Why Does *Your* Learner Score Poorly on Tests?

Using Self-Regulated Learning Theory to Diagnose the Problem and Implement Solutions

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Objectives

- List why a trainee may underperform on tests
- Introduce Self-Regulated Learning (SRL) theory
- Demonstrate a standardized method using SRL theory to determine test-taking deficiencies and suggest individualized solutions
- List common test-taking deficiencies

A 25-year-old woman is brought to the emergency department 1 hour after she fainted. She has had mild intermittent vaginal bleeding, sometimes associated with lower abdominal pain, during the past 3 days. She has had severe cramping pain in the right lower abdomen for 12 hours. She has not had a menstrual period for 3 months; previously, menses occurred at regular 28-day intervals. Abdominal examination shows mild tenderness to palpation in the right lower quadrant. Bimanual pelvic examination shows a tender walnut-sized mass in the right parametrium. Which of the following is the most likely diagnosis?

(A) Appendicitis
(B) Cancer of the ovary
(C) Ectopic pregnancy
(D) Endometriosis
(E) Ovarian cyst
(F) Placenta previa

How many of YOUR learners are "at risk"?

Scope of the problem

Licensing exam FAILURES % (#) in 2015

- ABIM Medicine: 11% (862)
- Pulmonary 4% (23) (17% in 2014!)
- Critical Care 8% (46)
- Sleep 8% (25)

Scope of the problem

- Between 7-28% of residents require formal remediation at some point during training [1]

- 94% of internal medicine programs surveyed in 2000 had at least one struggling learner [2]

- Remediating a single struggling learner at one institution required a median of **18 hours** of faculty time [1]

...

[1] Guerrasio J, Aagaard EM. Methods and outcomes for the remediation of clinical reasoning.
J Gen Intern Med. 2014 Dec;29(12):1607-14.
[2] Yao DC, Wright SM. National survey of internal medicine residency program directors regarding problem residents. JAMA. 2000 Sep 6;284(9):1099-104.

How do YOU remediate struggling test takers?

Google

exam taking tips

Web   Images   Videos   News   Shopping   More ▾   Search tools

About 36,900,000 results (0.38 seconds)

Ten Tips for Terrific Test Taking - Study Guides and Strategies
www.studygs.net/tsttak1.htm ▾
Tips for better test **taking** ... Click an icon to get a **tip** to help with your test **taking**: ...
especially when studying for the final. **exam**. Each test prepares you for the ...

Test Taking Tips - Study skills
www.test**takingtips**.com/ ▾
Whether you're a high school or college student, tests are unavoidable. If you take a
multiple-choice **exam** your strategy will be different than if you were to take ...
Test Taking Tips - Study tips & Study skills - Cramming Techniques - Resources

Tips on Taking Multiple-Choice Tests
www.socialpsychology.org/test**tips**.htm ▾   Social Psychology Network ▾
Tips on how to prepare for and take multiple-choice tests. ... the worst thing you can do
is to continue **taking** the **exams** without notifying your instructor that there ...

Secondary issues
The 7 "D's"

1. **D**istracted by life (e.g., family/financial issues)
2. **D**epression
3. **D**rugs and alcohol
4. Learning **D**isabilities
5. Sleep **D**eprivation
6. **D**isease
7. Personality **D**isorders

Lucey CR, Boote RM. Working with problem residents: a systematic approach. In: Holmboe ES, Hawkins RE, eds. *Practical guide to the evaluation of clinical competence*. Philadelphia, PA: Mosby; 2008.

What is Self-Regulated Learning (SRL)?

- "Self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals"[1]

- Three phases:

  - Forethought: task analysis & motivational beliefs

  - Performance: self-control & self-observation

  - Afterthought: self-judgment & self-reaction

[1] Zimmerman BJ. Attaining self-regulation: A social–cognitive perspective. In: Boekaerts M, Pintrich P, Zeidner M, eds. Handbook of Self-Regulation. Orlando, Fla: Academic Press; 2000:13–39.
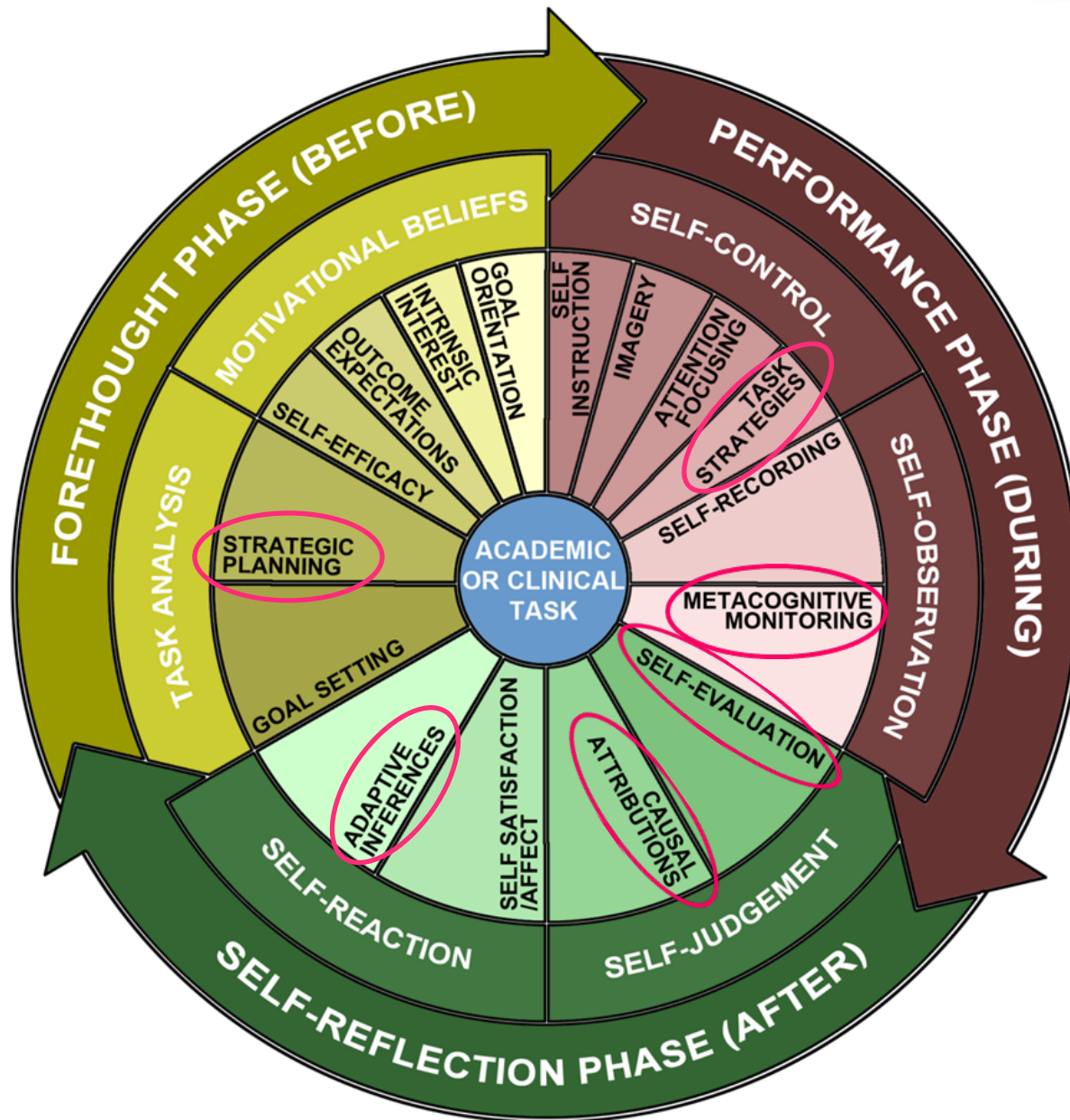
Adapted, with permission, from Artino, A. R., & Jones, K. D. (2013). Last Page: Self-regulated learning: A dynamic, cyclical perspective. *Academic Medicine, 88*, 1048.

Scripts

- Disease scripts
  - Clinical information which activates a network of knowledge containing the relationships between the symptoms, signs, clinical picture and different illnesses

Charlin B, Tardif J, Boshuizen HP. Scripts and medical diagnostic knowledge: theory and applications for clinical reasoning instruction and research. Acad Med 2000 Feb; 75(2):182-90.

Script theory in action

A 62 year old man presents to the clinic for evaluation of a one year history of worsening dyspnea on exertion that occurs several times per week. He has no shortness of breath at rest, chest pain, cough, abdominal pain, palpitations or night time symptoms. He has a 50 pack year history of smoking. He has no prior diagnosis of lung disease. Examination is significant for increase AP diameter of the chest and bilateral end-expiratory wheezing, and prolonged expiratory time.

What is this disease script?

# Self-Regulated Learning Microanalytic Assessment and Training (SRL-MAT)

- A semi-structured, think-aloud, direct observation protocol to assess the learner's use of regulatory behaviors during a specific educational activity (answering a test question)

- Designed for one-on-one use between learner and teacher, as well as learner self-assessment and practice

Applying SRL-MAT: Using the Question Review Form (QRF)

- (Uninterrupted think-aloud exercise)
- Present test question (with answers covered)
- Learner reads through stem
  - Answers QRF #1-6 (What is the disease script?)
- Uncover the stem question (= learning objective)
  - Answers QRF #7-10 (What is the objective? Predict the answer)
- Uncover the answer choices
  - Answers QRF# 11-17 (Were you right? Why/not? What's next?)
- Confidence assessments throughout
  - Assesses self-monitoring, calibration accuracy
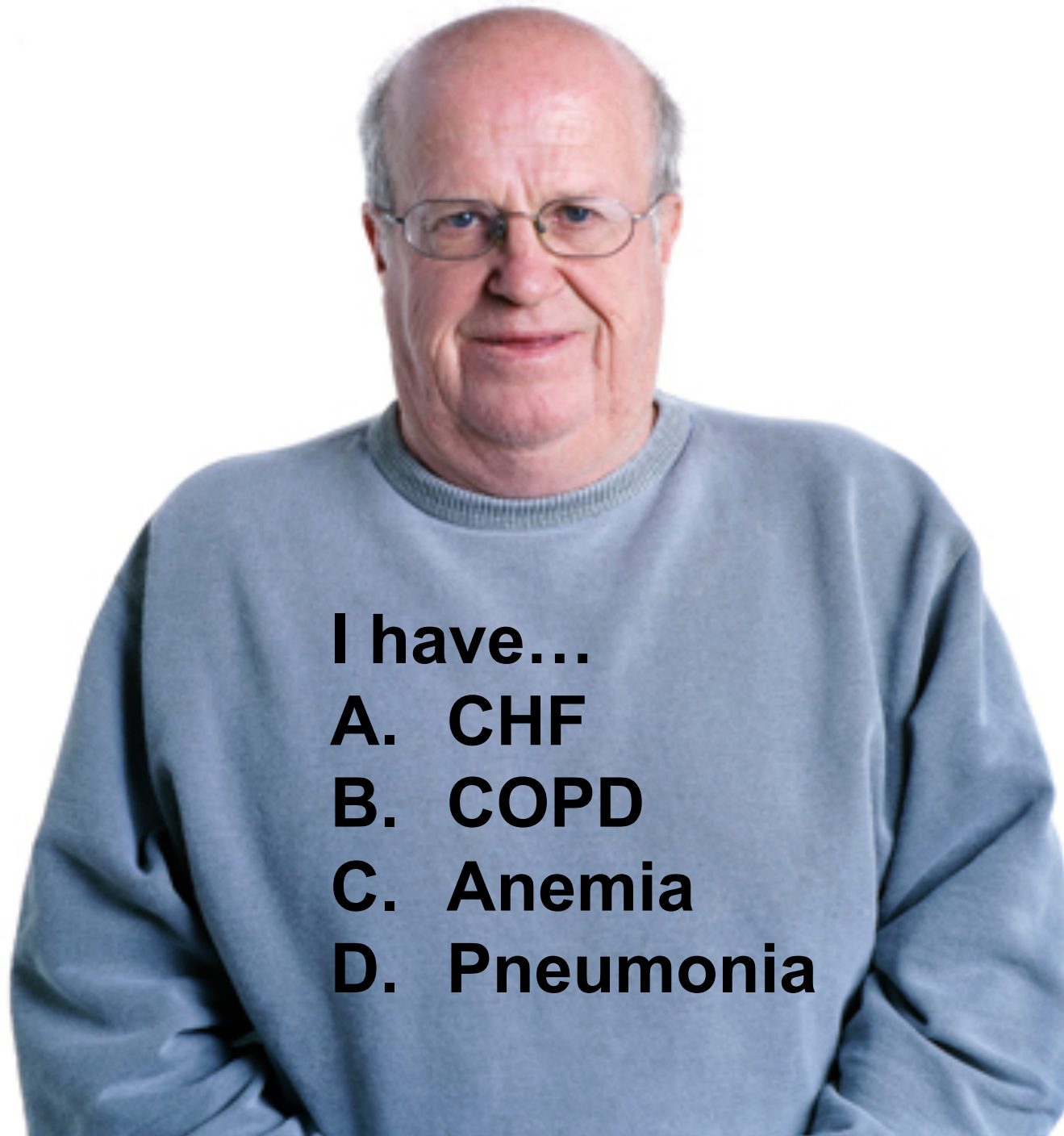
Struggling Test-taker Subtypes

1. <u>LACK OF SCRIPT RECOGNITION</u>
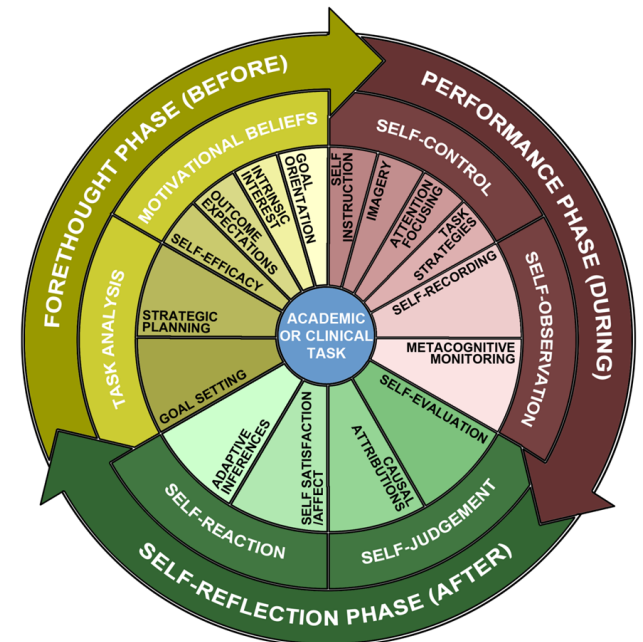
What goes wrong?

- Inefficient use of time (essentially read the question twice)
- No interior commentary/interpretation
- No prioritization of clinical information
- Uses answer choices to get ideas about what disease is present in the clinical stem

…

I have…
A. CHF
B. COPD
C. Anemia
D. Pneumonia

Struggling Learner Type #1: Lack of script recognition

- Struggles to identify diagnosis presented in clinical stem
- Reading and rereading the item without prioritizing and categorizing information in terms of the most likely script
- Looks at the answers to get a sense of what the case is about . Can't answer # 1-4 on the QRF

1. What diagnosis is the patient most likely to have? _____

2. What is the specific clinical scenario and/or severity of this disease (for example, if the disease was depression, is this uncomplicated depression, depression in the elderly, depression with history of mania, depression with suicidal ideation, etc.)?_____

3. What factor(s) support your impression of the specific clinical scenario?
_____

4. What factor(s), if any, are inconsistent with your diagnostic/clinical scenario impression? _____

Solution = Strategic Planning

- Engage the test question in terms of disease script from the START

- Sort clinical information based on the script and change scripts if needed to accommodate new information

- Study disease in context of clinical presentation

- Clinical exposure enriches disease scripts

Struggling Test-taker Subtypes

1. Lack of script recognition

2. **LACK OF SCRIPT SPECIFICITY**
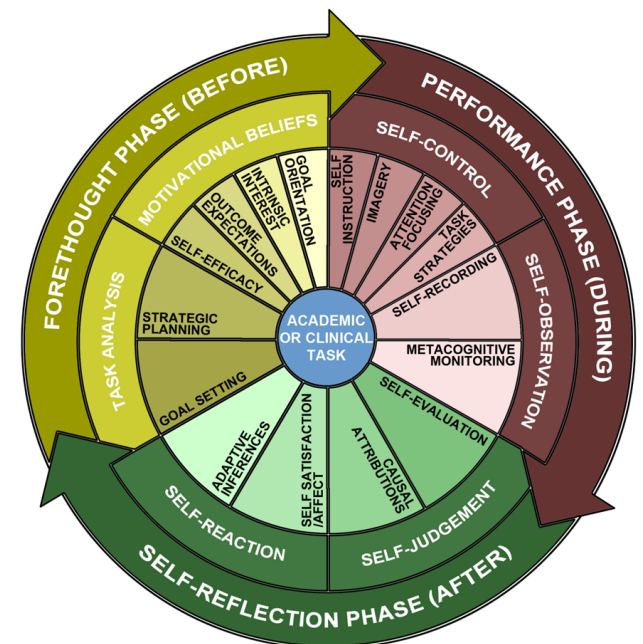
Struggling Learner Type #2: Lack of script specificity

- Learner recognizes the general disease script but not the severity or specific subtype presented in the clinical stem

- Narrows down the answers to two (both of which are treatments for the disease) and then has to guess

- Often, the diagnostic, therapeutic, and prognostic considerations differ based on the specific subtype of disease... Can't answer QRF items #2-4

2. What is the specific clinical scenario and/or severity of this disease (for example, if the disease was depression, is this uncomplicated depression, depression in the elderly, depression with history of mania, depression with suicidal ideation, etc.)?_____

3. What factor(s) support your impression of the specific clinical scenario?
_____

4. What factor(s), if any, are inconsistent with your diagnostic/clinical scenario impression? _____

Solution

- Engage the test question in terms of disease script and specific clinical scenario from the start
- Refine disease script using the clinical information to deduce the severity and/or subtype of disease
- Study the different diagnostic, therapeutic, and prognostic implications of disease subtypes
- Increase clinical exposure for richer scripts

Next learner subtype…

Question scenario:

82 year old with pleuritic chest pain for one week after a prolonged car ride with family. Temperature 103. Heart rate 110. tachycardia. Blood pressure 90/50. Purulent cough with scant hemoptysis. Bilateral infiltrates on chest x-ray. Serum WBC 19000. ECG shows sinus tachycardia. What is next best step?

A. CT pulmonary angiogram

B. Thrombolytics

C. Ceftriaxone and Azithromycin

D. Inhaled bronchodilators and IV steroids

Next learner subtype...

Question scenario:

82 year old with **pleuritic chest pain** for one week after a **prolonged car ride** with family. Temperature 103. Heart rate 110. tachycardia. Blood pressure 90/50. Purulent cough with scant hemoptysis. Bilateral infiltrates on chest x-ray. Serum WBC 19000. ECG shows sinus tachycardia. What is next best step?

A. CT pulmonary angiogram

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C. Ceftriaxone and Azithromycin

D. Inhaled bronchodilators and IV steroids

Learner guesses between A and B to address his diagnosis of pulmonary embolism

Struggling Learner Type #3: Premature closer/anchoring

- Learner makes an early decision on diagnosis and ignores/downplays **incongruent** information
- Incomplete/ superficial answers to #3-4 on QRF

3. What factor(s) support your impression of the specific clinical scenario?
_____

4. What factor(s), if any, are inconsistent with your diagnostic/clinical scenario impression? _____

Solution

- **STOP** after reading the question stem!
- Note…
  - features supportive of the diagnosis
  - features **inconsistent** with the diagnosis
  - **ALL markedly abnormal findings must be addressed**
    - Can circle these when reading the question
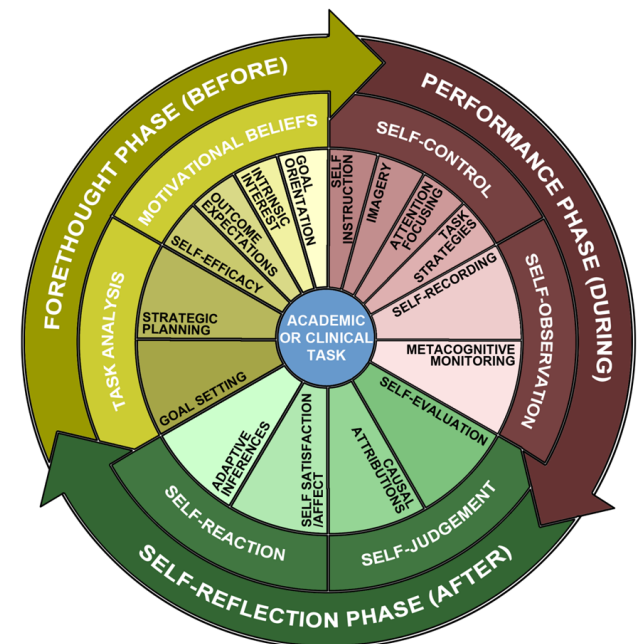- *Prove* diagnosis selected is the right one

Struggling Test-taker: "Charlie"

Struggling Test-taker Subtypes

1. Lack of script recognition

2. Lack of script specificity

3. Premature closure (anchoring)

4. <u>**UNDERCONFIDENCE**</u>

Struggling Learner Type #4: Underconfidence/self-monitoring

- The learner knows the correct answer, but subsequently talks himself out of it when he sees the answer choices

- Usually occurs when learner has been discouraged by repeated failures/suboptimal performances

- Can also result from "over-thinking" the question

- Evident during the "think aloud" QRF #5-6, 8,9, 13

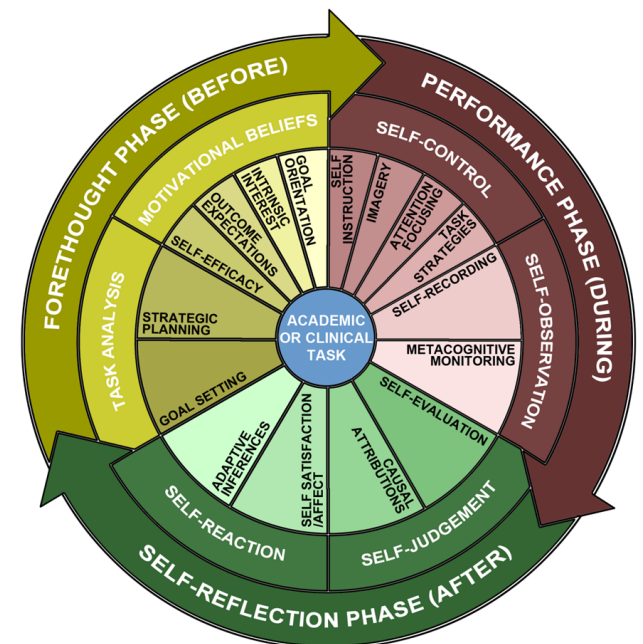13. How confident are you in your answer now?

Not at all confident	Slightly confident	Moderately confident	Quite confident	Extremely confident

Solution

- Use the test-taking worksheet to collect data on
  - Accuracy of his initial answer
  - Confidence (**BEFORE** looking at choices)
- Compare mean confidence scores on questions answered correctly vs. incorrectly
- Over time, learner re-calibrates his own confidence
- *Overconfidence can be a problem also, but usually occurs with another learning deficiency*

Leggett H, Sandars J, Burns P. Helping students to improve their academic performance: a pilot study of a workbook with self-monitoring exercises. *Med Teach.* 2012;34(9):751-753.

Struggling Test-taker Subtypes

1. Lack of script recognition

2. Lack of script specificity

3. Premature closure (anchoring)

4. Underconfidence

5. **INCORRECT CAUSAL ATTRIBUTION**

Struggling Learner Type #5: Incorrect causal attribution

- Learner **unable** to articulate why he/she got the answer right or wrong (QRF#16) – thus is at a loss for next steps

- May be able to complete hundreds of questions per study session, but doesn't try to understand correct or incorrect answers

- Correct answers may reflect lucky guessing, key word recognition without understanding or knowledge of the underlying disease

16. Why or why not? Whether or not you got the item correct, what else do you need to learn? Did you know the exact reason why the right answer was right? Did you know why each fact in the stem was consistent or inconsistent with the clinical scenario? Do you know why the wrong answers are wrong? _____

Solution

- When doing practice questions, the learner should examine each answer and explain why it is right or wrong

  - *Bonus:* Think in which situations would the wrong answers be right (compare/contrast)?

- Cut back on the number of questions per session to allow for the in-depth review required above

Struggling Test-taker Subtypes

1. Lack of script recognition

2. Lack of script specificity

3. Premature closure (anchoring)

4. Underconfidence

5. Incorrect causal attribution

6. **<u>Inappropriate adaptive inferences</u>**

Struggling Learner Type #6: Incorrect adaptive inference

- Learner is unable to articulate an effective learning plan
- Doesn't know/can't explain what he needs to do differently to answer this and similar questions in the future

17. Based on number 16, what is your plan to improve? _____

Struggling Learner Type #6: Incorrect adaptive inference

A learner who correctly identifies the disease script as acute hepatitis B infection but picks the wrong serologic test...

His remediation plan is

"Read more about hepatitis B"

Solution

- Prompting
  - Give learner examples of appropriate learning plans
  - "Make a graph of the different serologic markers of hepatitis B and the timing of each and explain which markers correspond infection"
- Mentor can help identify ways he learns best
  - Who were your most memorable teachers?
  - What concepts do you know well and how did you master those?

Struggling Test-taker Subtypes

1. Lack of script recognition
2. Lack of script specificity
3. Premature closure (anchoring)
4. Underconfidence
5. Incorrect causal attribution
6. Inappropriate adaptive inferences
7. **ISOLATED MEDICAL KNOWLEDGE DEFICIT**

Struggling Learner Type #7: Isolated medical knowledge deficit

- Learner…
  - Understands the script in detail
  - Can explain why an answer is right or wrong
  - Knows how to develop a study plan
  - **But hasn't spent the time to learn the material**
- Has the tools, but hasn't implemented them

Solution

- Explore reasons why time not spent
- Secondary causes of poor performance (7 D's):
  - Learning **D**isability
  - **D**epression
  - **D**istraction
  - **D**eprivation
  - **D**rugs
  - Personality **D**isorder
  - **D**isease

Lucey CR, Boote RM. Working with problem residents: a systematic approach. In: Holmboe ES, Hawkins RE, eds. *Practical guide to the evaluation of clinical competence*. Philadelphia, PA: Mosby; 2008.

Audience application

Coaching with the QRF

Identify the Learner's issue

A 56 year old female was brought to the emergency department via EMS for altered mental status. The patient's family reports that the patient had a three day episode of severe nausea, vomiting, and diarrhea prior to being found unresponsive in her home the morning of presentation. The patient has a history of hypertension treated with lisinopril, type 2 diabetes mellitus treated with insulin glargine and metformin, and a history of hyperlipidemia treated with atorvastatin.

On physical exam, blood pressure is 105/62, heart rate is 124, temperature is 97.8 F, respiratory rate is 28 and oxygen saturation is 90% on 4 liters nasal canula. Head is atraumatic. She is obtunded with a glasgow coma score of 7. Heart sounds are tachycardic but regular and without murmurs. Breath sounds are clear but diminished bilaterally. Abdomen is soft.

A finger stick blood glucose reading done by EMS was 878. Repeat finger stick blood glucose testing in the ED confirmed this reading.

Question (objective) and answer choices are hidden until learner answer
Question Review Form (QRF) # 1 - 6

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What is the most appropriate next step in management?

Answer choices hidden until learner answers
Question Review Form (QRF) # 7 - 10

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diminish

A finger stick blood glucose reading done by EMS was 878. Repeat finger stick blood glucose testing in the ED confirmed this reading.

What is the most appropriate next step in management?

A. Administer a 1 liter normal saline fluid bolus.
B. Administration of regular insulin 0.1 units/kg as an intravenous bolus
C. Assess airway and prepare for intubation
D. Obtain an ABG
E. Start a continuous intravenous infusion of regular insulin at 0.1 units/kg/hour

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What is the most appropriate next step in management?
C. Assess airway and prepare for intubation

Although the administration of IVF and insulin are also required in the management of HHS, this should not occur before her airway has been assessed and secured. Obtaining an ABG in this emergent setting may help delineate her acid-base status, but it is not likely to alter airway management. Kitabachi AE. Diabetes Care; 2006; 29(12): 2739-2748, Neumar RWCirculation 2010; 122(18):S3.

Faculty coaching

- The learner should spontaneously mention the following items when discussing their reasoning for this item. If not, challenge them.
  - Clinical presentation of HHS
  - Determination severity of HHS (airway assessment, vitals, volume status, acid base status)
  - Reasons for developing HHS (the three I's: indiscretion (medical or diet), infarction, infection)
  - Typical treatments for HHS (airway, volume, insulin, electrolytes, correction of underlying cause)
  - Prioritization of HHS

25 year old male presents to the ED for abdominal pain that began about 8 hours prior to presentation. When the pain progressively worsened and moved to the right lower quadrant, he decided to come in for evaluation. He denies any sick contacts, eating any undercooked meats, diarrhea, or urinary symptoms. He has not eaten since last night and the thought of eating makes him nauseous. He has not vomited.

He has a past medical history of gastroesophageal reflux and found to have helicobacter pylori 3 years prior. His only medications are esomeprazole 40mg daily and acetaminophen as needed. He reports a history of a contrast allergy. He has had no previous surgeries and denies tobacco and alcohol use.

His physical exam is significant for a heart rate of 121 beats per minute, fever to 100.4, diffuse abdominal tenderness with a focal point noted in the RLQ on palpation. Rebound tenderness was noted on exam with guarding.

CBC shows: WBC: 21,000 c/mm^3, Hemoglobin: 14, Hematocrit: 42, Plat: 300,000

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What is the next step in management for this patient?

A) Abdominal CT without contrast
B) Administer morphine 2mg IV
C) General Surgery consultation
D) Start ciprofloxacin and metronidazole

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CBC shows: WBC: 21,000 c/mm^3, Hemoglobin: 14, Hematocrit: 42, Plat: 300,000
What is the next step in management for this patient?
C) General Surgery consultation

This patient scores a 9 out of 10 on the Alvarado clinical score favoring appendicitis as the diagnosis. A CT without contrast cannot rule out appendicitis. Ohle R. BMC Medicine. 2011; 9:139.

Faculty coaching

- The learner should spontaneously mention the following items when discussing their reasoning for this item. If not, challenge them.
    - Clinical presentation of appendicitis
    - Differential dx of acute RLQ abdominal pain in a man
    - Additional considerations if patient was a women
    - Indication for CT scan in abdominal pain

A 24 y/o man presents for evaluation of a sore throat. The pain began the previous day and has steadily worsened. His symptoms now include a subjective fever and slight cough. He denies shortness of breath, sneezing, nasal drainage, joint aches, rash, or sick contacts. He has no drug allergies. His only medication is ibuprofen 400mg TID for the throat pain.

Physical exam is notable for a mildly ill appearing man. Vitals: T 100.8, HR 80, BP 122/78, R 12. Oral pharynx shows bilateral tonsillar exudate. Tonsils are 3+ enlarged. Nasopharynx is normal. There is a tender 1cm lymph node in the right anterior cervical chain. The remainder of the lymph node exam and the abdominal exam are normal.

Question (objective) and answer choices are hidden until learner answer
Question Review Form (QRF) # 1 - 6

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What is the most appropriate next step for this patient?
E) Rapid streptococci antigen detection test followed by penicillin V potassium if positive

- 3 of the 4 Centor criteria for Group A beta-hemolytic Streptococci: fever (which can either be subjective or measured >100.5), tender anterior cervical lymphadenopathy, and tonsillar exudates. The remaining criteria is absence of cough. Should get rapid strep test Ann Intern Med 2012;157(5): ITC 3-1.
- If treating, there is is resistance to macrolides but not PCN
- History suggests against viral pharyngitis (which typically includes conjunctivitis, coryza, cough, diarrhea, hoarseness, and may include a rash), or Epstein-Barr virus as no generalized lymphadenopathy and splenomegaly

Faculty coaching

- The learner should spontaneously mention the following items when discussing their reasoning for this item. If not, challenge them:
  - Centor criteria Group A beta-hemolytic Strep pharyngitis
  - Clinical presentation characteristics more suggestive of virus
  - Clinical presentation characteristics suggestive of EBV
  - Acute complications of strep pharyngitis (tonsillar abscess, retropharyngeal abscess in this case)
  - Indications for a rapid strep test (Centor criteria 2 or more, with 0 or 1 there is <3% chance of strep, so don't test)
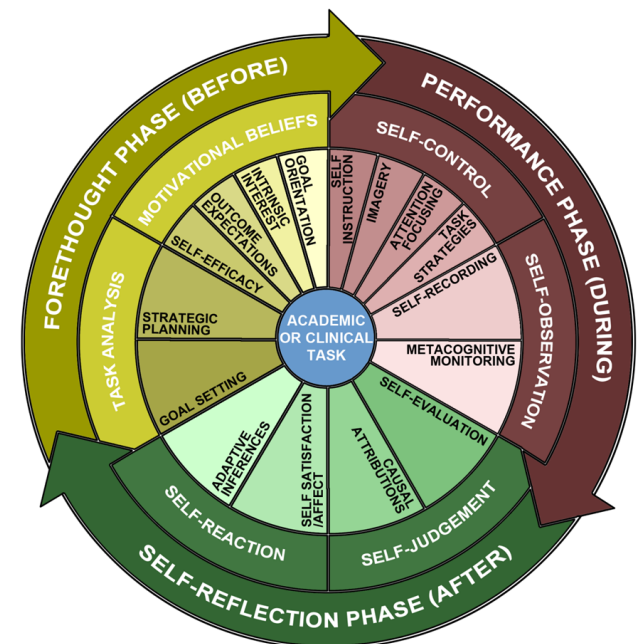 - Justification of PCN instead of other antibiotics

Audience Challenge #1: Using the QRF

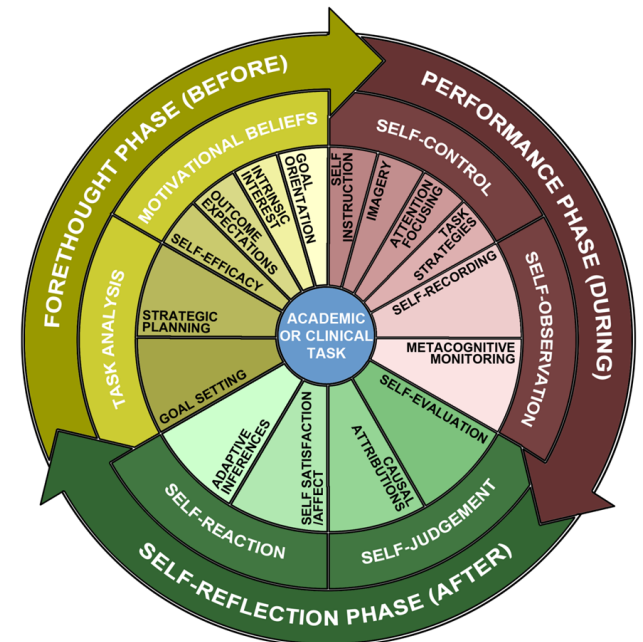## "Matthew"

Struggling Test-taker Subtypes

1. Lack of script recognition
2. Lack of script specificity
3. Premature closure (anchoring)
4. Underconfidence
5. Incorrect causal attribution
6. Inappropriate adaptive inferences
7. Isolated medical knowledge deficit

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3. Premature closure (anchoring)
4. Underconfidence
5. **<u>INCORRECT CAUSAL ATTRIBUTION</u>**
6. Inappropriate adaptive inferen
7. Isolated medical knowledge deficit

Audience Challenge #2: Using the QRF

"Paulette"

Struggling Test-taker Subtypes

1. Lack of script recognition
2. Lack of script specificity
3. Premature closure (anchoring)
4. Underconfidence
5. Incorrect causal attribution
6. Inappropriate adaptive inferences
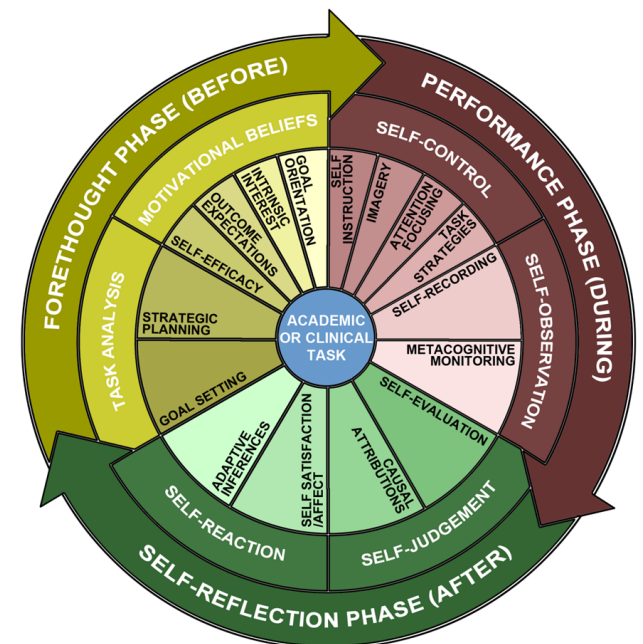7. Isolated medical knowledge deficit

Struggling Test-taker Subtypes

1. Lack of script recognition

2. Lack of script specificity

3. Premature closure (anchoring)

4. Underconfidence

5. Incorrect causal attribution

6. **<u>INAPPROPRIATE ADAPTIVE INFERENCES</u>**

7. Isolated medical knowledge deficit

To summarize…

- Script theory describes the interior knowledge structure containing the relationships between clinical information and potential diagnoses used by clinicians to rapidly generate hypothetical diagnoses

- The QRF can be used in a semi-structured, think-aloud protocol to identify deficiencies in learner regulatory processes and suggest remediation strategies

SRL-MAT via QRF

- **Feasible**

SRL-MAT via QRF

- Feasible
- **Well grounded in theory**

SRL-MAT via QRF

- Feasible
- Well grounded in theory
- **Emphasizes disease scripts**

SRL-MAT via QRF

- Feasible
- Well grounded in theory
- Emphasizes disease scripts
- **Empowers learner**

SRL-MAT via QRF

- Feasible
- Well grounded in theory
- Emphasizes disease scripts
- Empowers learner
- **Empowers faculty**

PubMed Reference Collection

http://www.ncbi.nlm.nih.gov/sites/myncbi/147TijGpfonAJ/collections/47374323/public/

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Student testimonial

"Dr. Kelly and Dr. Dezee,

I know it has been awhile, but as promised I would get back to you on the study strategy methods you showed me.

Overall the handout was helpful. I remember doing many practice internal medicine questions using the handout I was given, and it did help me focus on the questions. **I no longer use the handouts for my questions, but I still use the approach to questions.** Here is what the session and handouts have helped me improve on:

- Being engaged throughout the entire question. The one technique I now use more frequently is **highlighting parts of the question that I think are relevant**. I sometimes end up highlighting 90% of the paragraph long question, but even still, it **keeps me engaged and prevents me from glossing over the question. I do not have to re-read the long questions as frequently as I used to…"**

Student testimonial (cont'd)

- Making a prediction, and sticking to the prediction before reading the questions. More specifically, **I have learned that even if my prediction is not exactly one of the answers, picking the answer that is closest to the prediction usually works well for me**.

Here is what I still need to work on:

- Overt-thinking/Confidence.... I often overanalyze the answers. Every once in awhile I have the exacerbating habit changing my answer from my prediction and rationalizing why another answer could be correct. I have become much better at staying with my prediction and moving on the next question. **I find that 9 times out of 10 this serves me well...**

Our PGY3 Cohort

- In-Training Examination (ITE), n=16
- Anticipated *raw score* improvement: **4%**
  - 10 had > 8%
  - 1 had < 4% improvement but was 67$^{th\%ile}$
  - 3 that didn't improve were already 90$^{th\%ile}$
  - **ALL** met benchmark for being "on pace" to pass the ABIM

Memory

- Essential for passing tests

- Studying forever can't fix the inability to remember

Dual memory theory

Working memory ("Short term")

- Limited
  "chunk capacity" (~7)
- Temporal decay
- Quick recall

Long term memory

- Limitless
- But must be able to find it
- Permanent (theoretically)

Cowan N. What are the differences between long-term, short-term, and working memory? *Progress in brain research* 2008;169:323-338.

Baddeley, Alan D. (12/1975). "Word length and the structure of short-term memory". *Journal of verbal learning and verbal behavior (0022-5371)*, 14 (6), p. 575.

How does memory work?

- Encoding

- Storing

- Retrieving

Encoding

- Organization

- Elaboration

- Schema

Organization

- Which will you remember....

These letters...

aaaBCcddeeeFghiiiiiiLlkmnnnooooooRrr
rrSssssTTtttwy

?

Or these (same) letters...

Resilient Tom Brady Critics Looking Forward to This Season

Organization techniques

- Chunking
  - Grouping information into small, meaningful units
  - What's meaningful?
    - Defined by the learner
- Hierarchies
- Mnemonics

Baddeley, Alan D. *Human memory: Theory and practice*. Psychology Press, 1997.
Ericsson KA, Chase WG. Exceptional memory. *American scientist*. Nov-Dec 1982;70(6):607-615.

Elaboration

- Link information to *other* knowledge
  - Other information – basic science, pathophysiology, etc.
  - Image – a patient
  - Emotion – a difficult patient, a missed diagnosis

Buckner RL, Logan J, Donaldson DI, Wheeler ME. Cognitive neuroscience of episodic memory encoding. *Acta Psychologica*. 12// 2000;105(2–3):127-139.

Elaboration example

- How to learn antibiotics for community acquired pneumonia (CAP)…

NOT Elaboration

Memorizing a list of names…

Azithromycin

Levofloxacin

Ceftriaxone

Vancomycin

Elaboration example

- Make a chart

Antibiotic	Setting	Common pathogens
Azithromycin	Outpatient, No comorbidities	S.pneumoniae, Mycopasma pneumoniae, H.influenzae, Legionella, viral
Levofloxacin	Hospitalized	Above, plus oral anaerobes
Ceftriaxone + azithromycin + vancomycin	ICU patient	Above + MRSA, resistant pneumococcus

Elaboration example

- Even better = link to a prior patient

Antibiotic	Setting	Common pathogens
Azithromycin	Outpatient, No comorbidities	S.pneumoniae, Mycopasma pneumoniae, H.influenzae, Legionella, viral
Levofloxacin	Hospitalized	Above, plus oral anaerobes
Ceftriaxone + azithromycin + vancomycin	ICU patient	Above + MRSA, resistant pneumococcus