

You See Less Than You Think; Our seemingly detailed view of the world is more of an ever-changing sketch than a rich portrait--our minds fill in the blanks

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FULL TEXT

Consider your conscious experience right now. Eyes wide open, you see rich, detailed, colorful surroundings, perhaps crowded with objects, pieces of furniture, books, papers and coffee cups. The world of inner experience seems to be a mirror of the detail of the outer world.

But the conclusion of decades of experiments is that this idea is false. The apparent richness of our perception is an illusion. The flow of our conscious experience is, in fact, remarkably sparse--not a fully detailed 3-D cinematic extravaganza, but a wonderfully evocative and continually evolving sketch, drawn in rapidly fading ink.

We have known since the 19th century that the human eye only sees in full color and detail in the fovea, a tiny pit of densely packed light-sensitive cells on the retina. This corresponds to a tiny circular region of the visual field, the size of a small coin at arm's length. Outside this region, the image that the eye perceives is largely blurry and colorless.

Not only that, our sense that we can simultaneously grasp each object in the clutter around us is fake. In cluttered scenes, the ability to perceive any individual item is severely impaired by the presence of those nearby, as summarized in a study published last year in *Psychological Review*. The effect is known as visual crowding. Our brains can actually perceive just one object at a time, whether furniture, faces or fish.

For a concrete example, think about how many words you can see clearly right now, as you read this. You might think you are taking in a whole page or screen, or at least several lines' worth. Actually, it's less.

In the 1970s, George McConkie and Keith Rayner, then at Massachusetts Institute of Technology, began an influential line of research in which they tracked the eyes of people while they were reading. The researchers modified the display so that, outside a moving 15-letter window around where the reader's eye was looking, all the other words were replaced with strings of the letter "x." Someone looking over the participant's shoulder would see a small window of English text moving along the screen amid a sea of meaningless letters. But the reader noticed absolutely nothing unusual. He or she would have the impression of simultaneously perceiving whole lines of text--just as you do now.

Other recent work has shown that, just as we struggle to see more than one object or word a time, we may also see only one color at a time. Research conducted in 2007 at the University of California, San Diego by Liqiang Huang and Hal Pashler presented people with patterns, such as colored squares on a grid, like those seen here. Subjects were asked whether the patterns were perfect matches, precisely symmetrical, or neither.

If the human eye could simultaneously grasp all the colors in the grid, this should be an easy task. Yet participants had to check one square at a time. Tellingly, however, there is a shortcut. By paying attention to one color at a time, it is possible to detect the patterns created by just, say, the green squares. But when we focus on the green squares, the rest of the grid appears as little more than a jumble.

The trick our brain is playing is remarkably simple. In the reading experiments, how can the brain preserve the reader's illusion that the text is normal, when in fact words are blinking in and out of existence as the eye scans the

screen? It's because, when we wonder about the identity of an individual word, the brain flicks our eyes over to look at it. The word then comes into focus, so quickly that we imagine it was there all along.

An illusion devised by French researcher Jacques Ninio demonstrates the phenomenon with a grid of dots. All the dots are technically visible all the time, but if they are crisscrossed by a matrix of straight lines, each dot appears to pop up individually only when we focus on it.

Our experience of seeing the world around us, then, does not rely on our minds mirroring reality, but on the fact that the world is at our visual fingertips. Even though we only grasp one object, word, or color at a time, we can freely query any aspect of the world around us and receive an instant response.

Similarly, when I am listening to a conversation and writing on my smartphone, I have the illusion of multitasking, but I am actually just hopping rapidly from one task to the next. At University College London, neuroscientist Geraint Rees and colleagues put people in a brain scanner and presented them with overlapping words and line drawings. Given a task involving the words, the region of the subject's brain associated with word recognition lit up as expected. But given a task involving pictures, the word-specific brain activity disappeared. The brain was now oblivious to the words—even though the eyes were looking right at them.

Why does the brain fool us into imagining that conscious experience mirrors the outside world, when, in reality, we perceive the world through a narrow window? The answer is that the recognition and interpretation of objects is incredibly difficult, so the brain focuses its limited resources on one task at a time. Most of the time, the world is stable. I don't need to perceive the coffee mug I looked at a moment ago; I just need to remember where it was, well enough to find it when I need it.

The same illusion fools us when we try to imagine visual objects. Try to picture a baseball as vividly as you can. Then trace the seam that runs around the baseball in your mind's eye; imagine unpicking the seam and taking off the cover. How many pieces are you left with? Can they be laid out flat? What shape are they? The correct answer is that the cover divides into two identical dumbbell shapes. This is easy to see if you have a baseball in front of you, but it is very difficult to visualize. Unless you happen to be a baseball player, your mental image of a baseball, however vivid it might seem, is no substitute for the real thing. And what goes for visual imagery is also true of our beliefs, desires, emotions, memories—our entire "inner world," whose inner richness crumbles as soon as it is interrogated.

Mr. Chater is a professor of behavioral science at Warwick Business School. This is adapted from his book "The Mind is Flat: The Remarkable Shallowness of the Improvising Brain," being published Aug. 11 by Yale University Press.

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