The Cognitive Basis for Human Error; Best Practices to Reduce Error

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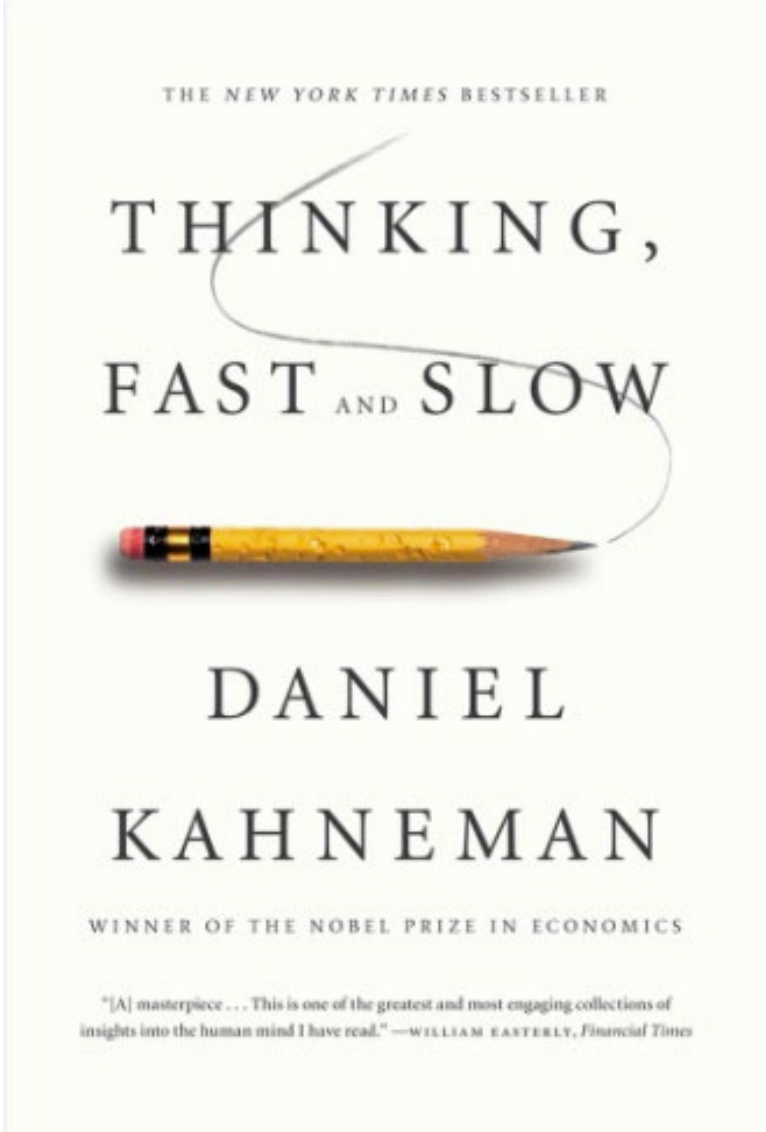
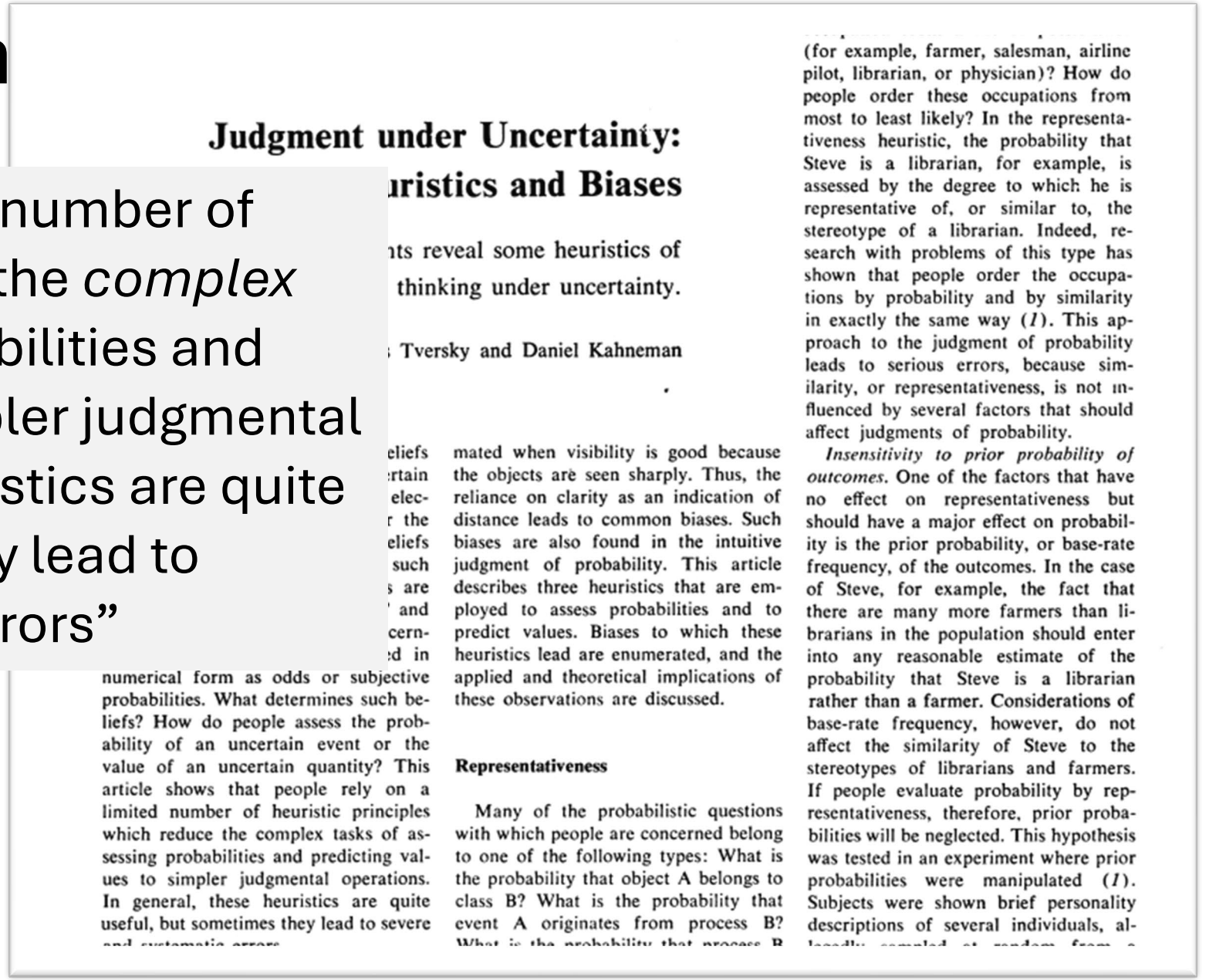
Honoring the giants

Thinking, Fast and Slow



Bounded Rationa

"people rely on a limited number of principles which reduce the *complex tasks* of assessing probabilities and predicting values to simpler judgmental operations. . .these heuristics are quite useful by sometimes they lead to severe and systematic errors"



Judgment under Uncertainty:
uristics and Biases

nts reveal some heuristics of
thinking under uncertainty.

Tversky and Daniel Kahneman

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numerical form as odds or subjective probabilities. What determines such beliefs? How do people assess the probability of an uncertain event or the value of an uncertain quantity? This article shows that people rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe

mated when visibility is good because the objects are seen sharply. Thus, the reliance on clarity as an indication of distance leads to common biases. Such biases are also found in the intuitive judgment of probability. This article describes three heuristics that are employed to assess probabilities and to predict values. Biases to which these heuristics lead are enumerated, and the applied and theoretical implications of these observations are discussed.

Representativeness

Many of the probabilistic questions with which people are concerned belong to one of the following types: What is the probability that object A belongs to class B? What is the probability that event A originates from process B?

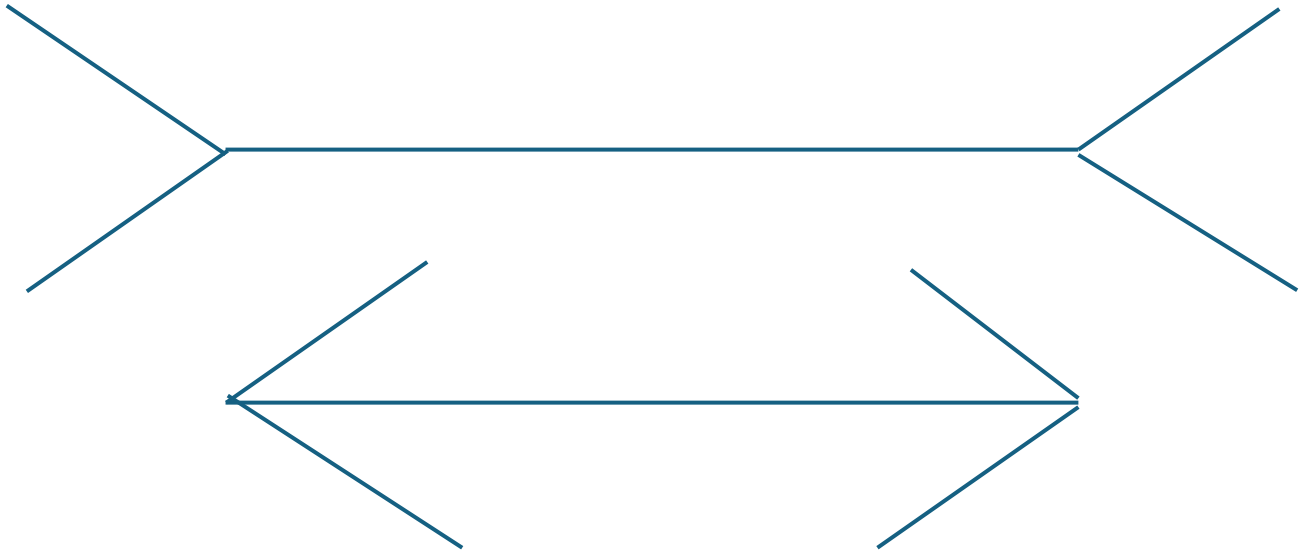
(for example, farmer, salesman, airline pilot, librarian, or physician)? How do people order these occupations from most to least likely? In the representativeness heuristic, the probability that Steve is a librarian, for example, is assessed by the degree to which he is representative of, or similar to, the stereotype of a librarian. Indeed, research with problems of this type has shown that people order the occupations by probability and by similarity in exactly the same way (*1*). This approach to the judgment of probability leads to serious errors, because similarity, or representativeness, is not influenced by several factors that should affect judgments of probability.

Insensitivity to prior probability of outcomes. One of the factors that have no effect on representativeness but should have a major effect on probability is the prior probability, or base-rate frequency, of the outcomes. In the case of Steve, for example, the fact that there are many more farmers than librarians in the population should enter into any reasonable estimate of the probability that Steve is a librarian rather than a farmer. Considerations of base-rate frequency, however, do not affect the similarity of Steve to the stereotypes of librarians and farmers. If people evaluate probability by representativeness, therefore, prior probabilities will be neglected. This hypothesis was tested in an experiment where prior probabilities were manipulated (*1*). Subjects were shown brief personality descriptions of several individuals, al-

Thinking Fast and Slow

- System 1
  - Fast
  - Subconscious
  - Automatic
  - Effortless
  - Includes synthesizing perceptions into mental model and then how to act on perceptions – in a split second
- System 2
  - Slow
  - Conscious
  - Uses first principles
  - Effortful
  - Consciously examines unconscious perceptions and attempts to make rational decisions

System 2 can supervise system 1 (but not control it)



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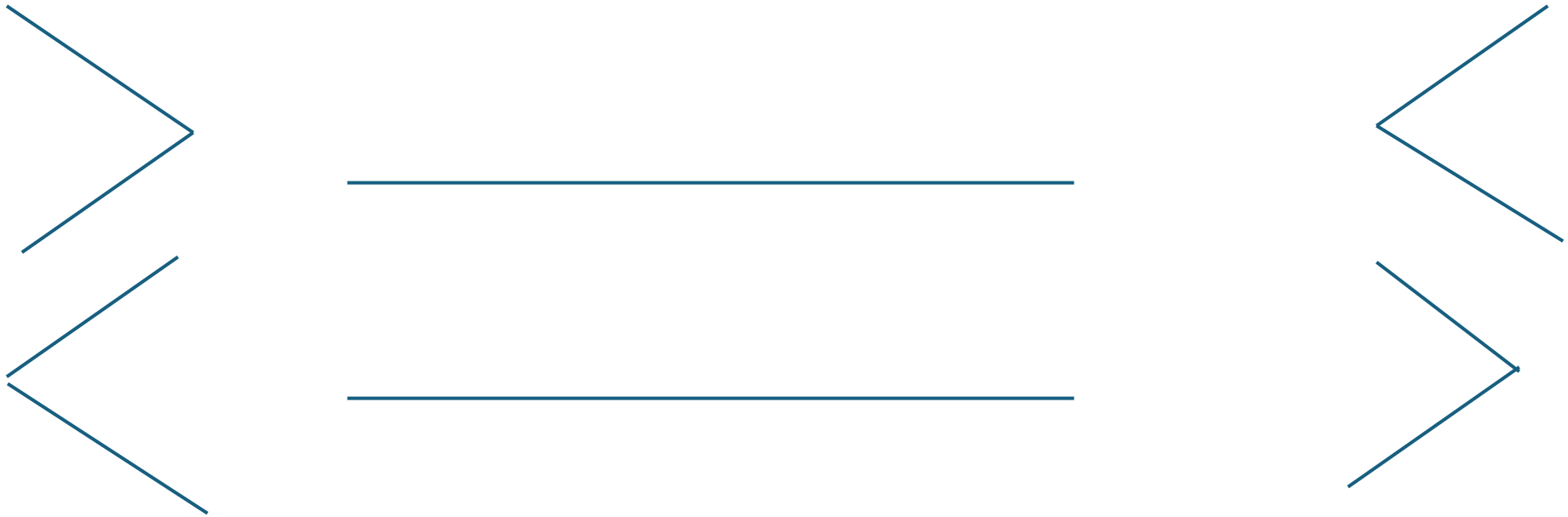

System 1 errors

- Availability heuristic: will fit the current perceptions into the most “available” model, not the most correct one (most recent or common, powerful, emotional)
- Confirmation bias: distorts or eliminates non-conforming information
- “Autocorrects”: when what is seen is not what is expected
- Emotion: loss feared more than gain desired

Elective C Section: TXA and bupivacaine

System 2 overseeing System 1

- System 2 requires *effort*

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- System 2 requires *effort*
- Limited reserves of effort
- Lots of competition for this limited reserve
  - Discipline of “holding back” (not shouting at unreasonable people)
  - Fatigue, cortisol level
  - Multi-tasking
  - Physical activity

What works? Strength of interventions

Weak	Intermediate	Strong
“Try harder”	Communication protocols	Forcing functions
Re-education and retraining	Redundancy	Standardization of technology
Warnings, alert labels	Reduced workload	Human factors testing
Double checks	Checklists, cognitive aids	Prefilled, premixed medications
		Bar code medication administration

Table 1:

Consensus Recommendations for Improving Medication Safety in the Operating Room

Standardization

1. High alert drugs (such as phenylephrine and epinephrine) should be available in standardized concentrations/diluents prepared by pharmacy in a ready-to-use (bolus or infusion) form that is appropriate for both adult and pediatric patients. Infusions should be delivered by an electronically-controlled smart device containing a drug library.
2. Ready-to-use syringes and infusions should have standardized fully compliant machine–readable labels.
3. *Additional Ideas:*
   a. Interdisciplinary and uniform curriculum for medication administration safety to be available to all training programs and facilities.
   b. No concentrated versions of any potentially lethal agents in the operating room.
   c. Required read-back in an environment for extremely high alert drugs such as heparin.
   d. Standardized placement of drugs within all anesthesia workstations in an institution.
   e. Convenient required method to save all used syringes and drug containers until case concluded.
   f. Standardized infusion libraries/protocols throughout an institution.
   g. Standardized route-specific connectors for tubing (IV, arterial, epidural, enteral).

Technology

1. Every anesthetizing location should have a mechanism to identify medications before drawing up or administering them (bar code reader) and a mechanism to provide feedback, decision support, and documentation (automated information system).
2. *Additional Ideas:*
   a. Technology training and device education for all users, possibly requiring formal certification.
   b. Improved and standardized user interfaces on infusion pumps.
   c. Mandatory safety checklists incorporated into all operating room systems.

Pharmacy/Prefilled/Premixed

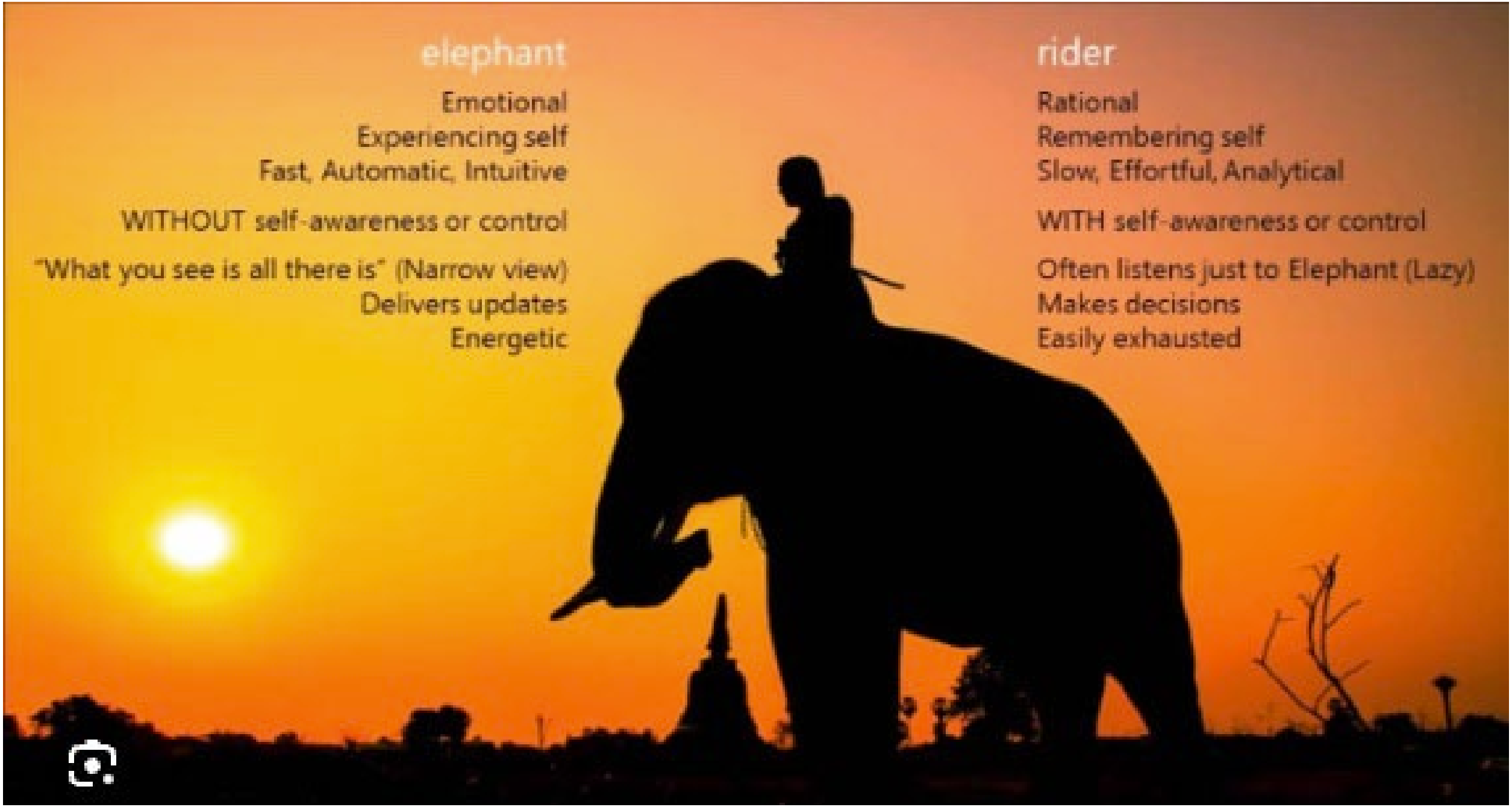
1. Routine provider-prepared medications should be discontinued whenever possible.
2. Clinical pharmacists should be part of the perioperative/operating room team.
3. Standardized pre-prepared medication kits by case type should be used whenever possible.
4. *Additional Ideas:*
   a. Interdisciplinary and uniform curriculum for medication administration safety for all anesthesia professionals and pharmacists.
   b. Enhanced training of operating room pharmacists specifically as perioperative consultants.
   c. Deployment of ubiquitous automated dispensing machines in the operating room suite (with communication to central pharmacy and its information management system).

Culture

1. Establish a *"just culture"* for reporting errors (including near misses) and discussion of lessons learned.
2. Establish a culture of education, understanding, and accountability via a required curriculum and CME and dissemination of dramatic stories in the *APSF Newsletter* and educational videos.
3. Establish a culture of cooperation and recognition of the benefits of STPC within and between institutions, professional organizations, and accreditation agencies.

Call to Action

- A sophisticated toolbox for anesthesiologists/OR pharmacists to use with the bean counters (justification for proven safety interventions) needs to be developed
  - Prefilled, premixed medications (ALL OF THEM)
  - Bar code medication administration
- Expand ISMP “goal” re implement BCMA in the OR, ED, etc, to become more of a standard, not a nice to have


elephant
Emotional
Experiencing self
Fast, Automatic, Intuitive
WITHOUT self-awareness or control
"What you see is all there is" (Narrow view)
Delivers updates
Energetic
rider
Rational
Remembering self
Slow, Effortful, Analytical
WITH self-awareness or control
Often listens just to Elephant (Lazy)
Makes decisions
Easily exhausted