Seeing Blue

Prolonged exposure to ultraviolet radiation, which can damage the eye’s lens and make it more difficult for people to perceive certain colors, may explain the fact that some languages lack a word for “blue.” This is one finding of a study by a multidisciplinary research team based at Ohio State University.

Angela Brown and Delwin Lindsey were drawn to the topic after learning that certain languages spoken in Papua New Guinea have five words to designate various colors. English has 11 words to designate the basic colors. Brown works in the College of Optometry and Lindsey is in the Department of Psychology.

“Particularly striking to us was the fact that they had only one color name that meant both blue and green,” Brown said. “We looked at their pattern of color naming, and we said it looks an awful lot like the result of a color vision deficiency.”

When the two began using dictionaries to do research on languages, they found that some peoples, particularly in the tropics, have a single word for both “blue” and “green” or “blue” and “black.”

“This is true especially among languages spoken near the equator,” Brown said. Using data from a NASA satellite which provided details about the daily irradiation of ultraviolet (UV) light, the team was able to track which parts of the planet receive higher doses of UV light.

“Then we did a virtual reality experiment,” Brown said. They presented a group of American teenagers with various colors. The young eyes were able to identify blue, but when a dense, “sun-damaged” lens was placed before their eyes, “less blue was perceived,” Brown said.

“As the lens in our eye ages, its ability to transmit light of different wavelengths changes quite considerably, and in particular it becomes less transparent in the blue end of the spectrum,” Lindsey said. “That process is accelerated by high UV-B.” The process is marked by an increase in the blue light absorbed, which means less reaches the retina as a visual signal. “So in areas that have very high UV-B, the eye is receiving less blue light because a lot of it is being absorbed.”

A world map produced by Brown and Lindsey (above) includes hundreds of dots that represent places where blue is seen—and identified by words—and many places where it is not. There is some overlap because exposure to sunlight produces a tendency for a language to lack a word for “blue,” Brown said. “Consistent with this observation, there is a lot of individual variation in the use of color names in these tropical languages. Color vision disorders are variable across individuals, with each person’s vision depending on some combination of genetic predisposition and personal exposure [to sunlight].” The map and the results of the research were published in Psychological Science.

Brown and Lindsey hope to travel to some of the communities they have written about to study the impact of sunlight on the lens and retina.

DID YOU KNOW?

Lehigh University researcher is designing multitier wireless networks to provide rural communities with the same high-speed Internet access and telecommunications services that urban and suburban areas enjoy. Multitier wireless networks are based on radios with areas of coverage that vary in order of magnitude. Shalinee Kishore, assistant professor of electrical and computer engineering at Lehigh, received a National Science Foundation (NSF) grant for the project, which focuses on Susquehanna County, Pa., on the eastern edge of the state’s boundary with New York. It tends to not be cost-effective for Internet providers to lay cable and wires in such hilly, lightly populated regions, Kishore said. Multitier networks can simultaneously support large coverage areas and high data rates. “In the past, multitier systems have been studied primarily in the cellular context and assuming little or no spectral reuse across tiers,” Kishore wrote in her NSF proposal.
Despite a slump in various optics-related industries, Haus doesn’t see the opportunities for his students waning. “When telecom collapsed, all these jobs were lost, but our students really did find jobs quickly. Fifty percent of the work force at the Air Force base is going to be eligible for retirement soon, and they’re looking to hire. We’re got a lot of small companies around here that are asking for students, too. We haven’t seen any slacking off of jobs in optics.”

The Department of Electro-Optics at the University of Dayton (UD) turns 20 this year. It is the only program of its kind in Ohio and one of only six in the country.

While the heads of the program are celebrating their successes over nearly two decades, their eyes are on the future. “My immediate goal is to double the number of students within three years,” Department Chair Joe Haus said.

Dayton’s program now has about 40 doctoral students.

Haus expects the number of students to increase at a steady pace in part because of the appeal of hands-on learning. The department has very close ties with the local Wright Patterson Air Force Base, which means that some students are not only working on school-related research projects, they’re tackling issues that have immediate relevance to the U.S. military. “We have access to equipment that no one else in the world has access to,” said Ed Watson, technical advisor for electro-optics technology at Wright Patterson’s Air Force Research Laboratory. “I’ve been working with UD for about a dozen years, and to me the primary benefit is that they are working very closely on problems that interest us, so it’s not just about us giving a grant and hoping they do something useful with it. We are growing our own intellectual capacity along with the students.”

Joe Binford is studying laser radiation detection methods at Wright Patterson as part of his doctoral degree. He says the relationship between the two institutions has given him interesting research opportunities: “I may choose to stay on with the Air Force,” he said.

The Dayton program was started thanks to a $300,000 grant from an anonymous donor who challenged the school to invest more in high-tech training. The university at first offered only a master’s degree; today more than 10 faculty members teach courses in the department and a doctoral degree is offered. A recent $775,000 grant from the state is supporting the creation of an on-campus nanophotonics facility, which Haus expects will become operational later this year.

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Articles in “Scatterings” are written by Kim Douglass, assistant managing editor of Optics & Photonics News.

Do you have a story idea? Write her at kdoug@osa.org.