

Stanford CASE (Clinical Assessment Simulation Engine): Assessment Tool for Clinical Critical Thinking

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Learning Objectives

Recognize the challenges in effectively assessing students' ability to justify their clinical reasoning

Describe how Stanford CASE is addressing this problem

Inspire instructors to emphasize clinical critical thinking and assess students' ability to justify their clinical decisions about patients.



How do people learn?



What does this have to do with medical education?

Patients are more complex

Healthcare is more complex and
ever-changing

The medical education approach
has not changed

Knowledge is King

Quiz: What is a JAG-1 mutation?

AND organization of knowledge is a must

- Alagille syndrome – narrowed or missing bile ducts, heart defects, distinctive facial features (broad forehead, small pointy chin).
- Digestible table of congenital heart defects: Tetralogy of Fallot associated with Alagille syndrome, Down syndrome, DiGeorge syndrome
- Illness scripts for cyanotic heart diseases
- Exemplars from experience



Routine experts



Adaptive experts

Routine vs. Adaptive Expert

Routine expert – stable recurrent tasks, premium on efficient completion

Adaptive expert – high degree of variability and change

Adaptive experts possess flexibility and evolution in their thinking
to create new solutions

Routine Experts

- You are a proficient routine expert



Very itchy



Heuristics

Mental shortcuts

Automatic and unconscious

You build these from repeated experiences, overlearned associations, stimuli triggers.

Bat & Ball

A bat and ball cost \$1.10

The bat costs one dollar more than the ball.

How much does the ball cost?

Bat & Ball

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

- \$.10 - total cost would be \$1.20

- Answer is \$.05.

Fast thinking doesn't always work

Question 5

What advice did you receive to get the best score on multiple choice tests?

- A. Trust your intuition
- B. At the end of the test, go back and reconsider the questions you weren't sure about

Should you trust your first answer or reconsider it ?

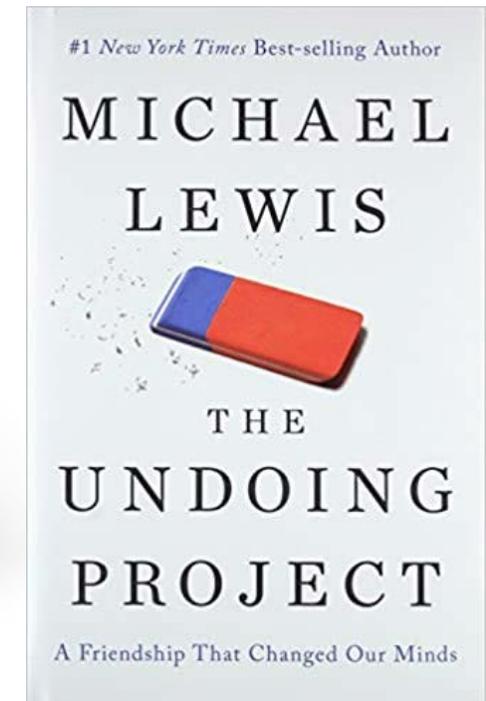
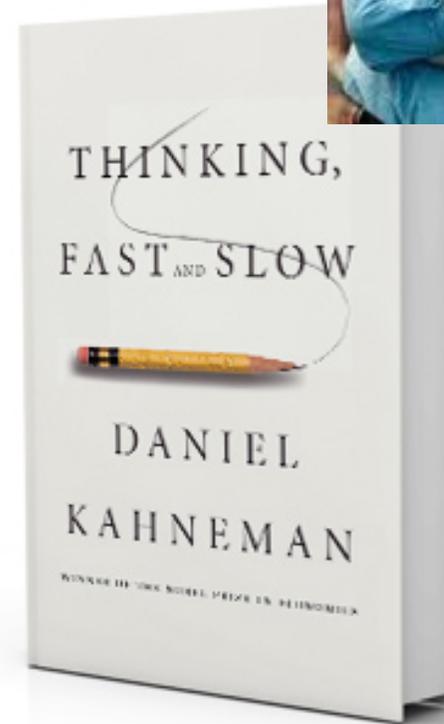
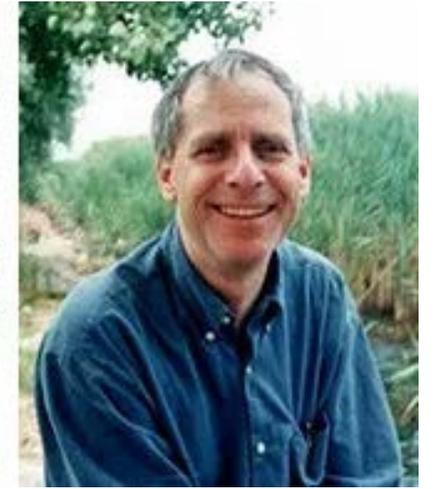
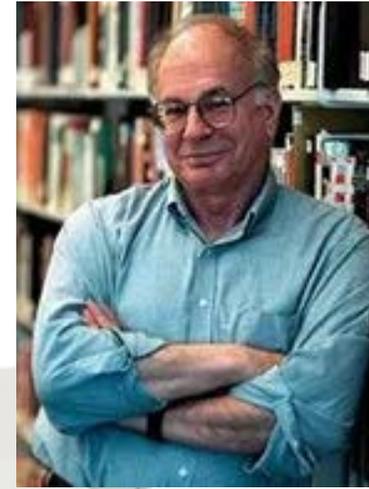
AUTHOR	YEAR	SETTING	Total Questions	% Changed	Right to Wrong	Wrong to Right
Davis	1929	C	22000	2.50%	21%	53%
Shahabudin	1929	C	21903	2.90%	34%	66%
Bath	1967	C	7700	4.30%	20%	60%
Mathews	1975	M	11630	5.40%	20%	58%
Lowe and Crawford	1983	M	39380	4.60%	22%	46%
Fabry and Case	1985	B	123,175	3.80%	23%	48%

Daniel Kahneman won the 2002 Nobel Prize in Economics for prospect theory. (and Amos Tversky)

The premise: standard economic models assumed economic rationality and did not take into account human behavioral biases.

People do not always make decisions based on rational thought.

Foundation for behavioral economics

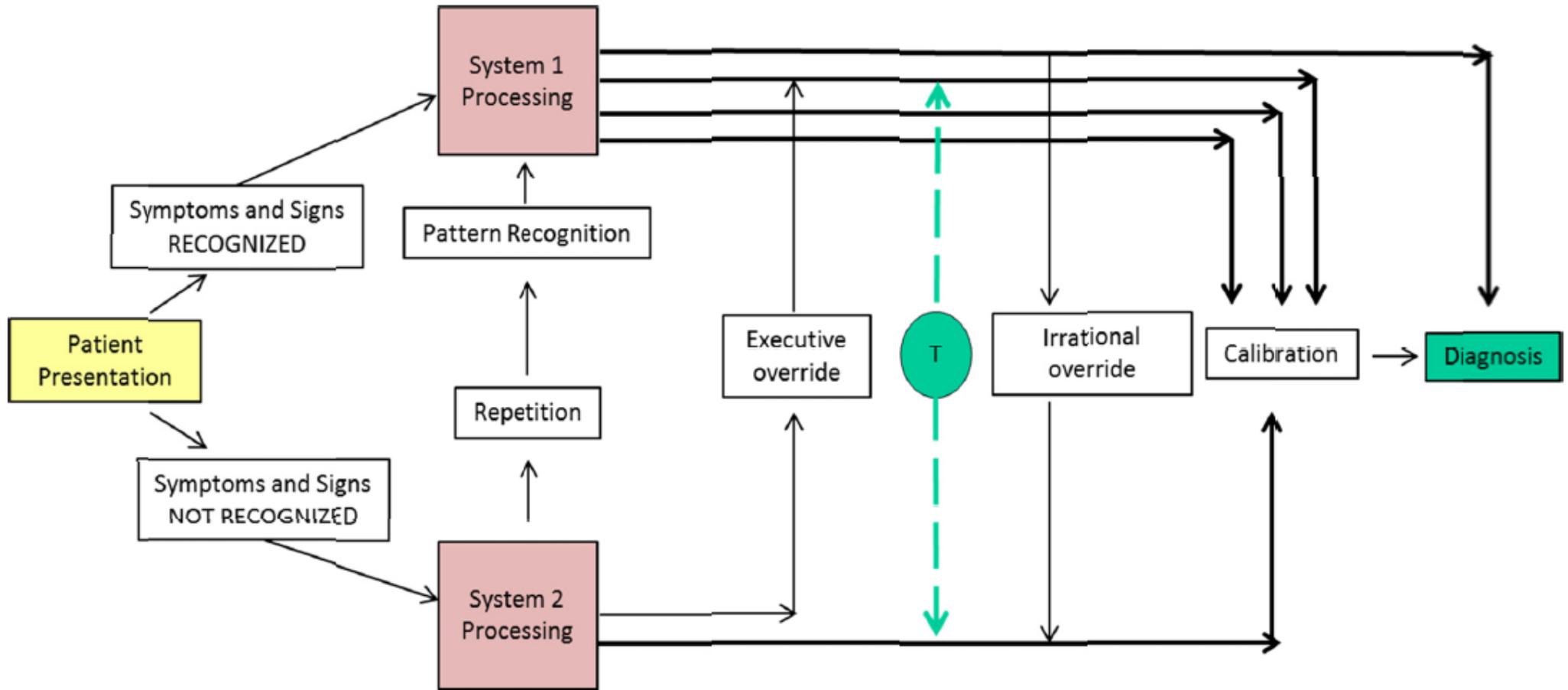


Dual Process theory – Decision making

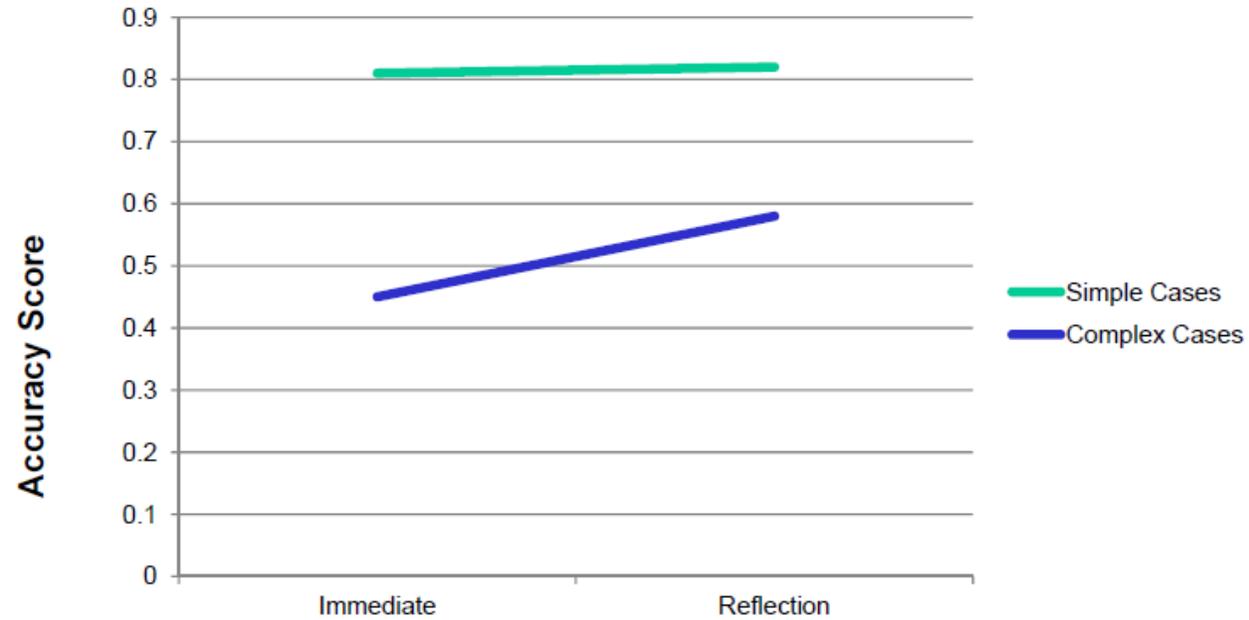
- Type 1
- Fast. unconscious.

- Type 2
- Slow. conscious.





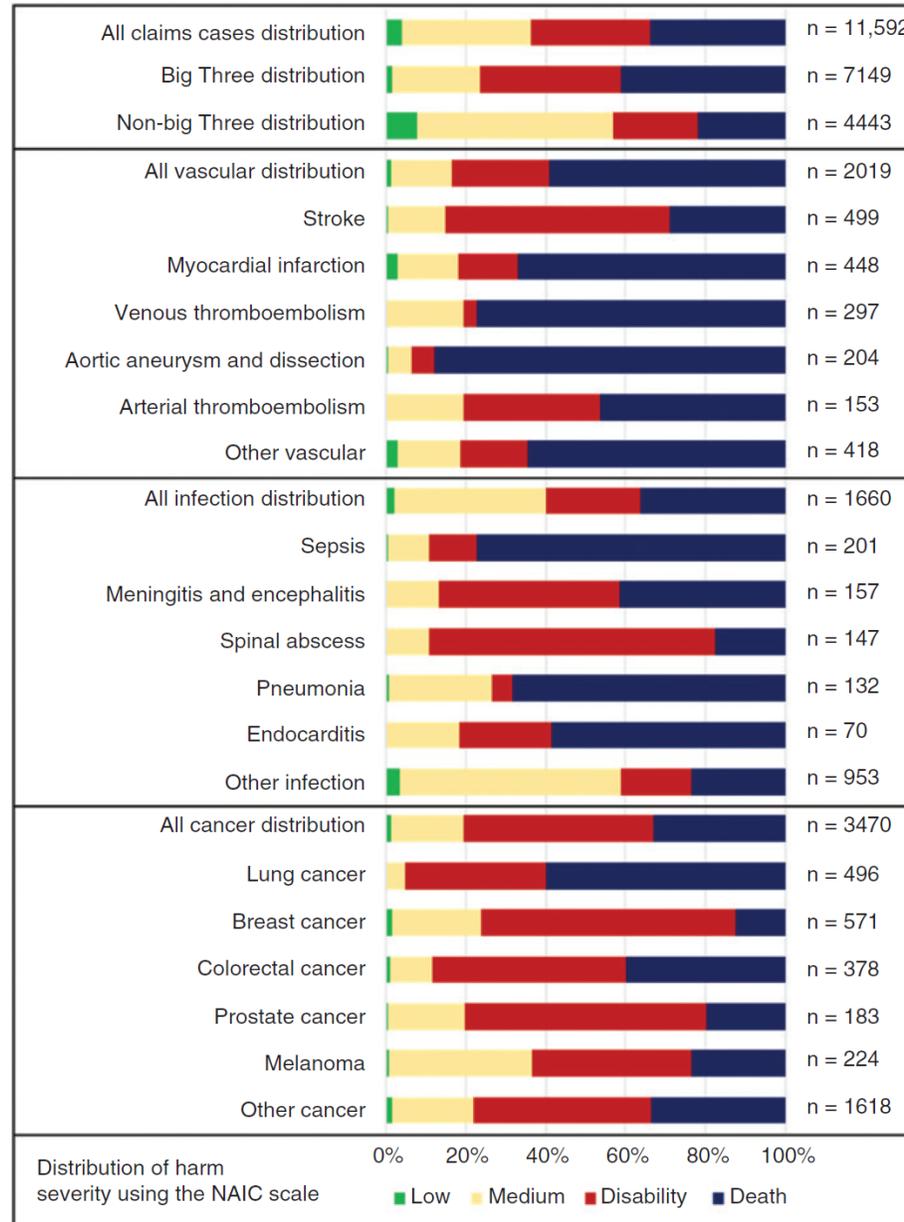
Does Reflection improve Diagnostic Performance?



Conscious thought beats deliberation without attention in diagnostic decision making – at least when you are an expert. S Mamede et al. Psychol Research 2010: 74: 586-592

Claims for High-severity Harm

Newman-Toker DE, et al.
 Diagnosis 2019, 6(3):227

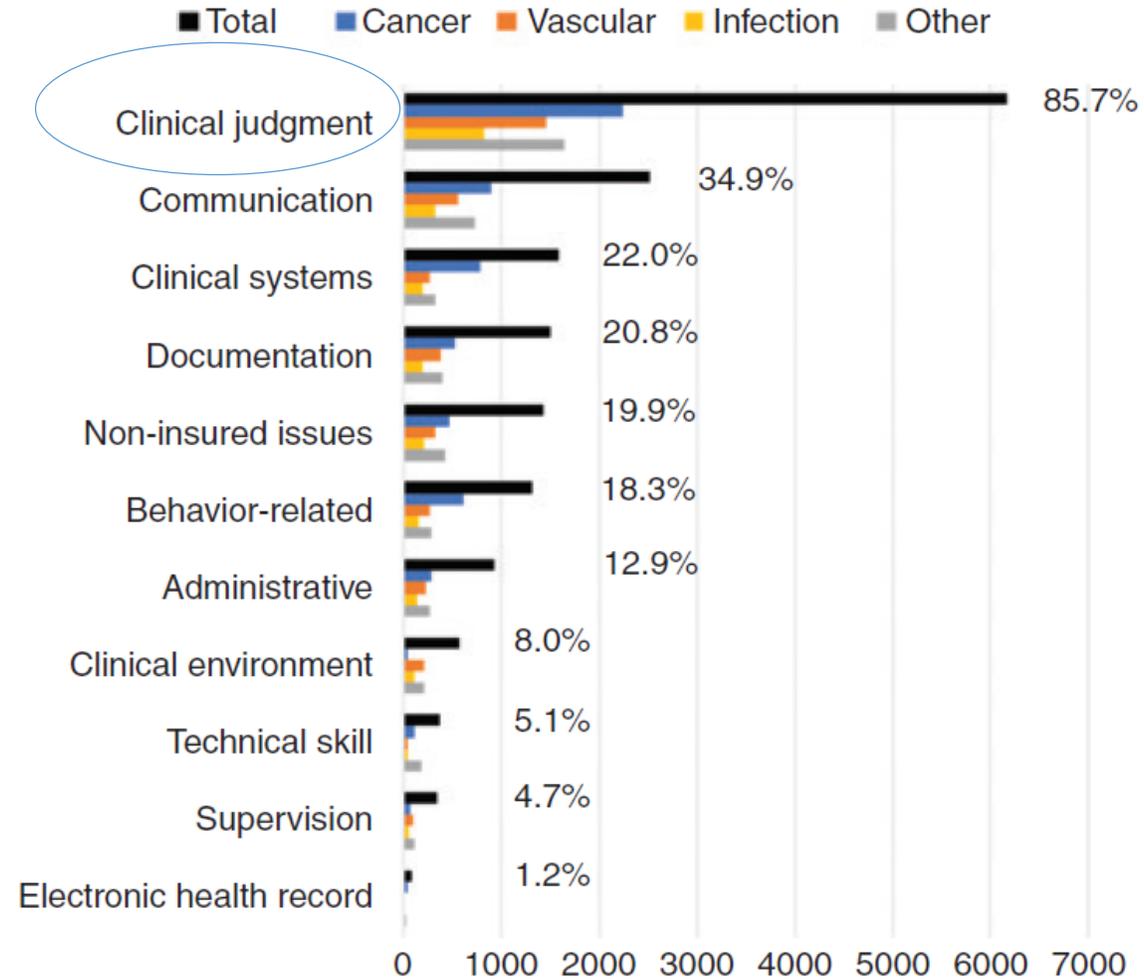


Vascular

Infection

Cancer

Contributing Causal Factors



6165/7193 = 85.7%

Newman-Toker DE, et al.
Diagnosis 2019, 6(3):227

Routine Expertise is not enough

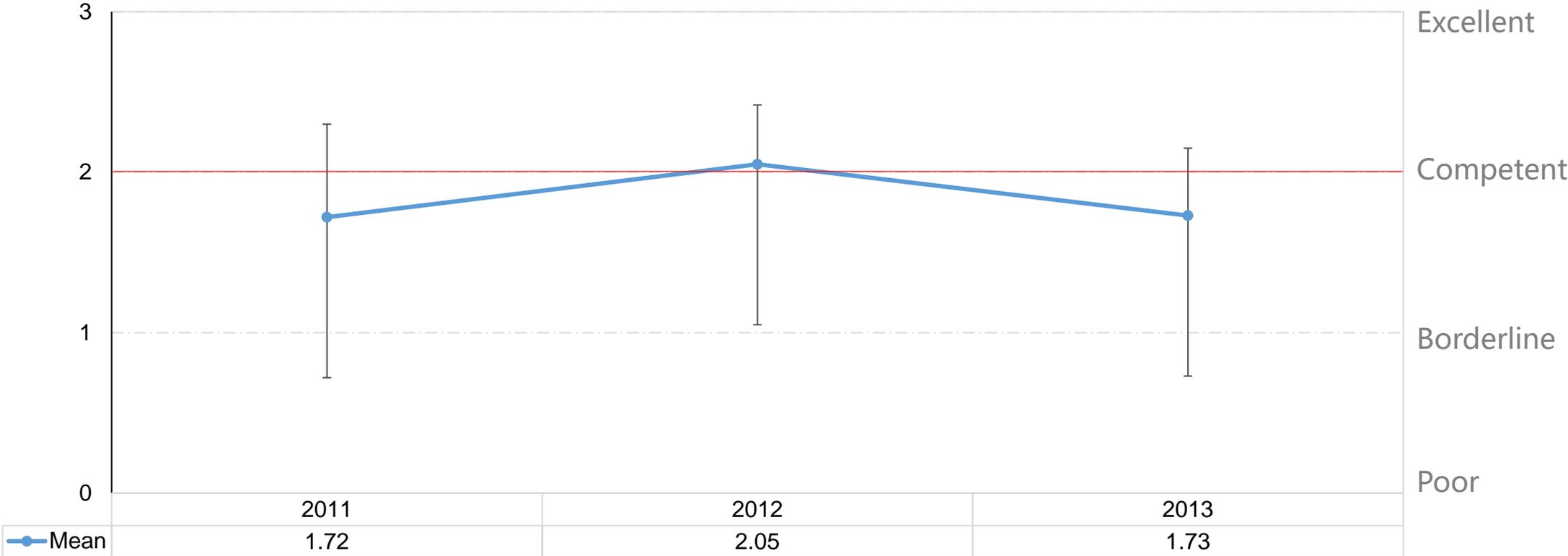
Adaptive experts are what we need

“Explain why” is missing

- **Why** do Alagille patients have bile duct problems, heart defects and dysmorphic facies?
- What caused it?

Senior medical students are deficient at diagnostic justification

Mean Thought Process Score



Williams RG. Academic Medicine 2014, 89:790



More complex patients and ever
changing health-care system



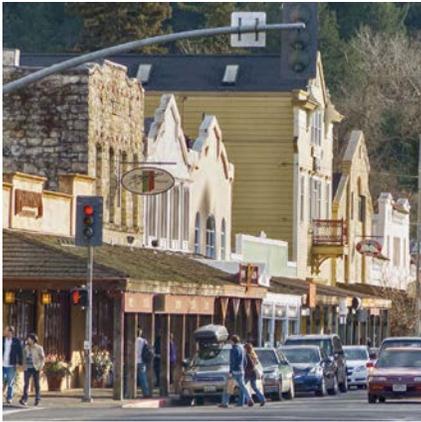
Adaptive Experts



Preparation
for future
learning
(PFL)



Branford JD, Schwartz DL. Rethinking Transfer 1999
Mylopoulos M, et al. Med Education 2016



Preparation for
future learning
(PFL)

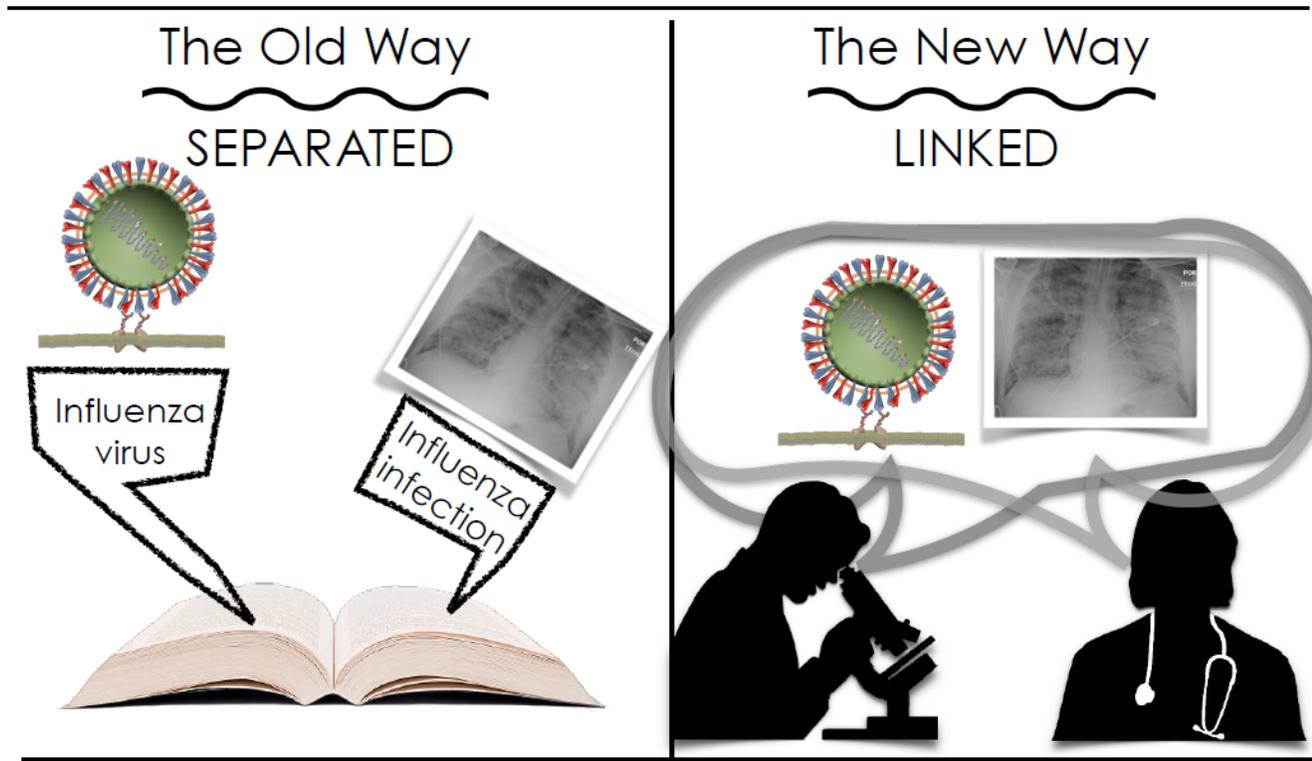


Understanding
rather than
performance

Emphasize struggle,
risk taking

Support meaningful
variation

Mylopoulos, M, et al. J Eval Clin Pract 2018
Schwartz DL, et al. Cogn Instr 2004.



Cognitive link:

Biological characteristics can be linked to clinical characteristics of a patient

Quiz:

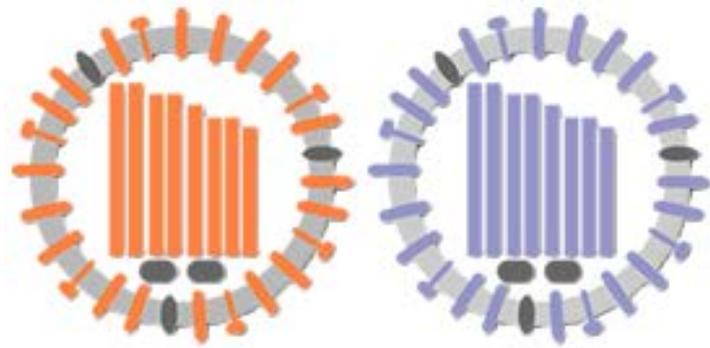
Why do we need a new influenza vaccine every year?

Genetic Shift & Drift



✧ **Reassortment → Shift →
Pandemics & Epidemics**

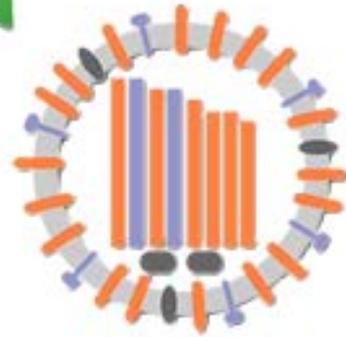
✧ **Mutations → Drift →
Epidemics**



Different subtypes of Influenza A

Antigenic shift
(Genetic shuffling)

Reassortment

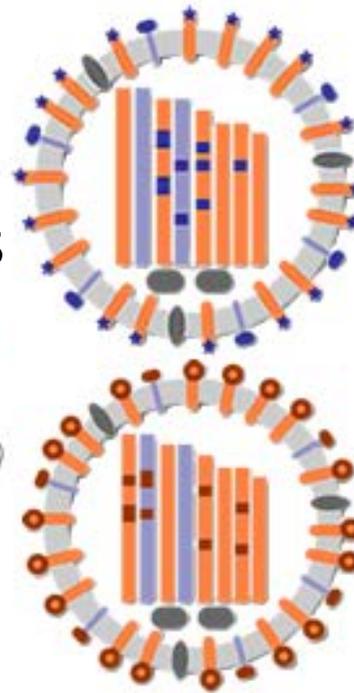


New Influenza A subtype

Proof-reading problems



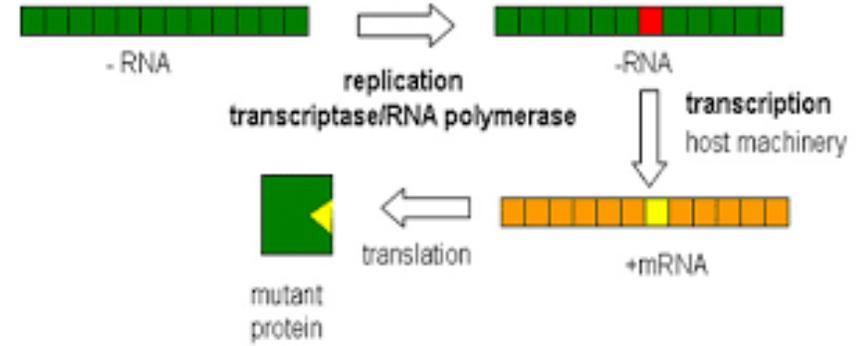
Antigenic drift
(Random mutation)



Different Influenza A strains

1. Antigenic Drift

no proof-reading



Breakout Room – Cognitive Links

Create a cognitive link in your field

2 people in each breakout room

5 minutes

Put your answer into PolLEV

Cognitive link:

Biological characteristics can be linked to clinical characteristics of a patient



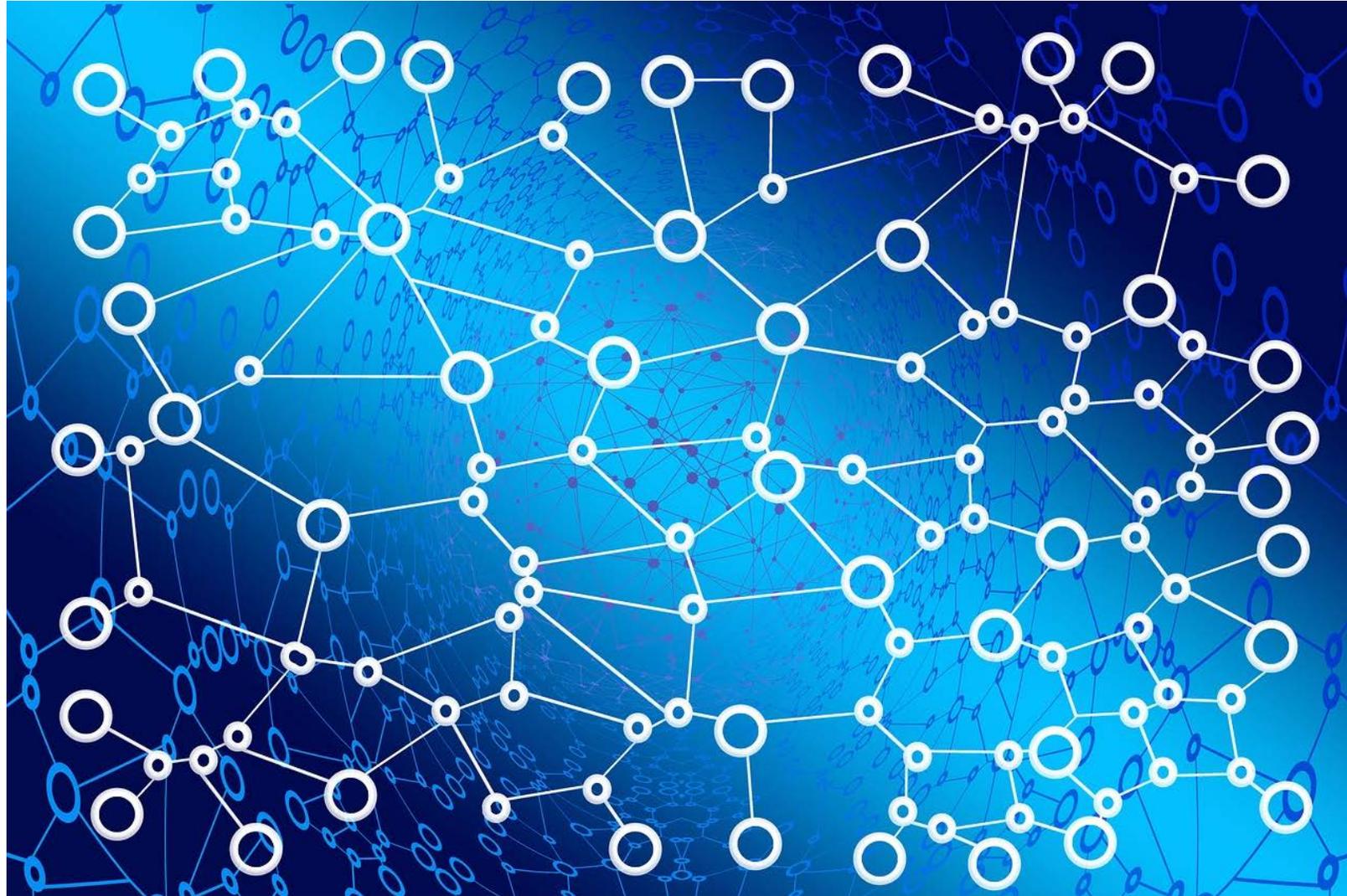
Create a cognitive link. Cognitive link: Biological characteristics can be linked to clinical characteristics.

Adaptive experts

Emphasize understanding, not performance

Encourage learners to make cognitive links
and ask “why”

Ask “Why”



“Why” Not?

What we do - What is the DDX of cough.

What we don't do - Explain why ACE inhibitors cause cough?

Breakout rooms

What prevents you from asking learners to “Explain Why”

- 2 people in each breakout room
- 5 minutes
- Put your answer into PolleEV



What prevents you from asking learners to "Explain Why" ?



Adaptive experts

Emphasize understanding, not performance

Encourage learners to make cognitive links
and ask “why”

Did they learn?

What kind of assessment?

Teaching is about explaining why. Assessment is about explaining why

What do we measure?

Start backwards. What does an adaptive expert look like?

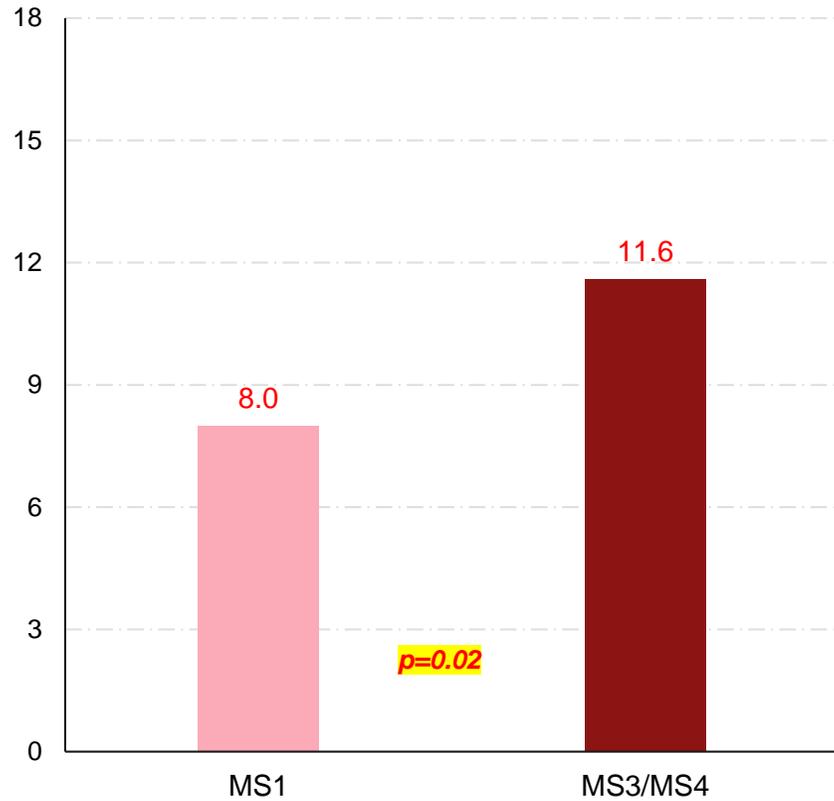
Dr. Carl Weiman (Professor of physics and Graduate School of Education) – what decisions do experts make when problem-solving?

Stanford CASE

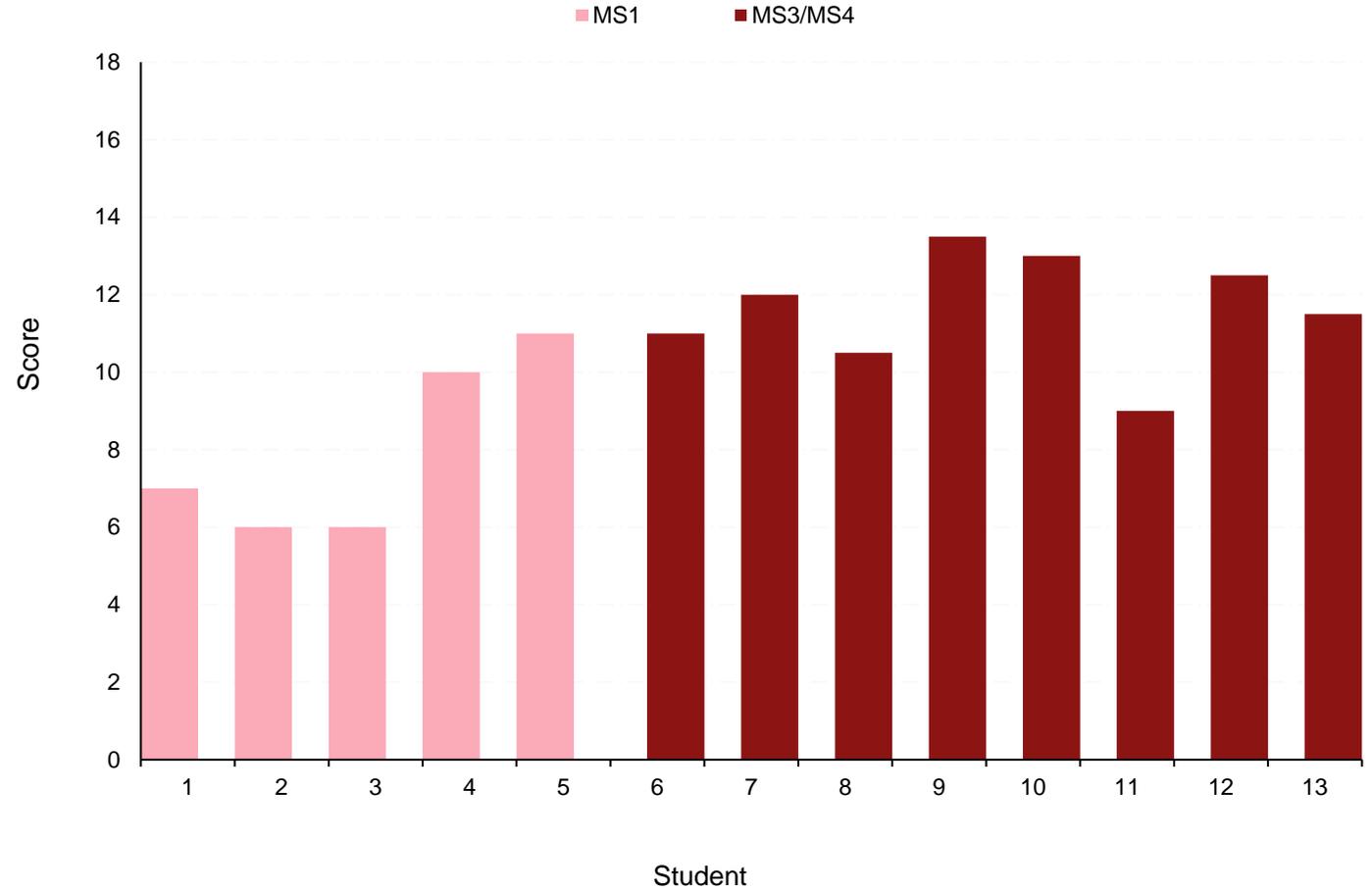
1. An assessment tool for skills of adaptive expertise.
2. How you might use it.

CASE can capture growth in learning

Mean CASE Score



CASE Total Score



Grading Rubric Sample

Although you would conduct a full physical exam, what parts of the physical exam are you going to emphasize in your presentation to the attending physician?

Grade	1	2	3
Element	MS1	MS3/4	ID Expert
General appearance		to get sense of how sick he is. Need to be in ICU or on wards	to get sense of how sick he is. Is he progressing to toxic shock? That would point to more of a S. aureus or S. pyogenes infection of his knee and toxin-mediated process. Does he appear to have a significant systemic process? That would point away from a reactive arthritis process and more towards systemic infection or systemic autoimmune process such as systemic JIA.
Extremities- Left knee	look for swelling, redness, pain	look for swelling, redness, location of pain.	look for swelling, redness, location of pain. make sure patella is in place and not dislocated and ligament integrity if possible – these may be source of pain from knee injury that wasn't recalled and knee injury may be inciting event, potentially with then a subsequent infection; assess for effusion not just overall swelling. Note angle of flexion and extension.
Extremities – right knee		Compare swelling to right knee	Compare all assessments to right knee.
Extremities - left hip and left ankle (joint above and below)			to get sense of other joint problems and if knee swelling is separate from pain (i.e knee pain is a referred pain).
Skin		Make sure no lesions, no breaks in skin, no overlying skin changes over other joints.	Make sure no lesions, no breaks in skin, no overlying skin changes over other joints. Skin breaks anywhere along both lower extremities, especially where skin would be exposed with baseball uniform. Get sense of introduction of commensal bacteria
Eyes			make sure no injected conjunctiva – seen with Leptospira infection. May also see with toxin-mediated process
Neck			Look for enlarged lymph nodes as hint of cancer or of primary infection (with post reactive arthritis). Can also see with systemic Histoplasma infection.
CV			listen for murmur – make sure no hint of infective endocarditis – can see immune-complex deposition in joint and subsequent swelling (maybe pain).
Abdomen			look for hepatosplenomegaly seen with systemic Histoplasma infection.
GU			look for rectal tags or significant fissures – consider inflammatory bowel disease such as Crohn's disease presenting with extra-intestinal manifestation.

H&P “Thinking” questions capture growth in learning

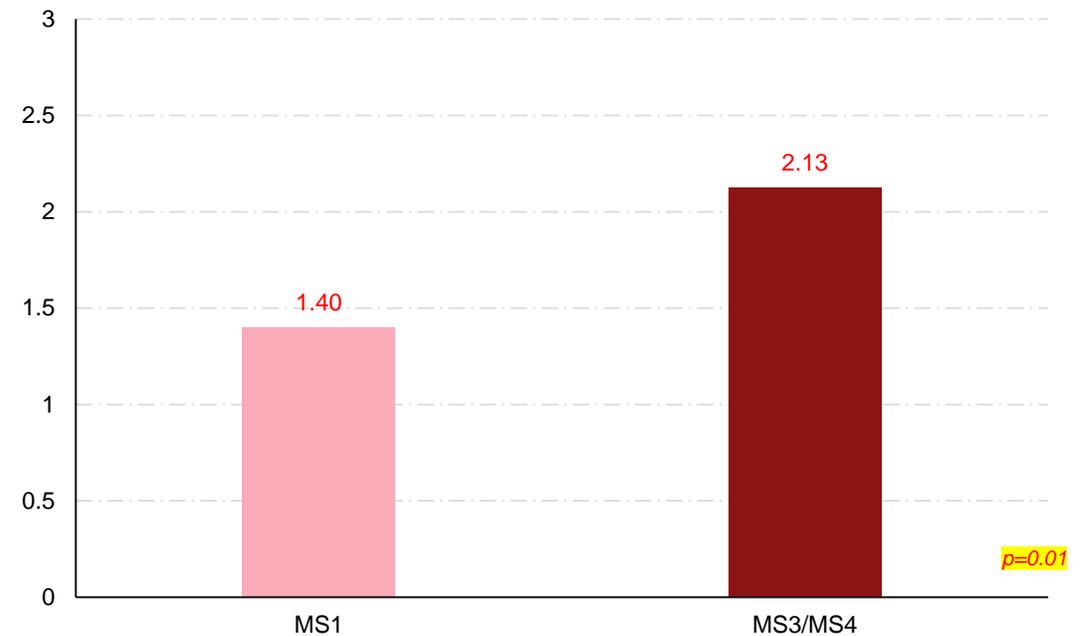
Question 1: Identify key clinical signs and **symptoms** in the patient’s history and explain why you believe those are key (e.g. relevant to a potential clinical diagnosis?)

Question 3: Although you would conduct a full physical exam, what parts of the physical exam are you going to emphasize in your presentation to the attending physician?

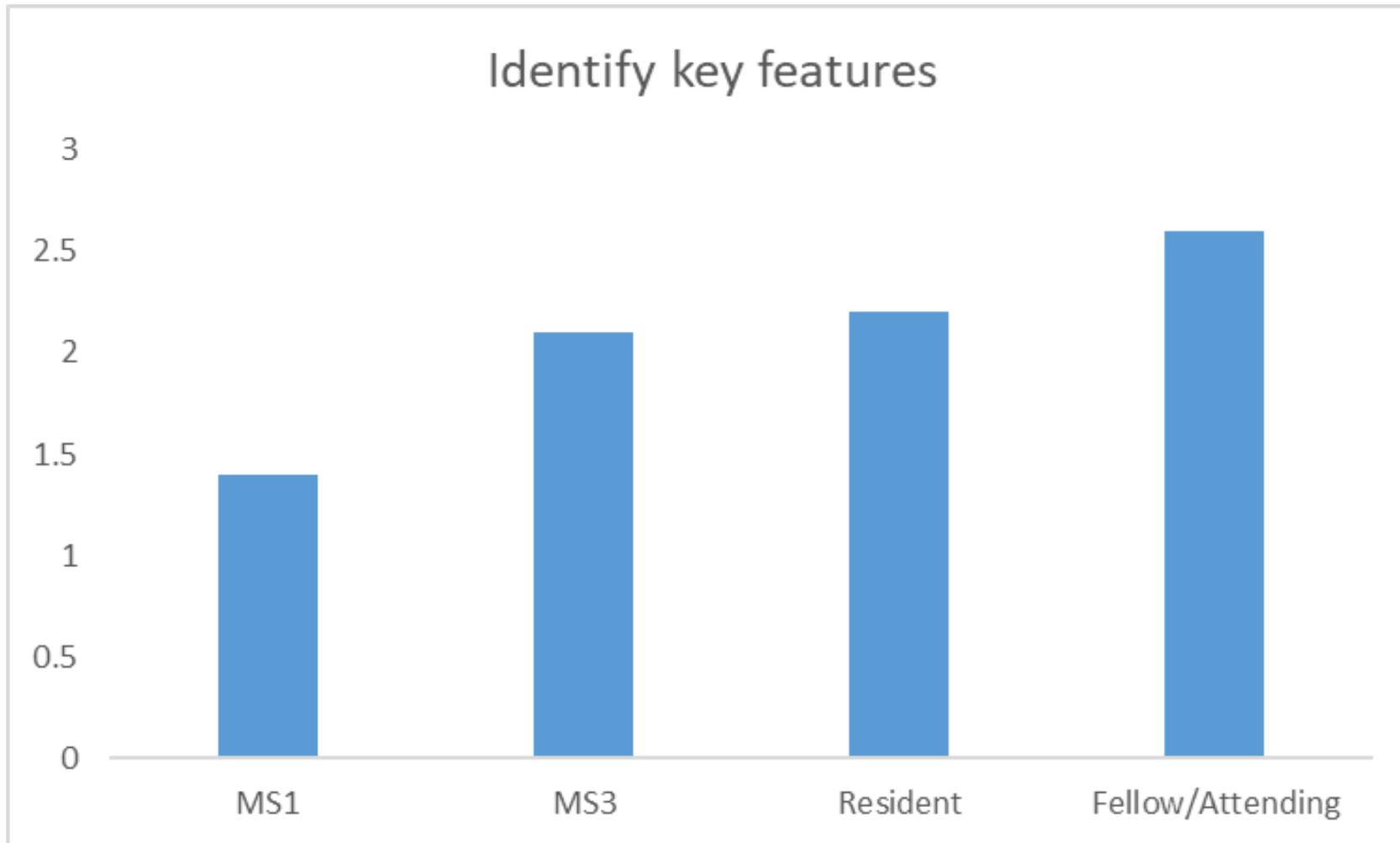
Question 1 Mean CASE Score



Question 3 Mean CASE Score



Growth in learning



Does the overall story about this patient “fit” (make sense)?

Confidence level

Residents/Fellows

22%

Attending Physicians

75%

Problems



How would you use Stanford CASE?

Inspire