Published in final edited form as:

*JAMA*. 2016 November 08; 316(18): 1867–1868. doi:10.1001/jama.2016.14174.

# Not thinking clearly? Play a game, seriously!

**Deepika Mohan, MD MPH**,

Department of Critical Care Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

**Jesse Schell, MS**, and

Schell Games, Pittsburgh, PA, USA

**Derek C. Angus, MD MPH FRCP**

Department of Critical Care Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

## Diagnostic error: the next frontier of patient safety

According to the National Academy of Medicine (NAM), every American suffers the consequence of at least one diagnostic error. In their white paper, *Improving Diagnosis in Health Care*, the NAM stated there was "a moral, professional, and public health imperative" to improve the diagnostic process. Although the report attributed diagnostic failures to many factors, including poorly designed healthcare systems, limitations of health information technology, and the increasing complexity of medicine, it poignantly identified timely, accurate, patient-centered diagnosis as the quintessential competency of the clinician.[1]

## The problem: poorly calibrated heuristics

When a clinician makes a diagnosis, she has to process information and estimate the probability that the patient has *x, y*, or *z* condition. In other words, she has to render a judgment. Over the last forty years, Nobel laureates in psychology and economics debunked the idea that judgment occurs in a consistent, reproducible and rational fashion. Rather, judgment arises from two separate cognitive processes: the first, called 'System 1', provides rapid solutions based on pattern recognition (heuristics), while the other, 'System 2', is a slower analytic process that produces answers derived from rule-based algorithms. The two systems work cooperatively to produce adequately accurate or sensible answers.[2] However, there are important limitations.

Most judgments arise exclusively from heuristics (System 1). Every physician, and every person, can make a host of spontaneous and cognitively effortless decisions based on judgments that 'come to mind' instantaneously when presented with a pattern of information. This capacity of System 1 decision making works well under time-pressure and uncertainty because it bypasses the need to carefully sift through all data and instead streamlines decision making. Heuristics generate accurate answers *most* of the time.

**Address for correspondence:** Deepika Mohan, MD MPH, Room 638 Scaife Hall, 3550 Terrace Street, University of Pittsburgh, Pittsburgh, PA 15261, Tel: (412) 647 6783, Fax: (412) 647 3791, mohand@upmc.edu.

However, when poorly calibrated, they draw attention to the wrong contextual cues, resulting in predictable errors (biases). People develop good heuristics when they perform the same task repeatedly, and receive feedback on their performance.[2] Unfortunately, most physicians do not have the luxury of doing one task. Moreover, they receive feedback only for the rare cases tied to performance measures or perceived as outliers.

This problem is particularly acute for conditions like sepsis or trauma where physicians must make time-sensitive diagnoses with imperfect information and with competing demands on their attention. As the population ages, the likelihood that patients with sepsis or trauma may present atypically or with comorbid conditions further adds diagnostic complexity. Additionally, these conditions, though common nationwide, make up only a small proportion of each physician's caseload. For example, emergency medicine physicians practicing outside academic centers treat 1000 patients for every 1 with severe trauma. In other words, time pressure and competing demands drive physicians to rely on heuristics when making critical decisions for these patients. They use the representativeness or the availability of an injury (the degree to which it appears typical of a severe injury or reminds them of a prior case) to make treatment decisions, rather than rule-based algorithms. But, the lack of predictability and routine feedback result in poorly-calibrated heuristics. Consequently, they treat patients with gunshot wounds differently from those with rib fractures after a fall, even though both patients have an equivalent risk of mortality.[3] Their heuristics lead them astray.

## Traditional solutions to overcome poor judgment and diagnostic error

Existing interventions typically employ one of two approaches to improving judgment. The first is to increase physicians' use of System 2 processes either implicitly through disseminating rule-based algorithms or explicitly by encouraging reflective reasoning (encouraging physicians to consider their diagnoses more carefully, and recognize the shortcomings of their intuitive judgments). The second approach is to remove the clinician from the decision problem, shifting the burden of judgment to decision tools or consultants. Both of these strategies have effectiveness and generalizability problems. However, most importantly, they share the same limitation: they waste human potential. Experts have unparalleled ability to parse complexity and sift through uncertainty. Instead of eliminating physicians (and their intuition) from difficult diagnostic problems, we need interventions that make intuition better and more reliable.

## An alternative solution: using serious games to recalibrate intuition

Herbert Simon, winner of the Nobel Prize in economics for his work on the boundaries of rationality, defined expertise as follows: "the situation has provided a cue. The cue has given the expert access to information stored in memory, and the information provides the answer. Intuition is nothing more and nothing less than recognition."[2] If Simon is right, then improving heuristics requires that we provide clinicians with experience. The key issue, particularly for rare events, is how to feasibly generate that experience. One solution is the use of so-called 'serious games' – video games with an applied purpose.

Games (even ones for entertainment) have the power to affect behavior, as demonstrated by *Pokémon Go*, the augmented-reality mobile phenomenon. Downloaded 100 million times during its first month, the game challenges players to capture virtual monsters by using a mobile app to search their environment.[4] Players report increased activity and weight loss as a by-product of their desire to win.

Serious games attempt to transform behavior deliberately. The military has spent hundreds of millions of dollars – $29.6 million in 2015 alone – on games for tactical training and skill development.[5] The Transportation Security Administration wants to use games to improve threat detection by baggage screeners.[6] The aviation industry has a long history with simulators for pilot training. While most of these games transmit information or promote the acquisition of new skills, a few have taken on the challenge of improving intuition. For example, *Peacemaker*, a simulation of the Israeli-Palestinian conflict, attempts to alter how players judge possible solutions to the problem. Practice reduces the correlation between religious/political affiliations and how people resolve conflict within the game.[7]

## Serious games in healthcare and medicine

Over the last decade, serious games have gained traction as a method of influencing health outcomes. For example, *NeuroRacer*, a three-dimensional driving game developed by researchers at the University of California-San Francisco, improves executive functioning in older adults, with gains lasting up to six months.[8] However, fewer than 10% of serious games target clinicians and none explicitly attempts to recalibrate heuristics.[9] This is a missed opportunity. Serious games have three attributes that make them ideal for the task. First, games facilitate the retention of new data. Instead of forcing physicians to process data, games present that information within an overarching narrative, thereby facilitating its integration into a mental model of the decision problem. Second, games promote self- and response-efficacy. By practicing desired behaviors in a safe environment, players can obtain confidence in their skills and experience the benefits of behavioral change. Third, games engage players both cognitively and emotionally. Identification with the character allows the player to absorb the message about best-practice decision principles in a way that transcends traditional forms of education.

People remember stories. Using narrative engagement and character identification as surrogates for exposure to difficult cases, games can produce recognition. They allow the player to create archetypes or patterns that serve as a reference in real-life. Consequently, serious games have the potential to succeed where other methods have failed.

## Will physicians play video games?

Video games are no longer the province of adolescent boys. Over 150 million Americans play video games, the average gamer is 34 years old, and a quarter (27%) are over 50, while almost half (44%) are female.[9] Statistics do not exist on the number of physicians who play games. However, states and professional organizations already require between 20 to 50 hours a year of continuing medical education – typically acquired through attendance at

lectures, reading journals, or viewing online presentations – as a condition for licensure. Games could easily become part of the roster of accepted educational activities.

## What's next?

There are early efforts to use games to recalibrate physicians' heuristics. For example, we have developed an adventure video game (*Night Shift*) to change how physicians think about the 'typical' trauma patient. Players take on the persona of Andy Jordan, an emergency medicine physician, who accepts a job in a small town. Through a series of cases that go awry, they learn the characteristics of severely injured patients, and experience the consequences of their diagnostic errors. Preliminary results suggest physicians enjoy playing the game. The challenge ahead is to ensure they change their practice. If successful, games can disrupt the paradigm of continuing medical education, and in doing so, will leverage the potential of the physicians at the heart of the patient-care relationship.

## References

1. National Academies of Sciences, Engineering, and Medicine. Improving diagnosis in health care. Washington DC: The National Academies Press; 2015.
2. Kahneman, D. Thinking, fast and slow. New York: Farrar, Straus and Giroux; 2011.
3. Mohan D, Barnato AE, Angus DC, Rosengart MR. Determinants of compliance with transfer guidelines for trauma patients: a retrospective analysis of CT scans acquired prior to transfer to a Level I Trauma Center. Ann Surg. 2010; 251(5):946–51. [PubMed: 20395856]
4. Perez, S. [Accessed August 4, 2016] Pokémon Go passed 100 million installs over the weekend. Tech Crunch. https://techcrunch.com/2016/08/01/pokemon-go-passed-100-million-installs-over-the-weekend. Published August 1, 2016
5. US Government Accountability Office. [Accessed August 23, 2016] Army training: efforts to adjust training requirements should consider the use of virtual training devices. (Publication No. GAO-16-636). http://www.gao.gov/assets/680/679104.pdf Effective August 2016.
6. Schactman, N. [Accessed August 4, 2016] Let's all play the TSA video game!. Wired. https://www.wired.com/2007/04/its_hard_to_sta/ Publicshed April 25, 2007
7. Gonzalez C, Saner LD, Eisenberg LZ. Learning to stand in the other's shoes: a computer video game experience of the Israeli-Palestinian Conflict. Soc Sci Comp Rev. 2013; 31(2):236–243.
8. Anguera JA, Boccanfuso J, Rintoul JL, et al. Video game training improves cognitive control in older adults. Science. 2013; 501(7465):97–101.
9. Primack BA, Carroll MV, McNamara M, et al. Role of video games in improving health-related outcomes. Am J Prev Med. 2012; 42(6):630–638. [PubMed: 22608382]