WHICH IS BETTER: 1 OR 0?

"It's difficult to make predictions, especially about the future." This quote, famously misattributed to the baseball player Yogi Berra, probably originated in a Danish proverb.[1]

I choose to believe that this saying was initially popularized by the physicist Niels Bohr, who may have been channeling fellow physicist Erwin Schrödinger's ideas on the paradox of quantum superposition.[2] In any event, I'm sure there must be some tenet of quantum physics that dictates that, if I believe this strongly enough, it will become a fact.

Futurists have a generally dismal track record. Nuclear-powered vacuum cleaners, self-cleaning houses, a meal in a pill, and vast undersea colonies are only a handful of the myriad misses postulated for every correct prediction by noted futurists.[3-5] As a child, I received most of my formative information on the future by watching reruns of *The Jetsons* and *The Six Million Dollar Man*. Now that I have seen the future, I find it somewhat lacking.

One technological revolution, however, appears to have gained sufficient traction to affect ophthalmology significantly. The growth of ubiquitous urban closed-circuit television surveillance coupled with machine learning–based AI has created object recognition, or computer vision, that is superior to human performance.[6] Surveillance imagery is by no means the only source of data for computer vision. As it turns out, we willingly hand over reams of imagery via our social media postings. In the aftermath of the Capitol protests on January 6, the Federal Bureau of Investigation stated that it had received more than 100,000 pieces of digital media from which it was pursuing leads and identifying suspects using computer vision.[7]

AI is an overused term. But in the deep learning approach to AI, computer vision algorithms learn through multiple trial and error cycles in neural networks.[7] Training these networks with large databases of images has become possible with large cloud-based resources. AI technology has advanced to the point that it can detect abnormalities on computed tomography scans (better known as CT scans) as effectively as a trained radiologist.[8]

Although some attempts have been made to employ AI in the interpretation of corneal topography, optic nerve head analysis, visual field testing, and retinal OCT scans, I predict that computer vision interpretation of these diagnostics will soon improve exponentially. The capabilities of our current systems may seem relatively primitive by comparison. In the area of refraction, I have heard from several respected colleagues that they have shifted their gold standard away from the manifest refraction and toward the wavefront refraction. Although the two are used comparatively, one must imagine that applying AI to wavefront refractions will ultimately prove superior to a patient's momentary impression of whether 1 is better than 2.

The revolution in computer vision—owing to the exponential growth in computer processing power—progressed with a velocity that surprised the best minds in the field. The technological challenge of identifying relatively stereotyped retinal vascular abnormalities or patterns of inferior corneal steepening seems fairly simple compared to parsing the identity of a single human face from a database of hundreds of billions of images uploaded to social media sites.

For now, our jobs as eye surgeons seem safe, but if I were starting a career reading CT scans, I'd be looking over my shoulder. The machines are gaining ground.[9] ■

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