北京师范大学

研究生英语

阅读讲义

2024~2025 学年秋季学期

Contents

Unit 1

Who was the First Scientist?

William Harris

1. The word “scientist” entered the English language in 1834. That’s when Cambridge University historian and philosopher William Whewell coined the term to describe someone who studies the structure and behavior of the physical and natural world through observation and experiment. You could make the argument, then, that the first modern scientist was someone like Charles Darwin or Michael Faraday, two iconic figures who also happened to be Whewell’s contemporaries. But even if the term didn’t exist before the 1830s, people who embodied its principles did.

2. To find the very first scientist, we must travel back in time even further. We could go back to the most ancient of the ancient Greeks, all the way back to Thales of Miletus, who lived from about 624 B.C. to about 545 B.C. By many accounts, Thales achieved much in both science and mathematics, yet he left no written record and may have been, like Homer, a celebrated figure who received credit for many great achievements but who may never have existed at all.

3. We could consider other ancient Greeks as well, such as Euclid (the father of geometry) or Ptolemy (the misguided astronomer who put Earth at the center of the cosmos). But all of these men, although great thinkers, relied on making arguments instead of running experiments to prove or disprove hypotheses.

4. Some scholars believe that modern science had its origins in an impressive class of Arabic mathematicians and philosophers working in the Middle East decades before the European Renaissance began.This group included al-Khwarizmi, Ibn Sina, al-Biruni and Ibn al-Haytham. In fact, many experts recognize Ibn al-Haytham, who lived in present-day Iraq between 965 and 1039 A.D., as the first scientist. He invented the pinhole camera, discovered the laws of refraction and studied a number of natural phenomena, such as rainbows and eclipses. And yet it remains unclear whether his scientific method was truly modern or more like Ptolemy and his Greek predecessors. It’s also not clear whether he had emerged from the mysticism still prevalent at the time.

5. It’s almost impossible to determine when the influence of mysticism had faded completely among scientists. What’s easier to identify are the characteristics of a modern scientist. According to author Brian Clegg, a modern scientist must recognize the importance of experiment, embrace mathematics as a fundamental tool, consider information without bias and understand the need to communicate. In other words, he or she must be unshackled by religious dogma and willing to observe, react and think objectively. Clearly, many individuals doing scientific work in the 17th century—Christiaan Huygens, Robert Hooke, Isaac Newton—satisfied most of these requirements. But to find the first scientist with these characteristics, you have to travel to the Renaissance, to the mid-16th century.

6. You probably think of Galileo Galilei at the mention of Renaissance science, and rightfully so. He overturned Aristotle’s ideas on motion and began to explain such complex concepts as force, inertia and acceleration. He built one of the first telescopes and used it to study the cosmos. What he saw through the lenses of his device removed Earth from the center of the universe and

put it in its proper place. In all his work, Galileo stressed the need for observation and experimentation. And yet Galileo owes much to another seminal figure born 20 years earlier.

7. His name was William Gilbert, a rather obscure figure in the history of science. Along with Galileo, Gilbert had been busy practicing the scientific method in his work and setting an example for his peers after the first decade of the 17th century had past. Here's what John Gribbin had to say about Gilbert and Galileo in his 2002 book *The Scientists*:

> Although Galileo is one of the towering figures in science, known by name to every educated person today, and Gilbert is less well known than he deserves, Gilbert had the earlier birth date and, chronologically speaking at least, deserves the title of first scientist.

8. Gilbert was born in 1544 to a prominent local family and attended Cambridge University between 1558 and 1569. Eventually, he settled in London and embarked on a successful career as a physician, attending to both Queen Elizabeth I and, upon her death in 1603, to King James I.

9. It was Gilbert's investigations into the nature of magnetism, however, that may make him the first modern scientist. This work culminated in *De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure* (*On the Magnet, Magnetic Bodies, and the Great Magnet of the Earth*), the first significant book about physical science published in England. In the book's preface, Gilbert described the need for "sure experiments and demonstrated arguments" instead of "conjectures and the opinions of philosophical speculators." He also discussed the need to conduct experiments "carefully, skilfully and deftly, not heedlessly and bunglingly."

10. The scientist followed his own advice. Gilbert's book recounted his investigations in so much detail that another person could replicate his work and verify his results. This research led to many important discoveries about magnetism. The learned fellow also turned his inquisitive mind to the heavens.

11. Gilbert directly influenced Galileo. The famous Italian scientist read *De Magnete* and repeated many of its experiments. It is easy to imagine Galileo poring over the book and nodding in affirmation at Gilbert's ideas about experimentation and observation—ideas that Galileo himself would apply in his groundbreaking work. Is it any wonder Galileo proclaimed Gilbert to be the founder of the scientific method? This endorsement alone may be enough to substantiate the claim that William Gilbert was the first modern scientist.

Where's the Bacon?

12. Many science books identify Francis Bacon as the father of the scientific method. Doesn't that make him the first scientist? It depends. Bacon certainly popularized the methods and techniques of scientific inquiry, but he was more of a philosopher than an experimenter. William Gilbert and Galileo, by contrast, were hands-on scientists. They designed experiments, carried them out and recorded their results—just like you did in your high school physics class. This commitment to conducting rigorous, repeatable experiments is one of the hallmarks of modern science

Unit 2

Why Study Humanities? What I Tell Engineering Freshmen

John Horgan

1. What's the point of the humanities? Of studying philosophy, history, literature and "soft" sciences like psychology and political science? The Commission on the Humanities and Social Sciences, consisting of academic, corporate, political and entertainment big shots, tries to answer this question in a big new report to Congress. The report is intended to counter plunging enrollment in and support for the humanities, which are increasingly viewed as "luxuries that employment-minded students can ill afford," as *The New York Times* put it.

2. Titled "The Heart of the Matter," the report states: "As we strive to create a more civil public discourse, a more adaptable and creative workforce, and a more secure nation, the humanities and social sciences are the heart of the matter, the keeper of the republic—a source of national memory and civic vigor, cultural understanding and communication, individual fulfillment and the ideals we hold in common. They are critical to a democratic society and they require our support."

3. I find this a bit grandiose, and obscure. I have my own humble defense of the humanities, which I came up with a couple of years ago, when I started teaching a new course required for all freshmen at Stevens Institute of Technology. The syllabus includes Sophocles, Plato, Thucydides, Shakespeare, Descartes, Hobbes, Locke, Kant, Mill, Marx, Nietzsche, William James, Freud, Keynes, Eliot—you know, Greatest Hits of Western Civilization.

4. I love teaching the class, but I don't assume that students love taking it. So on the first day of class I ask my wary-looking students, "How many of you would skip this class if it wasn't required?" After I assure them that they won't hurt my feelings, almost all raise their hands.

5. When I ask what the problem is, they say they came to Stevens for engineering, computer science, physics, pre-med, finance, digital music production, etc. They don't see the point of reading all this old impractical stuff that has nothing to do with their careers. When I ask them to guess why Stevens inflicts this course on them, someone usually says, smirking, "To make us well-rounded."

6. Whenever I get the "well-rounded" response, I want to reply, "Does 'well-rounded' mean, like, chubby?" But I don't want to offend overweight students. Instead I say, "I don't really know what 'well-rounded' means. Does it mean being able chitchat about Shakespeare at cocktail parties? I don't care about that." Then I give them my pitch for the course, which goes something like this:

> We live in a world increasingly dominated by science. And that's fine. I became a science writer because I think science is the most exciting, dynamic, consequential part of human culture, and I wanted to be a part of that. Also, I have two college-age kids, and I'd be thrilled if they pursued careers in science, engineering or medicine. I certainly want them to learn as much science and math as they can, because those skills can help you get a great job. But it is precisely because science is so powerful that we need the humanities now more than ever. In your science, mathematics and engineering classes, you're given facts, answers, knowledge, and truth. Your professors say, "This is how things are." They give you certainty. The humanities, at least the way I teach them, give you uncertainty, doubt and skepticism.

7. The humanities are subversive. They undermine the claims of all authorities, whether political, religious or scientific. This skepticism is especially important when it comes to claims about humanity, about what we are, where we came from, and even what we can be and should be. Science has replaced religion as our main source of answers to these questions. Science has told us a lot about ourselves, and we're learning more every day.

8. But the humanities remind us that we have an enormous capacity for deluding ourselves. They also tell us that every single human is unique, different than every other human, and each of us keeps changing in unpredictable ways. The societies we live in also keep changing—in part because of science and technology! So in certain important ways, humans resist the kind of explanations that science gives us.

9. The humanities are more about questions than answers, and we're going to wrestle with some ridiculously big questions in this class. Like, what is truth anyway? How do we know something is true? Or rather, why do we believe certain things are true and other things aren't? Also, how do we decide whether something is wrong or right to do, for us personally or for society as a whole?

10. Also, what is the meaning of life? What is the point of life? Should happiness be our goal? Well, what on earth is happiness? And should happiness be an end in itself or just a side effect of some other more important goal? Like gaining knowledge, or reducing suffering? Each of you has to find your own answer to these questions. Socrates, one of the philosophers we're going to read, said wisdom means knowing how little you know. Socrates was a pompous, but there is wisdom in what he says about wisdom.

11. If I do my job, by the end of this course you'll question all authorities, including me. You'll question what you've been told about the nature of reality, about the purpose of life, about what it means to be a good person. Because that, for me, is the point of the humanities: they keep us from being trapped by our own desire for certainty.

12. Postscript: My Stevens colleague Garry Dobbins, a philosopher, likes to give me a hard time, and I him, but I'm always provoked by his take on things, like this response to my post: "As to the Humanities being to teach us a healthy skepticism, we might all agree that this is indeed one of the consequences of such an education; but if this is necessary, as you make it out, because learning science alone we do not learn the importance, or necessity of 'uncertainty, doubt and skepticism,' something strange and even perverse has befallen the study of science! Those taking seriously the study of the history of science, for instance, will know that there was a time when science assumed the cultural preeminence it still occupies among us precisely because it did not teach dogmas, or as you put it, 'certainty.' On the contrary; scientific studies from the early modern period down to the early twentieth century, anyway, were liberal studies. Surely the justification of study of the Humanities, history, literature, philosophy and the rest, is not fundamentally different than the justification for the study of science. There are forces at work in human life, whether material or spiritual, which we seek to master, so far as possible. The language in which we express our knowledge of physical forces obeys somewhat different logical rules to that in which we express our knowledge of economics for example: but this doesn't mean that the one is less knowledge, or logical, or important, than the other, surely! That you speak of the kind of knowledge to be gained by close study of Shakespeare, Thucydides, or Plato, as 'impractical' surely goes to show a misunderstanding as to what is practical in a human life. Unless you can show good reason to believe Socrates mistaken in thinking that self-knowledge is only reliable foundation for a good

life."

13. I responded: "Garry, you're right that science if properly taught should incorporate skepticism. But science is becoming increasingly dogmatic and arrogant in our era, which is why we need the humanities to foster a healthy anti-dogmatism."

Unit 3

When Teaching Critical Thinking Backfires

John Horgan

> *As the fall semester ends, I'm brooding once again over the contradictions of teaching "critical thinking," especially as applied to science. Below is an edited version of an essay I wrote for* The Chronicle of Higher Education *when I was in a similar mood.*
>
> *–John Horgan*

1. Don't always believe what scientists and other authorities tell you! Be skeptical! Think critically! That's what I tell my students, *ad nauseam*. And some learn the lesson too well.

2. I want to give my students the benefit of my hard-won knowledge of science's fallibility. Early in my career, I was a conventional science writer, easily impressed by scientists' claims. Fields such as physics, neuroscience, genetics and artificial intelligence seemed to be bearing us toward a future in which bionic superhumans would zoom around the cosmos in warp-drive spaceships. Science was an "endless frontier," as physicist Vannevar Bush, a founder of the National Science Foundation, put it in 1945.

3. Doubt gradually undermined my faith. Scientists and journalists, I realized, often presented the public with an overly optimistic picture of science. By relentlessly touting scientific "advances"—from theories of cosmic creation and the origin of life to the latest treatments for depression and cancer—and by overlooking all the areas in which scientists were spinning their wheels, we made science seem more potent and fast-moving than it really is.

4. Now, I urge my students to doubt the claims of physicists that they are on the verge of explaining the origin and structure of the cosmos. Some of these optimists favor string and multiverse theories, which cannot be confirmed by any conceivable experiment. This isn't physics any more, I declare in class, it's science fiction with equations!

5. I give the same treatment to theories of consciousness, which attempt to explain how a three-pound lump of tissue—the brain—generates perceptions, thoughts, memories, emotions and self-awareness. Some enthusiasts assert that scientists will soon reverse-engineer the brain so thoroughly that they will be able to build artificial brains much more powerful than our own.

6. Balderdash! I tell my classes (or words to that effect). Scientists have proposed countless theories about how the brain absorbs, stores and processes information, but researchers really have no idea how the brain works. And artificial-intelligence advocates have been promising for decades that robots will soon be as smart as HAL or R2-D2. Why should we believe them now?

7. Maybe, just maybe, I suggest, fields such as particle physics, cosmology and neuroscience are bumping up against insurmountable limits. The big discoveries that can be made have been

made. Who says science has to solve every problem?

8. Lest my students conclude that I'm some solitary crank, I assign them articles by other skeptics, including a dissection of epidemiology and clinical trials by journalist Gary Taubes in *The New York Times*. He advises readers to doubt dramatic claims about the benefits of some new drug or diet, especially if the claim is new. "Assume that the first report of an association is incorrect or meaningless," Taubes writes, because it probably is. "So be skeptical."

9. To drive this point home, I assign articles by John Ioannidis, an epidemiologist who has exposed the flimsiness of most peer-reviewed research. In a 2005 study, he concluded that "most published research findings are false." He and his colleagues contend that "the more extreme, spectacular results (the largest treatment effects, the strongest associations, or the most unusually novel and exciting biological stories) may be preferentially published." These sorts of dramatic claims are also more likely to be wrong.

10. The cherry on this ice-cream sundae of doubt is a critique by psychologist Philip Tetlock of expertise in soft sciences, such as politics, history, and economics. In his 2005 book *Expert Political Judgment*, Tetlock presents the results of his 20-year study of the ability of 284 "experts" in politics and economics to make predictions about current affairs. The experts did worse than random guessing, or "dart-throwing monkeys," as Tetlock puts it.

11. Like Ioannidis, Tetlock found a correlation between the prominence of experts and their fallibility. The more wrong the experts were, the more visible they were in the media. The reason, he conjectures, is that experts who make dramatic claims are more likely to get air time on CNN or column inches in *The Washington Post*, even though they are more likely to be wrong.

12. For comic relief, I tell my students about a maze study, cited by Tetlock, that pitted rats against Yale undergraduates. Sixty percent of the time, researchers placed food on the left side of a fork in the maze; otherwise the food was placed randomly. After figuring out that the food was more often on the left side of the fork, the rats turned left every time and so were right 60 percent of the time. Yale students, discerning illusory patterns of left-right placement, guessed right only 52 percent of the time. Yes, the rats beat the Yalies! The smarter you are, the more likely you may be to "discover" patterns in the world that aren't actually there.

13. So how do my students respond to my skeptical teaching? Some react with healthy pushback, especially to my suggestion that the era of really big scientific discoveries might be over. "On a scale from toddler knowledge to ultimate enlightenment, man's understanding of the universe could be anywhere," wrote a student named Matt. "How can a person say with certainty that everything is known or close to being known if it is incomparable to anything?"

14. Other students embrace skepticism to a degree that dismays me. Cecelia, a biomedical-engineering major, wrote: "I am skeptical of the methods used to collect data on climate change, the analysis of this data, and the predictions made based on this data." Pondering the lesson that correlation does not equal causation, Steve questioned the foundations of scientific reasoning. "How do we know there is a cause for anything?" he asked.

15. In a similar vein, some students echoed the claim of radical postmodernists that we can never really know anything for certain, and hence that almost all our current theories will probably be overturned. Just as Aristotle's physics gave way to Newton's, which in turn yielded to Einstein's, so our current theories of physics will surely be replaced by radically different ones.

16. After one especially doubt-riddled crop of papers, I responded, "Whoa!"(or words to that

effect). Science, I lectured sternly, has established many facts about reality beyond a reasonable doubt, embodied by quantum mechanics, general relativity, the theory of evolution, the genetic code. This knowledge has yielded applications—from vaccines to computer chips—that have transformed our world in countless ways. It is precisely because science is such a powerful mode of knowledge, I said, that you must treat new pronouncements skeptically, carefully distinguishing the genuine from the spurious. But you shouldn't be so skeptical that you deny the possibility of achieving any knowledge at all.

17. My students listened politely, but I could see the doubt in their eyes. We professors have a duty to teach our students to be skeptical. But we also have to accept that, if we do our jobs well, their skepticism may turn on us.

Unit 4

On Running After One's Hat

G. K. Chesterton

1. I feel an almost savage envy on hearing that London has been flooded in my absence, while I am in the mere country. My own Battersea has been, I understand, particularly favored as a meeting of the waters. Battersea was already, as I need hardly say, the most beautiful of human localities. Now that it has the additional splendor of great sheets of water, there must be something quite incomparable in the landscape (or waterscape) of my own romantic town. Battersea must be a vision of Venice. The boat that brought the meat from the butcher's must have shot along those lanes of rippling silver with the strange smoothness of the gondola. The greengrocer who brought cabbage to the corner of the Latchmere Road must have leant upon the oar with the unearthly grace of the gondolier. There is nothing so perfectly poetical as an island; and when a district is flooded it becomes an archipelago.

2. Some consider such romantic views of flood or fire slightly lacking in reality. But really this romantic view of such inconveniences is quite as practical as the other. The true optimist who sees in such things an opportunity for enjoyment is quite as logical and much more sensible than the ordinary "Indignant Ratepayer" who sees in them an opportunity for grumbling. Real pain, as in the case of being burnt at Smithfield or having a toothache, is a positive thing; it can be supported, but scarcely enjoyed. But, after all, our toothaches are the exception, and as for being burnt at Smithfield, it only happens to us at the very longest intervals. And most of the inconveniences that make men swear or women cry are really sentimental or imaginative inconveniences—things altogether of the mind. For instance, we often hear grown-up people complaining of having to hang about a railway station and wait for a train. Did you ever hear a small boy complain of having to hang about a railway station and wait for a train? No; for to him to be inside a railway station is to be inside a cavern of wonder and a palace of poetical pleasures. Because to him the red light and the green light on the signal are like a new sun and a new moon. Because to him when the wooden arm of the signal falls down suddenly, it is as if a great king had thrown down his staff as a signal and started a shrieking tournament of trains. I myself am of little boys' habit in this matter. They also serve who only stand and wait for the two fifteen. Their meditations may be full of rich and fruitful things.

Many of the most purple hours of my life have been passed at Clapham Junction, which is now, I suppose, under water. I have been there in many moods so fixed and mystical that the water might well have come up to my waist before I noticed it particularly. But in the case of all such annoyances, as I have said, everything depends upon the emotional point of view. You can safely apply the test to almost every one of the things that are currently talked of as the typical nuisance of daily life.

3. For instance, there is a current impression that it is unpleasant to have to run after one's hat. Why should it be unpleasant to the well-ordered and pious mind? Not merely because it is running, and running exhausts one. The same people run much faster in games and sports. The same people run much more eagerly after an uninteresting, little leather ball than they will after a nice silk hat. There is an idea that it is humiliating to run after one's hat; and when people say it is humiliating they mean that it is comic. It certainly is comic; but man is a very comic creature, and most of the things he does are comic—eating, for instance. And the most comic things of all are exactly the things that are most worth doing. A man running after a hat is not half so ridiculous as a man running after a wife.

4. Now a man could, if he felt rightly in the matter, run after his hat with the manliest ardor and the most sacred joy. He might regard himself as a jolly huntsman pursuing a wild animal, for certainly no animal could be wilder. In fact, I am inclined to believe that hat-hunting on windy days will be the sport of the upper classes in the future. There will be a meet of ladies and gentlemen on some high ground on a gusty morning. They will be told that the professional attendants have started a hat in such-and-such a thicket, or whatever be the technical term. Notice that this employment will in the fullest degree combine sport with humanitarianism. The hunters would feel that they were not inflicting pain. Nay, they would feel that they were inflicting pleasure, rich, almost riotous pleasure, upon the people who were looking on. When last I saw an old gentleman running after his hat in Hyde Park, I told him that a heart so benevolent as his ought to be filled with peace and thanks at the thought of how much unaffected pleasure his every gesture and bodily attitude were at that moment giving to the crowd.

5. The same principle can be applied to every other typical domestic worry. A gentleman trying to get a fly out of the milk or a piece of cork out of his glass of wine often imagines himself to be irritated. Let him think for a moment of the patience of anglers sitting by dark pools, and let his soul be immediately irradiated with gratification and repose. Again, I have known some people of very modern views driven by their distress to the use of theological terms to which they attached no doctrinal significance, merely because a drawer was jammed tight and they could not pull it out. A friend of mine was particularly afflicted in this way. Every day his drawer was jammed, and every day in consequence it was something else that rhymes to it. But I pointed out to him that this sense of wrong was really subjective and relative; it rested entirely upon the assumption that the drawer could, should, and would come out easily. "But if," I said, "you picture to yourself that you are pulling against some powerful and oppressive enemy, the struggle will become merely exciting and not exasperating. Imagine that you are tugging up a lifeboat out of the sea. Imagine that you are roping up a fellow-creature out of an Alpine crevasse. Imagine even that you are a boy again and engaged in a tug-of-war between French and English." Shortly after saying this I left him; but I have no doubt at all that my words bore the best possible fruit. I have no doubt that every day of his life he hangs on to the handle of that drawer with a flushed face and eyes bright with battle, uttering encouraging shouts to himself, and seeming to hear all round him the roar of an applauding ring.

6. So I do not think that it is altogether fanciful or incredible to suppose that even the floods in

London may be accepted and enjoyed poetically. Nothing beyond inconvenience seems really to have been caused by them; and inconvenience, as I have said, is only one aspect, and that the most unimaginative and accidental aspect of a really romantic situation. An adventure is only an inconvenience rightly considered. An inconvenience is only an adventure wrongly considered. The water that girdled the houses and shops of London must, if anything, have only increased their previous witchery and wonder. For as the Roman Catholic priest in the story said: “Wine is good with everything except water,” and on a similar principle, water is good with everything except wine.

Unit 5

Driverless Cars Could Make Transportation Free for Everyone—With a Catch

Judith Donath

1. As self-driving cars inch closer to everyday reality, journalists, futurists, economists, and ethicists have weighed in with numerous predictions about autonomous vehicles’ future impact. Liquor sales will rise, the predictions go, since no one will worry about driving under the influence. Cars will have ethics knobs, with settings that vary from minimizing overall harm in a crash to saving the occupants at any cost. Steering wheels, traffic jams, and parking meters will become quaint relics, like hitching posts and watering troughs.
2. But these prognostications miss what will be one of the biggest developments of all: In a world full of autonomous autos, transportation will become free. Not just hands-free, or driver-free, or go-wherever-you-want free. But free as in beer: complimentary, gratis. Summon a car and travel for nothing—that is, so long as you are willing to make a stop or two en route at sponsoring locations.
3. Picture a not-too-distant future where a trip across town is available to anyone who will spend 15 minutes in McDonald’s on the way. Not a fast-food fan? Then for you it’s Starbucks, a bookstore, the game parlor. Rides with a child stop at the Disney store, while teenage girls are routed via next decade’s version of Zara and H&M. Unlike today’s UberPool, with its roundabout routes and multiple passenger pickups, “UberFree” features tailor-made routes and thoughtfully targeted stops.
4. Realtors could pay to have the cars drive slowly past featured properties for sale, past the nice new elementary school in the slightly more affluent neighborhood. At election time, a candidate’s campaign would route voters through run-down areas while a voice-over blames the opponent for this decline. And if you happen to mention at some point in the day that you are chilly, or your shoes hurt, or you have a party to go to, the friendly virtual assistant that lives on all your devices—Alexa’s granddaughter—ensures that your next trip’s stops include relevant sponsored solutions.
5. These rides will be popular both with passengers, who see a great bargain, and with marketers, who leap at the chance to not just show people ads, but to physically place potential customers in front of temptation. Say you and your friends want to go to the beach. For $20, a van

could take you all directly there. Or, you can go for free, with stops at Amazon Food and at Target. At the beach, you're pleased with the deal: You wanted snacks anyhow, and though you did not need a new beach towel, Target had really nice ones, so you picked up two—along with a cute hat and a phone case you saw by the register. A generation will grow up with the expectation that transportation—convenient, door-to-door transportation—is free. But how free is free? Less enthusiastic will be environmentalists, consumer watchdogs, obesity monitors, and others fearful of the dangers of unchecked consumption. And the person traveling fare-free may find that the free ride, like the proverbial free lunch, does not really exist.

6. Autonomous vehicles are still about a decade away, but the potential pitfalls and inherent conflicts of this transportation arrangement are already apparent in existing precursors of the promoted ride. Take sponsor-routed cab rides. In Las Vegas, it has been common practice—made legal and taxable in 2010—for businesses to pay taxi drivers for steering customers to them.

7. Which Vegas businesses did this and how much they paid was, until recently, valuable covert info, shared within the cab-driving community. Now, there's an app for that: Kickback helps drivers quickly find, by category—nightclub, gun range, wedding chapel, and so forth—all the businesses that will pay them, by the customer or carload. The going rate at cannabis dispensaries is $10 per drop-off. Vegas Weddings pays $50, so long as the customers purchase the $199 package. Even though apps like Yelp mean the local cabbie is no longer an indispensable guide, many people still seek their driver's advice, enjoying the feeling that they are getting secret insider information.

8. But the system benefits drivers at the passengers' expense. The drivers' incentive is to take people to the places offering the biggest kickbacks, but those businesses are often the least desirable. Indeed, the amount a club pays on the Kickback app seems to have an inverse relationship to its Yelp ratings: Sapphire Gentleman's Club offers among the highest kickbacks ($80 for male taxi riders), but has many one-star reviews, whose complaints range from watered down drinks to drugging and robbery. On top of that, some clubs present customers who arrive in a cab with high cover charges to make up for the driver's kickback.

9. Will replacing the human driver with an autonomous car shift the equation in the passenger's favor? Not necessarily. It will depend on how the systems are designed, who is designing them, and how aware the users are of the potential for manipulation.

10. How we get from point A to point B is a process determined by numerous and often-competing interests. Some of these tensions can be seen today in the rise of algorithmic navigation apps such as Waze and Google Maps. These apps are ad-supported, so their incentive is to retain the human drivers who want to get to their destinations as easily as possible. Thus the apps reroute, for instance, from congested highways onto obscure side streets. While this speeds the users along, it also disrupts life in areas intended to be quiet, residential neighborhoods. Currently, neither the irate neighbors nor city planners have much recourse: The roads are public and the cars driven by individuals, making intricate congestion pricing and driving zones infeasible.

11. Cities may have more control once these algorithms are routing autonomous cars. The "driver" would now be the algorithm—or more accurately, the company that controls the algorithm. At this scale, planners could create zones of permissions and pricing for traveling on different roads, regulations that the algorithmic "driver" must obey to continue to be licensed to

drive these streets. Ideally, their goal would be to fairly balance the competing needs of rich and poor, people and businesses, passengers and residents. The question of what is fair, however, is likely to be contentious. Wealthy neighborhoods could be made off-limits to all cars without resident or guest permits. Speedy scenic routes would become the business class of car travel, and the slow routes, lined with McDonald's, dry cleaners, and other strip-mall stalwarts, the urban economy class.

12. The relationship among businesses, passengers, and drivers is different. Payments (whether kickbacks or sponsorships) from a business to a driver (whether human or algorithmic) in return for redirecting people are a way for businesses to align the drivers' incentives with their own. In the case of the Las Vegas taxis, the passengers still have recourse: The drivers operate independently, and passengers are capable of directing them to a preferred location. But once independent drivers are replaced with autonomous vehicles under the control of a monolithic routing algorithm, if the company that controls the algorithm has special relationships with businesses, it can wield far more influence on where people shop and eat, on what they see—and where they do not go.

13. Without the equivalent of net-neutrality regulation to protect humans traveling in cars, the flip side of sponsored rides could be ride surcharges: barriers to visiting places the algorithm sees as rivals.

14. There are a few reasons why we do not have widespread sponsored rides today. One is that the cost of the driver's time is too high (the Las Vegas cabbies take tourists to destinations, not to additional stops on the way). But once the taxi equivalents of the future are autonomous, the cost of idle time should plummet. Another factor may be psychological: Suggestions about where to go and how to get there will come from a familiar, trusted virtual agent.

15. Indeed, while the behind-the-scenes brainpower of an autonomous fleet is a vastly complex algorithm, passengers will only interact with a friendly persona, something like Alexa, Siri, Cortana, but with all the advances—subtler vocal inflections, more accurate perception and manipulation of human emotional states—that a few years of concentrated technical development will bring.

16. Autonomous cars will be part of an ecosystem of intelligent agents and personal-data vendors. The information they are able to base your route on—and how they present an itinerary to you—will not be limited to where you say you want to go, but on all the data they have about you. Note that companies with immense personal-data collections, including Amazon, Baidu, Google, and Uber, are in the race to develop autonomous cars. (Uber has recently launched UberEats, a delivery service that collects data about customer habits for participating restaurants.) The same system that one day provides your ride may have access to, if not control over, your calendar, contacts, medical records, and holiday shopping lists.

17. With her deep knowledge of your life, the virtual agent that plans your trips will be great at her job. Unlike the insinuating cabbie or the awkwardly inexperienced Uber driver, her flawless persuasive banter will never make you feel uncomfortable or coerced. When she suggests you leave a bit early for your meeting across town so that you have time to stop on the way for a gift for your sister's birthday, and don't you also want to get your hair cut, and oh here's an excellent new place to try—she does so as your friend, your confidant. Or so she will be designed to make you feel.

18. This future might seem, at first glance, like a techno-utopian scenario. Yet little will have really changed. Like the Las Vegas cabbie, the goal of these systems will be to make profit for themselves. They'll just be much better at persuading you otherwise.