something is wrong. It might take you a few seconds' reflection to realize exactly what is wrong, but you will notice the change very quickly. As your hand reaches for the moved knob, you will realize that it is not in the correct location. Or when you see the door's new window, something will appear odd. Or if the door's weight has been changed, you will push with the wrong amount of force and be surprised. The point is that you will notice any of a thousand changes in a very short period of time.

How do you do that? How do you notice these changes? The AI or computer engineer's approach to this problem would be to create a list of all the door's properties and put them in a database, with fields for every attribute a door can have and specific entries for your particular door. When you approach the door, the computer would query the entire database, looking at width, color, size, knob position, weight, sound, and so on. While this may sound superficially similar to how I described my brain checking each of its myriad predictions as I glanced around my office, the difference is real and far-reaching. The AI strategy is implausible. First, it is impossible to specify in advance every attribute a door can have. The list is potentially endless. Second, we would need to have similar lists for every object we encounter every second of our lives. Third, nothing we know about brains and neurons suggests that this is how they work. And finally, neurons are just too slow to implement computer-style databases. It would take you twenty minutes instead of two seconds to notice the change as you go through the door.

There is only one way to interpret your reaction to the altered door: your brain makes low-level sensory predictions about what it expects to see, hear, and feel at every given moment, and it does so in parallel. All regions of your neocortex are simultaneously trying to predict what their next experience will be. Visual areas make predictions about edges, shapes, objects, locations, and motions. Auditory areas make predictions about tones, direction to source, and patterns of sound.

sory areas make predictions about touch, texture, contour, and temperature.

"Prediction" means that the neurons involved in sensing your door become active in advance of them actually receiving sensory input. When the sensory input does arrive, it is compared with what was expected. As you approach the door, your cortex is forming a slew of predictions based on past experience. As you reach out, it predicts what you will feel on your fingers, when you will feel the door, and at what angle your joints will be when you actually touch the door. As you start to push the door open, your cortex predicts how much resistance the door will offer and how it will sound. When your predictions are all met, you'll walk through the door without consciously knowing these predictions were verified. But if your expectations about the door are violated, the error will cause you to take notice. Correct predictions result in understanding. The door is normal. Incorrect predictions result in confusion and prompt you to pay attention. The door latch is not where it's supposed to be. The door is too light. The door is off center. The texture of the knob is wrong. We are making continuous low-level predictions in parallel across all our senses.

But that's not all. I am arguing a much stronger proposition. Prediction is not just one of the things your brain does. It is the *primary function* of the neocortex, and the foundation of intelligence. The cortex is an organ of prediction. If we want to understand what intelligence is, what creativity is, how your brain works, and how to build intelligent machines, we must understand the nature of these predictions and how the cortex makes them. Even behavior is best understood as a by-product of prediction.

I don't know who was the first person to suggest that prediction is key to understanding intelligence. In science and industry no one invents anything completely new. Rather, people see