

Academy Meetings

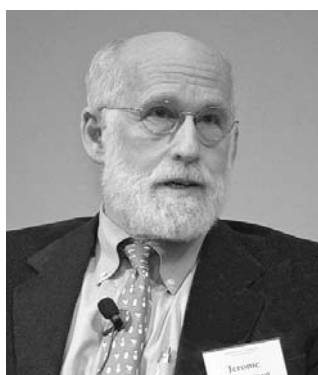


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What Is Missing in Medical Thinking

Jerome E. Groopman

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Jerome E. Groopman

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Presentation

About three years ago I was the attending physician in general internal medicine at the Beth Israel Deaconess Medical Center. I would round with Harvard medical students and the interns and residents, seeing all types of patients, not just those with the illnesses that I specialized in (blood diseases, cancer, and AIDS). I would see people with pneumonia, diabetes, and some whose problems were not clear but who were ill enough to be in the hospital. After a few weeks, I found myself unsettled. Here were all of these bright, motivated, and usually affable young men and women – Harvard medical students and Harvard house staff – but somehow they were not thinking deeply or broadly about the patients under our care. At first I held myself back. I thought, uh-oh, I’m gray and bald-

ing, and I’m starting to think that when I was a house officer thirty-three years ago the training was really rigorous, and we did it right; but this new generation. . . .

The mistakes that lead to delayed or never-made diagnoses are thinking mistakes.

I stopped myself because I realized that to teach these young doctors to think better I had to know how I thought as a physician. And I realized that despite all my training at prestigious institutions no one had ever really taught me to think; and at times (many times) I did not think deeply or broadly. The question was why.

So I spoke with various colleagues, men and women whom I knew in medicine and respected for their clinical acumen. I asked them, “How do you think?”

They said, “What are you talking about? I think.”

I said, “No, *how* do you think?”

“I don’t know how I think, I just think.”

So I said, okay, this is a problem. If I am going to be a more effective teacher – frankly, if I am going to improve my own abilities as a physician – I need to know how doctors think. I need to know why we as physicians get it right and what accounts for the times when we get it wrong, particularly when we misdiagnose.

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About ten years ago the Institute of Medicine came out with a report about medical mistakes called *To Err Is Human*.¹ Unfortunately, the report includes almost nothing about diagnosis and thinking. Instead, this important document focuses on systems and procedures and looks at the hospital essentially as a large factory, trying to pinpoint where on the assembly line workers screw up.

Most of the report is concerned with safety issues. It details shocking levels of sloppiness – for example, poor hand washing, which obviously can lead to the spread of infections – and the familiar headline-grabbing errors: the neurosurgeon who operated on the wrong side of the brain; an orthopedist amputating the wrong limb. These kinds of medical mistakes are jarring and

great fodder for critics, and they shouldn’t happen. Fortunately, they are rare – really rare – and systems have been instituted to help prevent them.

Recently I injured my arm and required surgery. When I went to have my arm put back together, I was given a bracelet, and I had to say my name three times. At first I was worried they thought I was demented.

“You are sure you’re Jerome Groopman?”

“Yes, I am sure I’m Jerome Groopman.”

Then they marked my hand to indicate which arm was to be fixed.

This and the other steps are all important in preventing systems errors. Unfortunately, systems errors of the type focused on by the Institute of Medicine don’t explain why 15 – 20 percent of all patients are misdiagnosed. The mistakes that lead to delayed or never-made diagnoses are thinking mistakes.

Incidentally, getting to the data on misdiagnosis is not easy. The data are hidden and take a while to find. Researchers have performed chart reviews, autopsy studies, and run simulations where “actor-patients” are asked to visit established physicians and mimic an illness and a history. About 80 – 85 percent of the time, doctors get it right. If you are a baseball player and you are batting .800 or .850, that’s unimaginable, right? Or if you manage your university’s endowment and made the right stock picks 80 – 85 percent of the time, you would be a genius, right? But in medicine a 15 – 20 percent rate of delayed or never-made diagnoses is simply too high.

So, how does a doctor think? We work under tremendous time pressure, and we work under conditions of uncertainty with limited data at hand. We are also doing what Donald Schön at MIT has called “thought-in-action.”² We are thinking while we are

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doing, so we’re not like an economist who sits quietly in his cozy office looking at a data set and analyzing everything from beginning to end in a linear, systematic way. Our minds work like magnets. We pull in information and cues from every direction. From the moment someone walks in and says hello, our eyes are performing a physical exam. From the patient’s first response to our initial question (What brought you here today? What’s wrong?), we are getting data and integrating them. The data increase as we do a physical exam and look at the patient’s labs, X-ray studies, and so on.

Amos Tversky and Daniel Kahneman were pioneers in cognitive science when they were at Hebrew University in Israel, where they studied thinking under conditions of uncertainty and time pressure. Tversky died an untimely death as a young man. Kahneman won the Nobel Prize in economics and is currently at Princeton. Together they defined using experimental paradigms for certain biases that many people argue are wired into the human brain. I believe their work explains much of the genesis of misdiagnosis.

Tversky and Kahneman performed a series of experiments to identify the shortcuts and mistakes that people make. For example, they showed one group of students – not math majors – a series of numbers that were to be multiplied. One times two times three times four, all the way to eight. They quickly showed the numbers on a screen and then told the group to estimate the product of multiplying all the numbers.

The group put down on their papers something like 500.

¹Institute of Medicine, *To Err Is Human: Building a Safer Health System*, ed. Linda T. Kohn, Janet M. Corrigan, and Molla S. Donaldson (Washington, D.C.: National Academy Press, 1999).

²Donald A. Schön, “From Technical Rationality to Reflection-in-Action,” in *Professional Judgment: A Reader in Clinical Decision Making*, ed. Jack Dowie and Arthur Elstein (Cambridge, U.K.: Cambridge University Press, 1988). Schön’s essay was originally published in Schön, *The Reflective Practitioner* (New York: Basic Books, 1983).

A second group with a similar composition – bright students but no math majors – was shown the same series of numbers in reverse: eight times seven times six times five, down to one.

The second group put down something like 2,200 as their estimate.

Both estimates are wrong, but the difference between them is nearly fivefold. Tversky and Kahneman defined what's called "anchoring" based on this type of experiment. Anchoring turns out to be more powerful, and more insidious, than this simple experiment with students would suggest. Our judgments – say, of whether a series of numbers multiplies to the hundreds of thousands or to the millions – are biased by the initial data we encounter, whether it is eight times seven times six, which is 336, or one times two times three, which is six.

I believe the time has come to incorporate cognitive science into the education of medical students and physicians. We need to know how we think and why we often, too often, think incorrectly.

When he was at MIT, Dan Ariely, realizing that he was dealing with math majors who would immediately know the formula for multiplying a series, invited a group of MIT undergraduates to play a game about auctioning automobiles. He told them to put, for identification purposes, the last two digits of their Social Security Number in the right-hand corner of their paper and then to forget about it. Everyone jotted down the last two digits of his or her Social Security Number – some had low digits (09 or 18), some had digits in the mid-range (45, 58), and some had high digits (88, 92). Ariely then showed three automobiles: a Chevette, which is a tin can; a Camry, which is a mid-level car; and a fancy, high-end Lexus. Ariely asked the students to imagine the cars were being sold at auction and to determine what they would be willing to bid for them.

He found that students with low final digits in their Social Security Number tended to put in lowball bids on every one of the cars. People with digits in the middle put in middle-range bids. And people with high digits overbid. Obviously, the last two digits of a Social Security Number have nothing to do with the price of a Chevette, Camry, or Lexus. But in Ariely's experiment, the mind anchors on those numbers. Even though the students are told to put the numbers to the side and even though rationally they know the numbers are irrelevant, they become biased.

Physicians anchor all the time. They take the first bit of data the patient gives them about what's wrong, and they run with it. The time pressures of modern medicine only exacerbate the problem. Many misdiagnoses are due to anchoring.

A second common mistake is the availability heuristic, also defined by Tversky and Kahneman, although mainly with regard to economics. Imagine that you go to a wedding with your spouse or significant other. You are sitting at the table with your Uncle Moe, who didn't go to college and is a schlub. Moe says, "I bought Google when it was \$83. I made so much money. I knew Google was a great company. I could tell they would do this, they would do that. And now it's trading at \$350."

On the drive home your significant other says, "I told you to buy Google, and you didn't listen. I told you, 'It's Google!' All these years you've been telling me Moe is a schlub and he doesn't know anything. He made a fortune. And look at us."

So, a month later someone says, "There's this new Internet company; it's unbelievable." You have Google on the brain, not to mention Uncle Moe. So when you analyze what this company does, what its prospects are, you superimpose the drama and success of Google on your decisions.

Dramatic or prevalent problems or cases are easily retrieved from memory. What is most available from the past becomes superimposed on the present. So, doctors who have seen a dramatic or unusual case are more prone to see the same dramatic or

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unusual problem elsewhere. Doctors in the middle of a flu epidemic will conclude that every patient they see has flu, even if those people don't have flu.

The last important error is related to attribution bias. We all have stereotypes in our mind. We see someone who's not shaved, has a stubbly beard, clothes don't look good, maybe there's a whiff of alcohol. Immediately we conclude he's a chronic alcoholic. In my book *How Doctors Think*,³ I describe a woman I call Ellen Barnett, who saw five doctors while in the middle of menopause. She told them she was feeling explosions in her body.

Now, when it's 4:30 in the afternoon and you've seen fourteen patients, and some high-strung perimenopausal woman comes in and says, "I'm feeling explosions in my body, I have explosions in my body," you say, "It's menopause," right? You think, "Another high-strung woman with hot flashes." You attribute her problem to the stereotype, often pejorative, that you have in your mind.

After seeing five really good physicians, all of whom patted Ellen Barnett on the head and told her she was just having problems with menopause, she saw a sixth doctor, an endocrinologist. She said to the doctor, "You know, I am a little cuckoo, and I am having a really tough time with menopause, but I'm telling you I am feeling explosions in my body." This doctor did not make an attribution error. She didn't say, "Ugh. One more menopausal woman driving me crazy." She said, "Let's be counterfactual. Let's say

³Jerome Groopman, *How Doctors Think* (New York: Houghton Mifflin, 2007).

it's not menopause. What else could it be?" She thought and she listened. The sixth doctor discovered that Ellen Barnett had a pheochromocytoma, a tumor that produces adrenaline and can cause sky-high blood pressure, precipitating a stroke or heart attack – in short, a tumor that can be fatal. The doctor who didn't make the attribution error, who avoided the misdiagnosis, saved Ellen Barnett's life.

Medicine has been very effective at incorporating important scientific disciplines that were initially not part of its fabric; for example, molecular biology. In the 1970s when I was training, other people on campus were working on bacteria. But they didn't talk to doctors, and doctors didn't talk to them. Now DNA analysis is mainstream. So are high-performance computers, bioinformatics, and MRI scans. Medicine has incorporated all of this technology, some of it good, some of it with downsides. I believe the time has come to incorporate cognitive science into the education of medical students and physicians. We need to know how we think and why we often, too often, think incorrectly.

While on rounds I also noticed that the interns, residents, and medical students all would immediately glom onto the computer, use it to arrive at a diagnosis, and find the so-called guidelines for the diagnosis. These guidelines are basically algorithms or decision trees that have been put together by expert committees based on "best evidence" or "best practices." Some guidelines are designed to help prevent shameful levels of contamination; for example, guidelines on hand washing or how to place a central line. Others are meant to keep doctors from making avoidable errors – leaving surgical instruments in someone's abdomen or prescribing medications that interact in a toxic way. Still others deal with aspects of acute care; for example, giving an aspirin after a myocardial infarction.

The problem is that guidelines are now moving beyond where I believe their reach is best set. They are recommendations, but they are becoming rules. And they have real scientific and cultural limitations. The main scientific limitation is that all evidence

is imperfect. In the last few years the lay public has repeatedly seen medical dogma overturned:

- Estrogen replacement therapy for postmenopausal women. This was gospel for 40 years because the medical profession thought it prevented heart disease and dementia. Recent results from a much better designed, randomized controlled study indicate that this isn't the case.
- Glucose control for diabetes. For years the dogma in certain circles was that you had to tightly control blood sugar. In the last six months, however, important studies have been published, mainly in *The New England Journal of Medicine*, showing that you kill more people than you help by so tightly regulating blood sugar. So that might not be such a smart idea.
- Low-fat diets. Ten, twelve years ago, all the emphasis was on low-fat diets. And what resulted? An epidemic of obesity as lay people and doctors alike thought that carbohydrates were a good substitute.

My cognitive burden as a physician is to figure out how the various guidelines do or do not correspond to the individual sitting in front of me.

So we are often not as smart as we think. The other problem with converting recommendations – or reference points (guidelines are important reference points) – into rules has to do with the very process by which guidelines are developed. Experts often don't agree. But guidelines come out of consensus. I have been on these committees. Sometimes the committee will include a forceful, dominating personality who says, "Tight blood sugar regulation is essential; we know this." And therefore the guideline is written that way. What is happening in Massachusetts, and may soon happen across the country, is that physicians who deviate from the guideline are being dinged.

The problem is twofold. First, I strongly believe in the autonomy of the patient. It is the patient, the sick person, who either enjoys the benefits or suffers the consequences of decisions made about treatment. Therefore, the patient's preferences, goals, and values need ultimately to prevail. That doesn't mean a patient should be able to come into the hospital and say, "I want you to have dirty hands in the OR." Or, "You don't have to mark my right hand. Just do whatever you want." But what if someone doesn't want to take a statin drug for borderline cholesterol – in effect, doesn't want to follow the guidelines many elite medical groups have developed for these drugs? A lot of people say, "I don't want to take it. I don't want to have muscle aches or risk getting them. I don't want to take another pill." One would hope that the interests of the physician would align with those of the patient, but if the physician is under financial pressure to follow the guidelines, his or her interests and those of the patient might no longer be in alignment.

The second part of the problem is conflict of interest, an issue recently heralded by the Institute of Medicine.⁴ The fact is that many of the people who write guidelines have financial interests in the areas covered by those guidelines. I don't believe that they are consciously prostituting themselves. I really don't. Some people truly do believe deeply in some things, and the pharmaceutical and medical device companies find those people, those opinion leaders who strongly believe, and they support them, make sure that they fund the guideline committees on which those people serve. A devastating recent article in *The Journal of the American Medical Association* showed how the diabetes guidelines were formulated with inadequate transparency and the support of a pharmaceutical company. No voices of dissent were included.

So, we are at a watershed moment in terms of health care. We need to have universal coverage, and we need to contain costs, but

⁴ Institute of Medicine, *Conflict of Interest in Medical Research, Education, and Practice*, ed. Bernard Lo and Marilyn J. Field (Washington, D.C.: National Academy Press, 2009).

we also have to be extremely attentive to making sure that as these imperatives are met we don't set up a system where we stop thinking about the individual. My cognitive burden as a physician is to figure out how the various guidelines do or do not correspond to the individual sitting in front of me. The studies on which guidelines are based consist of statistical averages of cherry-picked and relatively homogeneous populations that may or may not correspond to the patient in my office who also has kidney disease or heart disease in addition to his lymphoma. The skill is to understand how the individual does or does not correspond to the published data and then to find out from the individual what his or her goals and values and preferences are. While thinking about the disease, the physician should also be thinking about the individual.

Question: I would like you to speak more about differential diagnosis. Back when I was in medical school, the teaching we received was quite good on differential diagnosis, how to go about it, the process, and so on. But over my career I've certainly seen people do exactly as you say. They fixate on one issue, and they don't bother to proceed with a differential diagnosis. They aren't ruling things out. They're just putting them aside. Can you discuss what you think are some of the influences besides time pressure that cause physicians not to follow what (I assume) is still being taught? What pressures have you encountered as you've studied this problem?

Groopman: In addition to time pressure, which is a major factor, we need to consider the benefits and downsides of the electronic medical record. My wife, Pam Hartzband, and I have written about this in *The New England Journal of Medicine*.⁵ We are seeing a terrible abandonment of narrative. The average physician now interrupts a patient within eighteen seconds. Talk about anchoring! When you ask, "What's wrong with you?" but then interrupt so quickly, you don't hear the story. And the story is critical for two reasons: one, the most im-

⁵Pamela Hartzband and Jerome E. Groopman, "Off the record – Avoiding the pitfalls of going electronic," [Perspective] *The New England Journal of Medicine* (358) (2008): 1656 – 1658.

While thinking about the disease, the physician should also be thinking about the individual.

portant information often doesn't come at the beginning; two, ultimately you need to know who this person is in order to develop a shared strategy about what to do and how to treat. After my recent accident I experienced this problem firsthand. My physicians didn't look at me. They were absolutely glued to the computer screen. They didn't use open-ended questioning when speaking with me. All of their questions were close-ended because they needed to check off boxes to show on the electronic record that they had met the quality metrics. Otherwise they get dinged. I was shocked to see that the RAND organization has set forth 439 "quality" indicators that a doctor must measure up to.⁶ Some of these are overwhelming. Others are process measures of unclear utility, unproven with respect to changing disease outcomes. You would be checking boxes for twenty hours a day! When doctors stop thinking in an open, expansive way, they stop thinking about differential diagnoses. The errors, the shortcuts, the heuristics, the biases that Tversky and Kahneman defined are then amplified because the doctor's focus is on checking off the boxes and fragmenting the patient to fit the structure of the electronic record.

Question: You emphasized the importance of teaching students how to think about taking care of patients. Your thesis was that we don't pay enough attention to that anymore. I agree with you. I would suggest, however, that you omitted the most important reason for this phenomenon: our health care system has been turned into an industry. Medicine is no longer a social service rendered by professionals in a personal relationship with patients; it's a business. Doctors are being forced to be cost-

⁶Elizabeth A. McGlynn, Steven M. Asch, John Adams, Joan Keeseey, Jennifer Hicks, Alison DeCristofaro, and Eve A. Kerr, "The quality of health care delivered to adults in the United States," *The New England Journal of Medicine* (348) (2003): 2635 – 2645.

effective and to use their time efficiently to generate more income. That can't be done without changing the health care system. I have been a physician for sixty-three years, and I can clearly remember how it was when I started out in medicine and the kind of medicine I taught to students in the 1950s, 1960s, and 1970s. Students and house officers were required to spend time with patients; it was open-ended. For economic reasons, that practice is no longer available. Do you think that we physicians ought to be speaking more loudly and more clearly about the need to reform the health care system so that it doesn't continue to become simply a business that generates maximum income for investors, owners, private insurers, and so on?

When doctors stop thinking in an open, expansive way, they stop thinking about differential diagnoses.

Groopman: Yes, I strongly agree with that; it's another issue that my wife and I have written about in *The New England Journal*.⁷ Today doctors are subject to what's called "relative value units." Every physician has to account in dollars for his or her time. The social fabric of medicine is being changed as people are increasingly conditioned to think of time as money all the time. Therefore, they take the shortest distance between two points when making a "diagnosis" or recommending a treatment. The compassionate dimension of medicine is telescoped to a point where it is disappearing.

Cognitive psychologists have conducted studies in which they place people in rooms and ask them to "decode" sentences.⁸ In one room the person decodes neutral sentences. In the other room the person decodes sentences that include financial terms, words

⁷Pamela Hartzband and Jerome E. Groopman, "Money and the changing culture of medicine," [Perspective] *The New England Journal of Medicine* (360) (2009): 101 – 103.

⁸Kathleen D. Vohs, Nicole L. Mead, and Miranda R. Goode, "The psychological consequences of money," *Science* 314 (2006): 1154 – 1156.

about money. A confederate of the researchers enters each room and drops a bunch of pencils on the floor. Compared to the person who is decoding sentences that include monetary terms, the person who is decoding neutral sentences will pick up twice as many pencils. The same result occurs when someone enters the room and says, "Will you help me with these instructions? I don't understand the problem." Compared to the person who is being subliminally prompted about money, the person who is decoding neutral sentences will spend two to three times as much time trying to help.

A famous line in the Talmud begins, "Ayn kemach, Ayn Torah." Without bread there is no learning. Doctors need resources to do science and to educate patients. But the present-day focus on money in medicine is so intense that an entire dimension of medicine is being negated as a result.

Question: What benefit might be conveyed by truly intelligent computers that know all about differential diagnosis, including the uncertainties in differential diagnosis?

Groopman: This actually has been tested. Computers are a definitely useful resource. If I want to check a symptom or get a differential diagnosis or a span of possibilities, computers are very efficient. However, the field-testing of reasonably sophisticated computing with large medical databases has been a failure. Most of the data are negative, and the reason is, to use the jargon of some of my computer friends, "garbage in garbage out." If you don't have the skill set to extract from the patient's narrative what is really going on, if you take the symptom based on anchoring or availability or attribution, the computer is not going to step in and say, "Listen, guy, you interrupted at eighteen seconds. Give me something intelligent here, not the first bit of data the patient gave you – 'I have a headache' – because that data, the headache, is irrelevant." In a situation like this, the supposedly "intelligent" computer is inert: it spits out a differential diagnosis and decision tree based on the headache datum, and you send the person to the neurologist and the MRI and so on. You have misdiagnosed or delayed

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diagnosis by relying on the computer. But the problem is not the computer. The problem is the human being who relied on it.

Question: You have suggested that the medical profession should consult cognitive scientists such as Emilio Bizzi. Is that not naive, given that cognitive science, like computer science, is such a young discipline?

Groopman: We can learn or be trained in what's called metacognition: thinking about our thinking. It sounds simple, but people don't do it. Not only doctors but people in every sphere of work should constantly be asking themselves a series of straightforward counterfactual questions. The first is, "What else could it be?" Instead of just dismissing Ellen Barnett as a kooky, perimenopausal woman, ask what other diagnoses might explain her symptoms. The second question is, "Could two things be going on at once?" In medical school we are taught Occam's razor over and over again: look for a single unifying explanation. The problem is that people sometimes have two problems going on at once. This is a huge issue for radiology. Researchers have done some wonderful studies where they track the eyes of the radiologist looking at an image. As soon as radiologists find an abnormality, they stop looking. Even if their retina passes over a second abnormality, they don't assimilate it. This is termed "satisfaction of search." The third question is, "What in this set of data goes against my hypothesis?" This question protects you against confirmation bias, stops you from cherry-picking the data that confirm your assumption and discounting the data that are contradictory. These three simple metacognitive questions should be widely taught and practiced.

Question: Why can't the box-checking exercises be used as a way of countering the heuristics that lead doctors to misdiagnose or delay diagnosis? For example, the three metacognitive questions could be on the checklist. "Did you ask whether it could be something else?" That is a box the doctor could check off.

Groopman: The problem is that you then have an infinite set of questions to find the answer to "What else could it be?" A checklist can't encompass the universe of questions that would need to be asked if you don't have the skill set to engage in an open-ended narrative. When *How Doctors Think* came out, I received an email about one of the patients from someone who works in computers and databases. He said, "I ran her symptoms through the computer, and I got forty-three different diseases I could posit." But he can't evaluate those forty-three possibilities in the way that a well-trained physician can.

Maybe we can do checklists better. I am not against having information in a more structured way. But the way checklists are now implemented is limiting rather than expanding. We need to return to engaging the patient in a narrative. When you engage people with checklists, they often won't tell you things accurately until you are done with the checklist. You need to talk to find out what's wrong. In fact, studies of physician-patient interactions have found that if the doctor doesn't prompt the patient in an open-ended way, the doctor won't get good information. That's just how people are. We want to tell our story, and if we're not given that opportunity the doctor is put at a disadvantage. ■

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