Six Quick Questions

Take a piece of paper and write down your answers to each of these six questions.

You have about 10 seconds for each response.
On a standard Seattle fire truck, there are 2 drivers up front, one at the rear and three additional fire-fighters. What is the total personnel required for 5 standard trucks?
How many turtle doves did my true love send me on the 2\textsuperscript{nd} day of Christmas?
In 2009, the average time required to complete a critical incident review was 15½ hours, how much time should be allowed for the three that are expected next month?
A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball.

How much does the ball cost?
If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half the lake?
In a study 1000 people were tested. Among the participants there were 5 engineers and 995 lawyers. Jack is a randomly chosen participant of this study. Jack is 36 years old. He is not married and is somewhat introverted. He likes to spend his free time reading science fiction and writing computer programs.

What is most likely?  

a. Jack is an engineer  
b. Jack is a lawyer

De Neys & Glumicic, 2008
Answers

A. 30
B. 2
C. 46½ hours

D. The ball costs 5¢ and the bat $1.05
E. 5 minutes
F. 47 days
G. Jack is a lawyer
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De Neys & Glumicic, 2008
Cognitive Reflective Test

- The test distinguishes intuitive from analytical processing
- It tests the ability to resist first response that comes to mind
- Of 3428 people tested only 17% got all 3 correct
- 33% answered all three incorrectly

*Frederick 2002 (MIT)*
How we think
determines
How we make decisions
which determines
Accuracy of diagnosis
Diagnostic acumen

It is every doctor’s measure of his own abilities; it is the most important ingredient in his professional self-image

Nuland, 1994
64% of claims come from these four high-risk areas.

Percentage of all claims asserted 2002-2006, N=1,164 claims.
Factors contributing to diagnostic failure

- No-Fault Factors Only (7%)
- System-Related Error Only (19%)
- Both System-Related And Cognitive Factors (46%)
- Cognitive Error Only (28%)
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary embolism</td>
<td>26 (4.5)</td>
</tr>
<tr>
<td>Drug reaction or overdose</td>
<td>26 (4.5)</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>23 (3.9)</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>19 (3.3)</td>
</tr>
<tr>
<td>Acute coronary syndrome</td>
<td>18 (3.1)</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>18 (3.1)</td>
</tr>
<tr>
<td>Stroke, including hemorrhage</td>
<td>15 (2.6)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>13 (2.2)</td>
</tr>
<tr>
<td>Fracture, various types</td>
<td>13 (2.2)</td>
</tr>
<tr>
<td>Abscess, various locations</td>
<td>11 (1.9)</td>
</tr>
<tr>
<td>Pneumonia, including type</td>
<td>10 (1.7)</td>
</tr>
<tr>
<td>Aortic aneurysm/dissection</td>
<td>9 (1.5)</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>9 (1.5)</td>
</tr>
<tr>
<td>Depression</td>
<td>9 (1.5)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>8 (1.4)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>8 (1.4)</td>
</tr>
<tr>
<td>Anemia</td>
<td>6 (1.0)</td>
</tr>
<tr>
<td>Bacteremia</td>
<td>6 (1.0)</td>
</tr>
<tr>
<td>Metastatic cancer</td>
<td>6 (1.0)</td>
</tr>
<tr>
<td>Spinal cord compression</td>
<td>6 (1.0)</td>
</tr>
</tbody>
</table>
We need to understand how we think...
How Doctors Think

Clinical Judgment and the Practice of Medicine

KATHRYN MONTGOMERY

How Doctors Think

Jerome Groopman, M.D.
How then do we make decisions?
We have a new way of looking at decision making

It can be applied to all decision making in healthcare
Type 1 and Type 2 processes
(dual process theory)
<table>
<thead>
<tr>
<th></th>
<th><strong>Type 1</strong></th>
<th><strong>Type 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive style</td>
<td>Heuristic</td>
<td>Systematic</td>
</tr>
<tr>
<td>Cognitive awareness</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Automaticity</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Rate</td>
<td>Fast</td>
<td>Slow</td>
</tr>
<tr>
<td>Reliability</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Errors</td>
<td>Usually</td>
<td>Few</td>
</tr>
<tr>
<td>Effort</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Predictive power</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Emotional component</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Scientific rigour</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
A schematic model for how the systems work together
Initial percept or problem

Pattern Processor

RECOGNIZED

System 1

Expertise

Proficiency

Competence

Advanced Beginner

Novice

NOT RECOGNIZED

System 2

Calibration

Decision
Toggle Function

(Hypothesis Hopping)
Hard wiring
Ambient conditions/Context
Task characteristics
Age and Experience
Affective state
Gender
Personality

Type 1
Processes

RECOGNIZED

Pattern Processor

Type 2
Processes

Pattern Recognition

Executive override

Dysrationalia override

Calibration

Diagnosis

Patient Presentation

Type 1 Processes

Pattern Recognition

Repetition

Type 2 Processes

Education
Training
Critical thinking
Logical competence
Rationality
Feedback
Intellectual ability

RECOGNIZED

NOT RECOGNIZED
6 Main Features of the Model

• Toggle function
• Most errors occur in System 1
• Repetitive operations of System 2 >>> 1
• System 2 override of System 1
• System 1 override of System 2
• Cognitive Miser function
So, we have to learn how best to deal with System 1 and System 2
We need to know System 1
The power of
Type 1 processes
ABC
ABC

ZBA
United States Senator
Swallowing saliva
Would you drink a glass of your own saliva?
The emotion of disgust (Type 1) overcomes rational input (Type 2)
<table>
<thead>
<tr>
<th>RED</th>
<th>GREEN</th>
<th>BLUE</th>
<th>YELLOW</th>
<th>PINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORANGE</td>
<td>BLUE</td>
<td>GREEN</td>
<td>BLUE</td>
<td>WHITE</td>
</tr>
<tr>
<td>GREEN</td>
<td>YELLOW</td>
<td>ORANGE</td>
<td>BLUE</td>
<td>WHITE</td>
</tr>
<tr>
<td>BROWN</td>
<td>RED</td>
<td>BLUE</td>
<td>YELLOW</td>
<td>GREEN</td>
</tr>
<tr>
<td>PINK</td>
<td>YELLOW</td>
<td>GREEN</td>
<td>BLUE</td>
<td>RED</td>
</tr>
</tbody>
</table>
How may medical decision making be optimized?
You aren’t thinking critically enough, so be more careful.
The occasional slap might wake some people up
What decision making needs

- Raise awareness of importance of decision making
- Know operating characteristics of DPT model
- Educate and train intuition
- Promote reflective practice
- Teach the main cognitive biases
- Teach the main affective biases
- Promote critical thinking
- Promote use of cognitive aids
- Teach cognitive and affective forcing functions
- Raise awareness of conditions which may compromise decision making (fatigue, sleep deprivation, cognitive overload)
“It sort of makes you stop and think, doesn’t it.”
Improving Intuition

- Optimize decision-making environment
- Improve feedback
- Impose circuit breakers
- Acknowledge emotions
- Explore connections
- Accept conflict in choice
- Make scientific method intuitive

Hogarth, *Educating Intuition* 2001
Select / create decision-making environment

• Both Type 1 and Type 2 decisions will be better in a good environment
• Good environments are supportive, ergonomically sound
• Provide expert, high-level tutoring, mentoring
• Learners should be well-rested, well-slept, well-motivated
• Minimize cognitive load, interruptions, distractions
• Provide many opportunities for practice
• Proactively seek environments that favor acquisition of valid intuitions
Improve feedback

- Quick
- Relevant
- Accurate
- Unambiguous
- Use multiple attributes
Impose circuit breakers

- Do not act without thinking
- Screen and censor automatic tacit system processes
- Impose forcing functions for predictable errors
- Be skeptical and routinely challenge
- Seek dis-confirming evidence
Acknowledge emotions

- Encourage awareness of and insight into emotions
- Recognize the cues of visceral arousal
- Treat emotions as data
- Avoid decisions driven by immediate (hot) emotions
- Recognize that positive affect is associated with relaxation and openness to new ideas
- Promote ability to infer emotional state of others (emotional intelligence) and act on this information
Explore connections

• Encourage conscious use of narrative and analogies to make connections between different aspects of the problem
• Avoid rigid, pre-programmed reactions
• Think of what you cannot see rather than what is immediately apparent
• Look for relationships and co-variation between variables
• Configure problem in different ways
• Allow alternatives to stereotypical, logical analysis
• Use imaginative strategies to explore connections outside the boundaries in which information is presented (framed)
Accept conflict in choice

• Specifically consider trade-offs in choice situations
• Recognize bounded rationality of decision making
• Elaborate advantages and disadvantages
• Identify emotional and computational sources of conflict
• Re-frame problem in different ways
• Always consider worst case scenario
• Recognize influence of sunk-costs and status quo biases
Make scientific method intuitive