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Why Do Smart People Make Mistakes?

(The Answers are Worthy of a Nobel Prize)



1

Overview: Human Decision-Making

- Behavioral economics: studies the effects of psychological, cognitive, emotional, cultural, and social factors on the decisions of individuals and institutions
- Dual Process Theory
- Heuristics and cognitive bias
- Debiasing techniques

3 questions in < a minute

2

A bat and ball cost \$1.10. The bat costs one dollar more than the ball. How much does the ball cost?

- A. \$1
- B. 10¢
- C. 5¢



Adapted from D. Kahneman, *Thinking, Fast and Slow* (2011)

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3

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

- A. 5 minutes
- B. 50 minutes
- C. 100 minutes



Adapted from D. Kahneman, *Thinking, Fast and Slow* (2011)

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4

In a lake, there is a patch of lily pads. Every day the patch doubles in size. If it takes 48 days to cover the entire lake, how long would it take to cover half the lake?

- A. 24 days
- B. 47 days



Adapted from D. Kahneman, *Thinking, Fast and Slow* (2011)

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5



- A. \$1
- B. 10¢
- C. 5¢



- A. 5 minutes
- B. 50 minutes
- C. 100 minutes



- A. 24 days
- B. 47 days

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6



2002 Nobel Prize: Economics

Dual Process Theory



Thinking, Fast and Slow by Daniel Kahneman

Findings challenge the assumption of human rationality that prevail in modern economic theory



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7

Dual Process Theory

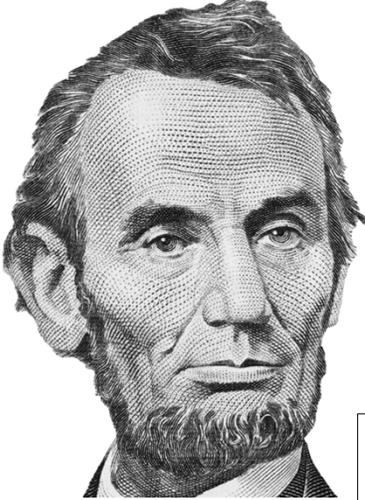
Thoughts arise from two different processes:

System I: an implicit, automatic, unconscious (95%)

- Unconscious
- Intuitive
- Fast
- *Usually* accurate
- Comfortable
- Easily reinforced



8



“If I had 6 hours to chop down a tree,
I would spend 4 hours sharpening the
ax.”



9

Dual Process Theory

Thoughts arise from two different processes:

System II: an explicit, controlled, conscious process (5%)

- Very accurate
- Time consuming
- Deliberate
- “Conscious”
- Easily overloaded (fatigues)
- Requires patience
- Demands multiple inputs (sometimes conflicting)




10

System I Thinking

- Fast/automatic/easy
- Undemanding
- Okay for familiar or practiced routines
- Can be used while tired, sick, or stressed
- Relies on impressions/intuition/feelings
- Susceptible to errors

System II Thinking

- Slow/effortful/hard
- Useful for hard questions
- Relies on logic/analysis/reflection
- Tiring/draining
- Can override errors through careful thought
- Necessary for novel decisions or routines
- Impaired by fatigue, illness, or stress

High Cognitive Demand → **Greater Reliance on System I**

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11

“Start an antibiotic now. I want to go back to OR tomorrow.”

- s/p mitral valve repair
Febrile, infiltrate
- T2D
Ejection fraction 29%
Moderate renal insufficiency
Creatinine 1.7 -> 2.1
Oliguric
- Pitting edema
BUN 93
AST 201
Hgb 9.3
Lasix 80mg BID
Imuran



Which antibiotic and in what dose?

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12

System I

Uses *Heuristics*:

Any approach to problem solving that employs a **practical method** not guaranteed to be optimal, perfect, logical, or rational—but **sufficient for reaching an immediate goal**.

- Consideration of fewer cues
- Simplification of weighting of cues
- Examination of fewer alternatives
- Attribute substitution
- Answering an easier question

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13

Medical Errors

- Are linked to **33.6 million** hospital admissions per year
- Cause **44,000–98,000** deaths per year
- Are the **8th** leading cause of death in the US (Johns Hopkins 3rd)

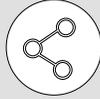


Source: *To Err is Human*, Institute of Medicine (1999)

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14

System I Heuristics



Availability



Optimism



Confirmation



Fixation
(Anchoring)

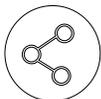


Representative



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15



Availability Heuristic

Thinking that is influenced by **recent or highly memorable event**, creating an **unconscious equivalence** between something that comes **quickly to mind** and its **probability**

Vividness: “Dr. X yelled at me”

Recentness: “There was this journal article last week”

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In the US, which is more likely?

- A. Dying from an illegal immigrant terrorist attack
- B. Dying from an asteroid strike

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17

Terrorists Pose a Very Small Threat to Americans

Cause of Death	Lifetime Odds
Choking on food	1 in 3,409
Bicycling	1 in 4,337
Accidental gunshot	1 in 7,945
Police	1 in 8,359
Airplane and spaceship incidents	1 in 9,738
Heat wave	1 in 10,785
Electricity/radiation/heat/pressure	1 in 14,697
Animal attack or accident	1 in 30,167
Sharp objects accident	1 in 30,863
Foreign-born terrorists (all forms)	1 in 45,808
Tornado	1 in 60,000
Cataclysmic storm	1 in 63,685

Sources: National Safety Council; National Center for Health Statistics; Alex Nowrasteh/Cato Institute; Stephen A. Nelson/Tulane University; "Natural Disasters"/Patrick L. Abbot

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18

Terrorists Pose a Very Small Threat to Americans

Cause of Death	Lifetime Odds	Cause of Death	Lifetime Odds
Choking on food	1 in 3,409	Asteroid (global impact)	1 in 75,000
Bicycling	1 in 4,337	Legal execution	1 in 111,449
Accidental gunshot	1 in 7,945	Dog attack	1 in 114,634
Police	1 in 8,359	Earthquake	1 in 130,000
Airplane and spaceship incidents	1 in 9,738	Bus, train, or streetcar	1 in 160,487
Heat wave	1 in 10,785	Lightning	1 in 174,443
Electricity/radiation/heat/pressure	1 in 14,697	Stinging by hornets, wasps, and bees	1 in 308,629
Animal attack or accident	1 in 30,167	Asteroid (regional impact)	1 in 1,600,000
Sharp objects accident	1 in 30,863	Shark attack	1 in 8,000,000
Foreign-born terrorists (all forms)	1 in 45,808	Refugee terrorists	1 in 46,192,893
Tornado	1 in 60,000	Illegal immigrant terrorists	1 in 138,324,873
Cataclysmic storm	1 in 63,685	Visa Waiver Program entrant	0 in 1

Sources: National Safety Council; National Center for Health Statistics; Alex Nowrasteh/Cato Institute; Stephen A. Nelson/Tulane University; "Natural Disasters"/Patrick L. Abbot

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19



Availability Heuristic

“ Surgeon: *Could you please give this patient some amiodarone?*

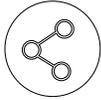
Anesthesiologist: *Why?*

Surgeon: *Because my last patient had rapid afib in the OR and we needed to cancel the procedure.*

”

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20



Availability Heuristic

“My last...”

- patient bled so I will do a T&C/arterial line/central line”
- hiatal hernia aspirated so I will...”
- epidural in an obese patient was a wet tap so I will...”
- patient with intrathecal hydromorphone needed naloxone so I will...”



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21



Optimism Heuristic

When a **strongly held preference**
for an outcome
clouds accurate assessment of reality

“I think the bleeding will stop when we get to the ICU.”

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22



Confirmation Heuristic

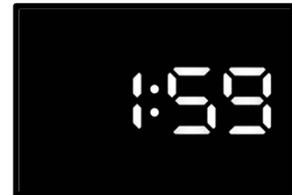
When we preferentially **seek or overweight confirmatory information** or use **selectively limited information** to support a previous conclusion

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23



Confirmation Heuristic



“ ICU Nurse: *The patient is getting worse, the pH is 7.19, and the MAP is 62mmHg.*

Doctor: *I think it will be OK...We gave less epinephrine this hour.* ”

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24

POD2 G5 P4 patient s/p 3rd C-section becomes acutely hypotensive and SOB



She is morbidly obese, has 2+ pitting edema. She's refused her last three doses of subcutaneous heparin. She rapidly loses consciousness and progresses to PEA arrest.

What is the most likely diagnosis?

- A. Pulmonary embolism
- B. Postpartum hemorrhage

Adapted from Anesthesiology 2014; 120:204-7

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25



Representativeness Heuristic

Basing a judgment or decision on similarity to a prototype established in one's mind

- Assumptions made based on what something "looks" like
- Strength of "match" overrides knowledge of probability
- Neglect of base rate leads to wrong conclusion

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26



Fixation (Anchoring):



Mitral valve surgery
 Transferred from outside hospital
 Fellow cancels case morning of surgery

“but the radiology report said pneumonia”

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27



Fixation (Anchoring):



Cognitive Fixation:
 Insufficient adaptation from initial
 starting point; failure to consider
 alternatives



“but the radiology report said pneumonia”

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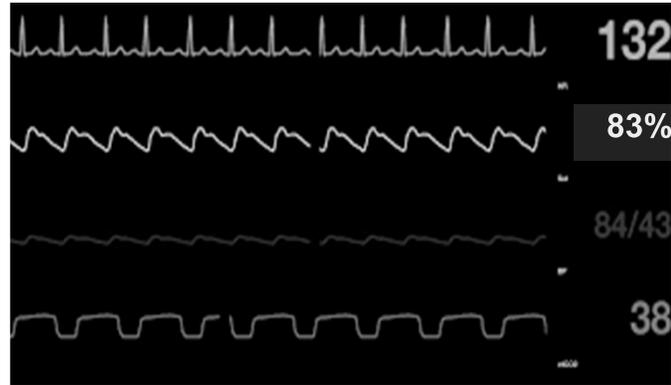
28



Fixation (Anchoring)

SPO₂ 83%

- Increase FiO₂
- ET CO₂ present
- Vent settings and alarms
- Circuit integrity verified
- Capnograph and flow curves
- Recruit and increase PEEP
- Reopen chest



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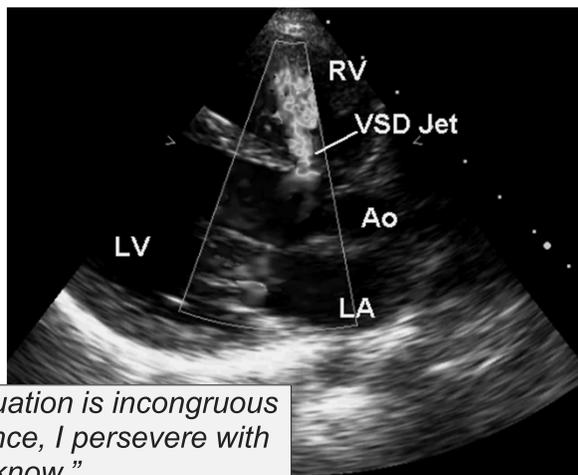
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Fixation (Anchoring):

SPO₂ 83%

- Increase FiO₂
- ET CO₂ present
- Vent settings and alarms
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- Capnograph and flow curves
- Recruit and increase PEEP
- Reopen chest



“When my present situation is incongruous with my past experience, I persevere with what I know.”

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30

Fixing Cognitive Bias to Improve Decision-Making

- Very difficult to study/document because the processes are internal/psychological
- Analysis can only occur retrospectively or externally
- Studying bias is fraught with Hawthorne effect
- No single approach will work—interventions may need to be bias-specific
 - **External:** improving decision-making environment
 - **Internal:** improving thought processes

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31

Debiasing: External Strategies

In process of care:

Cognitive aids free up System II to think creatively

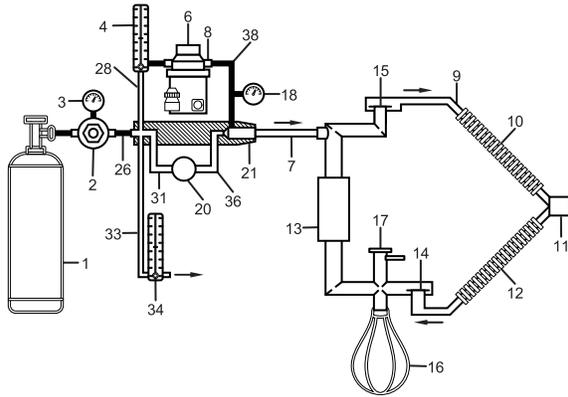
- Checklists
- Protocols
- Clinical decision support

Systemic or environmental

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32

The Anesthesia Pre-Case Checklist



10. Check initial status breathing system

- a. Set selector to bag mode
- b. Make sure breathing circuit is unobstructed, undamaged, and complete
- c. Confirm that CO₂ absorbent is adequate
- d. Install breathing-circuit accessory equipment to be used

11. Perform leak check of the breathing system

- a. Set all gas flows to zero or minimum
- b. Close APL valve
- c. Occlude Y piece
- d. Make sure pressure remains fixed for at least 10 seconds
- e. Open APL valve and make sure pressure decreases

MANUAL AND AUTOMATIC VENTILATION SYSTEMS

12. Test ventilation systems and unidirectional valves

- a. Place a second breathing bag on Y piece
- b. Set ventilator parameters for next patient
- c. Switch to ventilator mode
- d. Turn ventilator on and fill bellows and breathing bag with O₂ flush
- e. Set O₂ flow to minimum and other gas flows to zero
- f. Confirm that bellows deliver appropriate tidal volume during inspiration and that bellows fill completely during expiration
- g. Set fresh gas flow to approximately 5 L min⁻¹
- h. Confirm that bellows and simulated lungs fill and empty without sustained pressure at end expiration
- i. Check unidirectional valves for proper action
- j. Ensure proper function of breathing circuit accessories
- k. Turn ventilator off and switch to manual ventilation mode
- l. Ventilate manually, ensuring inflation and deflation of artificial lungs
- m. Remove second breathing bag from Y piece

MONITORS

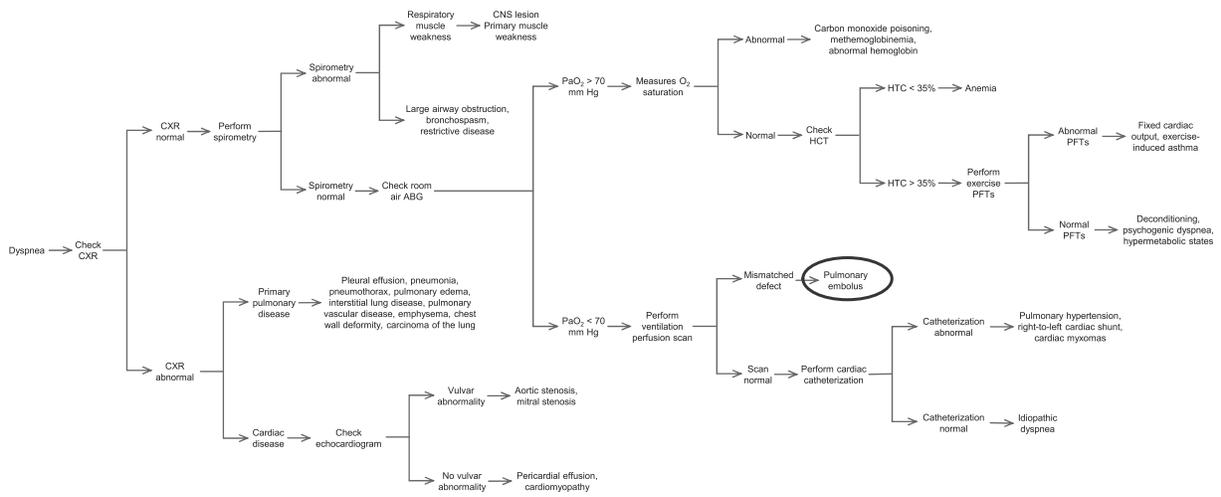
13. Check, calibrate, and set alarm limits of all monitors (capnograph, pulse oximeter, O₂ analyzer, spirometer, pressure monitor)

FINAL POSITION

- a. Vaporizers off
- b. APL valve open
- c. Selector switch to bag mode
- d. Selector switch to bag mode
- e. Patient suction level adequate
- f. Breathing system ready to use

33

Protocol-Based Differential Diagnosis for Dyspnea



34

Debiasing: External Strategies

Systemic or environmental

- Outside perspective (colleagues)
- Case discussions debriefing
- Culture change: create an environment where it's safe to ask questions of ourselves and each other



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35

Debiasing: Internal Strategies

Metacognition, or “thinking about thinking”

- Being aware of your process of reasoning
- Forcing thought alternatives:
 - Consider the opposite
 - Articulate the justification for a choice
 - Ask: *What might I be missing?*



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36

Debiasing: Internal Strategies

Metacognition, or “thinking about thinking”

- Awareness of your emotional and psychological state
- Ask:
 - *Am I tired?*
 - *Is this about my authority?*
 - *Was I hasty in judgment?*
 - *Do I want to go home?*
 - *Am I listening?*
 - *Am I distracted?*



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37



A short story...

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38



Recap

1. Behavioral Economics
2. Dual Process Theory
3. Heuristics:
 - Availability
 - Optimism
 - Confirmation
 - Representative Fixation (Anchoring)
4. Internal and external debiasing methods

39

Some Final Observations

- Debiasing in general is only modestly successful; System 1 is default
- Being wrong feels just like being right—until it's apparent you're not
- System II readily breaks down to System I
- Decision-making environments can be changed
- We *may* be able to debias ourselves and each other; requires self-awareness, humility, and leadership



40