Cognitive function and Decision making

10:45 - 11:35
Kim Ekelund
Chapter three. In Which Pooh and Piglet Go Hunting and Nearly Catch a Woozle
“Tracks,” said Piglet. “Paw-marks.” He gave a little squeak of excitement. “Oh, Pooh! Do you think it’s a–a–a Woozle?”

“It may be,” said Pooh. “Sometimes it is, and sometimes it isn’t. You never can tell with paw-marks.”
“There was a small spinney of larch trees just here, and it seemed as if the two Woozles, if that is what they were, had been going round this spinney; so round this spinney went Pooh and Piglet after them.”
Objectives

At the end of this lecture…
- You should be familiar with different theories of cognitive function and decision making
- And some of the heuristics and biases we tend to use.
- I hope you will pause from time to time and reflect on how and why you make certain decisions

And we will return to some of this at the last session today...
Agenda

- Case
- Models of Decision Making
- System 1 & 2
- Cognitive Influences on Anesthesiology Decision Making
- Educational Strategies to Improve Decision Making
Case, Mette 21 yrs

- Monday morning 08.00 am.
- Ready for planned CS (Karen do to a breech)
- But Mette is in labour room 2 and is in severe pain. “Desperate”….
- You attend her – instead!. „Just a quick labour-epidural“.
- Para 0, GA 40+0, 165,cm  103kg
- Medical history: ”Healthy”, Epilepsy, GDM, BMI 38
- Uncomplicated. Test it = negative → hurry to back to Karens back…
- 10 mins later you are called labour room 2 (and you have put the spinal in Karen)
Case cont 1
Mette has had a fit…

ABCD…

A: Safe? Threaten? Obstructed?
B: RF 10/min, SAT 98%, no side-difference
C: HR 100/min, BP 80/40mmHg, pale, cold, sweating,
D: Unconscious – drowsy

The midwife have given her 10mg ephedrine.

What’s the matter?
Case cont 2

What’s the matter with Mette?
Case cont 2
Treatments or diagnoses?

- Position – left lateral? On her back?
- Allergy. Anaphylaxis?
- Hypotension due to epidural?
- Amnion Embolism?
- Pulmonary Embolism?
- Epilepsy?
- Eclamptic debut?
- Cardiac shock?
- Bleeding?
Decisions!

Cognitive errors detected in anaesthesiology: a literature review and pilot study
M. P. Stiegl1, J. P. Neelankavil, C. Canales2 and A. Dhillon1

Achieving Quality in Clinical Decision Making: Cognitive Strategies and Detection of Bias
Pat Croskerry, MD, PhD

Cognitive Processes in Anesthesiology Decision Making
Marjorie Podraca Stiegl, M.D., Avery Tung, M.D., F.C.C.M.

Understanding Decision Making in Critical Care
Geoffrey K. Lighthall, MD, PhD and Cristina Vazquez-Guillamat, MD
Errors...

ANALYSIS

Medical error—the third leading cause of death in the US

Medical error is not included on death certificates or in rankings of cause of death. Martin Makary and Michael Daniel assess its contribution to mortality and call for better reporting.

Martin A Makary professor, Michael Daniel research fellow
Diagnostic errors in Medicine and Critical Care

- We make diagnoses and treatment plans...
  - Diagnostic failure rate 10-15%
  - Up to 10% of all admissions experience errors or adverse events

- All the others – not us

- ICU
  - Israel 1.7 error per patient per day
  - Germany 31% of ICU admission - iatrogenic complication
    (50% of these were major complications)
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Models of Decision Making

- Expected Utility
- Bayesian Probability
- Formalized Pattern-matching
- Heuristics
- Dual Process Reasoning
- Sense-making
Expected Utility: Heads or tails?
- $2$ heads, $0$ tails…. Or $1$ heads, $0.5$ tails? Rarely clinically applicable.

Bayesian Probability: $P(A|B) \cdot P(B|A) \cdot P(A)/P(B)$
- In theory clinically applicable. $P(A) \cdot P(B)$ or $(P(B|A))$?
- Pretest probability of disease, information of test sensitivity and specificity would help us…
- What about me?

Formalized Pattern-matching
- Symptom 1, 2 and 3… It must be Disease A, alternatives B, C or D, is unlikely because…
Models of Decision Making

- **Expected Utility: Heads or tails?**
  - $2$ heads, $0$ tails…. Or $1$ heads, $0.5$ tails? Rarely clinical applicable

- **Bayesian Propability: $P(\text{A|B}) := P(\text{B|A}) \times P(\text{A}) / P(\text{B})$**
  - In theory clinical applicable. $P(\text{A})? P(\text{B})?$ or $(P\text{B|A})$?
  - Pretest probability of disease, information of test sensitivity and specificity would help us…
  - What about me?

- **Formalized Pattern-matching**
  - Symptom 1, 2 and 3… It must be Disease A, alternatives B, C or D, is unlikely because…

(Anesthesiology 2014; 120:204-17)
Models of Decision Making

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Formalized Pattern-matching
- Symptom 1, 2 and 3… It must be Disease A, alternatives B, C or D, is unlikely because…
Models of Decision Making

Heuristics:
- Meek, tidy man, who loves books. Liberian or Salesman?

Dual Process Reasoning
- ....

Sense-making
- Reframe: decisions to dynamic situational assessment of contextual features. Requires and understanding if the ongoing event, involves initial and evolving impressions, dynamic feedback, attention to identify and decipher pieces of information. Learn from what has already happened. To become better.... (Hindsight bias?)
Models of Decision Making

Cognitive Processes in Anesthesiology Decision Making
Marjorie Podraza Stiegler, M.D., Avery Tung, M.D., F.C.C.M.

Heuristics:
- Meek, tidy man, who loves books. Liberian or Salesman?

Dual Process Reasoning
- ....

Sense-making
- Sensemaking, as described by Weick (1995), literally means making sense of what is happening.
- Sensemaking is always based on some set of existing data. The most fundamental level of data about patient safety is in the lived experience of staff, as they struggle to function within an imperfect system. Learn from what has already happened. To become better.... (Hindsight bias?)
Influences on decision making and diagnostic error.

Dual Process Reasoning
Agenda

- Case
- Models of Decision Making
- System 1 & 2
- Cognitive Influences on Anesthesiology Decision Making
- Educational Strategies to Improve Decision Making
System 1 & 2

System 1:
- The capital of France?
- 2+2
- Square root of 49
System 1 & 2

System 1:
- The capital of France?
- 2+2
- Square root of 49

System 2:
- Counts numbers ”e” on this slide
- Can compare pro and cons and deliver an proper answer
- Pay attention on how you should behave
System 1 & 2

**System 1:**  Automatically. Fast. No sense of effort or control
- The capital of France?
- 2+2
- Square root of 49

**System 2:**  Think! In control. Needs effort. Uses energy.
- Counts numbers "e" on this slide
- Can compare pro and cons and deliver a proper answer
- Pay attention on how you should behave
Daniel Kahneman

System 1 & system 2:

"Think of the letter $K$ - is it more likely, that $K$ is the first letter in a word or the third letter?"?
Daniel Kahneman

System 1 & system 2:

A bat and a ball costs $1.10. The bat costs $1.00 more than the ball. How much does the ball cost? ____cents
System 1 & 2
Heuristics

- **Representativeness heuristic**
  - What is most likely?
  - Salesman vs. Liberian. Pneumonia vs Preeclampsia

- **Availability heuristics**
  - When you hear hoofbeats, think of a…!
  - (She looks like the rare case we had yesterday…)

- **Anchoring heuristics**
  - Caught by surprise. (No bleeding or easy mask…)
The order you use present relevant information regarding a case – does it have any influence on the answer you get?
## System 1 & 2

<table>
<thead>
<tr>
<th>Alan:</th>
<th>Ben:</th>
</tr>
</thead>
<tbody>
<tr>
<td>intelligent</td>
<td>envious</td>
</tr>
<tr>
<td>hardworking</td>
<td>stubborn</td>
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In clinic-ish

- Teacher has to pay attention to the the **Halo-effect**.
  - Students’ papers

- Judges can be primed. **Anchoring-effect**.
  - Shoplifting and dices

Are we as medical doctors un-biased, when we make our decisions?
In clinic

- Mistakes - when you get tired?
  - **System 2 costs too much = Less control! System 1 is available...**

- Mistakes – when you are under pressure. Emergencies.
  - **Believe in your first impulse (system 1).**
  - **No control (system 2 is busy)...**
Clinical decision making
influence by....

Environmental factor:
- Context
- Team factors
- Patient factors
- Resource limitations
- Physical plant design
- Ergonomic factors

Individual factors:
- Affective stated,
- General fatigue
- Cognitive overload
- Decision fatigue
- Interruptions and distractions
- Sleep deprivation and sleep-depth
- Personality
- Intelligence
- Rationality
- Gender....
Agenda

- Case
- Models of Decision Making
- System 1 & 2
- **Cognitive Influences on Anesthesiology Decision Making**
- Educational Strategies to Improve Decision Making
<table>
<thead>
<tr>
<th>Cognitive Influence</th>
<th>Explanation</th>
</tr>
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<tr>
<td>Representativeness heuristic</td>
<td>Diagnosing or identifying by the degree of resemblance to preexisting or &quot;classic&quot; mental models.</td>
</tr>
<tr>
<td>Availability heuristic</td>
<td>Diagnosing or identifying by resemblance to previous, highly memorable, events. &quot;Memorability&quot; may be induced by an emotionally charged past experience (usually negative); media attention, legal action, peer review &quot;morbidity and mortality&quot; conference, or other novelty.</td>
</tr>
<tr>
<td>Anchoring/fixation/&quot;tunnel vision&quot;*</td>
<td>1. Insufficient adjustment from an initial assessment of a value or a state. &quot;Anchoring&quot; on the starting point can bias subsequent estimates.</td>
</tr>
<tr>
<td></td>
<td>2. Focus on a single feature of a case or event exclusively, at the expense of considering other aspects of the case. This may include task fixation, such as troubleshooting of an alarm at the expense of maintaining situation awareness.</td>
</tr>
<tr>
<td>Retrospective biases</td>
<td>Tendency to view events that have already occurred differently once the outcome is known.</td>
</tr>
<tr>
<td></td>
<td>1. Hindsight bias: Tendency to view events as having been more predictable, and thus actions more correct or incorrect, than was apparent as the situation was unfolding.</td>
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<tr>
<td></td>
<td>2. Outcome bias: Favorable (if the outcome is good) or unfavorable (if the outcome is bad) assessments of judgments, regardless of actual decision quality. (Example: drunk driver who arrives home safely rationalizes that he made a &quot;good choice&quot; - which is obviously incorrect)</td>
</tr>
<tr>
<td>Confirmation bias</td>
<td>A tendency toward only seeking (or only &quot;seeing&quot;) information that supports a diagnosis or hypothesis, rather than information that refutes it.</td>
</tr>
<tr>
<td>Visceral (transference) bias</td>
<td>Visceral bias describes the tendency to allow feelings about a patient to affect care decisions, as with a &quot;VIP patient,&quot; a victim of trauma, or a &quot;high-maintenance&quot; patient.</td>
</tr>
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<td>Omission bias</td>
<td>Tendency toward inaction rather than action, out of fear of causing harm (to patient, if action failed; to self, by damaging professional reputation if wrong). May be especially likely when a significant authority gradient is perceived or real.</td>
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<td>Bias blind spot</td>
<td>A flawed sense of invulnerability to bias; may be more prominent among cognitively sophisticated and highly intelligent.</td>
</tr>
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<td>Overconfidence</td>
<td>Inaccurately high self-assessment with regard to positive traits. Can refer to medical knowledge, certainty regarding diagnosis, technical abilities, and situational assessment.</td>
</tr>
<tr>
<td>Memory shifting/ reconstruction</td>
<td>Failure to accurately recall information. Occurs due to meaning and verbatim information being coded differently, and results in &quot;filling in&quot; details (sometimes misinformation) when memories are recalled. Also called &quot;memory reconstruction error.&quot;</td>
</tr>
<tr>
<td>Preference for certainty</td>
<td>Human preference for certainty over risk, even at the expense of sacrificing a greater expected value (i.e., calculated via expected utility theory).</td>
</tr>
<tr>
<td>Framing</td>
<td>A schema of interpretation that changes perception without altering facts. Equivalence framing refers to the interpretation of the same set of data as either a gain or loss. Emphasis framing focuses on a subset of selected data to match an event or explanation.</td>
</tr>
<tr>
<td>Loss aversion</td>
<td>Tendency for humans to view a loss as significantly more psychologically powerful than a gain of the same amount.</td>
</tr>
<tr>
<td>Affect (emotion)</td>
<td>Emotional influences on decision behavior. Anger describes the tendency for angry or disruptive behavior to influence the decisions of oneself or others. Regret describes the tendency to allow regret for previous decisions to affect future ones. Anticipated regret is the desire to avoid regret from future consequences or outcomes of decision choices.</td>
</tr>
<tr>
<td>Anger</td>
<td></td>
</tr>
<tr>
<td>Regret</td>
<td></td>
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<tr>
<td>Feedback bias</td>
<td>Significant time elapses between actions and consequences; lack of outcome data reporting. Absence of feedback is subconsciously processed as positive feedback.</td>
</tr>
<tr>
<td>Commission bias</td>
<td>Tendency toward action rather than inaction, even when those actions are unindicated or founded on desperation. This is the &quot;better safe than sorry&quot; mentality of adding additional invasive monitors, central venous access, or liberal blood transfusion. Backfires when those actions have untoward effects.</td>
</tr>
</tbody>
</table>

* Factors are presented in order of their appearance in the text; table is not intended to be exhaustive.

VIP = "very important person" as with a celebrity, personal friend, or high-level executive.
Cognitive influence and explanations

- **Confirmation bias**: Only information that supports
- **Visceral bias**: Feelings affect our decisions
- **Overconfidence**: I can do it. I don’t ask for help
- **Commission bias**: Better safe than sorry (Action vs. Inaction)
- **Omission bias**: I should, but I don’t
- **Feedback bias**: No feedback => positive feedback
Confirmation bias
Only information that supports

- Ordinary intubation or fiberoptic intubation?
  - ”She might have a history of difficult intubation.
  - But it was in a smaller hospital (i.e. their anesthetists might not be as skilled as you – and she doesn’t carry any papers to support the incident),
  - Her SARI score is only 2 (103kg)…
  - Or SARI 1, because you don’t trust her history…”
Visceral bias
Feelings affect our decisions

- Spinal or GA?
  - She has previously had a terrible experience with the spinal anesthesia.
  - She’s working as a journalist on one of the tabloid newspapers
  - She’s a colleague or a friend’s friend.
  -...

...
Overconfidence
I can do it. I don’t ask for help

- Cannot ventilate Cannot intubate!
- I think I just need another try...
- I think I just need another try...
- I think I just need another try...
Commission bias
Better safe than sorry
(action vs. inaction)

- PPH on a relative unstable patient - now she is stabilised…
  - Give her one SAG-M extra – and
  - Give her one pool of platelets - to make sure…
  - Give her metronidazole on top of the ordinary antibiotics
  - Give her a-line, and central venous line – better safe than sorry…
Omission bias

- Cannot ventilate Cannot intubate!
  - She needs a surgical airway...
  - ....and nobody is going to do it...

- Transfusions are indicated… but isn’t it potential dangerous to transfuse...
Feedback

No feedback – is that good?

- I would have heard if I was wrong – wouldn’t I?
- My postoperative analgesia plan was perfect.
- My TAP blockade always work
- I know I might have said things in a harsh tone – but it made them work faster…. And they don’t care – do they?
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Educational Strategies to Improve Decision Making

- Educational Strategies
  - Targeting Rationale (why) Instead of Behaviour (how)
  - Metacognition (Self-Reflection and Reflective Practice)

- Clinical Aids
  - Cognitive Self-Monitoring Strategies
  - Decision Support
Targeting Rationale Instead of Behavior

<table>
<thead>
<tr>
<th>Behavior/Rationale</th>
<th>Example</th>
<th>Educational Target</th>
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<tbody>
<tr>
<td>Right behavior, sound rationale</td>
<td>Preoxygenate to increase oxygen reservoir in lungs and delay desaturation with anesthetic-induced apnea</td>
<td>Positive reinforcement of correct behavior and rationale</td>
</tr>
<tr>
<td>Right behavior, flawed rationale</td>
<td>Preoxygenate before induction to “achieve 100% oxygen saturation”</td>
<td>Correction of flawed logic, discussion of preoxygenation purpose</td>
</tr>
<tr>
<td>(accident, coincidence)</td>
<td>Intend to preoxygenate, understands correct rationale, but forget to increase oxygen flowmeter</td>
<td>Discussion of memory aids or other methods to maintain situation awareness, check all essential items before beginning a procedure, etc.</td>
</tr>
<tr>
<td>Wrong behavior, sound rationale</td>
<td>Neglect to preoxygenate before induction “because patients consume less oxygen under anesthesia”</td>
<td>Discussion of respiratory physiology and effects of anesthesia</td>
</tr>
<tr>
<td>(slip or lapse)</td>
<td></td>
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Educational strategies...

- De-Biasing
  - Difficult. Need to be aware of bias. Activate system 2.
Debiasing....

NARRATIVE REVIEW

Cognitive debiasing 1: origins of bias and theory of debiasing

Pat Croskerry,¹ Geeta Singhal,² Silvia Mamede³

NARRATIVE REVIEW

Cognitive debiasing 2: impediments to and strategies for change

Pat Croskerry,¹ Geeta Singhal,² Silvia Mamede³
Educational strategies...

- **Simulation training**
  - Familiarise difficult diagnosis, rare events... overload...

- **Feedback**
  - I saw. I think. I wonder...

- **ABCDEs, DOPES...**

- **Forcing functions**
  - Checklists
  - Action cards...
“Rabbit's clever," said Pooh thoughtfully.
"Yes," said Piglet, "Rabbit's clever."
"And he has Brain."
"Yes," said Piglet, "Rabbit has Brain."
There was a long silence.
"I suppose," said Pooh, "that that's why he never understands anything."
Take Home Messages

- We made decision all the time, and mostly by using system 1
- We do make wrong decisions and mostly it is because we don’t activate system 2
- We have to be aware of some of the biases in our daily work
- We have to reflect on how we make our decisions.
What are we talking about?

- Cognitive function and Decision making
- Diagnostic errors in Medicine and Critical Care
Hypothetical-Deductive method

Generate a hypothesis.
- Confirmation vs elimination.
- Bayes’ Theorem
  - The probability of a diagnosis, is dependent of the probability of the diagnosis prior to a test and on the evidence added by this test…
- Not same result for all practitioners
- Experience
- ICU; less time to think… to make iterative diagnoses
Intuitive Methods

Heuristics. Kahneman & Tversky
Memory reconstruction error (also called “retrieval-induced distortion”). Neural processes are dynamic and vulnerable to disruption during reactivation. Information may be lost, and misinformation may be incorporated into memory, which is subsequently reconsolidated and stored in lieu of the original memory. This perpetuates with each memory reactivation, which is a necessary part of recollection. Note that this process is distinct from intentional distortion of the facts.
In what order?

Patient with lung cancer and severe symptomatic hypothyroidism?
  Dealying lobectomy?
    Reducing potential life-threatening complications!
    Increasing risk of metastasis!
  Chance of curing cancer
  Risk of perioperative complications

What is correct? Or is both correct?
System 1 & 2

LEFT
left
big

right
small

RIGHT
BIG
big

RIGHT
left
small

LEFT
right
big