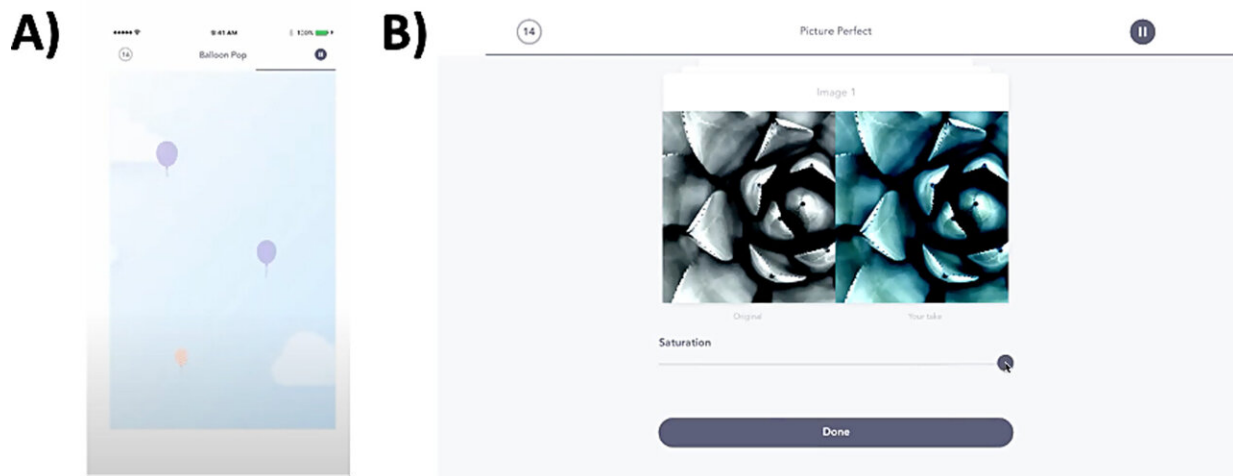


Using video games to measure the eye-brain-body connection

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(A) "Balloon Pop" and (B) "Picture Perfect" in-game user display. In Balloon Pop, the user is attempting to click target balloons (those with stripes) and ignore distractor balloons (those without stripes). In Picture Perfect, the user is attempting to adjust the saturation of the image on the right to match the "Original" image on the left. Credit: *Ophthalmology Science* (2023). DOI: 10.1016/j.xops.2023.100349

Video games could give ophthalmologists an easy window not into the soul, but into eye health and the eye-brain-body connection—the three-way reciprocal communication that influences our actions.

"Infusing science into games is like sneaking broccoli into ice cream,"

said Khizer Khaderi, MD, a clinical associate professor of ophthalmology. "It removes the resistance to do something that may not be viewed as fun, such as eating vegetables." Or in this case, evaluating your [vision](#) health.

In a Stanford Medicine-led study, researchers employed video games to evaluate participants' field of vision and visual stamina, their ability to distinguish contrast, and other factors that can indicate common eye diseases.

Vision influences our brain, at least in part determining our decision making, among other behaviors. Reading [body language](#) during a conversation, for instance, can tell us how to adapt our behavior to make a person more comfortable.

The visual acuity test that we've all done—covering one eye and reading letters and numbers varying in size—dates back to 1862 and is still the most widely used method to test vision. But its assessment of vision is incomplete. For example, the test can't determine a patient's ability to process contrast—such as distinguishing objects in the dark or in the fog—which can be a sign of cataracts.

Khaderi and his colleagues wanted to find a more holistic measurement of visual, cognitive and physical function. "You might not be performing as well as you want in some real-life scenarios, but we might not be able to pick it up in today's eye exams," said Khaderi, the senior author of a paper published in *Ophthalmology Science* on June 5. "You may pass the standard test but still have problems such as making split-second decisions after processing visual information."

So Khaderi and his team developed a different approach to assessing vision health, which they called the vision performance index (VPI). The index is a number based on five domains of vision, such as the ability to

sustain visual attention and a person's field of view, measured by clicks of a mouse in two video games played on the computer.

"What makes the VPI important is that it captures all those [different domains](#) that could be influenced by disease, and it's accessible: It can be done through interactive media," Khaderi said. "We put the science into the fun, without changing the user's behavior."

Developing the vision performance index

The team created the VPI eight years ago in response to the drawbacks of standard vision tests. For simplicity, Khaderi and his team made the index like the IQ scale, with the average VPI set at 100. Like IQ, the higher the score, the better one's eye-brain-body connection and performance.

In the current study, which is the first to apply the VPI, scientists programmed the VPI into games that would measure several aspects of vision.

The games included Balloon Pop, in which participants click striped balloons while ignoring non-striped balloons, and Picture Perfect, in which participants adjusted features of photos to match color saturation.

Successful play depends on seeing most of the screen, popping the right striped balloon or selecting the right hue with speed and, finally, maintaining accuracy. To ensure consistent scores, the researchers required participants to play two or three times.

Through each game, the scientists measured five domains of vision, each with subcomponents: Field of view measures central versus peripheral vision; accuracy measures response time and accurate choices, and multi-tracking measures the ability to choose correct responses with multiple

stimuli. Endurance shows whether a player can maintain accuracy and, lastly, detection indicates the player's ability to discriminate choices based on color, contrast or size.

Enrolled in the study were 66 patients with dry eye disease, glaucoma, cataracts, diabetic retinopathy, vision loss caused by diabetes, or age-related macular degeneration, which blurs central vision. The scientists compared the performance of this group with 27 participants with healthy vision.

Each person played two rounds of Balloon Pop and Picture Perfect. Color detection, which is a subcomponent of detection, was significantly lower in patients with diabetic retinopathy, a loss of vision due to abnormal blood vessels in the back of the eye, and glaucoma (people with diabetic retinopathy had an average VPI score of 96.8 and participants with glaucoma scored 98.5) compared with those without eye disease, who scored around 101.

The study showed that participants with diabetic retinopathy and [age-related macular degeneration](#) selected the correct balloons less often. Participants with cataracts and [diabetic retinopathy](#) had difficulty discerning contrast. Finally, participants with dry eyes had trouble matching saturation.

"In the future, dips in the components of the VPI score could be used by doctors as a screening tool, alerting them to concerning vision developments as well as helping them develop personalized therapies to optimize vision performance," Khaderi said.

Scaling up to popular video games

Khaderi likens VPI-embedded [video game](#) accessibility to wearables. The VPI isn't meant to be a diagnostic tool, he said. Khaderi expects it

will be more like a smartwatch, which can alert the wearer to potential problems such as an irregular heartbeat—a condition that suggests a doctor's appointment is in order.

Because researchers are obtaining the VPI in a non-invasive way, Khaderi anticipates more people will want to proactively engage with the games. He hopes that the index will become widespread with uptake in games with a big following, and that consumers will share their data with researchers to improve the understanding of the eye-brain-body connection.

Since the VPI software can be adapted to different games, in the future, the researchers suggest patients receive a rather odd prescription: Playing games, such as Fortnite or League of Legends—video games accessed by millions of people worldwide—to monitor eye disease.

"We haven't spent as much time teaching technology how to interact with humans as we have teaching humans how to interact with machines," Khaderi said. "I want to make a more symbiotic human-machine relationship that is productive rather than simply consumptive. I hope this study helps build that relationship."

More information: Yusuf Ahmed et al, Democratizing healthcare in the Metaverse. How video games can monitor eye conditions using the Vision Performance Index: A pilot study, *Ophthalmology Science* (2023). [DOI: 10.1016/j.xops.2023.100349](https://doi.org/10.1016/j.xops.2023.100349)

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