

If someone looks up and to the left while they say something, they're lying to you. If they're tugging at their sleeves, they're not being truthful. A stutter? Don't believe a word out of their mouth!

How many of these adages about detecting deceit have you heard before? From folk psychology to polygraph tests to truth serums, humans love the idea of a lie detector. The truth, as renowned psychologist and recognized authority on lying Paul Ekman points out, is that there is no Pinocchio nose that someone is definitely lying that applies to all people. People can have individual tells that can be learned, and certain physical changes, when viewed holistically, can be a good guideline, but a perfect lie-detecting system is yet to exist.

That being said, some people are *really* good at telling when someone's lying. You've probably encountered some — the player at the poker table who always seems to know when someone's bluffing, or your second-grade teacher who could somehow always tell that your dog didn't actually eat your homework. Machines have come close as well: the polygraph test, though not always accurate, is considered reliable enough to use in a police investigation, and in many states, to cite in a courtroom. These people and machines do it by observing fluctuations in pupil dilation, blushing, and a variety of other body language tells to single liars out from the crowd. There is a general set of heuristics that lie detectors — both people and machines — use to figure out if a person is lying. In the case of people, there's no mental formula that good lie detectors filter information through to tell if someone is lying, it more or less boils down to attentive intuition. While the polygraph test uses more concrete, quantifiable data like heart rate and blood pressure, any of the physiological changes it measures can also occur for reasons other than lying.

Instead of using just intuition or physiological changes exclusively, we can now take advantage of the totality of the data that's readily available to us. With advances in AI, it could be possible that we may live in a world where we know how to detect truth with absolute certainty.

Let's delve a little further into the current most widely accepted lie-detecting system: the polygraph test. The instrument used in polygraph tests is a physiological record that assesses various physical parameters, otherwise known as 'tells'. Pneumographs are wrapped around the chest to measure the rate of respiration. Cardiovascular activity is assessed by a blood pressure cuff. Skin conductivity is estimated through electrodes attached to the person's fingertips. Apart from everyday intuition, the polygraph is the most

common method used in detecting lies. However, considering that its primary use is in a high-stakes investigatory or courtroom setting, the margin of error is too close for comfort. Moreover, they are invasive and require an experienced human interviewer to conduct the interrogation and interpret the results. The validity of the polygraph has been called into question time and time again, with critics citing the fact that the physiological parameters measured only have a proven causal link to nervous excitement, not necessarily to lying.

Another lie detection system, the Psychologically Based Credibility Assessment Tool (PBCAT), belongs to a school of thought within deception research following something called the cognitive load approach (CLA). Cognitive load is a term used to refer to the amount of mental tax or effort needed to complete a certain task. The CLA proposes that lying requires a higher cognitive load, which then results in certain patterns of behavior. In studies used to develop the PBCAT, researchers found that participants were able to identify deception in others more easily when the lying participants had to recount events in backward order, as this creates a heavier cognitive load. The PBCAT is a system with 9 different rating scales meant to be used by humans to assess the truthfulness of another person's story. These scales are based largely on the semantic content of the story, including the number of contradictions in their story, the amount of sensory detail, and how vague or precise the person was.

All of these lie-detecting systems focus exclusively on one measure to reach a conclusion about whether someone is lying. Humans rely on intuition, polygraphs on physiological changes, and the PBCAT on semantic content. To create a truly comprehensive lie detector, we need to look at a wide range of parameters when it comes to telling if someone is lying or not. The parameters measured by the polygraph are a good place to start, but we should also try to identify the factors that inform human intuition on deception, and see how we might be able to quantify these factors. The underlying principle of the PBCAT, which is that lying requires more of a cognitive load than telling the truth, would manifest itself not just in the storytelling of the subject, but presumably in their brain activity as well, which could be measured using EEG data.

Additionally, another drawback of the lie-detecting systems discussed above is that they all require human judgment in order to make an assessment. Each requires a human interpreter to make sense of the results, and in the case of the PBCAT, it's a human who is doing all of the scoring in the first place. What if we

could take what works from all of these systems, and create an artificial intelligence-based system that is smart enough to make such assessments, without the human bias?

One recently developed lie-detecting system has put us one step closer to that goal, using AI to assess deception based on a parameter that existing systems have largely ignored: facial expression. Facial expression is crucial to our intuitive sense of when someone is lying, but it is difficult to quantify has left it out of structured lie-detecting systems for a long time — until now.

Researchers from the University of Maryland developed the Deception Analysis and Reasoning Engine (DARE), a system that uses artificial intelligence to autonomously detect deception in courtroom trial videos. DARE was taught to look for human expressions, such as “lips protruded” or “eyebrows frown,” and also analyze audio frequency for revealing vocal patterns that indicate whether a person is lying or not. It was then tested using a training set of videos in which actors were instructed to either lie or tell the truth.

Researchers at Cornell University also made a system that is built on the foundations of DARE. The system made at Cornell primarily focuses on deception detection in real-life courtroom trial videos. The researchers also showed that predictions of brief, fast facial movements could be used as features for deception prediction. The system was trained using videos of human expressions which lead to the system defining different classifiers based on various visual filters. A classifier is a function that gives a predicted value of the output that is used to assign categorical labels to particular data points in the dataset. Each classifier received a certain score that corresponded to a weight. Larger weight meant that the system would place more importance on that classifier when detecting a lie. For example, the researchers observed that “Eyebrows Raise” (~70% efficient) was more effective than other micro-expressions.