Superior color sense of women

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Stereotypes about the superior color sense of women may well be rooted in genetics. Brian Verrelli, a researcher at the Biodesign Institute at ASU, is co-collaborator on a study suggesting that natural genetic selection has provided women with a frequent ability to better discriminate between colors than men.

The results of the study by Verrelli and Sarah Tishkoff of the University of Maryland appear in the American Journal of Human Genetics . Their research focused on the gene that allows people to perceive the color red, a gene that is found only on the X chromosome. They found that the gene has maintained an unusual amount of variation that is about three times that of other genes.

“Normally, this degree of genetic variation is suppressed through natural selection,” Verrelli says. “In this case, nature is supporting a high degree of variation instead.”

Verrelli explains that variation in the red gene is created via the exchange of genetic material with a neighboring gene that detects green. The scientists speculate that enhanced color perception was important when women were the primary gatherers in the hunter-gatherer phase of human existence. It would have allowed them to better distinguish among fruits, foliage and insects. Therefore, nature supported the variation, despite some negative consequences to men.

Because women have two X chromosomes, women can receive one chromosome with the typical configuration of the red vision gene while

the other chromosome receives a slight variation. It is the combination of a normal and variant gene, which occurs in about 40 percent of women, that may provide a broader spectrum of color vision in the red-orange range.

By contrast, men have one X chromosome, and any variation in the single red gene that they receive reduces their ability to distinguish between red and green. This accounts for the relatively high percentage of men — 8 percent — who have a color vision deficiency. It was this statistical aberration that first interested Verrelli in pursuing this research.

“Most detrimental conditions caused by a genetic variation affect a tiny fraction of 1 percent of the population,” Verrelli says. “The fact that the problem of color-blindness was so common suggested an important mitigating advantage,” Verrelli says.

While genetic research traditionally has focused on significant mutations in genes, the research of Verrelli and Tishkoff suggests that subtle variations may exist for explicit reasons and are worthy of attention. This research adds considerably to the knowledge base on color vision deficiency.

While the common term used is “color blind,” Verrelli notes that color vision deficiency is the more appropriate descriptor. Deficiencies are grouped into three commonly identified conditions, but within these, individuals experience varying degrees of color deficiency.

Our perception of color comes from our ability to distinguish red, green and blue. The combination of these three colors forms the basis for all the colors humans perceive. Other forms of life have differing systems of color vision, and these distinctions may help us understand how and when life forms separated in the evolutionary process.

The researchers honed in on the advantages of subtle genetic variation with the aid of sophisticated computer analysis. Verrelli used computer technology to build evolutionary scenarios to demonstrate that this level of variation could not be explained through random biological processes.

They studied the DNA of 236 randomly selected men from geographically diverse populations, discovering that some of the variation occurred an astonishing 80 percent of the time. Men were studied because the presence of just one red vision gene allowed a way to establish parameters for the frequency of the variation.

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