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A Note on the Incidence of Colourblindness in Cook Island Males

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Genetic studies of colourblindness have clearly established the existence of a recessive sex-linked allelomorph carried in the X chromosome. As a result of sex-linkage the proportion of colourblind females in a population is generally estimated to be the square of the proportion of colourblind males. Therefore in a population of which 8% of the males are colourblind, 0.64% of the females would be expected to show the defect (Gray, 1943).

A large number of studies have demonstrated marked cross-cultural differences in the incidence of colourblindness. Kherumian and Pickford (1959), reporting on the incidence of colourblindness in various populations, note lower incidences among Negro and Indian males (2 to 4%) and among Chinese (5 to 7%) than for white males (8 to 9%). The Japanese census (1960), reported in Graham, Bartlett, Brown, Hsia, Mueller and Riggs (1965) puts the male incidence of colourblindness at around 2% to 4% and the female incidence at 0.2% to 0.4% for school and college students.

Bornstein (1973) has gathered evidence to support the hypothesis that the increase in exposure to ultraviolet radiation that occurs at higher altitudes, or with proximity to the equator results in an increased density of yellow pigmentation in the human eye. This pigment selectively absorbs short-wavelength radiation, resulting in decreased sensitivity to blue and green colours.

As part of a recent research project in the Cook Islands one of us was able to gather data on the incidence of colourblindness in Mangaia (the second largest island of the Cook group).

The Ishihara test (38 Plates Edition) was used to screen-test a sample of 100 male children between the ages of 8 and 14 years drawn at random from the population. The incidence of colourblindness in this sample was zero. If we take the expected incidence of colourblindness in Europeans as 8% (Graham et al., 1965) then the Chi-squared one-sample test (Popham, 1967) may be used to test the hypothesis that the incidence of colourblindness in Mangaian males differs from the incidence in European males. With an observed value of zero, the calculated Chi-square is 7.64, $p < .01$, 1 *df* (using Yates correction).

This low incidence of colourblindness is surprising in view of the tropical location of Mangaia (21° 54' south of the equator). It should be noted that the Ishihara test was designed to detect the most common types of colourblindness (protanopia and deuteranopia) and hence it is not particularly sensitive to blue-green confusions.

As well as predicting a loss of blue-green sensitivity with increasing proximity to the equator, Bornstein's hypothesis also predicts a collapsing of the names for the blue, green and black colours into a single category. This aspect of the hypothesis also lacks verification. The Rarotongan language fully differentiates these categories by using *auika, matie* and *kerekere* to refer to blue, green and black (James, 1923).

Quite apart from Bornstein's predictions, the absence from the sample of both protanopia and deuteranopia is surprising, given the fact that both of these deficiencies are inherited as sex-linked Mendelian recessive characteristics. If the observed incidence was to be sustained in a large sample and with a more precise test of colourblindness it may lead to new information on the genetics of colourblindness, particularly in view of the fact that the levels of consanguinity on Mangaia and in the Cook Islands as a whole are higher than in cultures that are less strongly subject to geographical isolation.

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References

Bornstein, M. H. Color vision and color naming: A psychophysiological hypothesis of cultural difference. *Psychological Bulletin*, 1973, *80*, 257-285.

Graham, C. H., Bartlett, N. R., Brown, J. L., Hsia, Y., Mueller, C. G., & Riggs, L. A. *Vision and visual perception*. New York: Wiley, 1965.

Gray, R. C. Incidence of green-red blindness. *Archives of Ophthalmology*, 1943, *29*, 446-448.

James, H. B. *Rough notes on Rarotongan*. O. Owen, Government Printer, Rarotonga, 1923.

Kherumian, R., & Pickford, R. W. *Heredite et frequence des anomalies congenitales du sens chromatique (Dyschromatopsies)*. Paris: Vigot Freres, 1959.

Popham, W. J. *Educational statistics*. New York: Harper & Row, 1967.