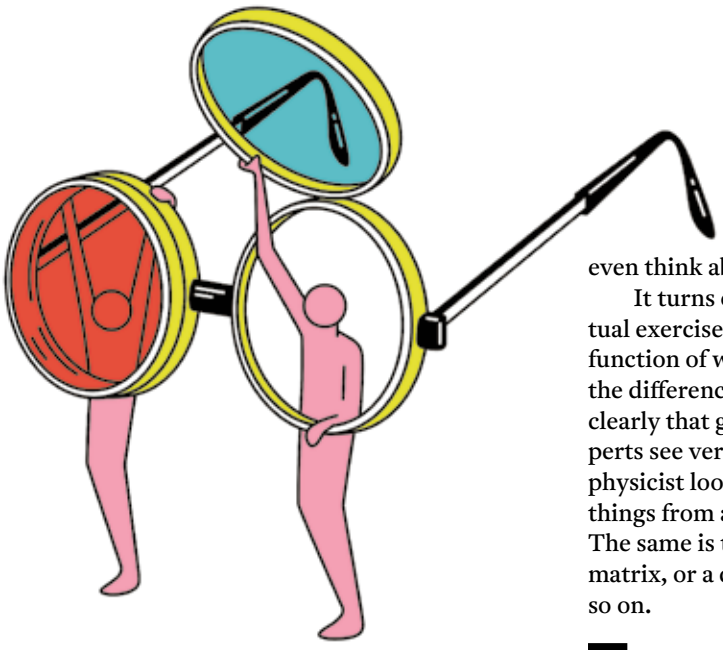

Column

Why we fail to see

I used to be a high-school maths teacher. Here my teaching philosophy was simple: motivate and explain as clearly as possible. I thought that if I could deliver an engaging lecture, explain the target concepts in a logically structured way and show my students step-by step how and when to use these concepts, that they would just get it. But I failed. Time and again, and rather frustratingly so, many students simply did not see what I was trying to show them. Well, if at first you don't succeed, try again. So I would go through the entire process of explaining the concept all over again. But the problem persisted. Why weren't my students seeing what I was trying to show them?

Let's indulge in a thought experiment: imagine you're watching a highly interesting and entertaining movie. Sitting next to you is an acclaimed director, an expert at making movies. At the end of the movie, I ask you: Did you see what the director saw? Chances are you'll say no. There were some things that the director saw that you wouldn't even think about seeing, let alone see them.

It turns out that seeing is not simply a perceptual exercise; it's also a cognitive one. Seeing is a function of what one knows. Decades of research on the difference between experts and novices show clearly that given the same perceptual stimuli, experts see very different things from novices. A physicist looks at F = ma, and sees very different things from a novice looking at the same equation. The same is true for a mathematician looking at a matrix, or a doctor looking at a medical case. And so on.

Expertise is not just about knowing more, but about what that knowledge allows us to see. Experts see critical features, underlying dynamics, conditions, assumptions, contextual constraints – the deep structure of the domain – that a novice finds very hard to see. The implication for teaching is clear. Here the primary task is not conveying knowledge but preparing the novice to see what you want them to see. Showing what you want them to see in an engaging and clear way is important – there can be no argument about that. But preparing the novice to see before you show them is even more important.

How does one do that? In my first article, I wrote about how failure can be bootstrapped for deep learning. It turns out that failure is a powerful way of preparing a novice to see.

So it was in my case: as a young maths teacher, I assumed that my students could see what I was trying to show them. I was wrong. And that failure made me see what the real problem was. Me.

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Illustration: Benedikt Rugar; Image: Courtesy of Manu Kapur