for this reason alone be somewhat shorter than their parents. But the effect would stop there; the third generation would not show any further regression.

In other words, regression to the mean does not in any way counter the effect of selection. Of course, if selection is applied to the mother only, and not to the father, the effect on the next generation will be the average of the two parents, i.e., half of the effect on the mother. But, after that, it will persist unaltered unless some other force (such as heterosis) acts against it. Similarly, regression in no way diminishes the effect of assortative mating.

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REFERENCES


