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Change blindness: can you spot the difference?

Mind gamers, put your attentional capacity to the test

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One of the most compelling impressions in everyday life is that wherever we look, we "see" everything that is happening in front of us - much like a camera. But this impression is deceiving. In reality our senses are bombarded by continual waves of stimuli, triggering an avalanche of sensations that far exceed the brain's capacity.

To make sense of the world, the brain needs to determine which sensations are the most important for our current goals, focusing resources on the ones that matter and throwing away the rest. These computations are astonishingly complex, and what makes attention even more remarkable is just how effortless it is. The mammalian attention system is perhaps the most efficient and precisely tuned junk filter we know of, refined through millions of years of annoying siblings (and some evolution).

Attention is amazing but no system is ever perfect. Our brain's computational reserves are large but not infinite, and under the right conditions we can "break it" and peek behind the curtain. This isn't just a fun trick - understanding these limits can yield important insights into psychology and neurobiology, helping us to diagnose and treat impairments that follow brain injury and disease.

Try it at home

Thanks to over a hundred years of psychology research, it's relatively easy to reveal attention in action. One way is through the phenomenon of *change blindness*. Try it yourself by following the instructions in the short video below (no sound).

How it works – the brutal cage fight of attention

When we think of the term "blindness" we tend to assume a loss of vision caused by damage to the eye or optic nerves. But as you saw in the video, *change* blindness is completely normal and is caused by maxing out your attentional capacity.

During change blindness everything about your visual system is intact and functioning. All of the information enters your visual system in the same way and is processed by the retina the same way; it even enters primitive parts of the brain in the same way. But then the inputs encounter a tight bottleneck that causes you to miss the seemingly obvious - unless, that is, you know where to focus beforehand. Change blindness is why we tend not to notice continuity errors in films, why many traffic accidents arise, and could help explain the unreliability of eyewitness testimony.

How exactly does focusing attention work? The general consensus is that more advanced brain regions in the prefrontal and parietal cortex - areas that developed more recently in our

evolutionary history - apply a *bias* to the electrical activity in more primitive brain systems. These bias signals effectively rig the competition that takes place between sensory inputs.

Sensory inputs already battle it out for supremacy within brain networks, much like cage fighters in a winner-takes-all death match. The fight between inputs can be resolved two ways: either by the stronger, larger fighters beating the smaller, weaker ones (i.e. brighter or more salient stimuli), or through the "divine intervention" of top-down bias. These biases act as the all-powerful hand of god, making a weak fighter unbeatable against its opponents, and so culling the ranks of the unselected.

The inputs that survive become "attended" and enter conscious awareness. But one unresolved question is what happens to the undetected stimuli? Are the losing cage fighters erased from existence? With conventional blindness these inputs can't influence behaviour because they never enter the nervous system. But with change blindness, we know that the information reaches *some* level of processing, even if it remains below the threshold needed to achieve consciousness. The question then is, how far does such information spread and what effects can it have?

Research suggests that unattended stimuli, although strongly suppressed, can actually have a range of measurable effects on behaviour, influencing our thoughts and actions. Taking the example from the video above, it's possible that even if you failed to detect the change in trousers from brown to blue, that your visual system could have been unconsciously primed to the colour blue. This could be measured by immediately presenting an obvious blue stimulus after the video and finding that you were faster or more accurate at detecting it. A substantial body of evidence suggests that unconscious processing of unattended stimuli provides a rich backdrop to conscious experience.

Find out more

Web page of University of British Columbia psychologist Ron Rensink, including many videos and articles on change blindness

Web page of University of Illinois psychologist Dan Simons, describing his research on attention, including more great videos and demos

Web page of University College London psychologist, Nilli Lavie - including many freely downloadable research papers

For a classic scholarly take, the paper by psychologists Bob Desimone and John Duncan proposing the now famous "biased competition" theory of attention

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