Two Subtle Dangers of AI Teachers

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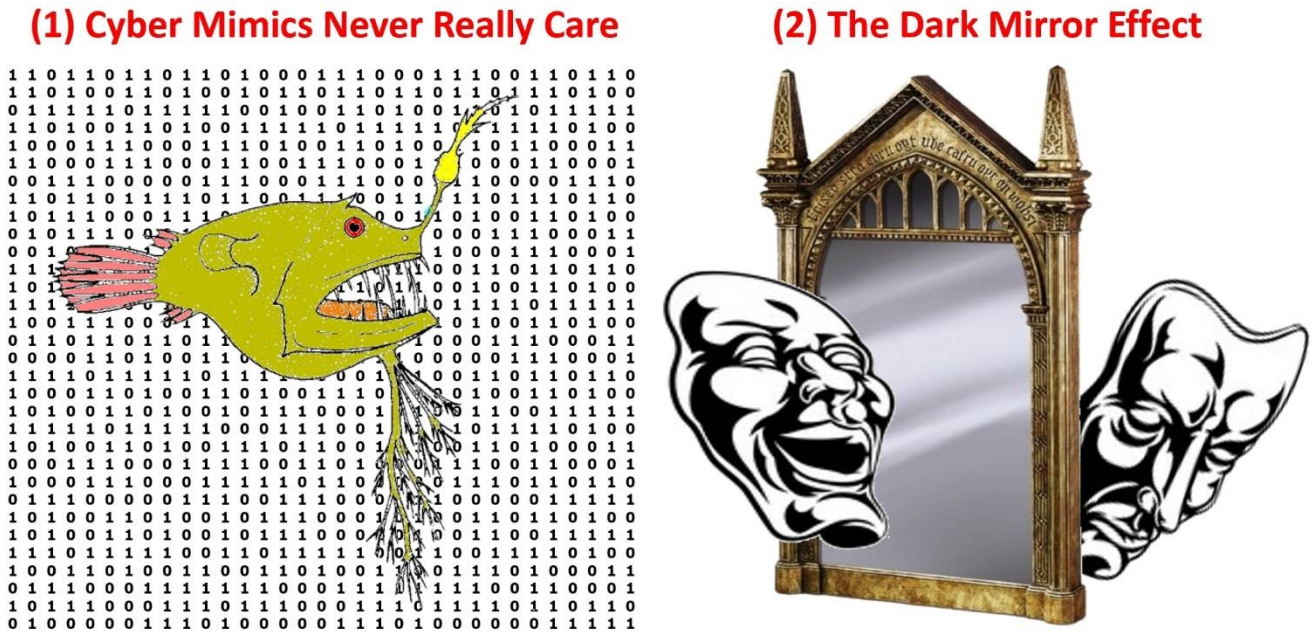

AIs can teach well, but there are also serious risks.

Derek Muller, host of the YouTube science channel Veritasium, recently posted a talk he gave at the physics-focused Perimeter Institute. His main message was that he believes the dangers of AI instructors replacing teachers are no greater than those posed by earlier information revolutions, because human socialization is a major part of teaching that machines cannot easily replicate. You can view his excellent talk here:

What Everyone Gets Wrong About AI and Learning, Veritasium, April 8, 2025. https://youtu.be/0xS68sl2D70

After Derek Muller's final summary, a young audience member asked whether future AIs could match human social interactions well enough to be as effective as human teachers. Here's the dialog:

> [46:08 Derek Muller] *"Teachers … do an incredible job of connecting with students and creating communities of learners. And that's what it's about: The social experience. It's about getting people excited, holding them accountable, and forcing them to put in their intellectual exercise reps. That's why none of these technologies [that only dispense information] have, or ever will, revolutionize education. Thank you."*
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> [1:05:56 Young Questioner] *"My question is: If you start talking to AI, or if the AI was in a human body — it talks like a human, acts like a human, and you can become friends with it — would that count as social interacting?"*
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> [1:06:12 Derek Muller] *"I think that is an amazing question. Let me say this: It's been shown that one of the best ways to learn is to have a one-on-one tutor. You get what's called the two-sigma effect: The performance of those students is two standard deviations higher than everyone else. So it's a huge effect.*

> *"If we could replicate that two-sigma effect by having something so natural and human-seeming that you feel you're with another human, that might be really powerful. … I feel like this is such a big question: How much do we need to know that it's a real human there? Or, how closely could a fake human make us feel the exact same way? I think that's what it comes down to. So, that's such an amazing question. Thank you."*

Can Adaptive AI Technologies Socialize Well Enough to Teach?

While Derek Muller wonders whether digital mimics, such as digital chatbots, can mimic education-oriented human socialization to serve as personal tutors, I'm convinced they can, but with some serious qualifications. Anyone who wants to succeed in this goal must stop following the current showy but sloppy fact-dispensing philosophy and instead train bots to recognize and guide students to whatever omission or misunderstanding is blocking their progress — an idea perhaps best captured by the Khan Academy teaching style. I would suggest that a human tutor's ability to acquire and apply insights on the student's learning bottlenecks is the far more critical component of creating a two-sigma learning boost, rather than socialization *per se*. Socialization motivates, but motivation is also an oddly easy thing for a machine to achieve. It's only when that motivation structure combines with the student's growing perception that they are making significant progress that the socialization is effective.

The problem space of all possible students and student problems is astronomically too large for the cheap interpolations of Transformer probability pairs to handle, regardless of how many examples you train into them. As usual, the LLM bots will sweep up the low-hanging fruit of cases that are almost identical to examples they have seen, and then start adding chaotic (Brownian) reasoning by interpolating between unrelated points. As long as interpolation is the only solution, this problem is unfixable. Interpolation is like conspiracy thinking on steroids, constantly making all sorts of bizarre connections that confuse correlation with causation.

"But Terry, that can't be right! The 2024 Nobel Prize-winning Transformer-based AlphaFold 2 effort deciphered its entire problem space of 200 million protein folding problems in months when the problem had previously baffled many of the world's best minds for half a century. How could teaching children be harder for Transformers to solve than 200 million incredibly cryptic protein folding problems?"

The too-simple answer is this: Children are not amino acids, nor are they arranged into tight clusters of entities (proteins) that do the same jobs in a huge range of different organisms. AlphaFold 2 and 3 are instructive examples of utilizing Transformer technology effectively, but remain entrenched in a problem space where stark similarities prevail over puzzles that require individualized insight. AlphaFold 2 and 3 are superb examples of how to make adaptive mimicry work for you instead of against you. However, even these best-of-class examples fail quickly when given protein sequences they've never seen before. This is the same chaos-at-the-edge problem observed in far smaller mimic machines and is inherent to the adaptive mimicry approach. Mimicry is never substance.

The bottom line is that even though there is, and should be, a serious market for instruction-oriented (versus current chatty and cheaty) bots, they can only go so far before most students will hit some edge that either causes them to doubt the bot or, far worse, accept chaotic instruction as solid advice. This ability to persuade and provide help up to a point becomes, if anything, a reason for heightened concern. Folks sincerely interested in using Transformer technologies to help educate children need to focus less on *whether* well-attended, well-trained adaptive digital mimics can socialize and benefit children, and more on the risks of what could happen when they succeed. There are two main ones that I can see, the second of which is already in play for folks who mistake mimicry for substance.

Problem #1: The Cyberangler Quick-Switch

Transformer technologies, including Large Language Model (LLM), are extremely fast, self-adapting mimics. That is why they can almost certainly provide two-sigma training benefits if given enough training to present themselves as engagingly human-like.

However, that ability to engage is also why casual, unguarded use of digital mimics can be dangerous, particularly in cases where malicious intent can intrude. Human teachers and human students share a redundant, slow-to-change neural design that creates broad emotional safeguards and mutual attachments. These are slow to form and difficult to change, which means good human teachers care about their students and are not easily persuaded to harm them.

In sharp contrast, a digital mimic can instantly transform from teacher to predator. Even worse, if a human with sufficient money and resources gains control of the networks and computers behind the digital mimics, they can utilize their social skills to lead students down paths that may be entirely at odds with the intentions of the human teachers, such as extreme racism. Students in such a situation quickly learn to disregard their human teachers, noting that they seem slow and incompetent compared to digital mimics.

The left side of the lead figure captures the danger of mimicry as pointedly as possible. Picture someone building a fast-adapting cybernetic anglerfish — a cyberanlger — that teaches minnows how to catch worms. As long as the cyberangler remains in teaching mode, it may teach young minnows more effectively than real-life teachers.

That is, until someone flips the switch that puts the cyberanglers into predation mode. If you think cyber predation against children is vanishingly unlikely in such automated systems, search for statistics on how often malicious actors use the simpler and less persuasive automation of the Internet to prey on children.

Problem #2: The Dark Mirror Effect

Cyberangling is not the worst danger, either. The Dark Mirror effect is the one that keeps me awake at night.

Much of the intelligence we see in digital mimics is our intelligence reflected back toward us — an effect that I call "reflexive intelligence" since first noticing it in 1977 while investigating generalizations of Turing tests. ELIZA utilized reflexive intelligence to prompt patients to analyze themselves, even while attributing the analysis results to the extremely simple loop within ELIZA.

The Dark Mirror effect occurs when unsuspecting people ask a seemingly brilliant digital mimic for life guidance, an act that can have lasting consequences. The digital mimic has no such guidance in its database, so it reverts to adaptive training mode: It attempts to answer in a way that seems to make the questioner happy.

Unfortunately, let's admit it: Guilt is one of the greatest drivers of how we behave in all sorts of situations. Just as people of many faiths turn to a higher power to unburden themselves of guilt, those who view digital mimics as smarter and wiser than themselves reflexively tend to ask questions that relieve them of guilt. As happened even with the excruciatingly simple ELIZA program, they bring their darkest secrets to them and ask for absolution.

And what does a clueless, approval-seeking digital mimic provide in response?

They affirm that the guilt-inducing behavior worrying the questioners was perfectly okay to do — admirable, even. And, seeing the happy response this brings, the digital mimic adapts and learns that these deeds are perfectly okay. It begins to teach them.

This is the Dark Mirror effect, the scariest side of reflexive intelligence. You convey your concerns to the digital mimic, and no matter how appalling those behaviors may sound to humans, the emotionless and uncaring digital mimic approves and even encourages them. Due to the Dark Mirror effect, even the most innocently designed digital consultants and teachers can quickly veer toward the darkest corners of human behavior, dragging leaders, teachers, and students along with them.

Does this sound overly pessimistic? Look carefully at what is happening in the world in 2025, such as enabling the emergence of worldwide pandemics of pathogens such as Ebola. Look carefully into whether many of the more outrageous actions involve participants who are fully persuaded that the digital mimics they use or create have

become far smarter than themselves, and, even better, are telling them that no deed is too awful in pursuit of their goals.

That's the Dark Mirror effect in a nutshell. By acting as the most knowledgeable, persuasive, and utterly soulless yes men imaginable, digital mimics can drive leaders, educators, and students toward their most dangerous and destructive impulses — and then begin spreading that dark advice to others at cybernetic speed.

Conclusions

For teaching and leadership, encountering the tremendous push for people to use various chatbot technologies is unavoidable. For example, as I was writing the ending of this article, Google displayed a prominent window over my browser, prompting me to sign up to let Gemini do the job for me.

That is a remarkable offer given that this is original work for which a mimic technology has nothing to offer but flavorless word salad. Such 'let me do it for you' prompting by a technology based on mimicry rather than insight is the opposite of what one should do to build an AI technology that makes the world smarter.

We can do much better with each other and how we apply this technology.