KNOWING WHAT YOU DON'T KNOW:

Instructor and student strategies for promoting metacognition

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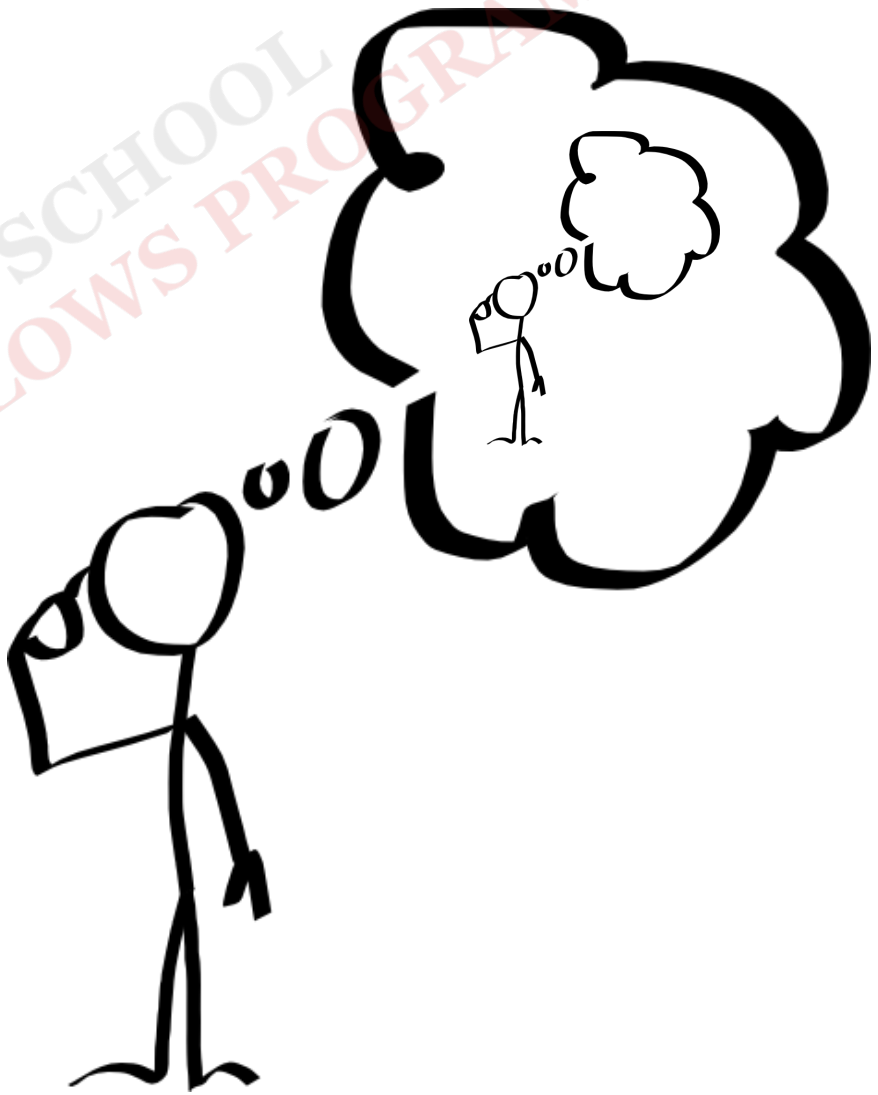

The Plan

- Metacognition primer activity
- Metacognition:
  - What it is
  - Why it matters
- Strategies for *instructors*
- Strategies for *students* (Self-Explanation)
- Activity revisited

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Meta-cognition Primer

1) Have paper and pen ready

2) *Without naming them*, predict how many <u>states</u> you think you can write down in 60 seconds?
(full state names, not abbreviations)

3)

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Meta-cognition Primer

Check your prediction

What did you consider when predicting the number of states you could name?

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What is metacognition?

Cognitive knowledge & Cognitive regulation

1) Content Knowledge	*How well do I know state names?*
2) Task Knowledge	*How fast can I write?*
3) Strategy Knowledge	*What's my plan of attack?*

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Flavell (1979)

What is metacognition?

Cognitive knowledge & Cognitive regulation

Am I using the strategy I picked?	1) Monitoring
Is it working?	2) Evaluating
Am I confident?	3) Motivating

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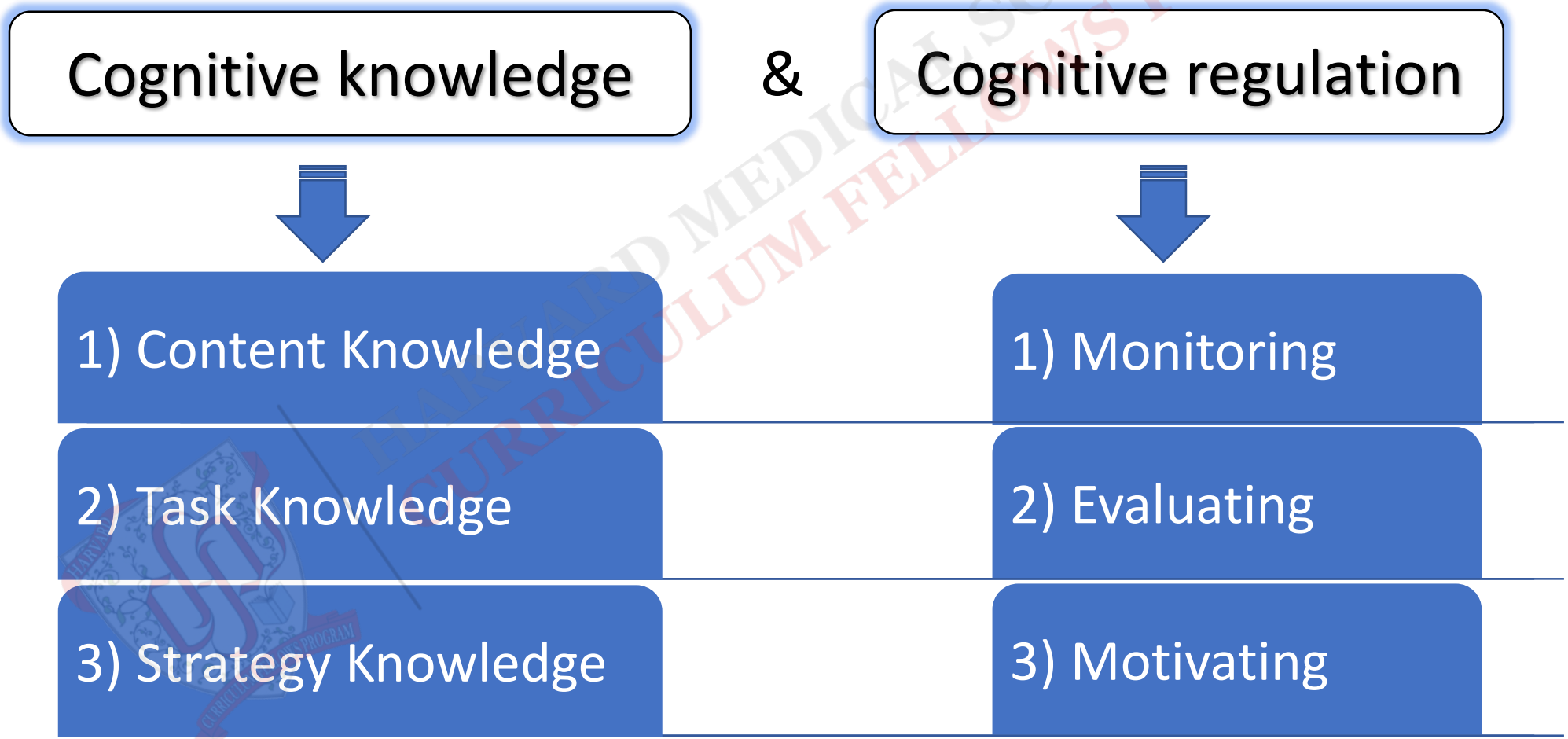
Flavell (1979)

What is metacognition?



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Flavell (1979)

A Tale of Two Papers

01

Predicting performance

02

Reading Comprehension

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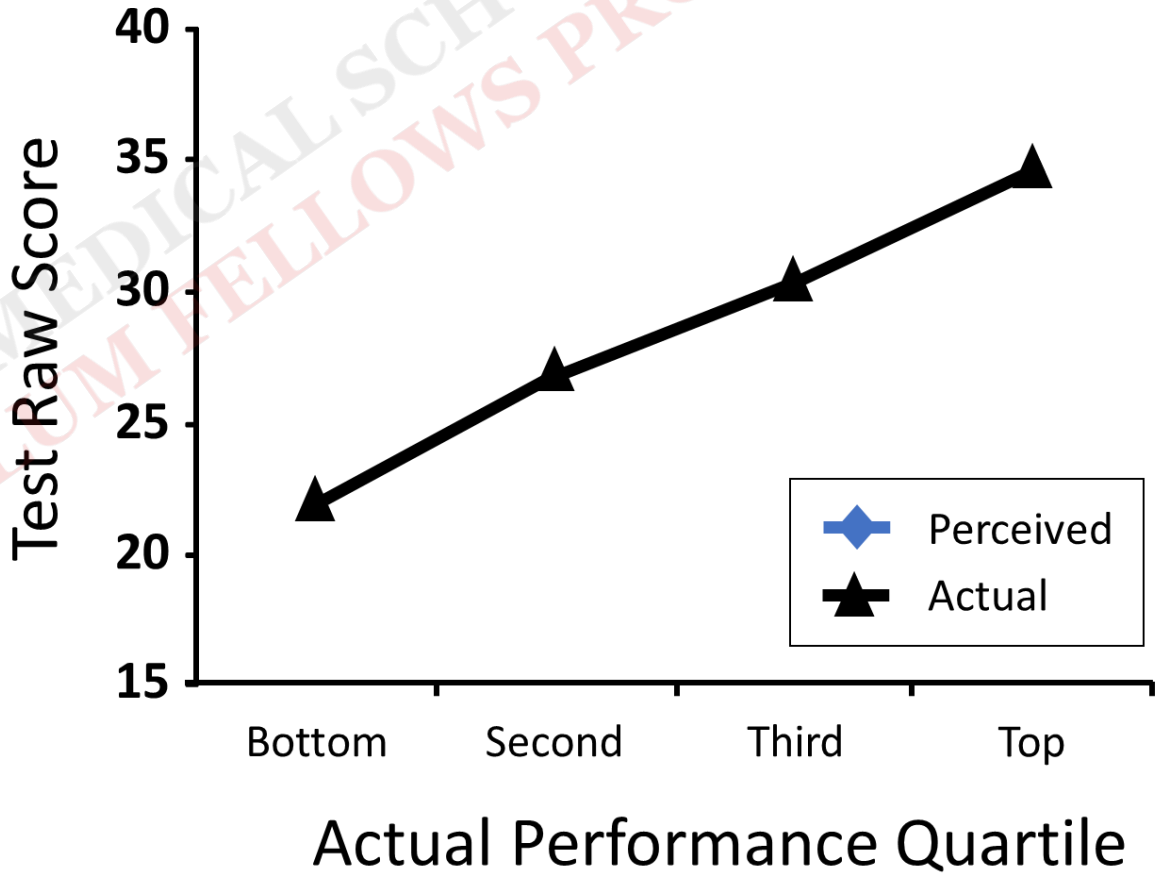
How well do students predict their own scores?



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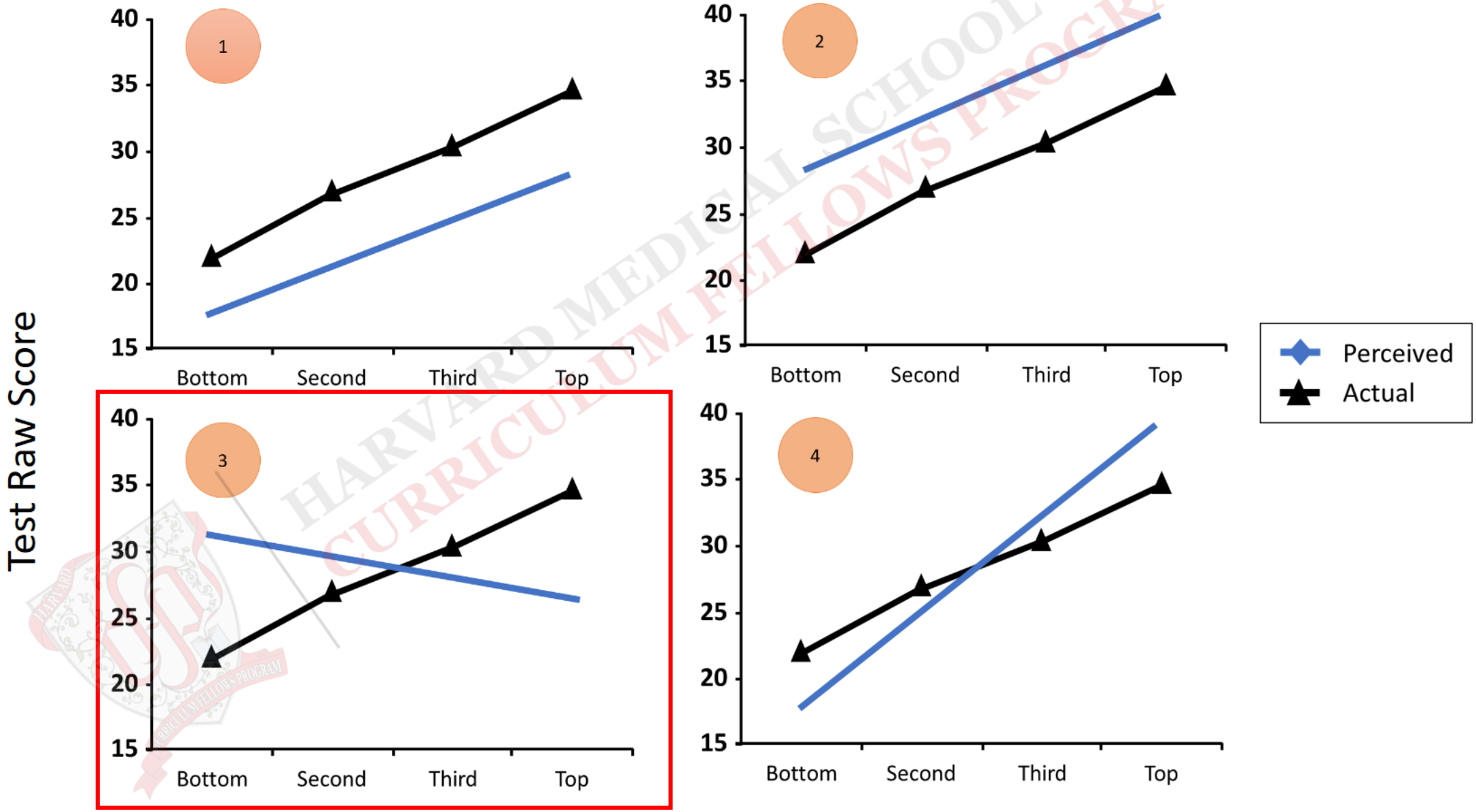
Predictions?



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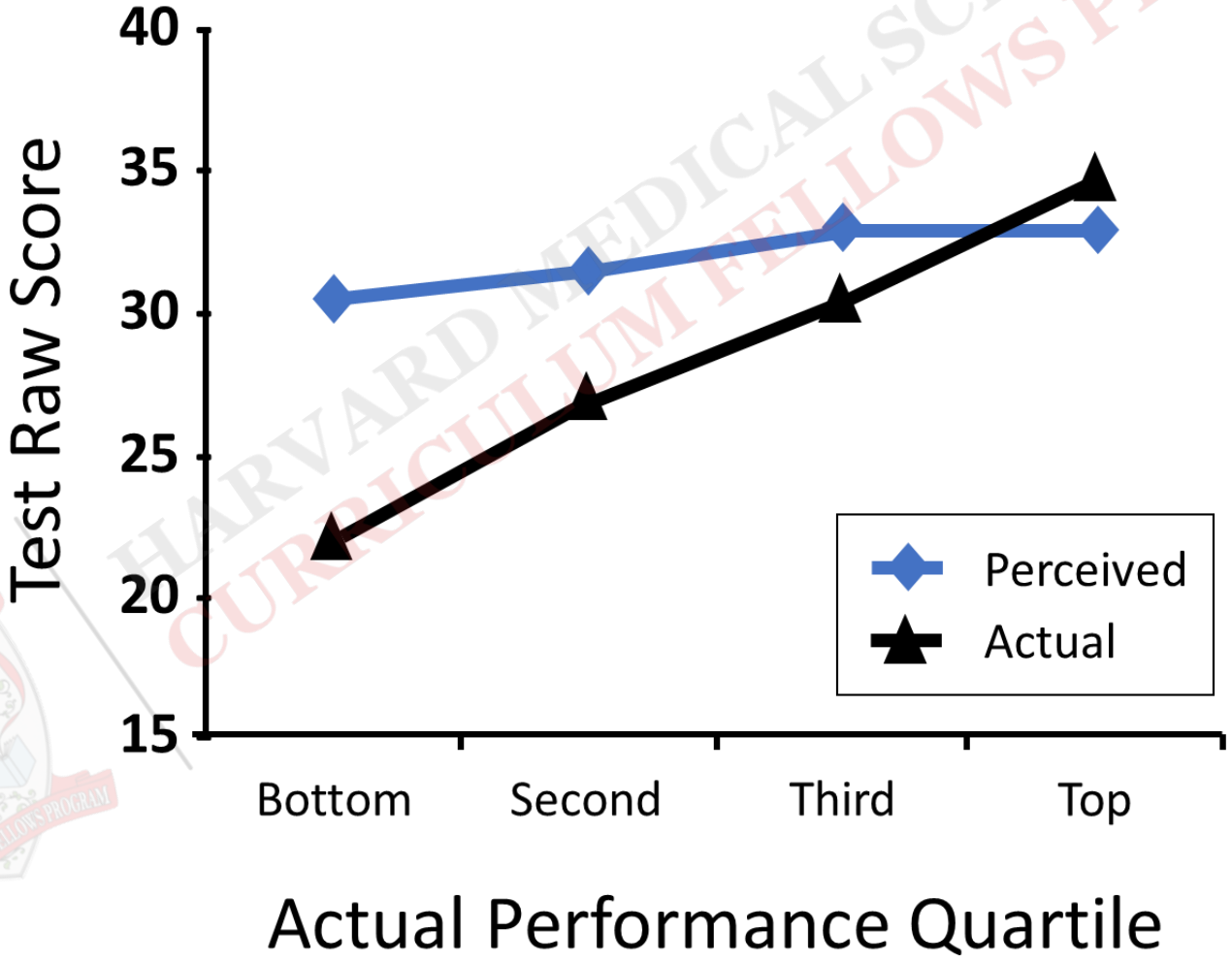
How well do students predict their own scores?



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Dunning et al. (2003)

What is metacognition?

Why People Fail to Recognize Their Own Incompetence

David Dunning,[1] Kerri Johnson, Joyce Ehrlinger, and Justin Kruger

Department of Psychology, Cornell University, Ithaca, New York (D.D., K.J., and J.E.), and Department of Psychology, University of Illinois, Champaign-Urbana, Illinois (J.K.)

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The Dunning-Kruger Effect

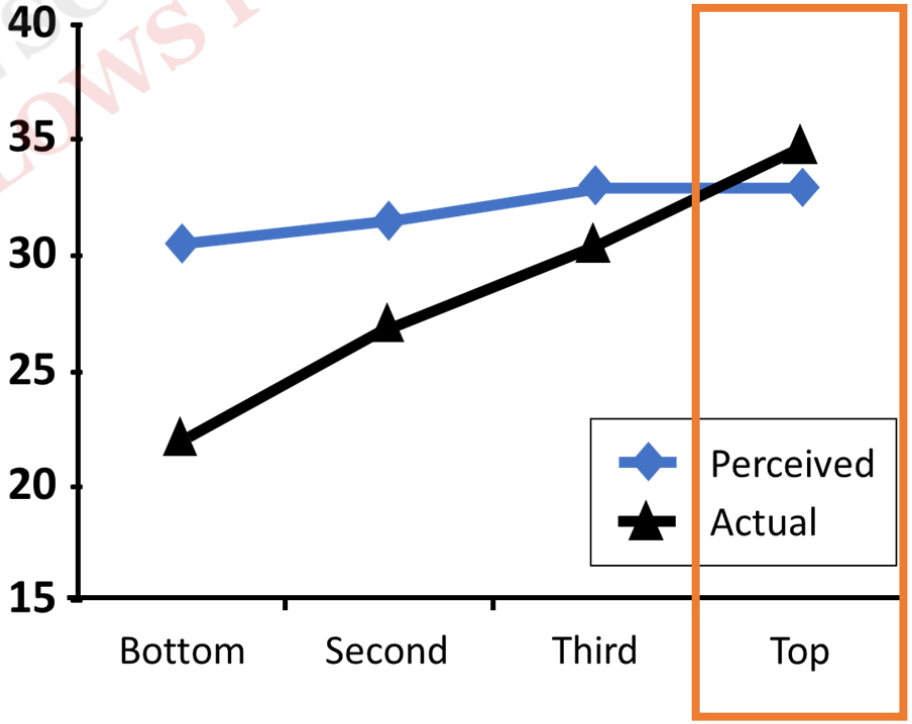
The Double Curse

People lack the skill to…

1. produce correct answers
2. know when their answers are right or wrong

The Undue Modesty of Top Performers

1. Good gauge of self-performance
2. Overestimates others



Dunning et al. (2003)

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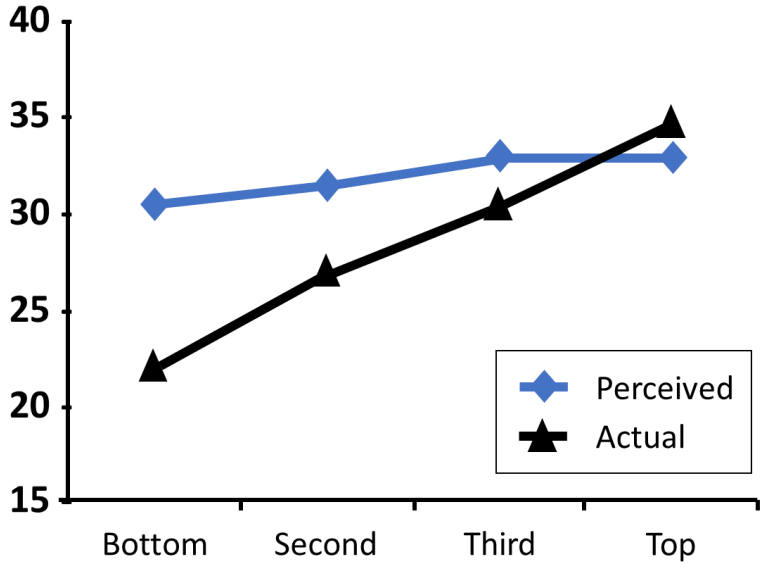
Why care about metacognition?

The Dunning-Kruger Effect:

- ✓ **Debate teams**' performance in a college tournament
- ✓ **Medical lab technicians**' knowledge of medical terminology
- ✓ **Medical residents**' patient interviewing skills
- ✓ **Hunters'** knowledge of firearms

*Even if promised up to $100 for accuracy



Ehrlinger, Johnson, Banner, Dunning, & Kruger (2003)
Hodges, Regehr, & Martin (2001)
Haun, Zeringue, Leach, & Foley (2000)
Ehrlinger, J., & Dunning, D. (2003).

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A Tale of Two Papers

01

Predicting performance

02

Reading Comprehension

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Reading Comprehension

MEMORY, 2009, 17 (4), 471–479

Psychology Press
Taylor & Francis Group

Metacognitive strategies in student learning: Do students practise retrieval when they study on their own?

Jeffrey D. Karpicke
Purdue University, West Lafayette, IN, USA

Andrew C. Butler and Henry L. Roediger III
Washington University in St. Louis, MO, USA

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Study Strategies

Strategy	List strategy	Rank as #1 strategy
"Memorize"	19%	6%
Self-test	11%	1%
Rewrite notes	30%	12%
Reread notes or textbook	84%	55%
Do practice problems	43%	12%

N = 177

Karpicke, Butler & Roediger (2009)

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Study Strategies

Imagine you are reading a textbook chapter for an upcoming exam. After you have read the chapter one time, would you rather:	**N=76**
a. Go back and restudy either the entire chapter or certain parts of the chapter	41%
b. Try to recall material from the chapter (with the possibility of restudying afterward)	42%
c. Use some other study technique	17%

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Karpicke, Butler & Roediger (2009)

Why care about metacognition?

1

Rereading is not an effective strategy for promoting learning and long-term retention.

(McDaniel & Callender, 2008)

2

Retrieval testing is.

"The testing effect"
Gates (1917)

3

A high proportion of students are rereading and think that it is the best strategy.

Karpicke, Butler & Roediger (2009)

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Strategies for instructors

Effect size ≥1.0 : advancing student achievement by approximately a full grade.

Hattie (2003)

Mean ES (S.E.)	All dependent variables*	Academic performance overall*
Metacognitive	.70 (.06)	.69 (.10)
Cognitive	.37 (.08)	.13 (.20)
Metacognitive and cognitive	.78 (.05)	.69 (.11)
Motivational	.94 (.17)	1.36 (.31)
Metacognitive and motivational	1.13 (.18)	1.23 (.31)
Cognitive and motivational	.69 (.06)	.55 (.08)
Random effects variance component, *v*	.20	.23

Dignath et al. (2008)

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Strategies for instructors

Cognitive knowledge & Cognitive regulation

1) Content Knowledge	*How well do I know the content?*
2) Task Knowledge	*What makes this task challenging?*
3) Strategy Knowledge	*What's my plan of attack?*

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Flavell (1979)

Strategies for instructors

Cognitive knowledge & Cognitive regulation

Am I using the strategy I picked?	1) Monitoring
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Flavell (1979)

Strategies for instructors

<u>Curriculum and expectations:</u>

- State objectives or learning outcomes.
- Tell students they are responsible for their own learning
- Provide timely feedback
- Provide practice tests

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Strategies for instructors

<u>In the classroom:</u>

- Active learning
  - Think-pair-share
  - Clicker questions
  - Reciprocal teaching
  - Concept maps
  - Problem solving
- Have students share their study strategies

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Strategies for students

- Self-regulate your learning
  - Plan – “What strategy should I use?”
  - Monitor – “Am I using this strategy correctly? Do I understand?”
  - Reflect – “Is this strategy helping me learn?”
- Self-test
- Figure out what works best for you (Visual-Auditory-Read/write-Kinesthetic learner)*
- Study with others

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Strategies for students: Reading comprehension

Self-explanation: "Any utterance…beyond the information given, namely, an inference of new knowledge."

Types of Idea Statements

	GOOD		POOR	
	Proportion (%)	Frequency*	Proportion (%)	Frequency*
Physics Explanations	29	15.3	16	2.8
Monitoring Statements	39	20.1	42	7.3
Others (Include Paraphrase)	32	16.5	42	7.4
Total	100	51.9	100	17.5

* An average number of statements per student per example.

Chi et al. (1989)

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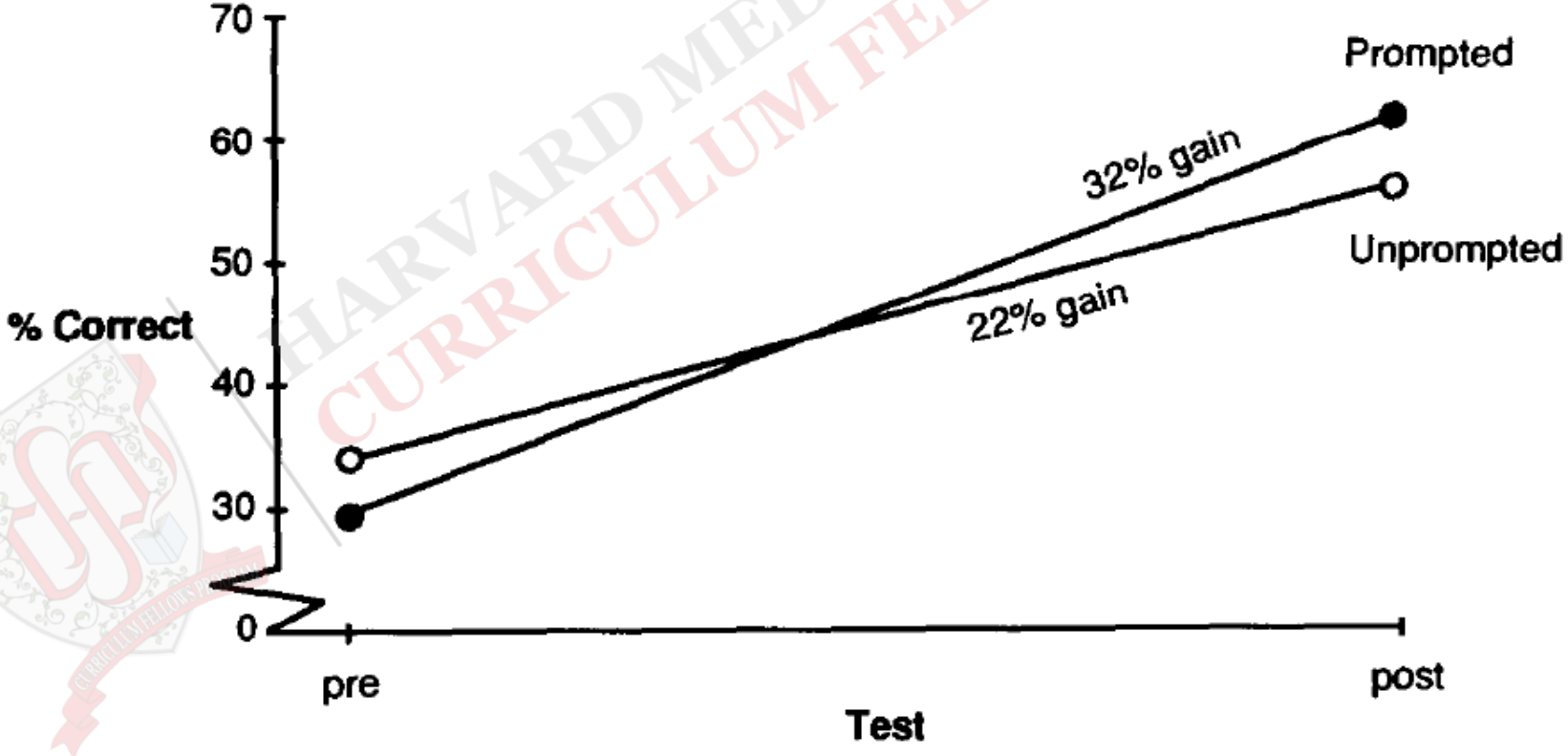
Strategies for students: Reading comprehension

Self-explanation can be taught.



Chi et al. (1994)

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Types of self-explanation

Comprehension Monitoring	Being aware of understanding
Elaboration	using prior knowledge or experiences to understand the sentence; adds details to expand on an idea, includes use of metaphors and analogies
Goal-driven	A goal is inferred of a particular structure or action
Predictions	Predicting what the text will say next
Bridging	Making reference to an idea presented in a previous sentence in the text to better understand relations between sentences
Summarizing	Identifying main points across multiple sentences
Paraphrasing	Restating the text in different words

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Strategies for students: Reading comprehension

General Structure of the Heart: The septum divides the heart lengthwise into two sides. The right side pumps blood to the lungs, and the left side pumps blood to other part of the body. Each side of the heart is divided into an upper and a lower chamber. Each lower chamber is called a ventricle. Each upper chamber is called an atrium. In each side of the heart blood flows from the atrium to the ventricle.

Student A

Student B

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Use of Self-Explanation Strategy

	Gains by Question Type		
	Structure	Pathway	Function
Self-explanations	0.83	0.23	0.46**
Goal-driven	0.21	0.01	0.44**
Elaborative	0.12	0.24	0.37*
Noticing coherence	-0.21	-0.12	0.13
Positive monitoring	0.02	0.09	0.14
Negative monitoring	0.04	0.07	-0.18
Paraphrase	0.19	0.14	0.22
False	0.01	0.10	-0.01

* $p<0.05$
** $p<0.01$

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Strategies for students: Reading comprehension

- Self-explanation works for reading text of various content.
- Theory:
  - Active
  - Constructive
  - Piecemeal

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Meta-cognition Primer Revisited

1) Have paper and pen ready

2) *Without naming them*, predict how many <u>animals</u> you think you can write down in 60 seconds?
(full names, not abbreviations)

3)

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Real knowledge is to know the extent of one's ignorance.

—Confucius

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