

AP Seminar Reading Packet

Summer 2024



Cambridge AP Seminar Introductory Texts

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AP Seminar Summer Assignment

Welcome to AP Seminar, where you will learn to read and think critically and synthesize information. This booklet will be your first textbook, and you will prepare for our first unit by reading and annotating this collection of texts. We have provided an annotation guide to help you, as well as reading strategies to help you determine the central idea or theme. (Hint – if you want to fill out the theme or central idea chart to help you, you can print one off from the Cambridge website).

READ THROUGH THE STRATEGIES AND DIRECTIONS CAREFULLY BEFORE BEGINNING! Using the resources provided and your annotations, craft a theme statement or central idea statement for EACH work. Then, write a written reflection on the connecting thematic idea. **Remember, it is NOT one word – a theme or central idea cannot be “justice”. What is the author SAYING about justice?**
Ex: “Justice is often applied differently based on socioeconomic status, even in a democratic system.”

1. “Kate Middleton, Britney Spears and the Online Trolls Doubting Their Existence” by Tiffany Hsu

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2. “Myth of the Genius Solitary Scientist is Dangerous” by Ken Clark

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3. “Ignorance” by Yuval Noah Harari

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After reading, annotating, and determining the theme or central idea, hopefully you have noticed a common thread running through these works. What **THEMATIC IDEA** (one word this time), is an idea that is common to all the works? To help you, you can consult a list of abstract nouns.

Thematic Idea for Summer Packet of Works:	
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This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

ANNOTATION GUIDE

★ = THIS IS IMPORTANT

UNDERLINE = KEY WORDS & DETAILS

✓ = UNDERSTOOD

○ = UNKNOWN WORD/VOCABULARY

? = CONFUSING/UNCLEAR INFORMATION

∞ = CONNECTION

NOTES IN MARGINS = THOUGHTS &
COMMENTS

Determining Central Idea Using Strategies (Non-Fiction Text)

How does the title relate to the rest of the text? Is it a hint to the central idea	
Examine what repeats	
List ideas, objects, etc. that repeat, then determine whether they are motifs:	

Introduction

Does the author state his/her intention?	What is the author's purpose?

Text Structure

How is the text structured? Cause and Effect? Problem and Solution? Chronological? Compare and Contrast? Your central idea statement will have all aspects of the text structure (i.e., the problem AND the solution)	
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Re-read Ending

Important (mike drop) sentences from final paragraphs

Examine your thinking and craft a central idea statement:

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Kate Middleton, Britney Spears and the Online Trolls Doubting Their Existence

Whether it is just for kicks or propelled by genuine doubt, the unsupported claims about celebrities and public figures keep gaining traction online.



By Tiffany Hsu

Published March 20, 2024 Updated March 21, 2024

Kate Middleton has long been a magnet for unproven rumors: She pressured an art gallery to remove a royal portrait! She split from her husband! She changed her hairstyle to distract from pregnancy rumors! She did not give birth to her daughter!

This year, speculation kicked into overdrive. Ms. Middleton — now Catherine, Princess of Wales — has lain low since Christmas. Kensington Palace said she was recovering from “a planned abdominal surgery” and unlikely to resume royal duties until after Easter. Conspiracy theorists had other, more sinister ideas. The only explanation for the future queen’s long absence, they said, was that she was missing, dying or deceased, and that someone was trying to cover it up.

“KATE MIDDLETON IS PROBABLY DEAD,” read one post on X, with the text flanked by skulls and screaming emojis.

In her invented death, the princess joins a host of other celebrities and public figures — from President Biden to Elon Musk — whom scores of online detectives have declared in recent months to be clones, body doubles, A.I.-generated avatars or otherwise not the living, breathing people they are.

For many of the people pushing the falsehoods, it is harmless fun: casual gumshoeing that lasts only a few clicks, a bonanza for meme generators. Others, however, spend “countless hours” on the pursuit, following other skeptics down rabbit holes and demanding that celebrities provide proof of life.

Whatever the motivation, what lingers is an urge to question reality, misinformation experts say. Lately, despite extensive and incontrovertible evidence to the contrary, the same sense of suspicion has contaminated conversations about elections, race, health care and climate.

Much of the internet now disagrees on basic facts, a phenomenon exacerbated by intensifying political polarization, distrust of institutions such as news and academia as well as the rise of artificial intelligence and other technologies that can warp people’s perception of truth.

In such an environment, celebrity conspiracy theories became a way to take control of “a really precarious, scary and unsettling moment,” said Whitney Phillips, an assistant professor of media ethics and digital platforms at the University of Oregon.

“The darkness that is characterizing our politics is going to insert itself into even the more lighthearted articulations of speculation,” she said. “It just speaks to a sense of unease in the world.”

Pop culture history is suffused with post-mortem claims that famous dead people (like Elvis and Tupac) are still alive. Now comes the reverse.

In recent weeks, frenzied online chatter claimed that Catherine was dead or even in an induced coma — a rumor dismissed by the palace as “ludicrous.” Internet sleuths declared that photos of Catherine in cars with her mother and husband were actually another woman who lacked the princess’s facial moles.

Last week, the palace sparked more conjecture with a Mother’s Day image of the royal with her three children. Inconsistencies in the clothing and background of the portrait led to rumors that the image had been lifted from old photos in an attempt

to hide her true whereabouts. By the time Catherine apologized for editing the image, the #WhereIsKateMiddleton hashtag was spreading on social media.

Another video of Catherine and her husband at a store in recent days was combed over by conspiracy theorists who said she looked too blurry, too healthy, too thin, too flat-haired, too unprotected by bodyguards to really be the princess. This week, after a video showing the Union flag at half-staff at Buckingham Palace began circulating, social media users interpreted the footage as a sign that either the princess or King Charles III, who has cancer, had died. The video turned out to be of a building in Istanbul in 2022, after Queen Elizabeth II died.

Recycled footage, easy-to-make computer-generated images, a general reluctance by most audiences to fact check easily debunked claims and even foreign disinformation efforts can help fuel doubt in celebrities' existence or independence. There are rumors that Mr. Biden is played by several masked actors, including Jim Carrey. Mr. Musk is one of up to 30 clones, according to the rapper Kanye West (himself often said to be a clone). Last year, Russia's president, Vladimir V. Putin, was confronted during a streamed news conference by an A.I.-generated version of himself asking about his rumored body doubles.

Peeks into celebrities' lives were once carefully curated and rationed through a limited set of media outlets, said Moya Luckett, a media historian at New York University. Few public figures faced the kind of uproar that Paul McCartney did in 1969, when a rumor circulated that the Beatle had died years earlier and had been replaced by a doppelgänger. The supposed evidence — winking lyrics and secret messages in reversed tracks on Beatles songs — so enthralled the public that Mr. McCartney sat through multiple interviews and photo shoots to prove his presence on the mortal coil.

obsession with true crime tales. “I don’t think it’s necessarily that you want to rescue or help.”

Britney Spears, fresh out of a restrictive conservatorship, shared a series of unfiltered and often eccentric posts last year that some fans read as evidence that she had been replaced by a stand-in.

So-called Britney truthers analyzed what they considered to be discrepancies in Ms. Spears’s tattoos, the gaps in her teeth and the color of her eyes. In one forum, a thread titled “She’s Been Cloned!” garnered nearly 400 comments. A popular hashtag warped one of Ms. Spears’s best-known lyrics into #itsbritneyglitch, which appeared alongside claims that a look-alike was using an A.I. filter to mimic the singer online.

Ms. Spears, who was filmed in Las Vegas this year, has repeatedly dismissed falsehoods about her demise or brushes with death. “It makes me sick to my stomach that it’s even legal for people to make up stories that I almost died,” she wrote on Instagram in February last year. A few months later, she posted (and then deleted) “I am not dead people !!!” She was quoted by People in October saying, “No more conspiracy, no more lies.”



Britney Spears has repeatedly dismissed falsehoods about her demise or brushes with death. Valerie Macon/Agence France-Presse — Getty Images

Conspiracy theory peddlers are not necessarily believers: Some of the top voices behind voter fraud lies have admitted in court that their claims were false. Ed Katrak Spencer, a lecturer in digital cultures at Queen Mary University of London, said publicly trying to unmask a bogus celebrity could feel playful.

This month, a years-old conspiracy theory involving the singer Avril Lavigne resurfaced in a tongue-in-cheek podcast from the comedian Joanne McNally, who named her first episode “What the Hell.” The claim — that Ms. Lavigne died and was supplanted by a doppelgänger — originated from a Brazilian blog called “Avril Está Morta,” or “Avril Is Dead,” which itself noted “how susceptible the world is to believing in things, no matter how strange they seem.” In 2017, more than 700 people signed an online petition pushing Ms. Lavigne and her double to provide “proof of life.”

“Fans are themselves vocal performers; the web and especially TikTok are platforms for performance,” Dr. Spencer said. “It’s more about content creation and circulation, with all of this existing as a kind of scene. It’s about the attention

economy more than anything else.”

Dr. Spencer, who worked on academic papers on rumors related to Beyoncé, said it was possible to defang celebrity conspiracy theories. In 2020, a politician in Florida accused the singer of faking her Black heritage “for exposure” and said she was actually an Italian named Ann Marie Lastrassi in league with a deep-state plot involving the Black Lives Matter movement.

Her supporters, the BeyHive, adopted “Lastrassi” as a term of endearment and incorporated it into fan-fiction and online tributes. Beyoncé herself has addressed claims that she and her husband, Jay-Z, are in a secret society, singing on “Formation” that “y’all haters corny with that Illuminati mess.”

“It all comes back to the issue of authenticity, and the crisis of confidence in people’s perception of authenticity,” Dr. Spencer said. “People are constantly questioning what they’re seeing.”

Audio produced by Sarah Diamond.

Tiffany Hsu reports on misinformation and disinformation and its origins, movement and consequences. She has been a journalist for more than two decades. More about Tiffany Hsu

A version of this article appears in print on , Section B, Page 1 of the New York edition with the headline: A World Warped By Suspicion

THE CONVERSATION

Academic rigor, journalistic flair



Rick Sanchez of the animated series Rick and Morty embodies the erroneous popular archetype of the scientist as eccentric lone genius. (Handout)

Myth of the genius solitary scientist is dangerous

Published: November 20, 2017 8:12pm EST

Ken Clark

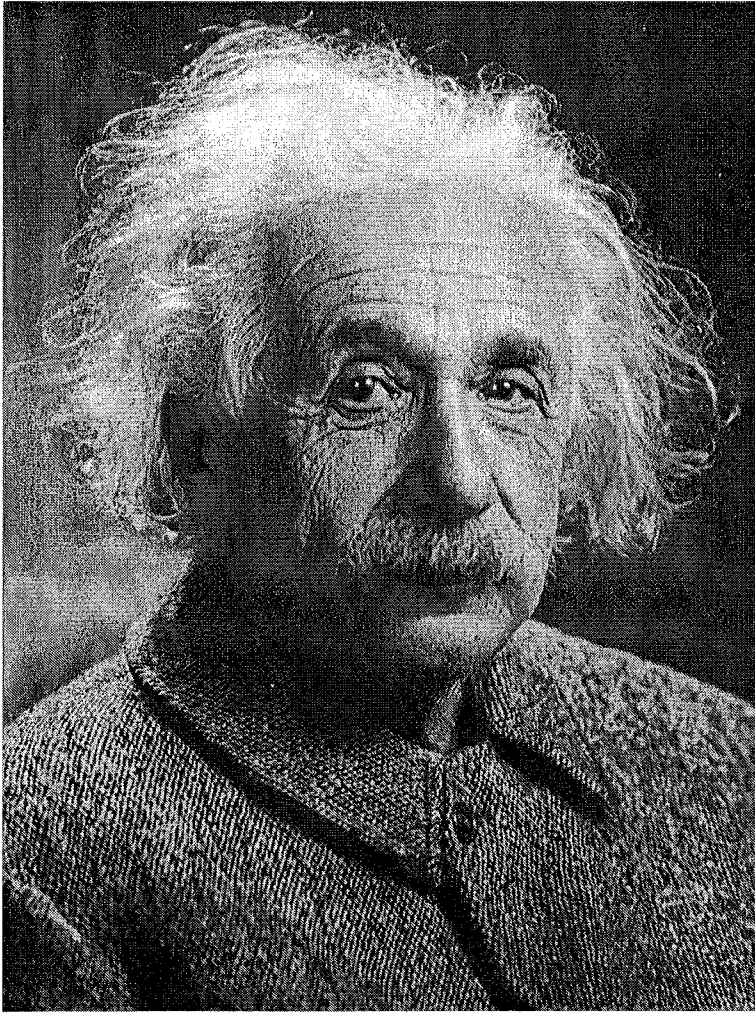
Professor of Astroparticle Physics, Queen's University, Ontario

Picture a scientist. Seriously, right now. I'm not going to discuss the nature of the person that you have in your mind (although I am going to guess: White? Male? Crazy hair? That's not surprising, but another topic entirely). I'm more curious about what they are doing.

It's a relatively safe bet that the scientist in your head is sitting somewhere in front of some very intimidating looking equipment, researching as hard as they can. What's more important to me is what you don't see in that image: All of the people worldwide with whom your pretend scientist collaborates.

Unfortunately, this omission can be dangerous, an idea that I will explain later.

First, let's try to figure out why the archetypal image of a scientist is one who works alone. In fact, for centuries this was close to the truth. Looking back at history you can see that many of the greatest scientific minds tended to work mostly in isolation or, at most, with a few indentured graduate students.



Albert Einstein, seen here in 1947, is the likely inspiration for the stereotypical image of scientists with wild hair. (Orren Jack Turner)

Sir Isaac Newton, for example, is credited with much of not only the physics still used today but also the mathematical framework, and famously preferred working alone (although that could have been due to his propensity for viewing his colleagues as enemies).

James Clerk Maxwell, father of electromagnetism as we know it today, also tended to work solo. Even Albert Einstein gave us the theory of general relativity (and probably the inspiration for the crazy hair mentioned earlier) working by himself.

So, the “lone genius” model of scientific progress has historical justification, right? Well maybe not.

Reality of scientific genius

Newton looked down on his contemporaries (while suspecting them of stealing his work) but regularly communicated with Gottfried Wilhelm Leibniz, who was also working on the development of calculus. Maxwell studied at several prestigious institutions and interacted with many intelligent people. Even Einstein made the majority of his groundbreaking discoveries while surrounded by people with whom he famously used as sounding boards.

Think back to the last pop culture representation of a scientist that you saw. I would tend to think of a few favourites like Eleanor Arroway (Contact), Doc Brown (Back to the Future), Peter Venkman (Ghostbusters), Dana Scully (The X-Files), Seth Brundle (The Fly), Hubert Farnsworth (Futurama), and even Rick Sanchez (Rick and Morty).

The one thread that connects all of these characters is that they worked alone. In fact, this is one of the defining characteristics for the majority of them. But this is far from how science has evolved, through many centuries of effort, to function.

Science doesn't happen in a vacuum (unless your experiment requires vacuum conditions). The whole philosophy of scientific investigation requires every idea to go through validation and scrutiny by many scientists. This process can be a bit time-consuming, and sometimes harsh, however it serves to improve not only the results, but the entire process.

Anything that passes through the fire of criticism from other scientists comes out the other side a vastly improved product.



Dr. Emmett 'Doc' Brown (Christopher Lloyd) of the Back to the Future films remains one of the iconic popular depictions of the lone genius scientist. (Handout)

Dangerous rejection of facts

Given that collaboration is the norm, you may be asking yourself the eternal question: Who cares? How does the image of a lone scientist hero cause any danger to me?

The problem arises when there is a debate about a scientific topic. Following this structure, debate is a necessary and encouraged part of the scientific process. This debate happens before the idea is released to anyone outside of a few scientists and, while it can become heated at times, takes place with great respect between proponents of different viewpoints.

The danger can come when scientific results are released to the public. Our society now provides a platform for anyone to comment, regardless of his or her education, experience or even knowledge of the topic at hand.

While this is an excellent method of disseminating knowledge, it can also provide a platform for any

Particularly in today's largely populist climate, people are looking to see the lone scientist hero overthrow the perceived dominance of facts coming from academia.

And herein lies the problem. In this situation, the opinion of a lone commenter may be considered on equal footing with that of tens or hundreds of people who have made the subject their life's work to ensure their interpretations are correct.

This could give the impression that there is debate about whether evolution is real (it is), or the connection between vaccination and autism (there is none), or whether humans have had an impact on the climate (we most certainly have). Taken to the extreme — which is the only way the internet seems able to take things — these misconceptions can be harmful to everyone.

Setting the record straight

So what can be done? Everyone in this scenario has some responsibility to enact change. The scientists have an obligation to present their results in a manner that's not cloaked behind impenetrable (to anyone but them) jargon, theories, and paywalls.

Particularly in a society in which science is publicly funded, it is the duty of researchers receiving that money to ensure that science can be understood by everyone. Scientists must also walk a fine line not to dismiss "external" viewpoints out of hand.

On the other side, the public has an obligation to consider the reliability of any opinions they read. In this way, discussions can be had which are well-informed and can further lead to the improvement of the final results.

It's important to make science accessible so that the perception of the "hero scientist" does not cause widespread harm to the results as a whole.

Ignorance

You Know Less than You Think

The preceding chapters surveyed some of the most important problems and developments of the present era, from the overhyped threat of terrorism to the underappreciated threat of technological disruption. If you are left with the nagging feeling that this is too much, that you cannot process it all, you are absolutely right. No person can.

In the last few centuries, liberal thought developed immense trust in the rational individual. It depicted individual humans as independent rational agents and has made these mythical creatures the basis of modern society. Democracy is founded on the idea that the voter knows best, free-market capitalism believes that the consumer is always right, and liberal education teaches students to think for themselves.

It is a mistake, however, to put so much trust in the rational individual. Postcolonial and feminist thinkers have pointed out that this "rational individual" may well be a chauvinistic Western fantasy, glorifying the autonomy and power of upper-class white men. As noted earlier, behavioral economists and evolutionary psychologists

have demonstrated that most human decisions are based on emotional reactions and heuristic shortcuts rather than on rational analysis, and that while our emotions and heuristics were perhaps suitable for dealing with life in the Stone Age, they are woefully inadequate in the Silicon Age.

Not only rationality, but individuality too is a myth. Humans rarely think for themselves. Rather, we think in groups. Just as it takes a tribe to raise a child, it also takes a tribe to invent a tool, solve a conflict, or cure a disease. No individual knows everything it takes to build a cathedral, an atom bomb, or an aircraft. What gave *Homo sapiens* an edge over all other animals and turned us into the masters of the planet was not our individual rationality but our unparalleled ability to think together in large groups.¹

Individual humans know embarrassingly little about the world, and as history has progressed, they have come to know less and less. A hunter-gatherer in the Stone Age knew how to make her own clothes, how to start a fire, how to hunt rabbits, and how to escape lions. We think we know far more today, but as individuals, we actually know far less. We rely on the expertise of others for almost all our needs. In one humbling experiment, people were asked to evaluate how well they understood the workings of an ordinary zipper. Most people confidently replied that they understood zippers very well—after all, they use them all the time. They were then asked to describe in as much detail as possible all the steps involved in the zipper's operation. Most people had no idea.² This is what Steven Sloman and Philip Fernbach have termed "the knowledge illusion." We think we know a lot, even though individually we know very little, because we treat knowledge in the minds of others as if it were our own.

This is not necessarily bad. Our reliance on groupthink has made us masters of the world, and the knowledge illusion enables us to go through life without being caught in an impossible effort to understand everything ourselves. From an evolutionary perspective,

trusting in the knowledge of others has worked extremely well for *Homo sapiens*.

Yet like many other human traits that made sense in past ages but cause trouble in the modern age, the knowledge illusion has its downside. The world is becoming ever more complex, and people fail to realize just how ignorant they are of what's going on. Consequently, some people who know next to nothing about meteorology or biology nevertheless propose policies regarding climate change and genetically modified crops, while others hold extremely strong views about what should be done in Iraq or Ukraine without being able to locate these countries on a map. People rarely appreciate their ignorance, because they lock themselves inside an echo chamber of like-minded friends and self-confirming news feeds, where their beliefs are constantly reinforced and seldom challenged.³

Providing people with more and better information is unlikely to improve matters. Scientists hope to dispel wrong views by better science education, and pundits hope to sway public opinion on issues such as Obamacare or global warming by presenting the public with accurate facts and expert reports. Such hopes are grounded in a misunderstanding of how humans actually think. Most of our views are shaped by communal groupthink rather than individual rationality, and we hold on to these views due to group loyalty. Bombarding people with facts and exposing their individual ignorance is likely to backfire. Most people don't like too many facts, and they certainly don't like to feel stupid. Don't be so sure that you can convince Tea Party supporters of the truth of global warming by presenting them with sheets of statistical data.⁴

The power of groupthink is so pervasive that it is difficult to break its hold even when its views seem to be rather arbitrary. For example, in the United States, right-wing conservatives tend to care far less about things such as pollution and endangered species than left-wing progressives, which is why Louisiana has much weaker

environmental regulations than Massachusetts. We are used to this situation, so we take it for granted, but it is really quite surprising. One would think that conservatives would care far more about the conservation of the old ecological order and about protecting their ancestral lands, forests, and rivers. In contrast, progressives would be expected to be far more open to radical changes to the countryside, especially if the aim is to speed up progress and increase the human standard of living. However, once the party line has been set on these issues by various historical quirks, it becomes second nature for conservatives to dismiss concerns about polluted rivers and disappearing birds, while left-wing progressives tend to fear any disruption to the old ecological order.⁵

Even scientists are not immune to the power of groupthink. In fact, scientists who believe that facts can change public opinion may themselves be the victims of scientific groupthink. The scientific community believes in the efficacy of facts, and those loyal to that community continue to believe that they can win public debates by throwing the right facts around, despite much empirical evidence to the contrary.

Similarly, the liberal belief in individual rationality may itself be the product of liberal groupthink. In one of the climactic moments of Monty Python's *Life of Brian*, a huge crowd of starry-eyed followers mistakes Brian for the Messiah. Brian tells his disciples, "You don't need to follow me, you don't need to follow anybody! You've got to think for yourselves! You're all individuals! You're all different!" The enthusiastic crowd then chants in unison, "Yes! We're all individuals! Yes, we are all different!" Monty Python was parodying the counterculture orthodoxy of the 1960s, but the point may be true of the belief in rational individualism in general. Modern democracies are full of crowds shouting in unison, "Yes, the voter knows best! Yes, the customer is always right!"

Name: _____

Class: _____

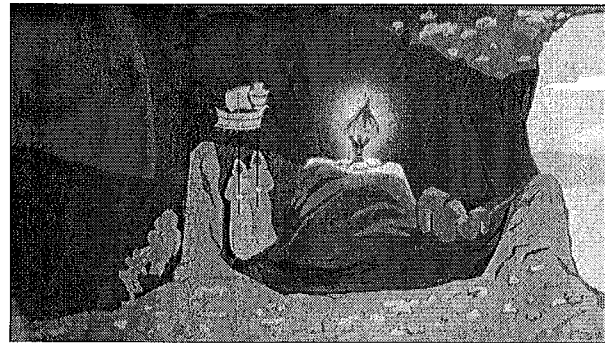
Allegory of the Cave

By Plato

380 B.C.

The Greek philosopher Plato wrote most of his work in the form of dialogues between his old teacher Socrates and some of Socrates' followers and critics. This particular story comes from Plato's book of philosophical fiction, The Republic. In The Republic, Socrates tells his follower Glaucon a story about people living in a cave, which serves as an allegory for human society and the pursuit of knowledge. As you read, track the prisoner's changing perception of the world around him as he moves from the cave to the outer world.

- [1] **Socrates:** And now, let me show in a figure how far our nature is enlightened or unenlightened: — Behold! human beings living in a underground den,¹ which has a mouth open towards the light and reaching all along the den; here they have been from their childhood, and have their legs and necks chained so that they cannot move, and can only see before them, being prevented by the chains from turning round their heads. Above and behind them a fire is blazing at a distance, and between the fire and the prisoners there is a raised way; and you will see, if you look, a low wall built along the way, like the screen which marionette² players have in front of them, over which they show the puppets.



"Plato cave_small" by Rachel Tan is licensed under CC BY-NC-ND 2.0.

Glaucon: I see.

Socrates: And do you see men passing along the wall carrying all sorts of vessels, and statues and figures of animals made of wood and stone and various materials, which appear over the wall? Some of them are talking, others silent.

Glaucon: You have shown me a strange image, and they are strange prisoners.

- [5] **Socrates:** Like ourselves; and they see only their own shadows, or the shadows of one another, which the fire throws on the opposite wall of the cave?

1. that is, in a cave

2. A marionette is a type of puppet that is worked from above by strings attached to its limbs.

Glaucou: True; how could they see anything but the shadows if they were never allowed to move their heads?

Socrates: And of the objects which are being carried in like manner they would only see the shadows?

Glaucou: Yes.

Socrates: And if they were able to converse with one another, would they not suppose that they were naming what was actually before them?

[10] **Glaucou:** Very true.

Socrates: And suppose further that the prison had an echo which came from the other side, would they not be sure to fancy when one of the passers-by spoke that the voice which they heard came from the passing shadow?

Glaucou: No question.

Socrates: To them the truth would be literally nothing but the shadows of the images.

Glaucou: That is certain.

[15] **Socrates:** And now look again, and see what will naturally follow if the prisoners are released and disabused³ of their error. At first, when any of them is liberated and compelled suddenly to stand up and turn his neck round and walk and look towards the light, he will suffer sharp pains; the glare will distress him, and he will be unable to see the realities of which in his former state he had seen the shadows; and then conceive some one saying to him, that what he saw before was an illusion, but that now, when he is approaching nearer to being and his eye is turned towards more real existence, he has a clearer vision, — what will be his reply? And you may further imagine that his instructor is pointing to the objects as they pass and requiring him to name them, — will he not be perplexed? Will he not fancy that the shadows which he formerly saw are truer than the objects which are now shown to him?

Glaucou: Far truer.

Socrates: And if he is compelled to look straight at the light, will he not have a pain in his eyes which will make him turn away to take and take in the objects of vision which he can see, and which he will conceive to be in reality clearer than the things which are now being shown to him?

3. **Disabuse** (*verb*) to free or correct someone from a mistaken or misguided notion

Glaucou: True.

Socrates: And suppose once more, that he is reluctantly dragged up a steep and rugged ascent, and held fast until he's forced into the presence of the sun himself, is he not likely to be pained and irritated? When he approaches the light his eyes will be dazzled, and he will not be able to see anything at all of what are now called realities.

[20] **Glaucou:** Not all in a moment.

Socrates: He will require to grow accustomed to the sight of the upper world. And first he will see the shadows best, next the reflections of men and other objects in the water, and then the objects themselves; then he will gaze upon the light of the moon and the stars and the spangled⁴ heaven; and he will see the sky and the stars by night better than the sun or the light of the sun by day?

Glaucou: Certainly.

Socrates: Last of he will be able to see the sun, and not mere reflections of him in the water, but he will see him in his own proper place, and not in another; and he will contemplate him as he is.

Glaucou: Certainly.

[25] **Socrates:** He will then proceed to argue that this is he who gives the season and the years, and is the guardian of all that is in the visible world, and in a certain way the cause of all things which he and his fellows have been accustomed to behold?

Glaucou: Clearly, he would first see the sun and then reason about him.

Socrates: And when he remembered his old habitation, and the wisdom of the den and his fellow-prisoners, do you not suppose that he would felicitate himself on the change, and pity them?

Glaucou: Certainly, he would.

Socrates: And if they were in the habit of conferring honours among themselves on those who were quickest to observe the passing shadows and to remark which of them went before, and which followed after, and which were together; and who were therefore best able to draw conclusions as to the future, do you think that he would care for such honours and glories, or envy the possessors of them? Would he not say with Homer,⁵ Better to be the poor servant of a

4. **Spangled** (*adjective*) sparkling

5. The famous Greek poet who wrote the Iliad and the Odyssey, whom Plato quotes in italics.

poor master, and to endure anything, rather than think as they do and live after their manner?

- [30] **Glaucón:** Yes, I think that he would rather suffer anything than entertain these false notions and live in this miserable manner.

Socrates: Imagine once more, such an one coming suddenly out of the sun to be replaced in his old situation; would he not be certain to have his eyes full of darkness?

Glaucón: To be sure.

Socrates: And if there were a contest, and he had to compete in measuring the shadows with the prisoners who had never moved out of the den, while his sight was still weak, and before his eyes had become steady (and the time which would be needed to acquire this new habit of sight might be very considerable) would he not be ridiculous? Men would say of him that up he went and down he came without his eyes; and that it was better not even to think of ascending; and if any one tried to loose⁶ another and lead him up to the light, let them only catch the offender, and they would put him to death.⁷

Glaucón: No question.

- [35] **Socrates:** This entire allegory,⁸ you may now append,⁹ dear Glaucon, to the previous argument; the prison-house is the world of sight, the light of the fire is the sun, and you will not misapprehend me if you interpret the journey upwards to be the ascent of the soul into the intellectual world according to my poor belief, which, at your desire, I have expressed whether rightly or wrongly God knows. But, whether true or false, my opinion is that in the world of knowledge the idea of good appears last of all, and is seen only with an effort; and, when seen, is also inferred to be the universal author of all things beautiful and right, parent of light and of the lord of light in this visible world, and the immediate source of reason and truth in the intellectual; and that this is the power upon which he who would act rationally, either in public or private life, must have his eye fixed.

"Allegory of the Cave" from The Republic by Plato (380 B.C.) is in the public domain.

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6. set free

7. In fact, Plato's teacher Socrates had just been put to death because his teachings were seen as too radical at the time.

8. An allegory is a story, poem or picture that can be interpreted to reveal a hidden meaning.

9. add as a supplement

BIG THINK

NEWSLETTERS



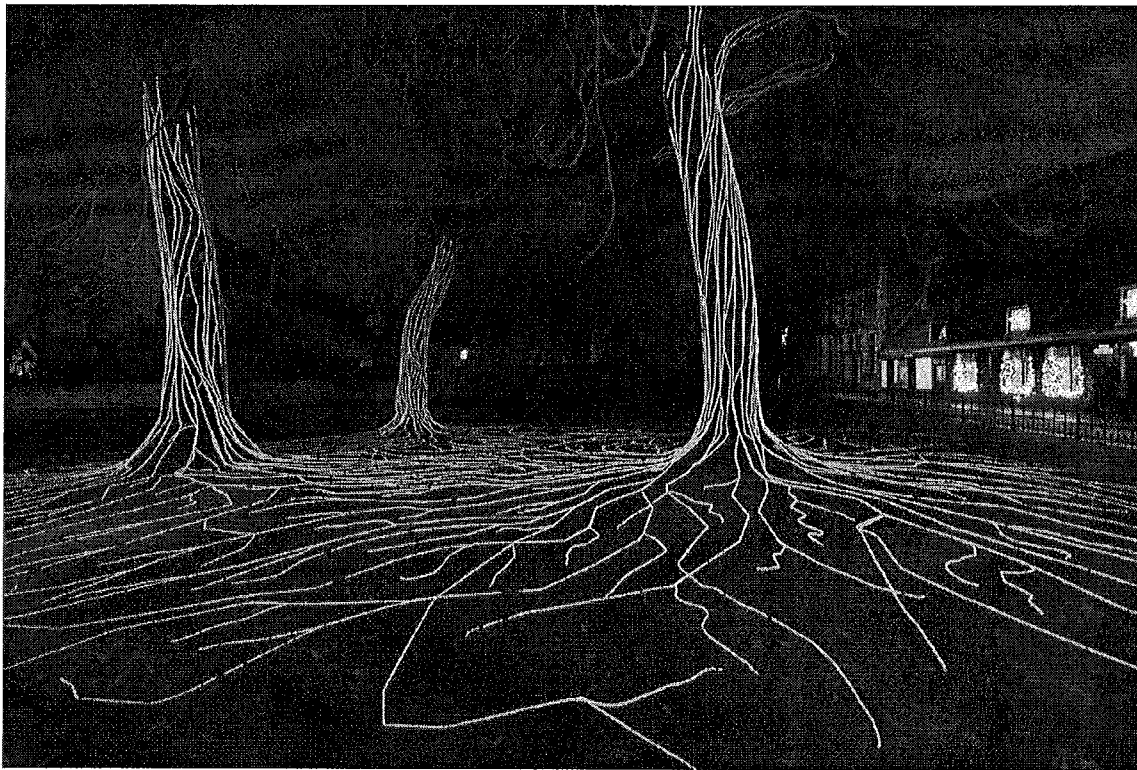
The science of misremembering

It's not a glitch in the matrix. It's not the Mandela effect. There's actually a scientific reason you remember things wrong.

► 8 min — with Lisa Genova

<https://bigthink.com/series/the-big-think-interview/memory-explained/>

Go to this URL and watch the video.



This display in Bruges, Belgium, celebrates networks that connect trees and other plants through fungi underground. It's just one of the ways plants can “talk” to each other and organisms from microbes to animals like us.

PHOTOGRAPH BY SYLVAIN LEFEVRE, GETTY IMAGES

Plants can talk. Yes, really. Here’s how.

Animals aren’t the only ones with the gift of gab. But what are plants actually “saying” to each other? The answer could help feed the world.

By Allie Yang

Published on [nationalgeographic.com](https://www.nationalgeographic.com) on April 12, 2023

“Help!” “Land here!” “Conserve resources!” “Get off!” “My fruits are ready to eat!”

These are just some of the many messages we know plants—from a patch of moss to a 300-foot sequoia—can send. In fact, if you’ve ever smelled freshly mowed grass, you’ve communicated with a plant.

“I think we’re seeing that the complexity [of communication] is just as great with plants as it is with animals,” says Mamta Rawat, a microbiologist and program director at the National Science Foundation (NSF). “I think there’s a lot more to be learned—we’re just touching the tip of the iceberg.”

In March, [a new study](#) showed many different plant species make ultrasonic sounds to communicate stress. It’s the latest evidence showing how plants “talk” with everything from predators to pollinators.

This research has an important use. Understanding how plants communicate could help us increase arable lands to feed our growing population and adapt to climate change.

Heard it through the grapevine

To react to their environment, a single plant must communicate among its roots, stems, leaves, flowers, and fruit.

Instead of signals moving through a nervous system like ours, Simon Gilroy, professor of botany at University of Wisconsin-Madison, says in plants, it's more like plumbing.

Leaves detect predators or changes in light and sound, and roots monitor conditions below ground—problems with nutrients, water, and predators could be there too.

Electrical signals travel through the movement of chemicals in those tubes, explains Courtney Jahn, a biologist and NSF program director who studies plant interactions. For example, roots can detect drought and tell leaves to limit transpiration and conserve water.

Researchers can observe this electrical communication by placing electrodes in two different places on a plant. We've even made instruments (like this [one](#)) that can translate that electric charge into sounds we can hear. If a plant is wounded, electrical signals emanate from that wound, Gilroy says. And plants can transmit these electric signals between individuals if they are [touching](#).

Both venus fly traps and sensitive plants (*Mimosa pudica*) transmit electrical signals when touched, Jahn says. The former closes its mouth to trap their prey, while the sensitive plant moves to shake insects off.

Chemicals, including hormones, also travel within a plant.

A hormone called [auxin](#) is produced at the top of a plant and travels downwards—telling a sprout trying to break through the soil's surface which way is up. When there's an urgent threat, like predation from insects, the plant must react quickly or be entirely consumed. Many plants under this kind of stress send out the hormone [jasmonic acid](#), which tells the plant to start producing a toxin to defend itself.

Some species can detect plants responding to danger (a mouse might “hear” it, an insect might “smell” it), like hearing someone yell “ow!” in the distance. It's difficult to say whether those signals just happen, or if they are intended for others to receive them.

Shout it from the rooftops

Communicating with their surroundings can help plants survive. Eye-catching flowers blooming in the spring send a message to insects and animals that their flowers are ready for pollination.

Researchers found that with special microphones that detect bat calls, you can hear plants, too. A wide range of species from tomatoes to cacti emit ultrasonic popping

sounds when they're stressed that can be heard by insects like moths, and mammals like bats and mice. Scientists are listening to these sounds of distress to find new methods to diagnose, treat, and monitor plants without touching them.



| Mosses (like this one in Omora Ethnobotanical Park in Chile) are one of many kinds of plants that form symbiotic relationships with fungi. Mosses provide sugars they make through photosynthesis, and the fungi give the mosses nutrients.

As humans, we may not be able to naturally hear them, but we can often smell plant messages. When grass is cut, it releases gaseous chemicals, a fragrant distress signal. It's a comforting scent to those of us who associate it with being outside in warmer months. Plants also release this scent when eaten by a caterpillar—and as if responding to their call for help—other bugs take notice and prey on those caterpillars.

This smelly signal belongs to a group of chemicals called volatiles, which can travel far as gasses both above and below ground. Each plant species has their own special mixture of volatile compounds.

Natalia Dudareva, biochemist at Purdue University, says these volatile compounds have many different functions. Volatiles can draw in pollinators when a flower is ready, and even direct them to flowers left unpollinated. Volatiles from fruits attract organisms that will eat and distribute seeds. They're also sent from leaves to "intoxicate" and drive away predators (think of how you react when you're next to someone who's wearing too much perfume.)

Researchers have also learned plants can send messages through volatiles about specific threats they're facing, like predation. Plants neighboring a volatile-emitting plant have been observed to prepare to defend against a threat before they experience it themselves.

Plants can also detect kin vs non-kin using volatiles and change their behavior accordingly. For example, plants will detect their offspring and help them grow instead of competing with them for resources, says Andrea Clavijo McCormick, research officer at the school of agriculture and environment at Massey University.

Plants release volatiles underground, too. Especially prevalent in forests, plants send a “come here” signal to fungi underground, which wraps around the root. Many fungi can stretch and gather nutrients, delivering it back to the plant in exchange for sugar the plant made through photosynthesis.

Let’s stay in touch

A tree in a forest will form relationships with many different fungi, and one fungus will have relationships with many different trees—connecting them in a mycorrhizal network (“myco” means fungus, “rhizal” means root), says Cathie Aime, professor of mycology at Purdue University and rotating program director at NSF.

Interesting “conversations” happen where fungus meets root. The two parties have been observed swapping bits of small RNA, which alter gene expression in the other organism. If the fungus is an ally, it says: “you can trust me,” and it helps the plant grow. If the fungus is a foe, the small RNA from the fungus turns off the plant’s defensive genes, making it easier for the fungus to attack, says Rawat.

When multiple trees are connected by one fungus, they can share resources. Carbon has been traced going through an older “nurse” tree through fungal networks to another, younger tree that's too young to get a good source of light and photosynthesize.

Below ground, plants also communicate with microbes. Like fungi, they’re drawn to the roots and attach themselves by forming a biofilm. For example, growth-promoting bacteria can prime the plant’s defenses, increasing their resistance to disease.

Research into plants’ microbiome below ground is ripe for exploration, and findings could help us enrich soil to feed our growing population.



New Report Finds Americans Willing to Trust Scientific Knowledge of Anyone Holding Glass Beaker Up to Light

Published on theonion.com on March 30, 2020

WASHINGTON—A new report released Monday by the Pew Research Center revealed that Americans were much more willing to trust the scientific knowledge of anyone holding a glass beaker up to the light. “It doesn’t matter if it’s a graduated cylinder or Erlenmeyer flask, if it contains a bright, colorful liquid and a person is lifting it up to peer at the illuminated substance, we found that over 90% of Americans were willing to trust their scientific authority,” said head researcher Frank Chavez, adding that the study found that 100% of Americans expressed confidence in the “science-looking person’s” expertise if the individual was dressed in a white lab coat and muttered “interesting, interesting” while gazing at the beaker. “These results show that Americans are overwhelmingly turning for direction to any Tom, Dick, or Harry who, after looking at the beaker, runs across the lab, looks into a microscope and audibly gasps. However, our data revealed a marked decrease in public trust if the beaker falls to the ground, explodes, and burns a hole through the floor.” The study also found that the vast majority of Americans believed that they would receive accurate information from a child in an oversized lab coat and goggles.

Excerpt from *To Kill a Mockingbird* by Harper Lee. The narrator, Scout, is describing her first day of school.

Then she went to the blackboard and printed the alphabet in enormous square capitals, turned to the class and asked, "Does anybody know what these are?"

Everybody did; most of the first grade had failed it last year.

I suppose she chose me because she knew my name; as I read the alphabet a faint line appeared between her eyebrows, and after making me read most of My First Reader and the stock-market quotations from The Mobile Register aloud, she discovered that I was literate and looked at me with more than faint distaste. Miss Caroline told me to tell my father not to teach me any more, it would interfere with my reading.

"Teach me?" I said in surprise. "He hasn't taught me anything, Miss Caroline. Atticus ain't got

time to teach me anything," I added, when Miss Caroline smiled and shook her head.

"Why, he's so tired at night he just sits in the livingroom and reads."

"If he didn't teach you, who did?" Miss Caroline asked good-naturedly. "Somebody did. You

weren't born reading The Mobile Register."

"Jem says I was. He read in a book where I was a Bullfinch instead of a Finch. Jem says my

name's really Jean Louise Bullfinch, that I got swapped when I was born and I'm really a--

"Miss Caroline apparently thought I was lying. "Let's not let our imaginations run away with us,

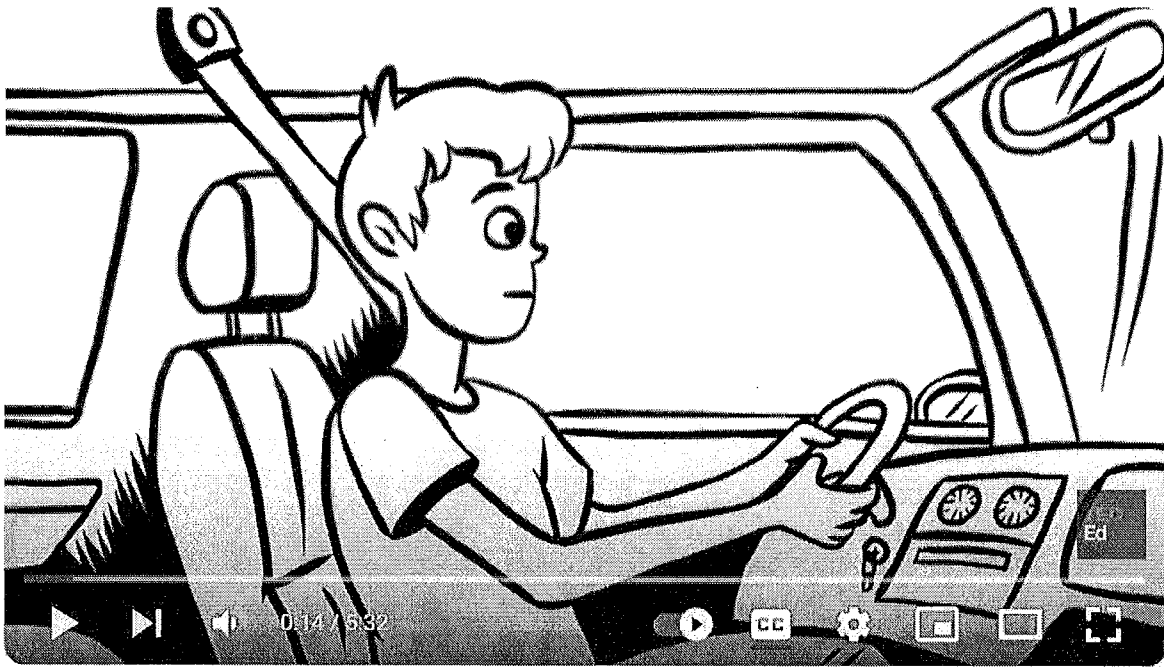
dear," she said. "Now you tell your father not to teach you any more. It's best to begin reading with a fresh mind. You tell him I'll take over from here and try to undo the damage--"

"Ma'am?"

"Your father does not know how to teach. You can have a seat now."

I mumbled that I was sorry and retired meditating upon my crime. I never deliberately learned

to read, but somehow I had been wallowing illicitly in the daily papers. In the long hours of church—was it then I learned? I could not remember not being able to read hymns. Now that I was compelled to think about it, reading was something that just came to me, as learning to fasten the seat of my union suit without looking around, or achieving two bows from a snarl of shoelaces. I could not remember when the lines above Atticus's moving finger separated into words, but I had stared at them all the evenings in my memory, listening to the news of the day, Bills to Be Enacted into Laws, the diaries of Lorenzo Dow--anything Atticus happened to be reading when I crawled into his lap every night. Until I feared I would lose it, I never loved to read. One does not love breathing.



Rethinking thinking - Trevor Maber



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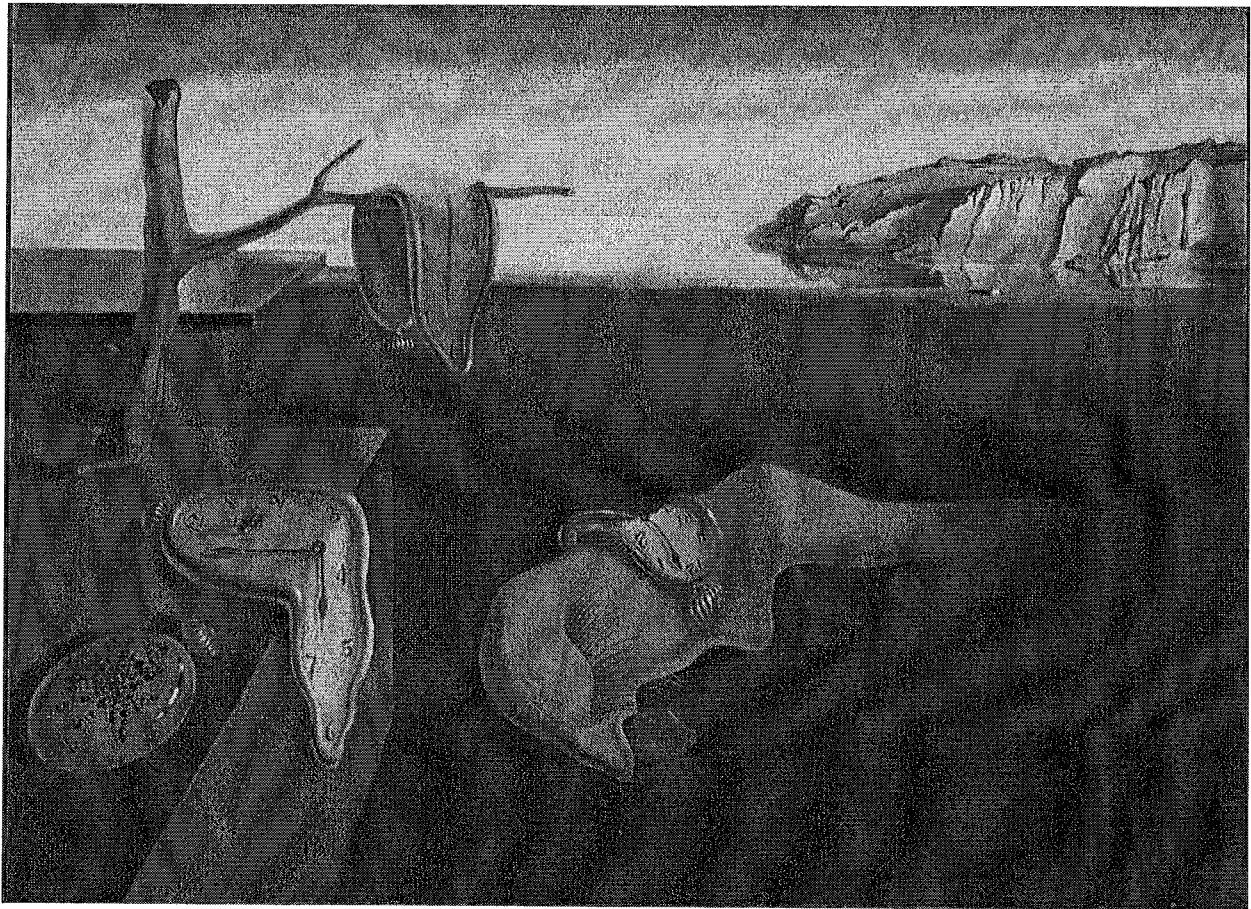
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Source 10 – “The Persistence of Memory” by Salvador Dali



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AUGUST 15, 2019 | 8 MIN READ

Can We Rely on Our Intuition?

As the world becomes more complex, making decisions becomes harder. Is it best to depend on careful analysis or to trust your gut?

BY LAURA KUTSCH



We face decisions all day long. Intuition, some believe, is an ability that can be trained and can play a constructive role in decision-making. [Windsor and Wiehahn Getty Images](#)

Behavior ▾

"I go with my gut feelings," says investor Judith Williams. Sure, you might think, "so do I,"— if the choice is between chocolate and vanilla ice cream. But Williams is dealing with real money in the five and six figures.

Williams is one of the lions on the program *The Lions' Den*, a German television show akin to *Shark Tank*. She and other participants invest their own money in business ideas presented by contestants. She is not the only one who trusts her gut. Intuition, it seems, is on a roll: bookstores are full of guides advising us how to heal, eat or invest intuitively. They promise to unleash our inner wisdom and strengths we do not yet know we have.

But can we really rely on intuition, or is it a counsel to failure? Although researchers have been debating the value of intuition in decision-making for decades, they continue to disagree.

A SOURCE OF ERROR?

Intuition can be thought of as insight that arises spontaneously without conscious reasoning. Daniel Kahneman, who won a Nobel prize in economics for his work on human judgment and decision-making, has proposed that we have two different thought systems: system 1 is fast and intuitive; system 2 is slower and relies on reasoning. The fast system, he holds, is more prone to error. It has its place: it may increase the chance of survival by enabling us to anticipate serious threats and recognize promising opportunities. But the slower thought system, by engaging critical thinking and analysis, is less susceptible to producing bad decisions.

Kahneman, who acknowledges that both systems usually operate when people think, has described many ways that the intuitive system can cloud judgment. Consider, for example, the framing effect: the tendency to be influenced by the

way a problem is posed or a question is asked. In the 1980s Kahneman and his colleague Amos Tversky presented a hypothetical public health problem to volunteers and framed the set of possible solutions in different ways to different volunteers. In all cases, the volunteers were told to imagine that the U.S. was preparing for an outbreak of an unusual disease expected to kill 600 people and that two alternative programs for combating the disease had been proposed.

For one group, the choices were framed by Tversky and Kahneman in terms of gains—how many people would be saved:

- * If Program A is adopted, 200 people will be saved.
- * If Program B is adopted, there is $1/3$ probability that 600 people will be saved, and $2/3$ probability that no people will be saved.

The majority of volunteers selected the first option, Program A.

For another group, the choices were framed in terms of losses—how many people would die:

- * If Program C is adopted 400 people will die.
- * If Program D is adopted there is $1/3$ probability that nobody will die, and $2/3$ probability that 600 people will die.

In this case, the vast majority of volunteers were willing to gamble and selected the second option, Program D.

In fact, the options presented to both groups were the same: The first program would save 200 people and lose 400. The second program offered a one-in-three chance that everyone would live and a two-in-three chance that

everyone would die. Framing the alternatives in terms of lives saved or lives lost is what made the difference. When choices are framed in terms of gains, people often become risk-averse, whereas when choices are framed in terms of losses, people often became more willing to take risks.

INTUITION'S BENEFITS

Other cognitive scientists argue that intuition can lead to effective decision-making more commonly than Kahneman suggests. Gerd Gigerenzer of the Max Planck Institute for Human Development in Berlin is among them. He, too, says that people rarely make decisions on the basis of reason alone, especially when the problems faced are complex. But he thinks intuition's merit has been vastly underappreciated. He views intuition as a form of unconscious intelligence.

Intuitive decisions can be grounded in heuristics: simple rules of thumb. Heuristics screen out large amounts of information, thereby limiting how much needs to be processed. Such rules of thumb may be applied consciously, but in general we simply follow them without being aware that we are doing so. Although they can lead to mistakes, as Kahneman points out, Gigerenzer emphasizes that they can be based on reliable information while leaving out unnecessary information. For example, an individual who wants to buy a good pair of running shoes might bypass research and brain work by simply purchasing the same running shoes used by an acquaintance who is an experienced runner.

In 2006 a paper by Ap Dijksterhuis and his colleagues, then at the University of Amsterdam, came to a similarly favorable view of intuition's value. The researchers tested what they called the "deliberation without attention" hypothesis: although conscious thought makes the most sense for simple

decisions (for example, what size skillet to use), it can actually be detrimental when considering more complex matters, such as buying a house.

In one of their experiments, test subjects were asked to select which of the four cars was the best, taking into account four characteristics, among them gas consumption and luggage space. One set of subjects had four minutes to think about the decision; another set was distracted by solving brainteasers. The distracted group made the wrong choice (according to the researchers' criteria for the best car) more often than those who were able to think without being distracted. But if participants were asked to assess 12 characteristics, the opposite happened: undisturbed reflection had a negative effect on decision-making; only 25 percent selected the best car. In contrast, 60 percent of the subjects distracted by brainteasers got it right.

Investigators have been unable to replicate these findings, however. And in a 2014 review Ben R. Newell of the University of New South Wales and David R. Shanks of University College London concluded that the effect of intuition has been overrated by many researchers and that there is little evidence that conscious thought arrives at worse solutions in complex situations.

WHAT ABOUT REAL LIFE?

Of course, problems in the real world can be considerably more complicated than the artificially constructed ones often presented in laboratory experiments. In the late 1980s this difference sparked the Naturalistic Decision Making movement, which seeks to determine how people make decisions in real life. With questionnaires, videos and observations, it studies how firefighters, nurses, managers and pilots use their experience to deal with challenging situations involving time pressure, uncertainty, unclear goals and organizational constraints.

Researchers in the field found that highly experienced individuals tend to compare patterns when making decisions. They are able to recognize regularities, repetitions and similarities between the information available to them and their past experiences. They then imagine how a given situation might play out. This combination enables them to make relevant decisions quickly and competently. It further became evident that the certainty of the decider did not necessarily increase with an increase in information. On the contrary: too much information can prove detrimental.

Gary Klein, one of the movement's founders, has called pattern matching "the intuitive part" and mental simulation "the conscious, deliberate and analytical part." He has explained the benefits of the combination this way: "A purely intuitive strategy relying only on pattern matching would be too risky because sometimes the pattern matching generates flawed options. A completely deliberative and analytic strategy would be too slow." In the case of firefighters, he notes, if a slow, systematic approach were used, "the fires would be out of control by the time the commanders finished deliberating."

INTUITION IS NOT IRRATIONAL

Kamila Malewska of the Poznań University of Economics and Business in Poland has also studied intuition in real-world settings and likewise finds that people often apply a combination of strategies. She asked managers at a food company how they use intuition in their everyday work. Almost all of them stated that, in addition to rational analyses, they tapped gut feelings when making decisions. More than half tended to lean on rational approaches; about a quarter used a strategy that blended rational and intuitive elements; and about a fifth generally relied on intuition alone. Interestingly, the more upper-level managers tended more toward intuition.

Malewska thinks that intuition is neither irrational nor the opposite of logic. Rather it is a quicker and more automatic process that plumbs the many deep resources of experience and knowledge that people have gathered over the course of their lives. Intuition, she believes, is an ability that can be trained and can play a constructive role in decision-making.

Field findings published in 2017 by Lutz Kaufmann of the Otto Beisheim School of Management in Germany and his co-workers support the view that a mixture of thinking styles can be helpful in decision-making. The participants in their study, all purchasing managers, indicated how strongly they agreed or disagreed with various statements relating to their decision-making over the prior three months. For example: "I looked extensively for information before making a decision" (rational), "I did not have time to decide analytically, so I relied on my experience" (experience-based), or "I was not completely sure how to decide, so I decided based on my gut feeling" (emotional). The researchers, who consider experience-based and emotional processes as "two dimensions of intuitive processing," also rated the success of a manager based on the unit price the person negotiated for a purchased product, as well as on the quality of the product and the punctuality of delivery.

Rational decision-making was associated with good performance. A mixture of intuitive and rational approaches also proved useful; however, a purely experience-based and a purely emotional approach did not work well. In other words, a blending of styles, which is frequently seen in everyday life, seems beneficial.

Economists Marco Sahm of the University of Bamberg and Robert K. von Weizsäcker of the Technical University of Munich study the extent to which our background knowledge determines whether rationality or gut feeling is

more effective. Both Sahm and Weizsäcker are avid chess players, and they brought this knowledge to bear on their research. As children, they both learned intuitively by imitating the moves of their opponents and seeing where they led. Later, they approached the game more analytically, by reading chess books that explained and illustrated promising moves. Over time Weizsäcker became a very good chess player and has won international prizes. These days he bases his play mainly on intuition.

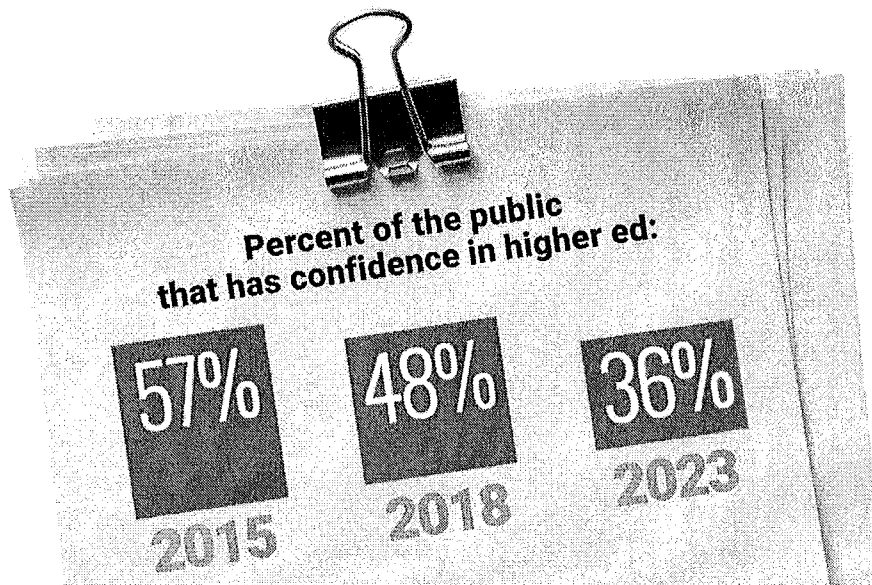
The two economists developed a mathematical model that takes the costs and benefits of both strategies into account. They have come to the conclusion that whether it is better to rely more on rational assessments or intuition depends both on the complexity of a particular problem and on the prior knowledge and cognitive abilities of the person. Rational decisions are more precise but entail higher costs than intuitive ones—for example, they involve more effort spent gathering and then analyzing information. This additional cost can decrease over time, but it will never disappear. The cost may be worth it if the problem is multifaceted and the decision maker gains a lot of useful information quickly (if the decision maker's "learning curve is steep"). Once a person has had enough experience with related problems, though, intuitive decision-making that draws on past learning is more likely to yield effective decisions, Sahm and Weizsäcker say. The intuitive approach works better in that case because relying on accumulated experience and intuitive pattern recognition spares one the high costs of rational analysis.

One thing is clear: intuition and rationality are not necessarily opposites. Rather it is advantageous to master both intuition and analytic skills. Let us not follow our inner voice blindly, but let us not underestimate it either.

Public Trust in Higher Ed Has Plummeted. Yes, Again.

By Zachary Schermele

Published on the website for The Chronicle of Higher Education on July 11, 2023



Americans' confidence in higher ed is continuing to shrivel — a troubling sign that could foreshadow further erosion of colleges' enrollment, funding, and stature in the coming years.

Five years ago, roughly half of people surveyed by Gallup expressed confidence in colleges and universities. That share has dwindled to just over one third, according to a new poll released Tuesday. Since 2015, confidence in higher ed has fallen by 21 percentage points.

In the world of public-opinion polling, that's a "pretty precipitous" drop, said Zach Hrynowski, a research consultant at Gallup.

"It raised our eyebrows," he said. "It's something that we don't tend to see." Gallup surveyed more than a thousand people by phone.

The numbers are the latest indication — and a stark one — of higher ed's image problem. Polling in recent years has documented a widening distrust of postsecondary education among broad swaths of the general public, as partisan debates over the value of a college degree have intensified, the cost to enroll has risen, and student-loan debt has ballooned into a crisis.

Most Americans surveyed by Gallup, 62 percent, have "very little" or just "some" confidence in colleges and universities. In 2015, that number was 42 percent.

Since these findings were collected in early- to mid-June, they don't factor in the Supreme Court's consequential decisions striking down race-conscious admissions and axing President Biden's student-loan debt forgiveness plan.

The survey also didn't investigate the reasons behind the loss of trust. But other recent Gallup polling shows the findings square with a larger crisis of confidence Americans are feeling when it comes to institutions, including the military, banks, and the healthcare industry.

Trends more specific to higher ed are very likely still driving the downturn though, Hrynowski said. Rising costs, a typical gripe, are specifically cited in the survey.

Then there's partisanship. Republicans reported the steepest trust deficit in the survey, with a 17-point drop in confidence since 2018. In 2015, more than half of them — 56 percent — said they had a "great deal" or "quite a lot" of confidence in higher ed. Now, that share is less than a fifth. Confidence among Democrats is dropping, too, though less drastically.

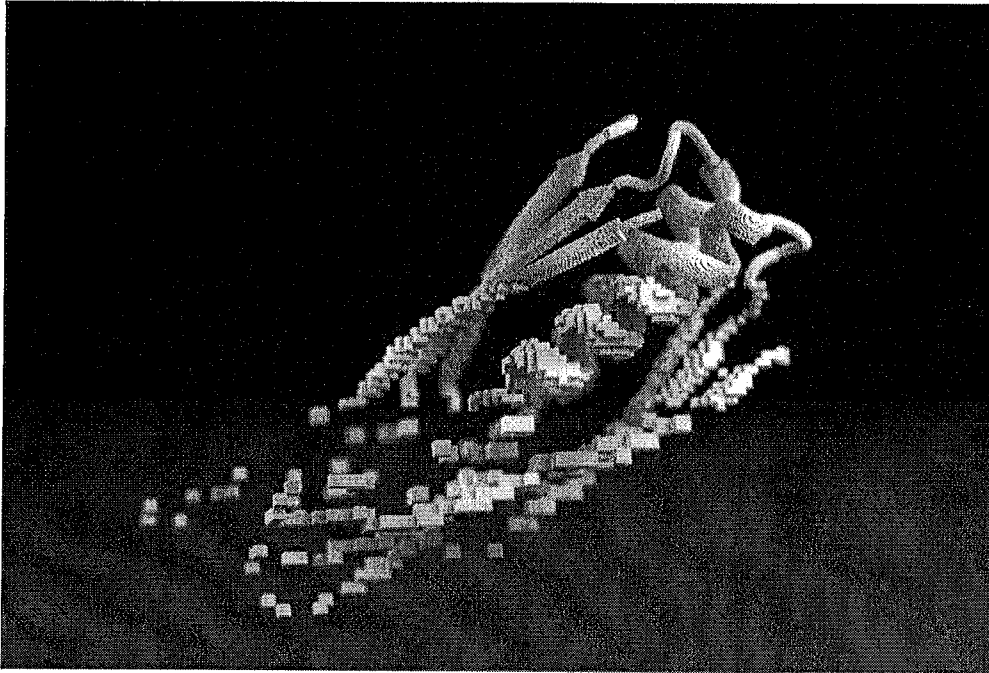
Yet the bigger concern for university leaders may not be partisanship, Hrynowski said. Even college graduates are hemorrhaging confidence in the system. In the most recent survey, less than half of people with college degrees expressed confidence in higher ed. The trust decline over time was even larger for those with advanced degrees.

"In some ways, that should be a little bit more of a flag if you're a president of a university or dean of admissions," he said. "It's even those Americans who have gone to college saying, 'I'm less confident in these institutions than I used to be.'"

New proteins, better batteries: Scientists are using AI to speed up discoveries

By Geoff Brumfiel

Published on npr.org on Oct. 12, 2023



AI similar to the kind used to make images is now being used to design synthetic proteins. Scientists say its radically sped up their research.

Ian C Haydon/UW Institute for Protein Design

Susana Vazquez-Torres is a fourth-year graduate student at the University of Washington who wants to someday invent new drugs for neglected diseases.

Lately, she's been thinking a lot about snake bites: Around a hundred thousand people die each year from snake bites, according to the World Health Organization — and yet, she says, "the current therapeutics are not safe and are very expensive."

Part of the problem is that developing new drugs for things like snake bites has been a slow and laborious process. In the past, Torres says, it might have taken years to come up with a promising compound.

But recently, a new tool in her laboratory has rapidly sped up that timeline: Artificial intelligence. Torres started her current project in February and already has some candidate drugs lined up.

"It's just crazy that we can come up with a therapeutic in a couple of months now," she says.

Artificial intelligence is promising to upend the knowledge economy. It can already code computer programs, draw pictures and even take notes for doctors. But perhaps nowhere is the promise of AI closer to realization than the sciences, where technically-minded researchers are eager to bring its power to bear on problems ranging from disease to climate change.

On Thursday, the U.S. National Academies convened a two-day meeting on the potential for AI to change science. "AI scientists can really be more systematic, more comprehensive and not make errors," says Yolanda Gil, director of AI and data science initiatives at the Information Sciences Institute at the University of Southern California, who is attending the event.

Rather than using AI to do all science, she envisions a future in which AI systems plan and execute experiments, in collaboration with their human counterparts. In a world facing increasingly complex technical challenges, "there's not enough humans to do all this work," she says.

Proteins by Design

At the University of Washington, Vazquez-Torres is one of about 200 scientists working in a laboratory to design new therapies using proteins. Proteins are molecules that do much of the day-to-day work in biology: They build muscles and organs, they digest food, they fight off viruses.

Proteins themselves are built of simpler compounds known as amino acids. The problem is that these amino acids can be combined in a nearly infinite number of ways to make a nearly infinite number of proteins.

In the past, researchers had to systematically test many thousands of possible designs to try and find the right one for a particular job. Imagine being given a bucketful of keys to open a door — without knowing which one will actually work. You'd end up "just trying them out one at a time, to see what fits the best," says David Baker, the senior scientist who runs the lab.

AI has changed all that.

"Rather than having to make a bunch of possible structures on the computer and try them one by one, we can build one that just fits perfectly from scratch," he says.

The particular type of AI being used is known as diffusion modeling. It's the same technology used by popular AI image generators, like DALL-E or Midjourney. The system starts with a field of random pixels, essentially white noise, and then slowly tweaks each one until it creates what the user has asked for. In the case of an AI image generator that might be a picture of a flower. In the case of this lab's AI, it's a protein with a specific shape.

The shape of a protein often determines how well it will work, so this kind of AI is particularly well-suited for the job, Baker says. The AI also requires examples to learn from, and luckily, scientists have spent decades and billions of dollars developing a massive database full of proteins that it can study.

"There really aren't many places in science that have databases like that," Baker says.

And that's part of the reason that it's not yet clear whether every field will benefit equally from AI. Maria Chan is at Argonne National Laboratory in Illinois. She's working on developing new materials for the renewable economy — things like batteries and solar panels.

She says, unlike the field of proteins, there just isn't that much research on the sorts of materials she's studying.

"There hasn't been enough sort of measurements or calculations — and also that data is not organized in a way that everybody can use," she says.

Moreover, materials are different from proteins. Their properties are determined by interactions on many different scales — from the molecular all the way up to large scales.

The lack of data and complexity of materials make them harder to study using AI, but Chan still thinks it can help. Just about anything is better than the way scientists in the field worked prior to the computer revolution.

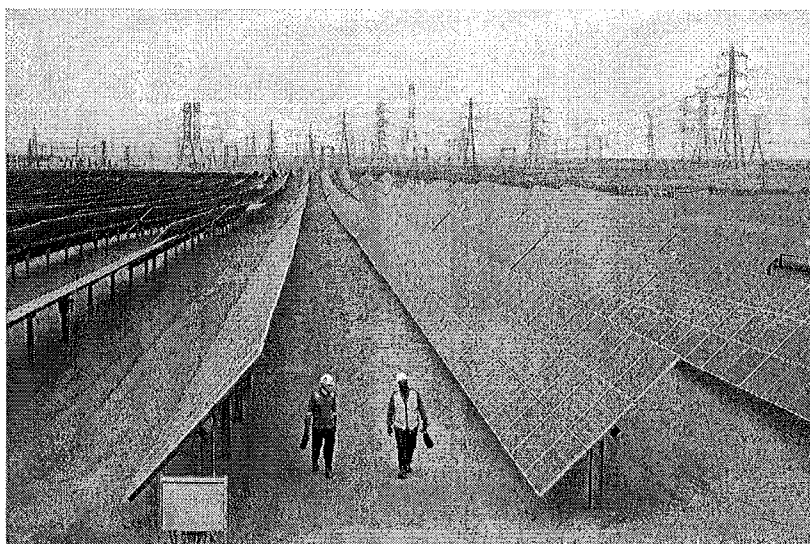
"The previous hundred years of science has to do with a lot of serendipity, and a lot of trial and error," she says. She believes AI will be needed to drive research forward — especially when it comes to the climate crisis, one of the most complicated problems in modern times.

Materials and proteins are far from the only fields working with AI in various ways. Systems are being actively developed in genetics, climate studies, particle physics, and elsewhere. The goal in many cases is to spot new patterns in vast quantities of scientific data — such as whether a genetic variation will cause a harmful abnormality.

Hypothesis hunters

But some researchers believe that AI could take a more fundamental role in scientific discovery. Hannaneh Hajishirzi, who works at the Allen Institute for Artificial Intelligence in Seattle, wants to develop new AI systems similar to ChatGPT for science. The goal would be a system that could crunch all the scientific literature in a field and then use that knowledge to develop new ideas, or hypotheses.

Because the scientific literature can span thousands of papers published over the course of decades, an AI system might be able to find new connections between studies and suggest exciting new lines of study that a human would otherwise miss.



Some researchers hope that AI could be used to find new materials for things like solar cells. There's limited data on these materials, and it's not stored centrally, so results are not guaranteed.

Amr Nabil/AP

"I would argue that at some point AI would be a really good tool for us to make new scientific discoveries," she says. Of course, it would still take human Sponsor Message researchers to figure out if the scientific ideas the AI wanted to pursue were worthwhile.

Yolanda Gil at the University of Southern California wants to develop AI that can do all of science. She envisions automated systems that can plan and carry out experiments by themselves. That will likely mean developing entirely new kinds of AI that can reason better than the current models — which are notorious for fabricating information and making mistakes.

But if it could work, Gil believes the AI scientists could have a huge impact on research. She envisions a world in which AI systems can continuously reanalyze data, and update results on diseases or environmental change as it's happening.

"Why is it that the paper that was published in 2012 should have the definite answer to the question?" she asks. "That should never be the case."

Gil also thinks that AI scientists could also reduce errors and increase reproducibility, because the systems are automated. "I think it would be a lot more trustworthy; I think it could also be more systematic," she says.

But if AI scientists are the future, Susana Vazquez-Torres at the University of Washington doesn't seem worried about it. She and her labmates are attacking a wide swath of problems using their designer proteins — everything from new drugs, to vaccines, to improving photosynthesis in plants and finding new compounds to help break down plastics.

Vazquez-Torres says there are so many problems that need to be solved, and that many exciting discoveries lie ahead thanks to AI. "We can just make drugs right now so easily with these new tools," she says. Job security isn't a worry at all. "For me, it's the opposite — it's exciting."

GUEST ESSAY

Skeptics Say, ‘Do Your Own Research.’ It’s Not That Simple.

Jan. 3, 2022

By Nathan Ballantyne and David Dunning

Dr. Ballantyne is a philosopher who studies how to improve judgment. Dr. Dunning is a social psychologist who studies misbelief.

A new slogan has emerged in the culture: “Do your own research.” On internet forums and social media platforms, people arguing about hotly contested topics like vaccines, climate change and voter fraud sometimes bolster their point or challenge their interlocutors by slipping in the acronym “D.Y.O.R.”

“Two days after getting the jab, a friend of mine’s friend had a heart attack,” a Reddit user wrote recently in a discussion about Covid-19 vaccines. “I’m not saying they’re connected, but D.Y.O.R.”

The slogan, which appeared in conspiracy theory circles in the 1990s, has grown in popularity over the past decade as conflicts over the reliability of expert judgment have become more pronounced. It promotes an individualistic, freethinking approach to understanding the world: Don’t be gullible — go and find out for yourself what the truth is.

That may seem to be sound advice. Isn’t it always a good idea to gather more information before making up your mind about a complex topic?

In theory, perhaps. But in practice the idea that people should investigate topics on their own, instinctively skeptical of expert opinion, is often misguided. As psychological studies have repeatedly shown, when it comes to technical and complex issues like climate change and vaccine efficacy, novices who do their own research often end up becoming more misled than informed — the exact opposite of what D.Y.O.R. is supposed to accomplish.

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Consider what can happen when people begin to learn about a topic. They may start out appropriately humble, but they can quickly become unreasonably confident after just a small amount of exposure to the subject. Researchers have called this phenomenon the beginner's bubble.

In a 2018 study, for example, one of us (Professor Dunning) and the psychologist Carmen Sanchez asked people to try their hand at diagnosing certain diseases. (All the diseases in question were fictitious, so no one had any experience diagnosing them.) The participants attempted to determine whether hypothetical patients were healthy or sick, using symptom information that was helpful but imperfect, and they got feedback after every case about whether they were right or wrong. Given the limited nature of the symptom information that was provided, the participants' judgments ought to have been made with some uncertainty.

How did these would-be doctors fare? At the start, they were appropriately cautious, offering diagnoses without much confidence in their judgments. But after only a handful of correct diagnoses, their confidence shot up drastically — far beyond what their actual rates of accuracy justified. Only later, as they proceeded to make more mistakes, did their confidence level off to a degree more in line with their proficiency.

The study suggested that people place far too much credence in the initial bits of information they encounter when learning something. “A little learning,” as the poet Alexander Pope wrote, “is a dangerous thing.”

Anecdotal, you can see the beginner’s bubble at work outside the laboratory too. Consider do-it-yourself projects gone wrong. Power tools, ladders and lawn mowers are easily mishandled by untrained users who know just enough to put themselves in danger. A study found that U.S. consumer injuries from pneumatic nail guns increased about 200 percent between 1991 and 2005, apparently as a result of the increased availability of nail guns that were affordable for nonprofessionals.

Research also shows that people learning about topics are vulnerable to hubris. Consider a 2015 study by one of us (Professor Dunning) and the psychologists Stav Atir and Emily Rosenzweig. It found that when novices perceive themselves as having developed expertise about topics such as finance and geography, they will frequently claim that they know about nonexistent financial instruments (like “prerated stocks”) and made-up places (like Cashmere, Ore.) when asked about such things.

Likewise, a 2018 study of attitudes about vaccine policy found that when people ascribe authority to themselves about vaccines, they tend to view their own ideas as better than ideas from rival sources and as equal to those of doctors and scientists who have focused on the issue. Their experience makes them less willing to listen to well-informed advisers than they would have been otherwise.

There should be no shame in identifying a consensus of independent experts and deferring to what they collectively report. As individuals, our skills at adequately vetting information are spotty. You can be expert at telling reliable cardiologists from quacks without knowing how to separate serious authorities from pretenders on economic policy.

For D.Y.O.R. enthusiasts, one lesson to take away from all of this might be: Don’t do your own research, because you are probably not competent to do it.

Is that our message? Not necessarily. For one thing, that is precisely the kind of advice that advocates of D.Y.O.R. are primed to reject. In a society where conflicts between so-called elites and their critics are so pronounced, appealing to the superiority of experts can trigger distrust.

The problem is compounded by the fact that outsider critics frequently have legitimate complaints about advice provided by insider authorities. One example might be the initial instruction from public officials at the outset of the Covid-19 pandemic that people need not wear masks.

Instead, our message, in part, is that it's not enough for experts to have credentials, knowledge and lots of facts. They must show that they are trustworthy and listen seriously to objections from alternative perspectives.

We strive to offer careful guidance when it comes to our own areas of expertise. Even so, some D.Y.O.R. enthusiasts may reject our cautions. If they do, we hope that they will nonetheless heed at least one piece of advice: If you are going to do your own research, the research you should do first is on how best to do your own research.

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