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Are Your Eyes Playing Tricks on You?

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STORY AT-A-GLANCE -

- Nearly 30 different areas of the brain participate in the perception of what your eyes "see," including optical illusions such as those created by H. Munker and Michael White
- Daniel Simons and Christopher Chabris designed and implemented the now famous gorilla experiment in the 1990s, which Simons resurrected and altered to test whether knowledge of an unexpected event impacts your ability to see other unexpected events
- Evidence suggests the brain can unconsciously change your perception to meet your expectations using your past experiences. In other words, what you see may be biased by what you've experienced in the past
- Some of the processes that define your perception of sight may explain emotionally biased reasoning that produces justification for decisions rather than decision-making based on empirical evidence. This may be one factor in your perception of the events in 2020

The act of vision and seeing seems so effortless that it may be difficult to appreciate the sophisticated, and yet poorly understood, neurological processes that underlie the mechanism. In the past several decades neuroscience has found there are nearly 30 different areas of the brain that process visual information[1] sent from the retina through the optic nerve to the brain.

There are dozens of diseases that have ocular symptoms, which means ophthalmologists and optometrists may be the first to help you recognize certain

medical conditions.[2] Data from one study[3,4] of 120,000 patients suggest an eye exam may be the first indication of problems in 39% of people with high blood pressure and 34% of people with diabetes.

Dr. Rachel Bishop, chief of the National Eye Institute's consult service, who was not involved in the study, affirmed the research results when speaking with a reporter from CNN Health, saying:[5]

> *"If the retinal blood vessels are unhealthy, there's every reason to think the brain blood vessels are unhealthy as well. The blood vessel supply is essential to all function — the function of all organs — and so if the blood vessels are unable to do their job, there's no way the brain can be functioning as well as a brain that has a good [blood] supply."*

When asked for her opinion related to screening the eye and retina for potential negative conditions in the brain, such as **memory loss**, Bishop said, "I share a common hope we could detect things early enough and have interventions early enough to change the course of a negative [brain] event."[6]

Have you ever thought that being tricked by an optical illusion means your eyesight has changed? It hasn't. Illusion is not a function of disease, but is the difference between what your eyes see and your brain perceives.

Interestingly, this is a function of vision that marketers use and psychologists have been testing for years. Some suggest it plays a role in your perception of the pandemic.[7]

White's Illusion Created With Light Dark Patterns

One of the first illusions used in testing is now commonly referred to as White's Illusion. Michael White, from the University of Adelaide, Australia, was reading a book in 1976 in which a design of an 11th grade student was published.[8] The design was made of black, white and gray elements that appeared to have different shades of lightness and darkness.

He was intrigued by the effect and went on to explore further, discovering that when stripes of black and white are partially replaced by gray, the brightness appears to shift. It's an optical illusion. Colored versions of the illusion were published by psychologist Hans Munker in 1970[9] and became known as the Munker Illusion.[10]

Using this trick, **colors** can completely change before your eyes. It works even when you know that it's wrong. The illusion relies on your brain's perception of color. As in White's Illusion that uses black, white and gray, Munker's Illusion relies on three colors.

One color covers the background, a second color offers tinted shapes, and the third color presents bars that go over the entire picture. In one picture, the background is dark and the bars are bright, and in the second picture this is reversed. The color of the shape doesn't change, but it appears to change as you look at it. Even when you know the trick and see it done before your eyes, you still see the shape change color.

Today, the phenomenon is known as the Munker-White Illusion. David Novick, professor of engineering education and leadership at the University of Texas at El Paso, described the process to a reporter at Live Science.[11] He said that although the shape appears identical, the color "bleeds over, or assimilates, to adjacent spaces."

The illusion depends on the color of the stripes in the foreground and not the color of the background. When the stripes are removed, the illusion disappears. There are competing theories as to how the shift in perception happens. Some believe the illusion happens at the retina, before signals reach the brain, while others believe the illusion takes place while the brain processes the data.

Novick has discovered that the illusion appears to be more vivid when spheres are used on the image and not flat discs. In 2017 he began working on a new version for fun and posted some to his Twitter account.

One of these images received nearly 17,000 likes and 6,700 retweets in two weeks. He was surprised by how quickly his optical illusion became a viral image. He said in a press release:[12]

"These sorts of illusions are really the domain of specialists in visual perception. My illusions typically get just a few likes. The most popular ones might get 40. The point of disseminating the illusions was to share my research results and correspondingly to get feedback from other people working in this area."

Gorilla Business Tests Selective Visual Perception

In a now famous experiment from the late 1990s, Daniel Simons and Christopher Chabris asked participants to count the number of basketball passes between people dressed in white and in black. You may have seen the original video in which a gorilla saunters among the players, pounds his chest and then leaves the screen. In the study, nearly half of the participants didn't see the gorilla.[13]

Simons used the notoriety of the video to test whether knowing about the gorilla would increase or decrease the viewer's ability to **see other unexpected events**. Simons showed the above video to the participants in the study. Before reading on, you may want to test yourself by watching the short video. Simons suggested:[14]

"You can make two competing predictions. Knowing about the invisible gorilla might increase your chances of noticing other unexpected events because you know that the task tests whether people spot unexpected events.

You might look for other events because you know that the experimenter is up to something. [Alternatively,] knowing about the gorilla might lead viewers to look for gorillas exclusively, and when they find one, they might fail to notice anything else out of the ordinary."

The results were interesting. Just as in the past experiment, nearly half of the people who had never heard or seen the video did not see the gorilla in the new video. However, there were participants who had seen the original video. In this group all of them spotted the gorilla in the new experiment.

However, the new experiment also included two other unexpected events. Only 17% of the people who expected to see the gorilla noticed one or both, yet 29% who did not expect the gorilla saw at least one of the unexpected events.

The researchers said this was not a statistically significant difference, but it did demonstrate that knowing beforehand that there may be unexpected events did not improve your ability to perceive other unexpected events. Simons explained:[15]

> *"The main finding is that knowing that unexpected events might occur doesn't prevent you from missing unexpected events. People who are familiar with the purpose and conclusions of the original study — that people can miss obvious events when focused on something else — still miss other obvious events in exactly that same context.*
>
> *Even when they know that the experimenter is going to fool them, they can miss something that's obvious, something that they could spot perfectly well if they knew it was there."*

The Difference Between Vision and Perception

Visual illusions demonstrate that our vision and brain have the potential to misperceive reality. The Munker-White Illusion reinforces the idea that your brain sometimes generates a story that does not match the physical world.

Neuroscientist Patrick Cavanagh from Dartmouth College spoke with a reporter from Vox, saying, "It's really important to understand we're not seeing reality. We're seeing a story that's being created for us."[16]

According to one published paper,[17] your visual experience is likely based on input from the retina to the cerebral cortex, while your perception of what you are seeing is more complex than "a simple topographical representation of the visual world." In other words, what your brain perceives that it sees is more than the image delivered by the retina.

Science has shown us that what your brain perceives as reality may not always be right. And, as the Vox reporter then asks, “Shouldn't we be curious about, and even seek out the answers to, how that reality might be wrong?”[18]

Evidence suggests the brain can unconsciously change your perception to meet your expectations using your past experiences. In other words, what you see may be biased by what you've experienced in the past. How the brain perceives color is also impacted by life experiences.

Sam Schwarzkopf from the University of Auckland talked about how the eye differentiates color, saying,[19] “We’re not trying to measure wavelengths; we’re trying to tell something about the color. And the color is an illusion created by our brain.”

Life Experiences and ‘The Dress’

Have you seen the optical illusion called “The Dress?” In 2015, a photo of a dress taken in a U.K. store circulated the internet. It appeared that many people saw the dress as black and blue, and others saw the image as white and gold. Pascal Wallisch, a neuroscientist at New York University, dug deep into why people's brains may interpret this image differently.[20]

He believes that the brain uses different filtering schemes based on life experiences that lead you to see the dress as black and blue or white and gold. He did a study of 13,000 people using an online survey and found some interesting correlations, including that people who **like to go to bed late** and wake up late in the morning are more likely to report the dress was black and blue.

Conversely, people who went to bed early and got up early were more likely to see the dress as white and gold. Wallisch hypothesized that people who wake up early spend more time in daylight, and when looking at a poorly lit image they are more likely to filter out the blue light from sunlight. When the brain assumes it's daylight, your eyes see the dress as white and gold.

He believes the brains of night owls assume artificial lighting, which makes the dress look black and blue. Another study[21] used functional magnetic resonance imaging and found those who thought the dress was white and gold had higher activation in their brain regions that were involved in higher cognition.

Although scientists have not completely answered the question of why people see the dress differently, it's important to remember what illusions teach us — our brains fill in ambiguity with our past experience.

In 2003, scientists had the opportunity to test some of these theories using a man who had lost his sight at 3 1/2 years of age and had it restored when he was 40.[22] What they found was that without a lifetime of visual experiences to make predictions, he was not fooled by illusions.

Test Your Eyes and Exercise Your Brain

On the surface, it may seem as if this research has no functional application. Yet, it may be that some of the processes that define your perception of sight explain emotion-biased reasoning that produces justification for decisions rather than decision-making based on empirical evidence.

As the reporter from Vox points out,[23] a variety of experiments have demonstrated that when the information is unclear, we tend to see what we want to see.[24,25] Wallisch named the phenomenon that generates different perceptions based on individual characteristics "substantial uncertainty combined with ramified or forked priors and assumptions yields disagreement" (SURFPAD).[26]

In other words, when you are exposed to a stimulus that isn't perfectly clear, your brain fills in gaps with your prior experience and makes a presumption about reality. Because each of us have different prior experiences, it can lead to a disagreement about what is happening in an image or an event. In June 2020, Wallisch commented on how people's prior experiences have colored their perception of COVID-19, saying:[27]

> *"If there is a spike, it will be hard to discern whether it was reopening or protests, so people will go with their prior. As the priors are different, there will be massive disagreement ... What's truly terrifying is that given this framework, no matter what happens, [people] will feel vindicated, reinforcing the strength of the prior and increasing polarization."*

It is important to remember that you are not limited by your past experiences. Instead, you can incorporate evidence-based data and seek out verified sources and information for any event. Instead of accepting what experts or the news media may be telling you, it's important to question the information and compare it against historical data. Illusions remind you that reality is not always what you see.

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