How mistakes help us recognise things

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When looking at the same object twice in quick succession, the second glance always reflects a slightly falsified image of the object. Guided by various object characteristics such as motion direction, colour and spatial position, our short-term memory makes systematic mistakes. Apparently, these mistakes help us to stabilise the continually changing

impressions of our environment. This has been discovered by scientists at the Institute of Medical Psychology at Goethe University.

Children know when crossing the street, first look to the left, then to the right, and finally once more to the left. If we see a car and a cyclist approaching when we first look to the left, this information is stored in the short-term memory. During the second glance to the left, the short-term memory reports: bicycle and car were there before, they are the same ones, they are still far enough away. We cross the street safely.

This is, however, not at all true. the short-term memory is deceptive. When looking to the left the second time, our eyes see something completely different: The bicycle and the car do not have the same colour as before because they are just now passing through the shadow of a tree, they are no longer in the same location, and the car is perhaps moving more slowly. The fact that we nonetheless immediately recognise the bicycle and the car is due to the fact that the memory of the first leftward look biases the second one.

Scientists at Goethe University, led by psychologist Christoph Bledowski and doctoral student Cora Fischer reconstructed the traffic situation—very abstractly—in the laboratory: Student participants were told to remember the motion direction of green or red dots moving across a monitor. During each trial, the subject saw two moving dot fields in short succession and subsequently had to report the motion direction of one of these dot fields. In additional tests, both dot fields were shown simultaneously next to each other. The subjects all completed numerous successive trials.

The Frankfurt scientists were interested in the mistakes made by the subjects and how these mistakes were systematically connected in successive trials. If, for example, the observed dots moved in the direction of 10 degrees, and in the following trial in the direction of 20

degrees, most people reported 16 to 18 degrees for the second trial. However, if 0 degrees were correct for the following trial, they reported 2 to 4 degrees for the second trial.

The direction of the previous trial therefore distorted the perception of the following one—"not very much, but systematically," says Christoph Bledowski. He and his team extended previous studies by investigating the influence of contextual information of the dot fields like colour, spatial position (right or left) and sequence (shown first or second). "In this way, we more closely approximate real situations in which we acquire different types of visual information from objects," Bledowski explains. This contextual information, especially space and sequence, contribute significantly to the distortion of successive perception in short-term memory. First author Cora Fischer says: "The contextual information helps us to differentiate among different objects and consequently to integrate information of the same object through time."

What does this mean for our traffic situation? "Initially, it doesn't sound good if our short-term memory reflects something different from what we physically see," says Bledowski. "But if our short-term memory were unable to do this, we would see a completely new traffic situation when we looked to the left a second time. That would be quite confusing, because a different car and a different cyclist would have suddenly appeared out of nowhere. The slight 'blurring' of our perception by memory ultimately leads us to perceive our environment, whose appearance is constantly changing due to motion and light changes, as stable. In this process, the current perception of the car, for example, is only affected by the previous perception of the car, but not by the perception of the cyclist."

More information: Cora Fischer et al. Context information supports serial dependence of multiple visual objects across memory episodes, *Nature Communications* (2020). DOI: 10.1038/s41467-020-15874-w

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