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Perspective

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From Mindless to Mindful Practice — Cognitive Bias and Clinical Decision Making

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The two major products of clinical decision making are diagnoses and treatment plans. If the first is correct, the second has a greater chance of being correct too. Surprisingly, we don't make correct diagnoses as often as we think: the diagnostic failure rate is estimated to be 10 to 15%. The rate is highest among specialties in which patients are diagnostically undifferentiated, such as emergency medicine, family medicine, and internal medicine. Error in the visual specialties, such as radiology and pathology, is considerably lower, probably around 2%.[1]

Diagnostic error has multiple causes, but principal among them are cognitive errors. Usually, it's not a lack of knowledge that leads to failure, but problems with the clinician's thinking. Esoteric diagnoses are occasionally missed, but common illnesses are commonly misdiagnosed. For example, physicians know the pathophysiology of pulmonary embolus in excruciating detail, yet because its signs and symptoms are notoriously variable and overlap with those of numerous other diseases, this important diagnosis was missed a staggering 55% of the time in a series of fatal cases.[2]

Over the past 40 years, work by cognitive psychologists and others has pointed to the human mind's vulnerability to cognitive biases, logical fallacies, false assumptions, and other reasoning failures. It seems that much of our everyday thinking is flawed, and clinicians are not immune to the problem (see box). More than 100 biases affecting clinical decision making have been described, and many medical disciplines now acknowledge their pervasive influence on our thinking.

Cognitive failures are best understood in the context of how our brains manage and process information. The two principal modes, automatic and controlled, are colloquially referred to as "intuitive" and "analytic"; psychologists know them as Type 1 and Type 2 processes. Various conceptualizations of the reasoning process have been proposed, but most can be incorporated into this dual-process system. This system is more than a model: it is accepted that the two processes involve different cortical mechanisms with associated neurophysiologic and neuroanatomical

substrates. Functional magnetic resonance imaging scans vividly reveal the changes in neuronal activity patterns as processes move from one system to the other during learning. Although the two processes are often construed as two different ways of reasoning, in fact very little (if any) reasoning occurs in Type 1 processing — it is largely reflexive and autonomous. The *Augenblick* diagnosis, made in the blink of an eye, is an impressive piece of medical showmanship and the stuff of television entertainment (and corridor consultations), but in real clinical life it is fraught with danger.

Descriptions of the operating characteristics of the dual processing system in clinical reasoning provide a useful starting point for learning about medical decision making.[3] Intuitive processes are generally either hard-wired or acquired through repeated experience. They are subconscious and fast and mostly serve us well, enabling us to conduct much of our daily business in all fields of human activity. We mostly get through life by moving from one of the intuitive mode's associations to the next in a succession of largely mindless, fixed-action patterns. These patterns are indispensable; however, they are also the primary source of cognitive failure. Most biases, fallacies, and thinking failures arise from the intuitive mode (see box). When primary care physicians trust their intuition that a patient's chest pain does not have a cardiac origin, they will usually be correct — but not always. The clinical gamble of trusting one's intuitions generally carries good odds, but inevitably those intuitions will fail some patients. The issue is whether we can tolerate the current levels of failure — or is there room for improvement?

Analytic processes, by contrast, are conscious, deliberate, slower, and generally reliable. They follow the laws of science and logic and therefore are more likely to be rational. Despite the ubiquity and usefulness of intuitions, they are not reliable enough for us to use them to send a spaceship to Mars. By contrast, when a patient undergoes analytic assessment for chest pain in a cardiac clinic that culminates in angiography, the conclusion is invariably correct. Analytic failures can occur, but usually when the wrong rules are followed or other factors come into play, such as cognitive overload, fatigue, sleep deprivation, or emotional perturbations. The biggest downside of analytic reasoning is that it's resource-intensive. Although analytic reasoning can often be done quickly and effectively, in most fields of medicine, it would be impractical to deal with each clinical decision analytically.

Given the substantial impact of our evolving understanding of cognition over the past few decades, it is somewhat surprising that these major social science findings have not readily made their way into medicine. Although our awareness of research biases led to the development of the randomized, prospective, double-blind clinical trial, we remain unrealistic about the scale of everyday cognitive and affective biases and their effect on clinical reasoning. Cognitive psychology has not historically been considered within the remit of medicine, but I believe that we should embrace any work that helps us think about our thinking (metacognition) and that it would be beneficial both to include basic psychology courses in the medical school curriculum and to expand medicine's lexicon to incorporate terms from cognitive psychology.

If cognitive biases are so abundant and troublesome in clinical decision making, why not simply identify them and use a "debiasing" strategy to avoid them? Unfortunately, that's not as easy as it sounds. First, many decision makers are unaware of their biases, in part because our psychological defense mechanisms prevent us from examining our thinking, motivation, and desires too closely. Second, many clinicians are unaware of, or simply don't appreciate the effect of, such influences on their decision making.

Becoming alert to the influence of bias requires maintaining keen vigilance and mindfulness of one's own thinking. When a bias is identified by a decision maker, a deliberate decoupling from the intuitive mode is required so that corrective "mindware" can be engaged from the analytic mode. "Mindware" is defined as the "rules, knowledge, procedures, and strategies that a person can retrieve from memory in order to aid decision making and problem solving."[4] It includes knowledge about the properties of the particular bias and what strategies might eliminate or reduce it. This process appears to be uncommonly difficult, although there have been some successes. A variety of debiasing strategies have beenproposed,

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_lb rfcw jc_b rm _dcu gk nmpr_lr amlajsqgmlq8 debias-ing is not easy, no one strategy will work for all biases, some customization of strategies will be necessary, and debiasing will probably require multiple interventions and lifelong maintenance.

Cognitive failures like those described in the box can be ad-dressed by educational strategies that embrace critical thinking — the "ability to engage in purpose-ful, self-regulatory judgement."[5] Regulating judgment requires training that can permit judi-cious interventions by the ana-lytic mode when needed — spe-cifically, in its capacity to override the intuitive mode. This critical step has been referred to as de-coupling, metacognition, mind-fulness, and self-reflection. Most of us never reach our ceilings for critical thinking, and many people go through life unaware of their thinking limitations.

We are not born critical thinkers. Like any other skill, however, critical thinking can be taught and cultivated, but even accom-plished critical thinkers remain vulnerable to occasional undis-ciplined and irrational thought.

I believe that medical educators should promote critical thinking throughout undergraduate, postgraduate, and continuing medical education. One key element of training in critical thinking should be a review of the major cognitive and affec-tive biases and the ways they af-fect thinking. Greater effort is needed to develop effective cog-nitive debiasing strategies in medicine. All clinicians should develop the habit of conducting regular and frequent surveil-lance of their intuitive behavior. To paraphrase Socrates, the un-examined thought is not worth thinking.

Disclosure forms provided by the author are available with the full text of this arti-cle at NEJM.org.

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Clinical Examples of Cognitive Failure

Case 1

A 21-year-old man is brought to a trauma center by ambulance. He has been stabbed multiple times in the arms, chest, and head. He is in no significant distress. He is inebriated but cooperative. He has no dyspnea or shortness of breath; air entry is equal in both lungs; oxygen saturation, blood pressure, and pulse are all within normal limits.

The chest laceration over his left scapula is deep but on exploration does not appear to penetrate the chest cavity. Nevertheless, there is concern that the chest cavity and major vessels may have been penetrated. Ultrasonography shows no free fluid in the chest; a chest film appears normal, with no pneumothorax; and an ab-dominal series is normal, with no free air. There is considerable discussion between the resident and the attending physician regarding the management of posterior chest stab wounds, but eventually agreement is reached that computed tomogra-phy (CT) of the chest is not indicated. The remaining lacerations are cleaned and sutured, and the patient is discharged home in the company of his friend.

Five days later, he presents to a different hospital reporting vomiting, blurred vision, and difficulty concentrating. A CT of his head reveals the track of a knife wound penetrating the skull and several inches into the brain.

Case 2

An 18-year-old woman is referred by her family doctor to a psychiatric service for symptoms of severe anxiety and depression. She has been having frequent episod-ic dyspnea, associated with hyperventilation, carpopedal spasm, and loss of con-sciousness. The admitting psychiatrist wants to exclude the possibility of a respira-tory problem and sends the patient to the emergency department (ED) with a re-quest for a chest film to rule out pneumonia.

She is seen and assessed by an ED resident. The patient was not noted to be in any significant distress other than feeling breathless. She is obese, has a history of asthma, and smokes cigarettes. She is currently being treated with a benzodiaze-pine and anxiolytics and is taking a birth-control pill. Her chest and cardiovascular examination are normal. The resident orders routine blood work and a chest film. He reviews the film, reads it as normal, and believes the patient can be safely re-turned to the psychiatric facility. He attributes her respiratory problems to anxiety.

While she awaits transfer, she becomes very agitated and short of breath. Several nurses attempt to settle her, encouraging her to breathe into a paper bag. Shortly afterward, she loses consciousness. Her monitor shows pulseless electrical activity and then asystole. She cannot be resuscitated. At autopsy, she is found to have pelvic vein thrombosis extending from the femoral vein and saddle emboli in both lungs, as well as multiple clots of varying age.