New Outlook on Colorblindness

Phone Apps, Videogames Offer Color Help; Seeking a Cure Through Gene Therapy

By Melinda Beck

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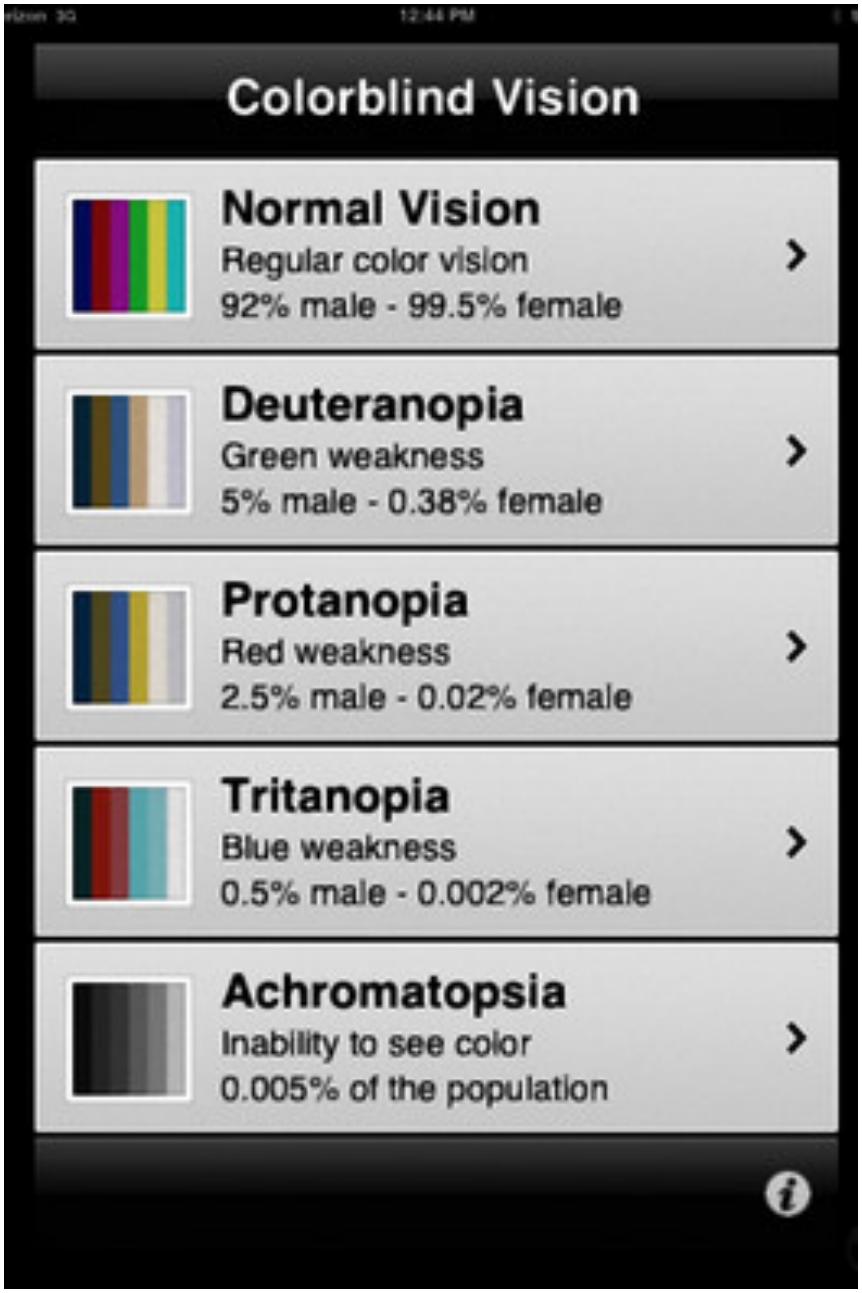
For people who are colorblind, life involves little workarounds and big compromises alike. Daily challenges range from not knowing whether meat is fully cooked to not being able to read whether a horizontal traffic light is showing green or red. More serious repercussions include being shut out of a dream job, like piloting planes, because misreading landing-strip lights can have life-or-death consequences.



Apps for Eyes: Colorblind Vision, lets users choose their specific deficiency and compensates colors accordingly.

ILLUSTRATION: COLORBLIND VISION

Now, a host of new research and tools promise to improve life for the estimated 32 million Americans—8% of men and 0.5% of women—who have some degree of colorblindness. For many, getting through the day—avoiding wardrobe perils and worse—has often involved bringing in a second pair of eyes. But new websites and smartphone apps offer to help identify or enhance hard-to-see colors. Videogame manufacturers are increasingly including "colorblind" modes in their games. And researchers are homing in on more specific vision tests that may allow mildly colorblind people to qualify for jobs that, until now, have been closed to them.

A genetic test, made by Genevolve Vision Diagnostics, will soon be available that can identify the exact type of colorblindness someone has, which the company hopes could pave the way for customized tools.

A cure for colorblindness might even be in the offing. Vision scientist Jay Neitz and his colleagues at the University of Washington are building on their 2009 breakthrough in which they restored red-green vision in two colorblind squirrel monkeys by inserting the missing gene into a virus and injecting it into their retinas. Four years later, the monkeys, Sam and Dalton, still pass daily vision tests, identifying colors on a computer screen correctly. They also have a newfound liking for green M&M's, Dr. Neitz says.

He and his colleagues are working on a similar therapy for humans, but many hurdles remain. "We know it's effective. The issue is whether it's safe," says Dr. Neitz.

Many colorblind people aren't even aware they have a "color-vision deficiency," as it's officially known, unless they apply for a job that requires precise color recognition. Even people with mild colorblindness can be barred from being pilots, air-traffic controllers, police officers, lab technicians and electricians—usually for safety reasons.

The term "colorblindness" is actually a misnomer. "People think you're living in a black-and-white TV show and that's not true. There are all different degrees, from mild to severe. And you can see colors—they're just different," says Terrance Waggoner, an ophthalmologist consulting on color vision for the U.S. Navy.

But the impact does go beyond missing just one color. "A colorblind person who can't see red can't see the red in purple—he just sees blue," says Dr. Neitz. Since red and green make brown, people with red-green blindness often have trouble telling the three colors apart.

The vast majority of colorblind people have trouble seeing red or green, due to a genetic defect in the color-sensing cells, called cones, at the back of the eye. About 75% of them are specifically green-deficient; another 20% are red-deficient. Either way, the impact on their vision is so similar that it's considered one disorder, red-green colorblindness, which is the most common single-gene disorder in humans, affecting 1 in 8 men and 1 in 230 women of Northern European descent world-wide (and slightly fewer in other racial groups).

Blue-yellow colorblindness is rarer and develops later in life, often brought on by aging,

illness, medication or head injuries. Rarer still is achromatopsia, the inability to see any color.

Red-green colorblindness is far more common in men than women because it's a recessive gene carried on the X chromosome. Men have one X and one Y, so a defective gene on the X shows itself readily. Women have two X chromosomes, and a normal copy of the gene will override the defective one. But women who have one defective X will be carriers of colorblindness. Each of their children has a 50% chance of inheriting the defective gene. Within families, red-green colorblindness typically travels from the maternal grandfather to grandson. A woman can only exhibit colorblindness if she receives a defective X chromosome from a colorblind father and another from a carrier mother.

But it does happen—and it can come as a surprise if previous generations didn't notice or didn't discuss their colorblindness. Ingrid Perri, a life coach in Melbourne, Australia, discovered she was mildly colorblind at age 47. "My family howled, 'That explains so much!'" says Ms. Perri.

Experts recommend that children have regular eye exams, including color-vision tests, starting between ages 3 and 5. Some children with color vision problems are labeled "learning-disabled" if they can't follow instructions. That happened with Dr. Waggoner's son at age 6, prompting the doctor to develop pediatric color-vision tests using shapes instead of numbers, now used by about 15% of school nurses.

Many colorblind people say they have no problem recognizing pure, strong colors. It is the blended and muted colors in between that are often difficult to tell apart.

The DanKam, an augmented-reality app for iPhone and Android, works on the same principle. Users look through the phone's camera and the program converts all the reds and greens in view into pure, basic versions that are easier for colorblind people to see. "It is like having magic eyes," says Andy Baio, a writer and programmer in Portland, Ore., who is red-green colorblind. "It doesn't make me see red or green the way you see them, but it makes it blazingly obvious the difference between them."

Contact lenses and glasses for colorblind people, which can cost up to $700, use tinted lenses to alter light coming into the eye. Manufacturers say they make hard-to-see colors brighter. Many employers don't let applicants use them during vision tests. Other online

tools, such as Color Name & Hue, can identify colors by name or numerical codes, so that graphic artists, say, can "see" what colors they are using. Apps such as Colorblind Avenger let people do the same thing through smartphone cameras. Other apps, such as HueVue and Colorblind Helper, assist with matching or harmonizing colors.

Some tools, like Colorblind Vision, help businesses and marketers see what their materials look like to colorblind people by simulating various color-vision deficiencies.

To help colorblind users in the trading world, Bloomberg financial-data terminals include plus and minus symbols or up and down arrows to indicate the direction of the market or stock price, says a spokeswoman for Bloomberg LP. After speaking with many traders with color-vision deficiencies, designers of DJ FX Trader, a foreign exchange tool offered by Dow Jones, the publisher of The Wall Street Journal, say they made a point of using icons to supplement color. FactSet Research Systems Inc., a financial information company, says it uses patterns and labels in its graphs, and avoids using colors that most colorblind people can't discern.

Some popular videogames, such as PopCap's Peggle and Zuma Blitz, now let gamers switch to colorblind modes, where color codes turn into shapes.

Advocates for the colorblind say the world could be more accommodating to the nearly 10% of people who have trouble seeing shades of red and green. Battery chargers blink orange for empty and green for full. Hotel keycards flash green for entry and red for stop.

Vision and design experts say the best maps, charts and presentations use words and icons in addition to color. "Color deficiency is way low on the totem pole of accessibility problems, but when doing the right thing isn't hard, you should at least take that into account," says Mr. Baio.

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