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Inbreeding depression and IQ in a study of 72 countries

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ABSTRACT

In this ecological study, a robust negative correlation of $r = -.62$ ($P < .01$) is reported between national IQs and consanguinity as measured by the $\log_{10}$ transformed percentage of consanguineous marriages for 72 countries. This correlation is reduced in magnitude, when IQ is controlled for GDP per capita ($r = -.41$, $P < .01$); education index ($r = -.40$, $P < .01$); and democracy index ($r = -.42$, $P < .01$). Multiple regression analysis revealed that in the absence of the democracy index; percentage consanguineous marriages, education index and GDP per capita all exhibited stable final standardized β coefficients, however consanguinity had the least impact ($\beta = 0$, $P > .05$) whereas GDP per capita had the highest ($\beta = .35$, $P > .01$). This result is interpreted in light of cultural feedback theory, whereby it is suggested that consanguinity could subtly influence IQ at larger scales as a result of small IQ handicaps bought about through inbreeding being amplified into much larger differences through their effect on factors that maximize IQ such as access to education and adequate nutrition. Finally, consideration is given to future potential research directions.

1. Introduction

Intelligence researchers have studied the effects of inbreeding on the psychological development of individuals extensively. “Consanguinity”, which can be broken down into *con* meaning ‘with’ and *sanguine* meaning ‘blood’, traditionally describes the property of two people sharing the same “blood line” which in a more modern sense equates to closely shared genetic heritage. Consanguineous marriages are described as those involving individuals who are biologically second-cousins or closer; defined in terms of the kinship coefficient (F) as having a kinship of greater than or equal to .0156 or 1/64 (Bittles et al., 2001).

Table 1 describes the range of potentially consanguineous relationships. Incestuous marriages (involving first-degree relatives) are generally strongly discouraged throughout the world, and in many countries, the most consanguineous legal relationship is the marriage of first-cousins (Bittles, 2004). Detrimental effects associated with inbreeding are attributable to the increased homozygosity of rare deleterious recessive alleles.

Consanguinity at the national level tends to be measured in two ways. Its genetic impact on a population can be described through the use of the mean inbreeding coefficient, α, which is the probability that an individual has inherited both alleles of a pair from a shared ancestor; alternatively, its prevalence (i.e. how common it is) can be estimated through a measure of the per capita percentage of consanguineous marriages.

1.1. An overview of the deleterious effects of consanguinity

The inbreeding depression that results from consanguinity has a variety of known deleterious correlates with factors that effect health, fitness and morbidity within Human populations. It has been suggested that it negatively impacts fertility due to the increase in the homozygosity of alleles that either prevent conception or have deleterious effects on embryonic development (Ober, Elias, Kostyu, & Hauck, 1992), similarly, fetuses produced via consanguineous mating are thought to be at a higher risk of being spontaneously aborted (Diamond, 1987; FitzSimmons & Tunis, 1984), in addition to being at a higher risk of spontaneous preterm birth and being born underweight (Carr-Hill, Campbell, Hall, & Meredith, 1987; Khlat, 1989). Intriguingly though, higher fitness has also been observed in consanguineous couples, where it has been speculated that it may occur as a compensatory mechanism

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Table 1
Table of consanguineous relationships along with values for the coefficients of kinship (*F*) and relatedness (*R*)

Consanguinity type	Nature of relationship	Kinship coefficient (*F*)	Coefficient of relatedness (*R*)
Full-siblings	Mating between individuals who share a full set of parents.	.25	.5
Parent–child	Mating between individuals and their biological offspring	.25	.5
Half-siblings	Mating between individuals who share a single parent	.125	.25
Grandparent–grandchild	Mating between individuals and the offspring of their offspring	.125	.25
Uncle/niece–aunt/nephew	Mating between the brothers or sisters of the father or mother and their offspring	.125	.25
Double first-cousins	Mating between individuals who are the offspring of two brothers marrying two sisters (of another family) who share each others grandparents	.125	.25
First-cousins	Mating between individuals who share a grandparent	.0625	.125
Half first-cousins	Mating between individuals whose parents are half-siblings	.0313	.0625
Double second-cousins	Mating between individuals whose parents are double first-cousins	.0313	.0625
Second-cousins	Mating between individuals who share a common great-grandparent	.0156	.0313

Note: The parental kinship coefficient *F* is numerically equivalent to the child's inbreeding coefficient, which is the child's likelihood of being homozygous as a consequence of parental consanguinity. The coefficient of relatedness *R* is two times the kinship coefficient and describes the fraction of the genome that is identical by descent in two related individuals.

for infant losses (Bittles, Grant, Sullivan, & Hussain, 2002; Schull & Neel, 1972; Tunçbilek & Koç, 1994). A recent study has also suggested that mild inbreeding (at the level of third and fourth-cousins) has been responsible for an increase in fertility amongst couples in Iceland, whereas close inbreeding reduced it. Iceland exhibits a high degree of socioeconomic heterogeneity, so the findings lend support to the theory that increases in homozygosity can enhance fertility through a variety of physiological and bio-behavioral mechanisms, provided they are relatively mild (Helgason, Pálsson, Guðbjartsson, Kristjánsson, & Stefánsson, 2008).

Consanguineous mating is known to increase the incidence of physical deformities and diseases, including childhood blindness (Baghdassarian & Tabbara, 1975), neonatal diabetes mellitus (Brickwood et al., 2003) and limb malformations (Breuning et al., 2000). A study by Jaber, Halpern, and Shohat revealed that the overall incidence of congenital malformations was 2.5 times higher amongst the offspring of consanguineous mating when compared to the offspring of non-consanguineous mating (1998). Consanguinity is also thought to predispose offspring to neuropsychological disorders such as hereditary parkinsonism (Mitsui, Kawai, Sakoda, Miyata, & Saitio, 1994).

1.2. Deleterious effects on IQ at individual data levels

The study of Bashi (1977) revealed that the extent to which consanguinity affects IQ is proportional to the degree of inbreeding. He found that based on the outcomes of three tests of cognitive ability, the children of double first-cousins (within an Arab population) exhibited on average significantly greater inbreeding depression of test scores than the children of first-cousins, who in turn scored lower than the children of non-consanguineous parents. Bashi also noted that the children of double first-cousins exhibited larger variance in test scores than the children of first-cousins. These findings tend to disconfirm environmentalist theories such as those of Kamin (1980), who proposed that socioeconomic status is the dominant factor in determining the IQ of the offspring of consanguineous mating.

Jensen concluded based on a survey of the literature that consanguinity involving first-cousins leads to an inbreeding depression of between 2.5 and 3.5 IQ points on average (Jensen, 1983; see also Bashi, 1977; Goldschmidt, Cohen, Bloch, Keleti, & Wartski, 1963; Neel et al., 1970; Schull & Neel, 1965, 1972; Slatis & Hoene, 1961), although as Jensen notes, not all of these studies generated statistically significant results owing to small sample sizes. More recent studies have reported significant reductions of means in test scores of the magnitude reported by Jensen, associated with the children of consanguineous mating amongst Indian Muslims (Agrawal, Sinha, & Jensen, 1984; Badaruddoza, 2004; Badaruddoza & Afzal, 1993).

The most pronounced effects of a consanguineous decline in IQ of the magnitude reported will be on the proportion of the group whose IQ's fall below 70 (Jensen, 1983). A study by Böök (1957) revealed an incidence of mental retardation that was over three times higher among the offspring of first-cousin consanguineous mating, when compared to a control group of non-consanguineous children in Sweden. The study used indicators of scholastic performance (grades, teacher ratings) in order to assess its subjects.

A familial study conducted by Reed and Reed (1965) similarly revealed an incidence of mental retardation among the children of first-cousins that was four times greater than in the controls. The study of Morton (1978) study revealed that the offspring of first-cousins had over a five times higher risk of mental retardation when compared to controls. The study concluded that declines in IQ and the increase of mental retardation are consistent with rare recessive alleles associated with around 325 loci, whose likelihood of being transmitted into offspring increases with the relatedness of the parents. The study of Madhavan and Narayan (1991), which reported a similarly significantly high increase in the incidence of retardation, noted that within their sample the risks were highest in cases involving uncle–niece relationships.

1.3. Deleterious effects on IQ at national data levels

Ecological research (research at the national data level) is capable of yielding valuable insights into the structure of the relationships between variables of psychological significance at large scales, however such research has to be careful so as