

Teaching critical thinking An ethical imperative

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Three Quick Questions

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

You have about 10 seconds for each response

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?

The Capacity to Reflect

Leads to:

- Mindfulness
- Less impulsivity in decision making
- More thinking about how you think
- Increased likelihood of bias detection
- Improved clinical decision making

Case 2

- ❑ A 12-year-old girl, with a history of asthma, complained of shortness of breath and chest pain shortly after beginning a basketball game. Despite using her inhalers, she appeared to be worsening and an ambulance was called. She was given nebulised albuterol by facemask and immediately taken to the nearby PED. On arrival she deteriorated further, stopped breathing and had a cardiac arrest.
- ❑ Chest compressions were initiated immediately and she was intubated. Despite prolonged efforts by the resuscitation team she did not respond and all further efforts were ceased after an hour.
- ❑ At autopsy she was found to have a tension pneumothorax.

How well do we do?

Diagnostic Failure

15%



It is likely that **most of us** will experience at least one diagnostic error **in our lifetime**, sometimes with devastating consequences.

Mostly, it's not what we don't know, it's
how we think

We need to know more about how we
think...

Decision Making

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graph TD; A[Decision Making] --> B[Intuitive (System 1)]; A --> C[Rational (System 2)]; B --> D[Fast  
Informal  
Subjective  
Context-dependent  
Qualitative  
Flexible]; C --> E[Slow  
Formal  
Objective  
Context-independent  
Quantitative  
Rigorous];
```

Intuitive
(System 1)

Fast
Informal
Subjective
Context-dependent
Qualitative
Flexible

Rational
(System 2)

Slow
Formal
Objective
Context-independent
Quantitative
Rigorous

Dual Process Decision Making

System 1

Fast / Automatic

Emotional

- Impulses / Drives
- Habits
- Beliefs



System 2

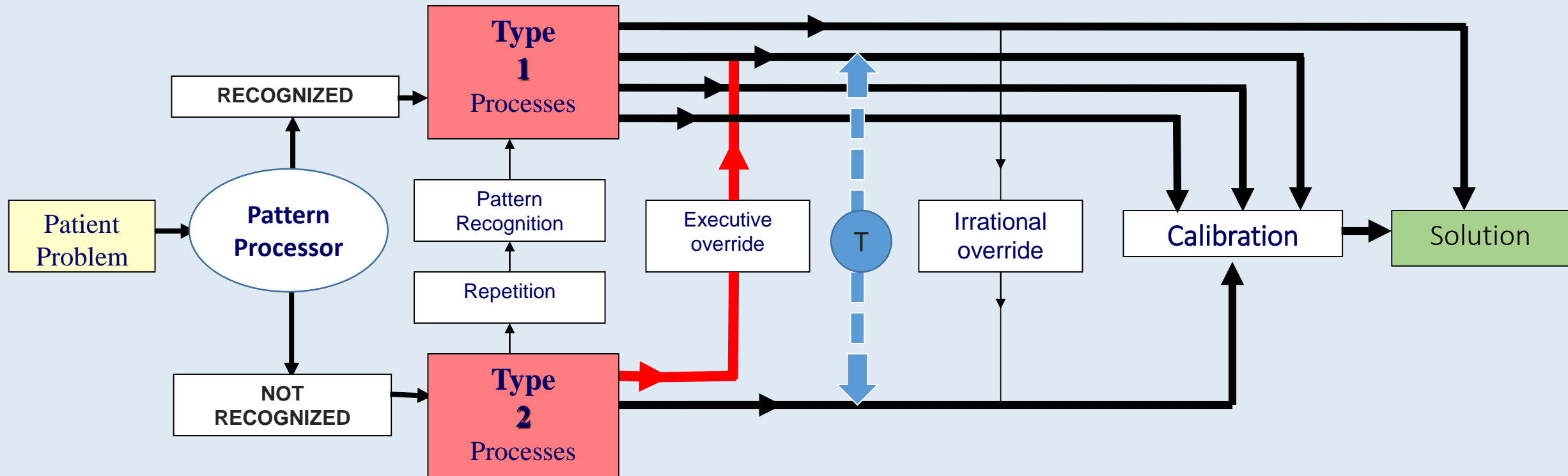
Slow / Effortful

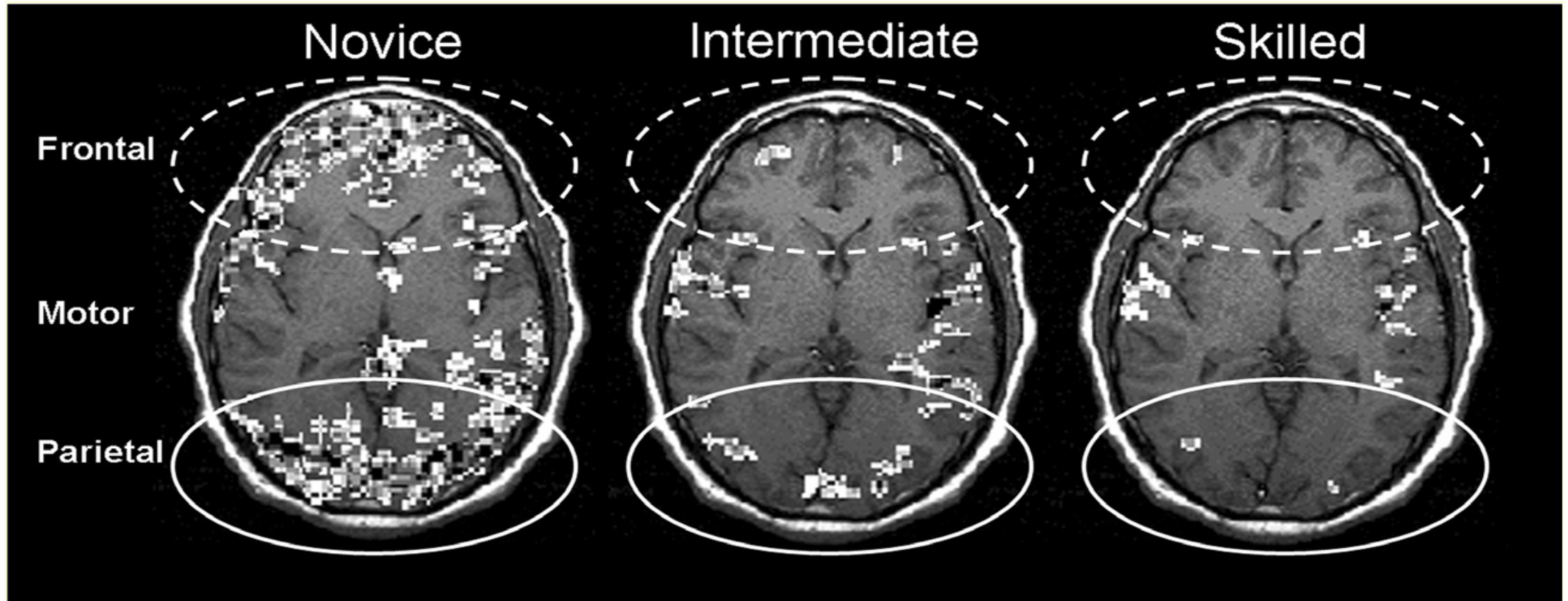
Logical

- Reflection
- Planning
- Problem solving



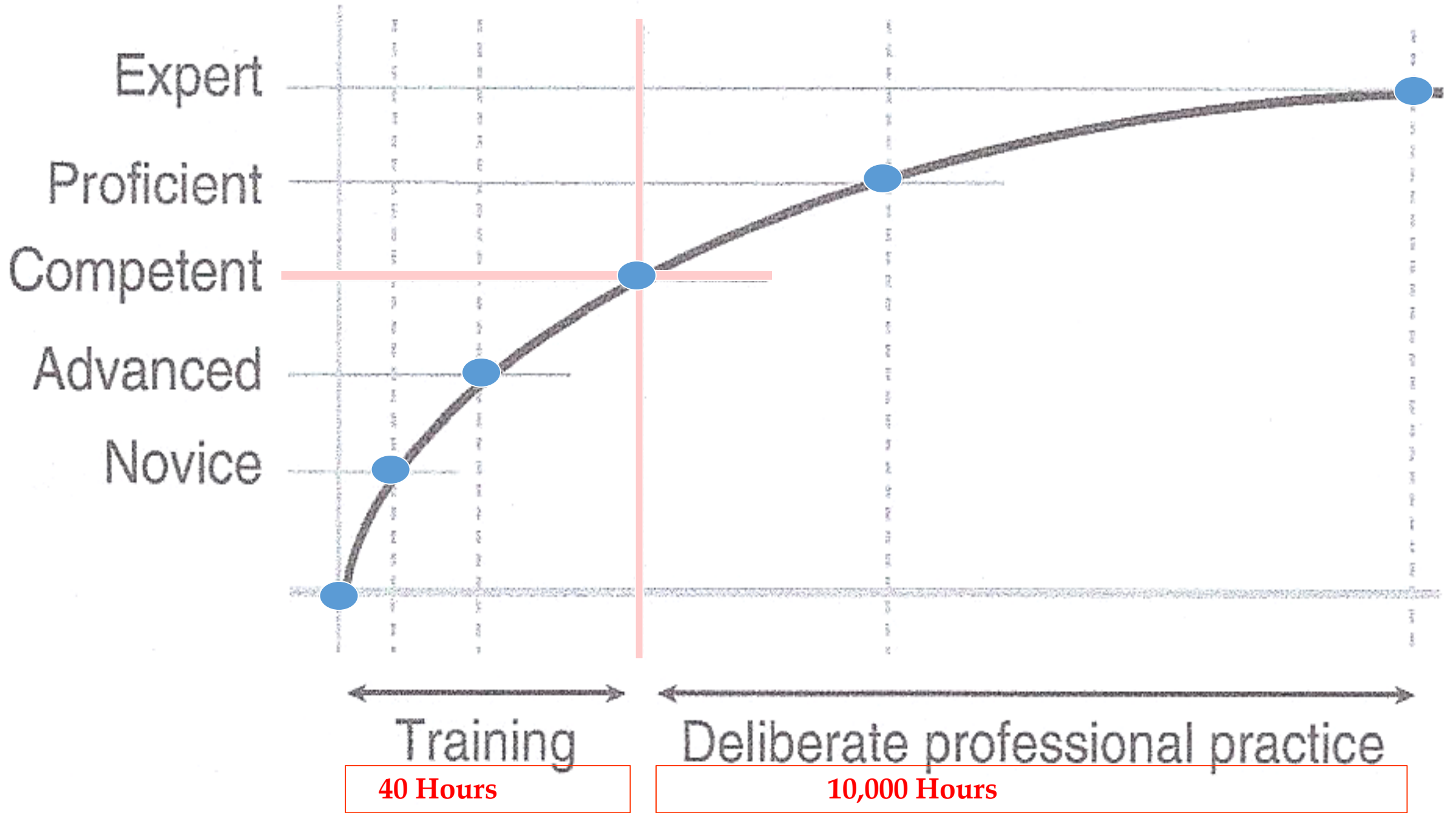
A schematic model for how the systems
work together

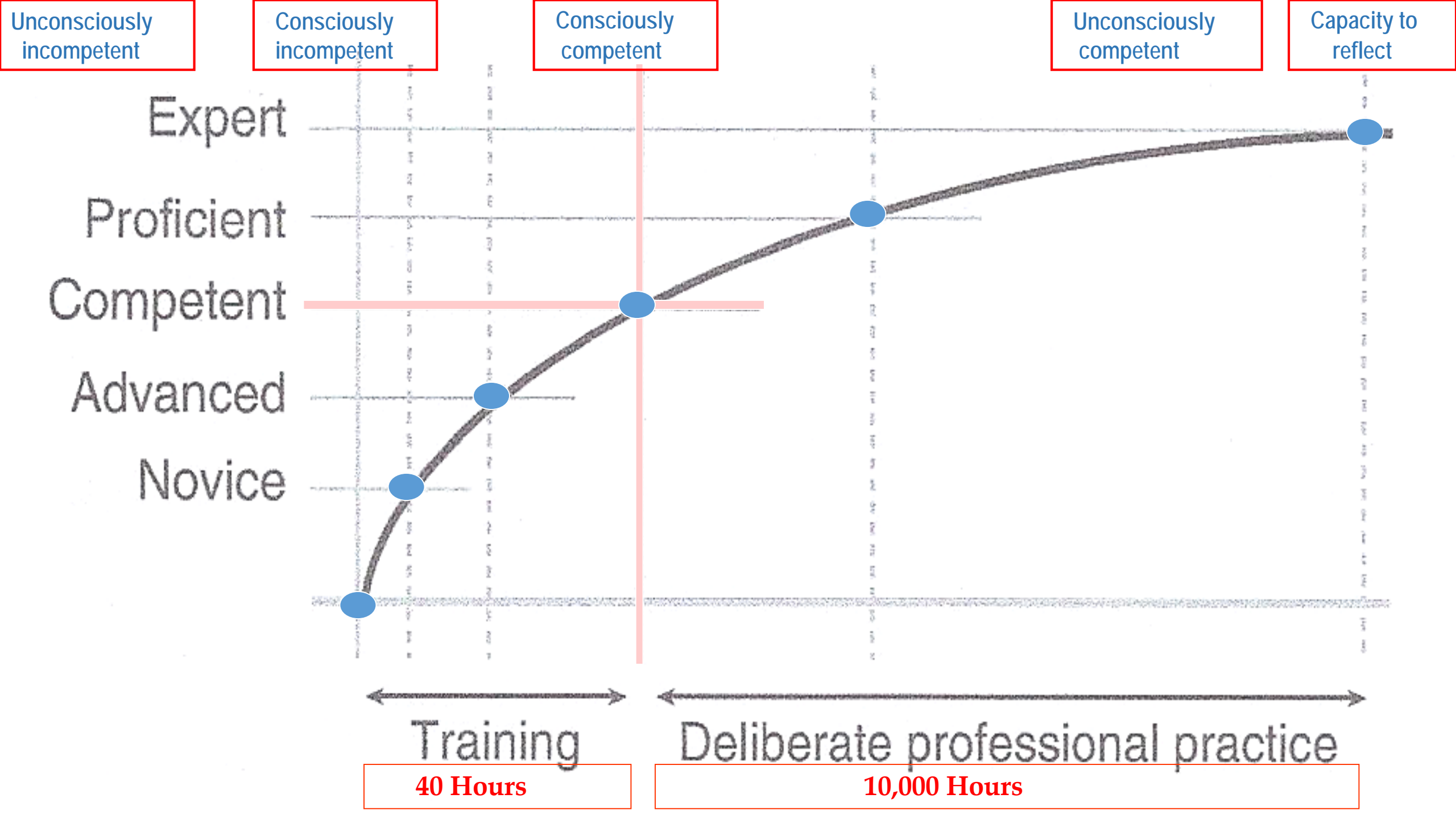




Axial view of fMRI activation of the brain as a function of practice over 60 minutes

Hill and Schneider, 2006





Unconsciously incompetent

Consciously incompetent

Consciously competent

Unconsciously competent

Capacity to reflect

Expert

Proficient

Competent

Advanced

Novice

Training

40 Hours

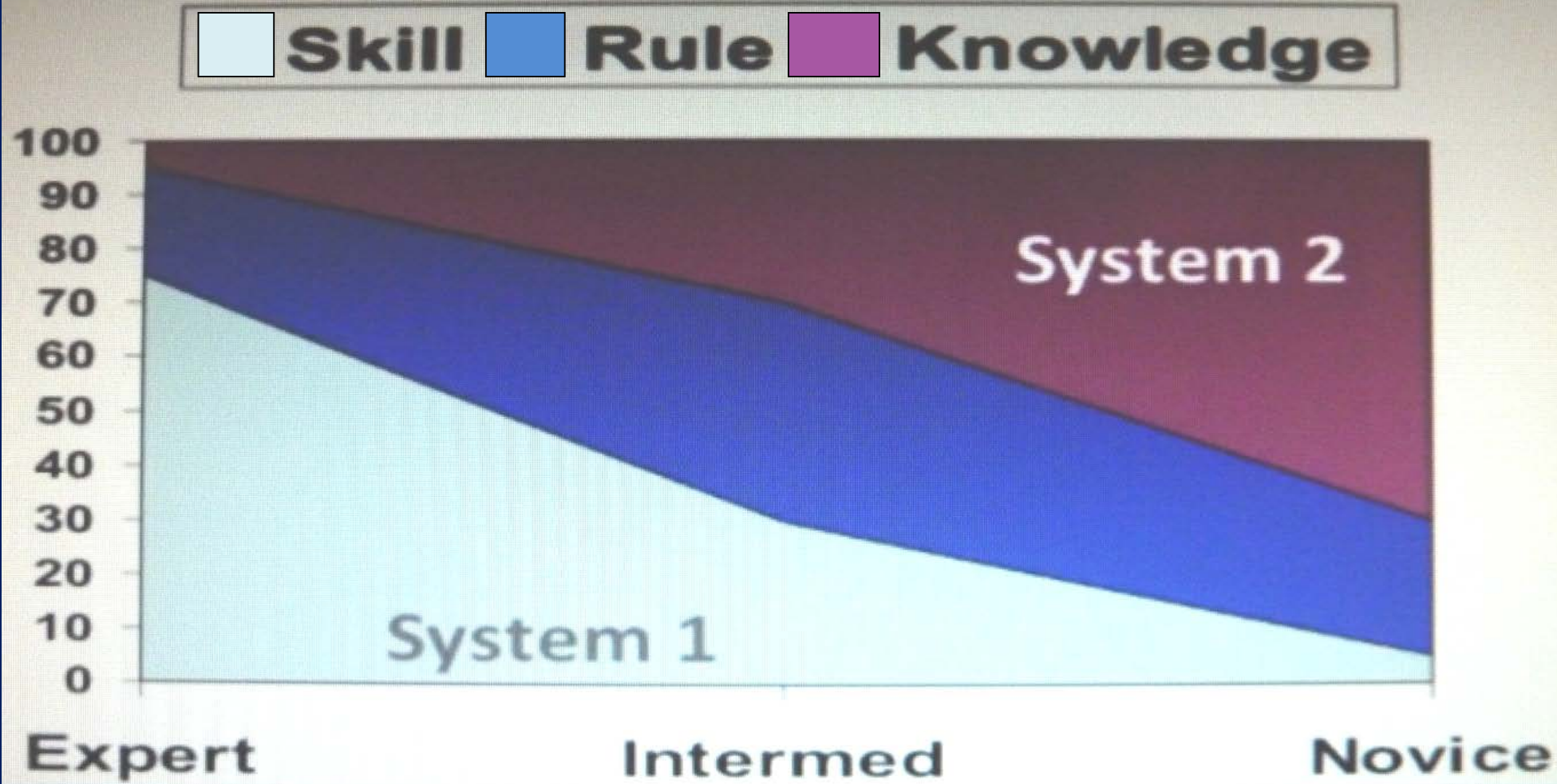
Deliberate professional practice

10,000 Hours

8 Main Features of the Model

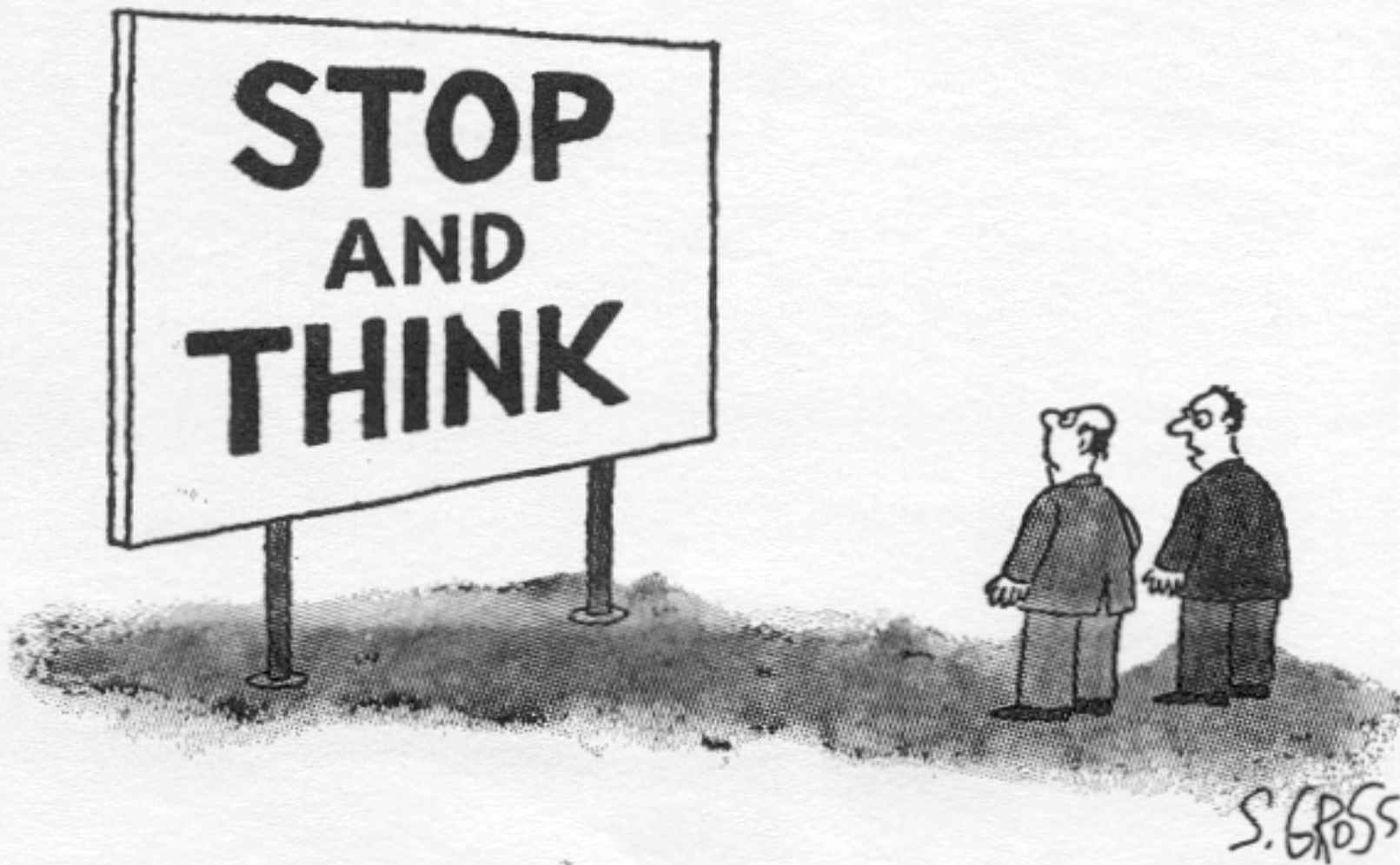
- We spend most of our time in System 1
- Most heuristics and biases are in System 1
- Most errors occur in System 1
- Repetitive operations of System 2 \gggg 1
- System 2 override of System 1
- System 1 override of System 2
- Toggle function
- Cognitive Miser function (being comfortably numb)

Experts vs Novices



High Risk Situations

- Cognitive overloading
- Interruptions/distractions
- Fatigue
- Stress
- Sleep deprivation/sleep debt
- Negative mood
- Influence of medications, drugs, alcohol



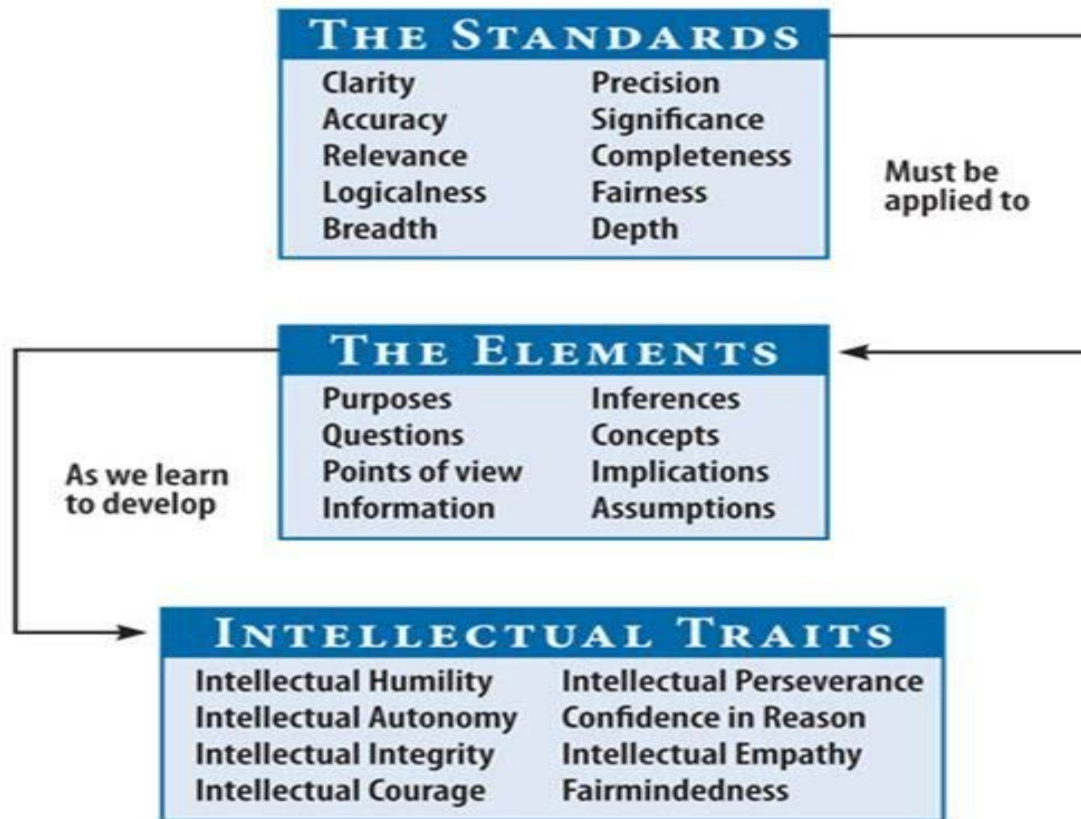
"It sort of makes you stop and think, doesn't it."

What is the best intervention to improve
quality of thinking, problem solving, and
reasoning?

Critical Thinking

Critical thinking is the ability to be in control of one's thinking. It includes the ability to consciously examine the elements of one's reasoning, or that of another, and evaluate that reasoning against universal intellectual standards - clarity, accuracy, precision, relevance, depth, breadth, and logic. It also involves the structured examination of sources of information.

Critical Thinkers Routinely Apply Intellectual Standards To The Elements Of Reasoning In Order To Develop Intellectual Traits



Can you teach it?

UK Thinking Skills Review Group (2005)

- Examined 6500 sources – chapters, articles, papers
- Age range 5-16yrs
- 191 had all necessary information
- 23 identified as ‘highly relevant’ - in depth analysis

Results

- Majority of CT interventions - positive impact
- None reported a negative impact
- Effect is relatively greater than other researched educational interventions

Results

Thinking skills programmes and approaches are effective in improving the performance on tests of cognitive measures (such as Raven's progressive matrices) with an overall effect size of 0.62.

(This effect would move a class ranked at 50th place in a league table of 100 similar classes to 74th or a percentile gain of 24 points.)

*Normal,
Bell-shaped Curve*

Percentage of
cases in 8 portions
of the curve

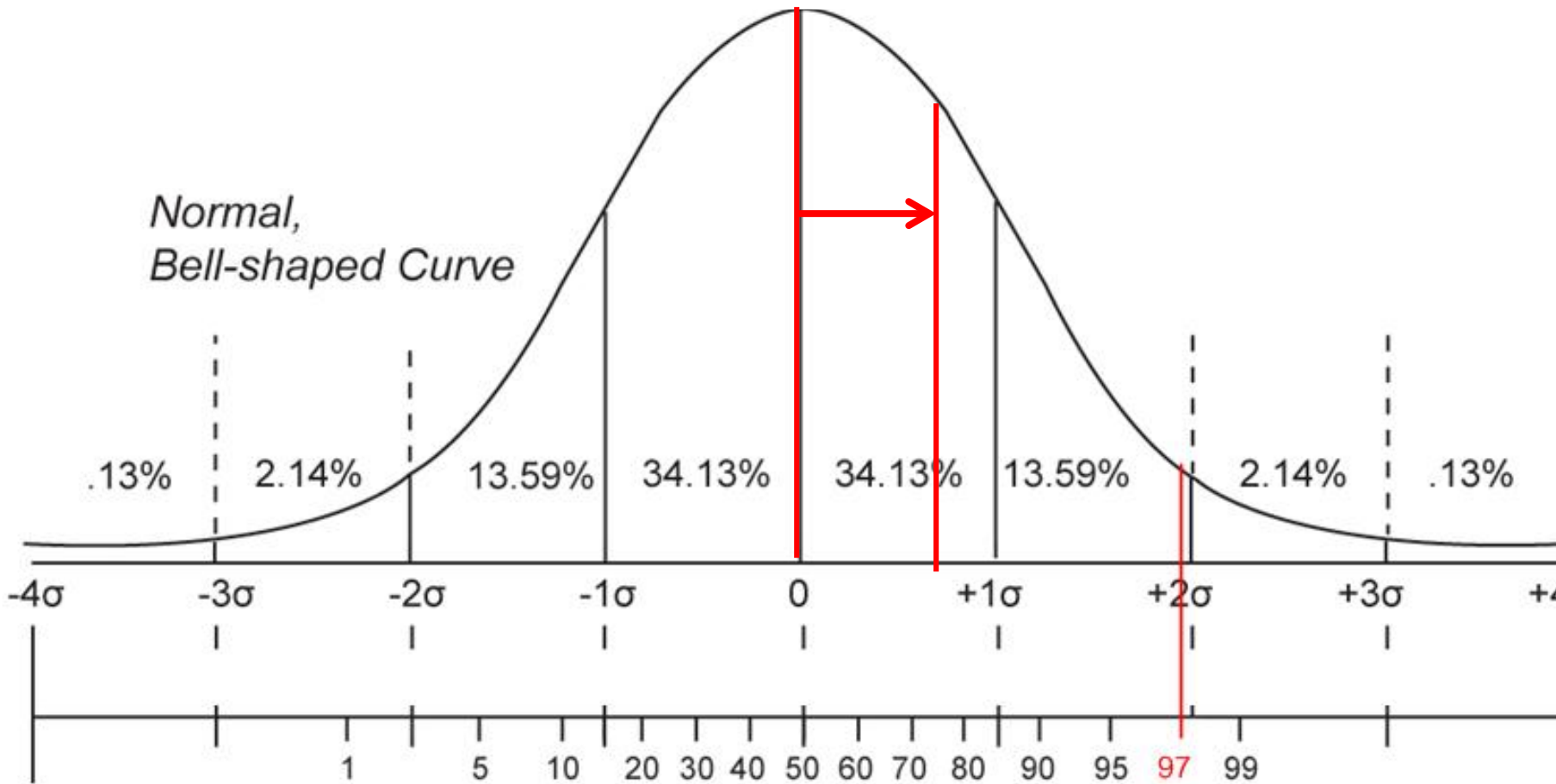
.13% 2.14% 13.59% 34.13% 34.13% 13.59% 2.14% .13%

Standard Deviations

-4σ -3σ -2σ -1σ 0 $+1\sigma$ $+2\sigma$ $+3\sigma$ $+4\sigma$

Percentiles

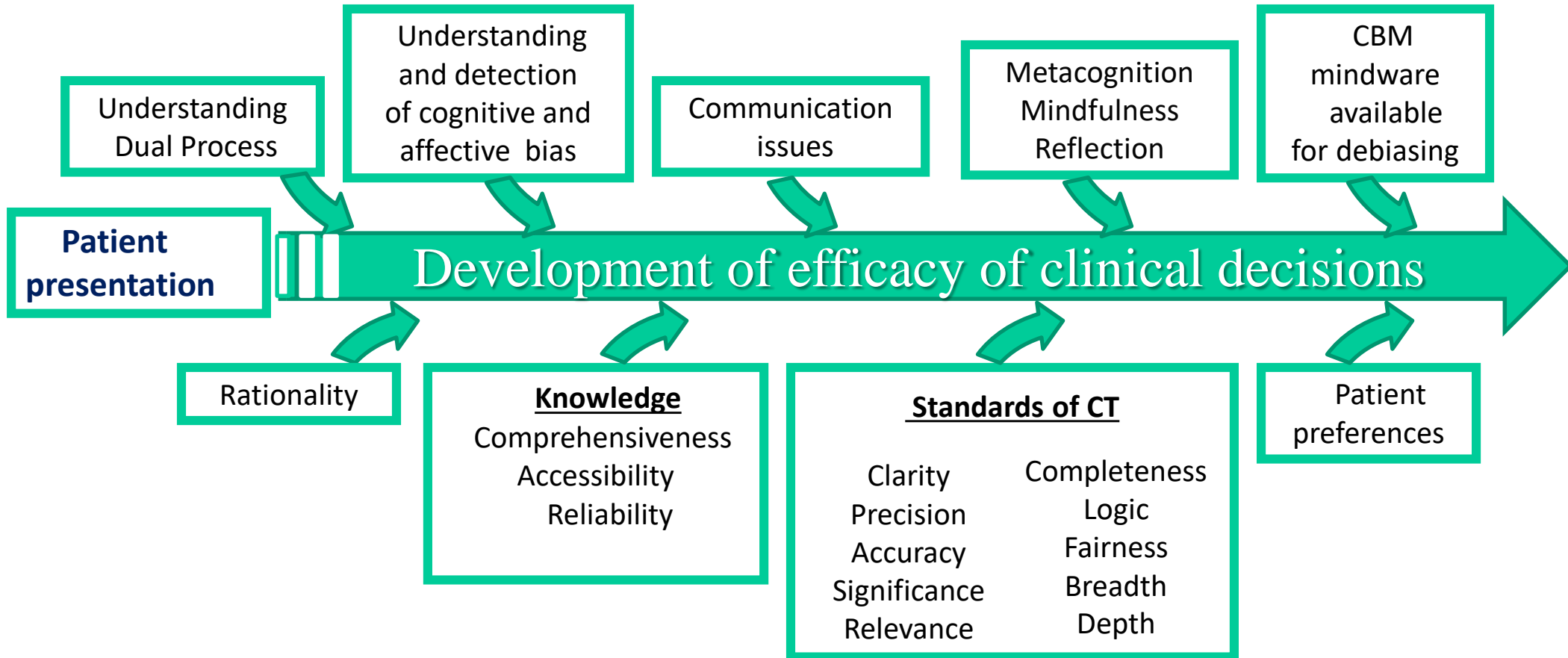
1 5 10 20 30 40 50 60 70 80 90 95 97 99



Post secondary learners

- Specific instruction in thinking skills (rules of logic, statistics, causal deduction, cost-benefit analysis) enhances CT (Nisbett et al studies 1980-90s)
- Woods (1987) ,Rubenstein (1987) and Facione et al (2000) all demonstrated improvements in critical thinking and problem solving with training
- Using argument mapping, Australian undergrads showed threefold gains in CT compared with standard training (Twardy, 2003)
- Korean study (2004) 10x2hr sessions with pre-service teachers ‘significantly improved’ CT
- Spanish study (2006) psychology students improved with CT training
- US psychology students (2007) showed ~15% gain in CT after 10 hours classroom and 20 hours homework in generic CT training (Solon)
- Irish Psychology students (2012) showed significant gain of about ~12% after 6 week online course (using argument mapping)

Dalhousie model of cognitive processes and clinical decision making

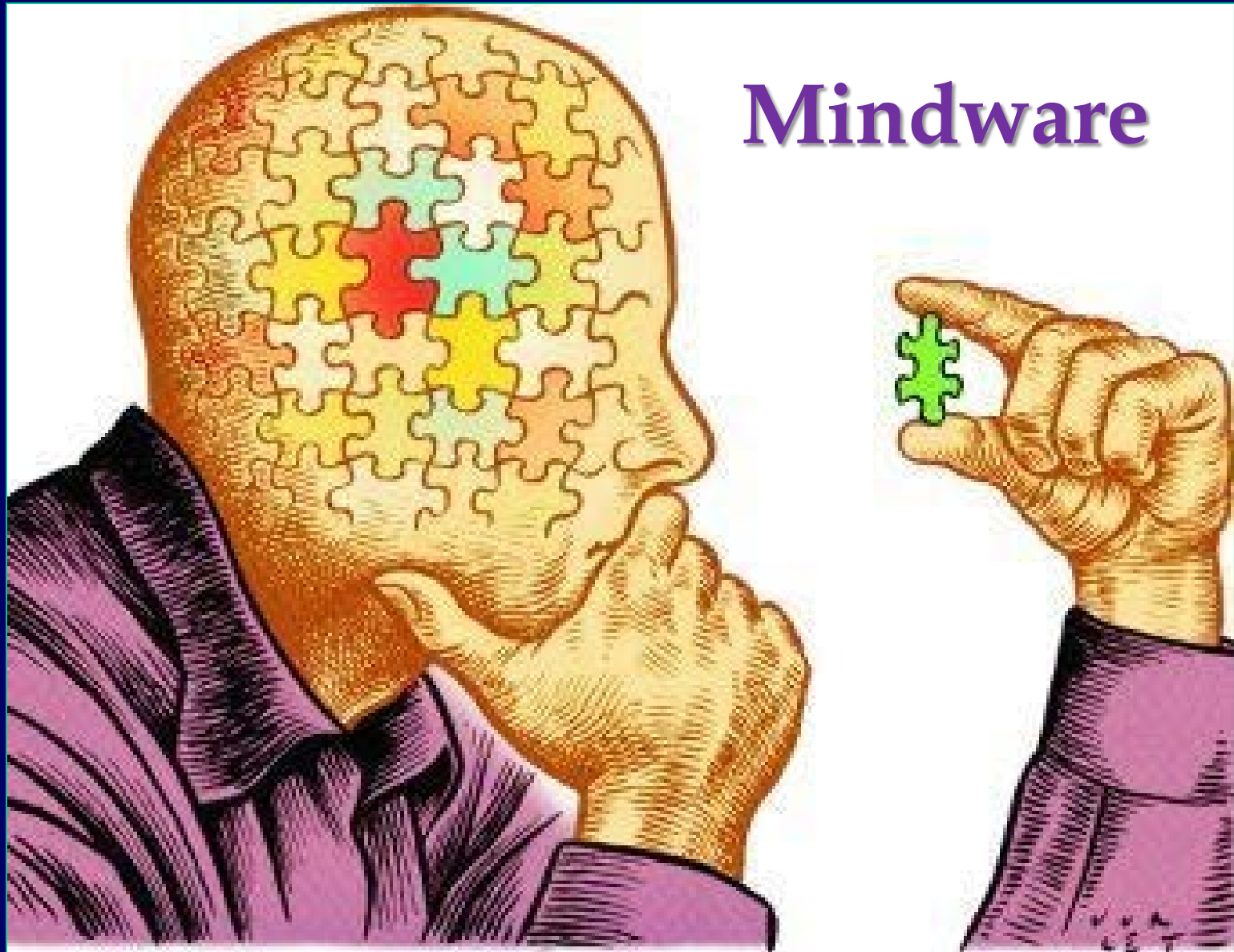


Rational thinking tendencies

- to collect information before making up one's mind
- to seek various points of view before coming to a conclusion
- to think extensively about a problem before responding
- to calibrate the degree of strength of one's opinion to the degree of evidence available
- to think about future consequences before taking action
- to explicitly weight pluses and minuses of situations before making a decision
- to seek nuance and avoid absolutism

Stanovich et al, 2012

Mindware



Take Home

- All decision making needs work
- Critical thinking (CT) improves reasoning
- It should be explicit (not implicit or tacit)
- It's never too late
- It is an ethical imperative