Center for Excellence and Innovation in Teaching and Learning
University of New Hampshire

The Student Cognition Toolbox: Empowering Students to Become Better Learners

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Acknowledgments

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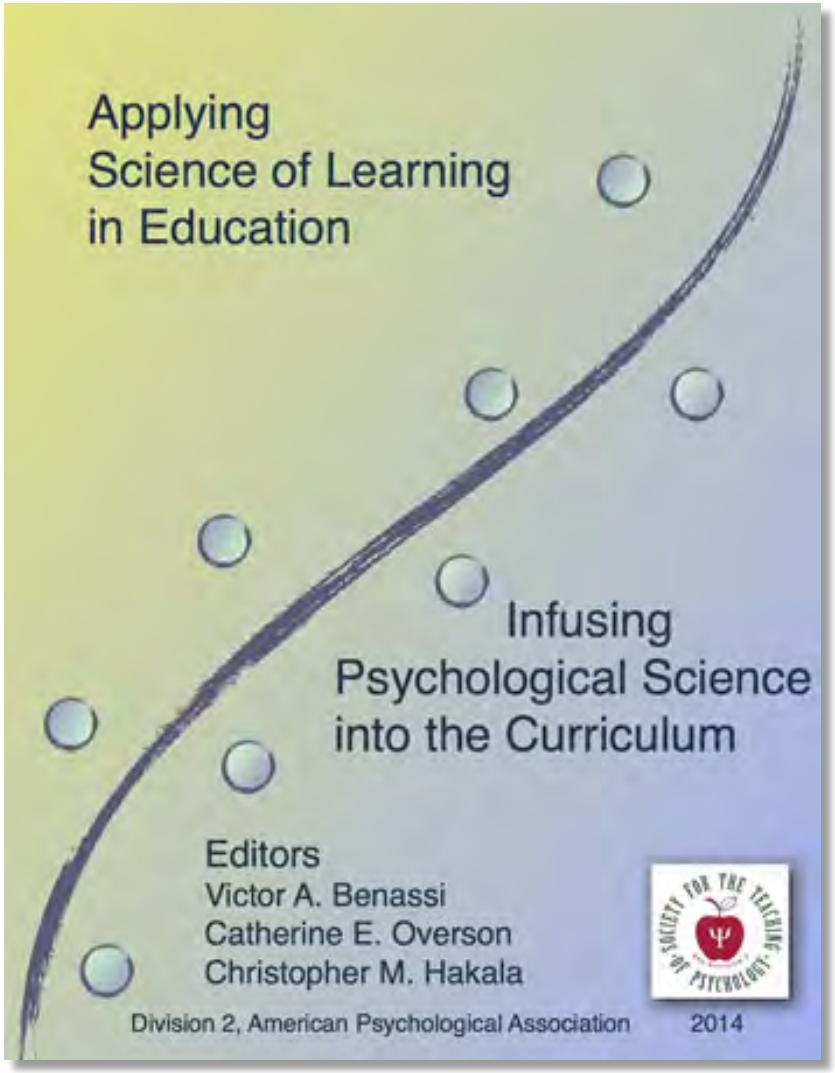
Applying the Science of Learning in Education

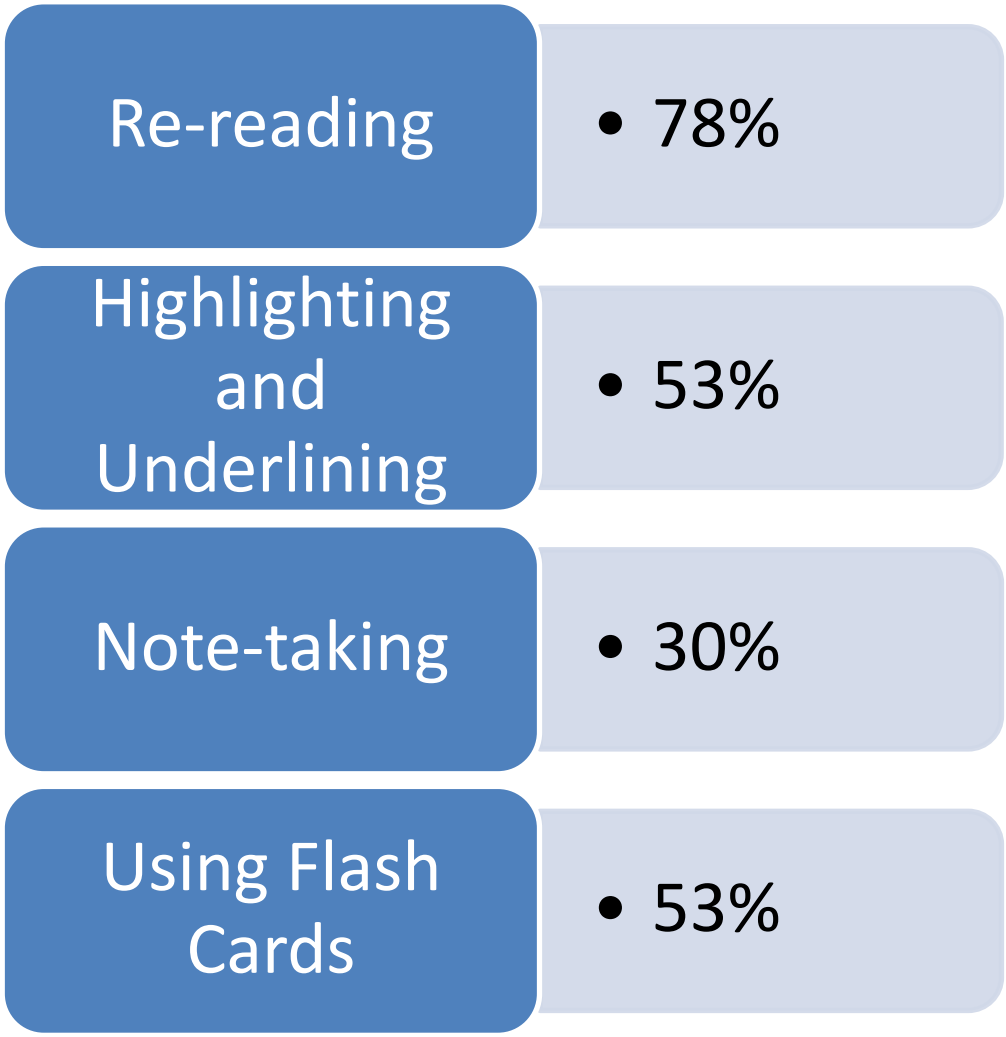


Presentation Overview

- How Students Study
- How Students Learn (effectively and efficiently)
- Applying Science of Learning with Course Activities/Assignments
- Teaching Students to Use and Transfer Effective Study Strategies: Student Cognition Toolbox
- SCT Demo
- Early Results and Future Directions

How Students Study

Miyatsu, Nguyen, & McDaniel (2018). Five popular study strategies, *Perspectives on Psychological Science, 13,* 390–407



How Do Students Learn (effectively and efficiently)?

It Depends

What kind of knowledge do you want your students to attain?

- Facts?
- Concepts?
- Principles?

What kind of learning processes is required for your learning objective?

- Memory and fluency?
- Understanding and sense-making?
- Induction and refinement?

What kind of instruction will you provide to promote learning your objectives?

- Quizzing?
- Self-explanation?
- Problem solving?

A Decade of Applying Science of Learning with Course Activities/Assignments

Three examples of learning activities that promote student learning

Some Cognitively-based Learning Activities

- **Retrieval Practice** (Test Enhanced Learning)
- Elaborative Interrogation
- **Self Explanation**
- **Spaced Practice**
- Interleaved Practice
- Worked Examples
- Duel Coding
- Multimedia Principles and techniques
- Making Predictions
- SQ3R
- etc.

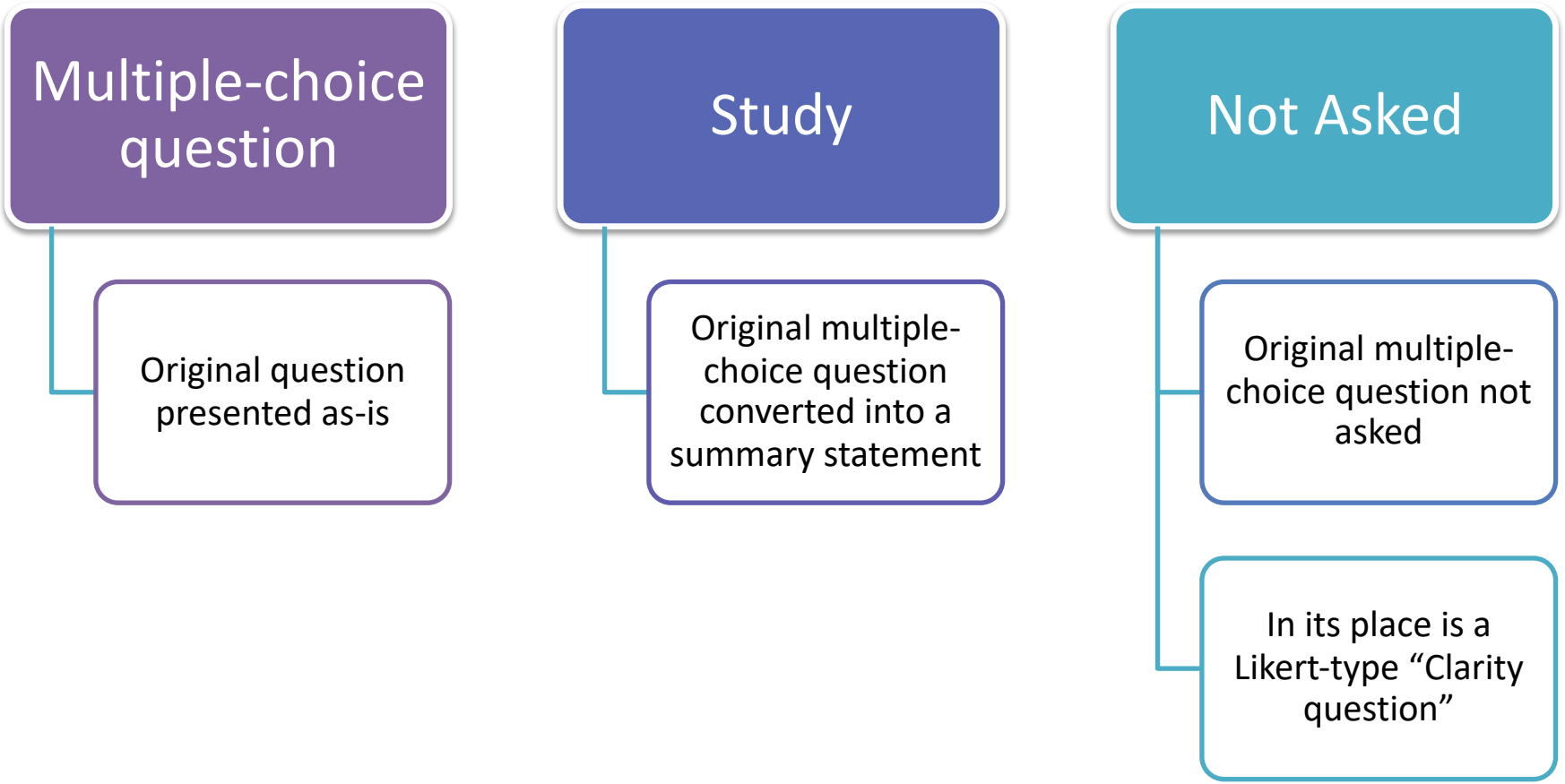
Retrieval Practice Outside the Classroom: Embedding Questions During Video Presentations to Benefit Learning

Course: Occupational Therapy Evaluation & Intervention for Children

N = 56

Griswold, L. A., Overson, C. E., & Benassi, V. A. (2017).

Quiz Question Conditions

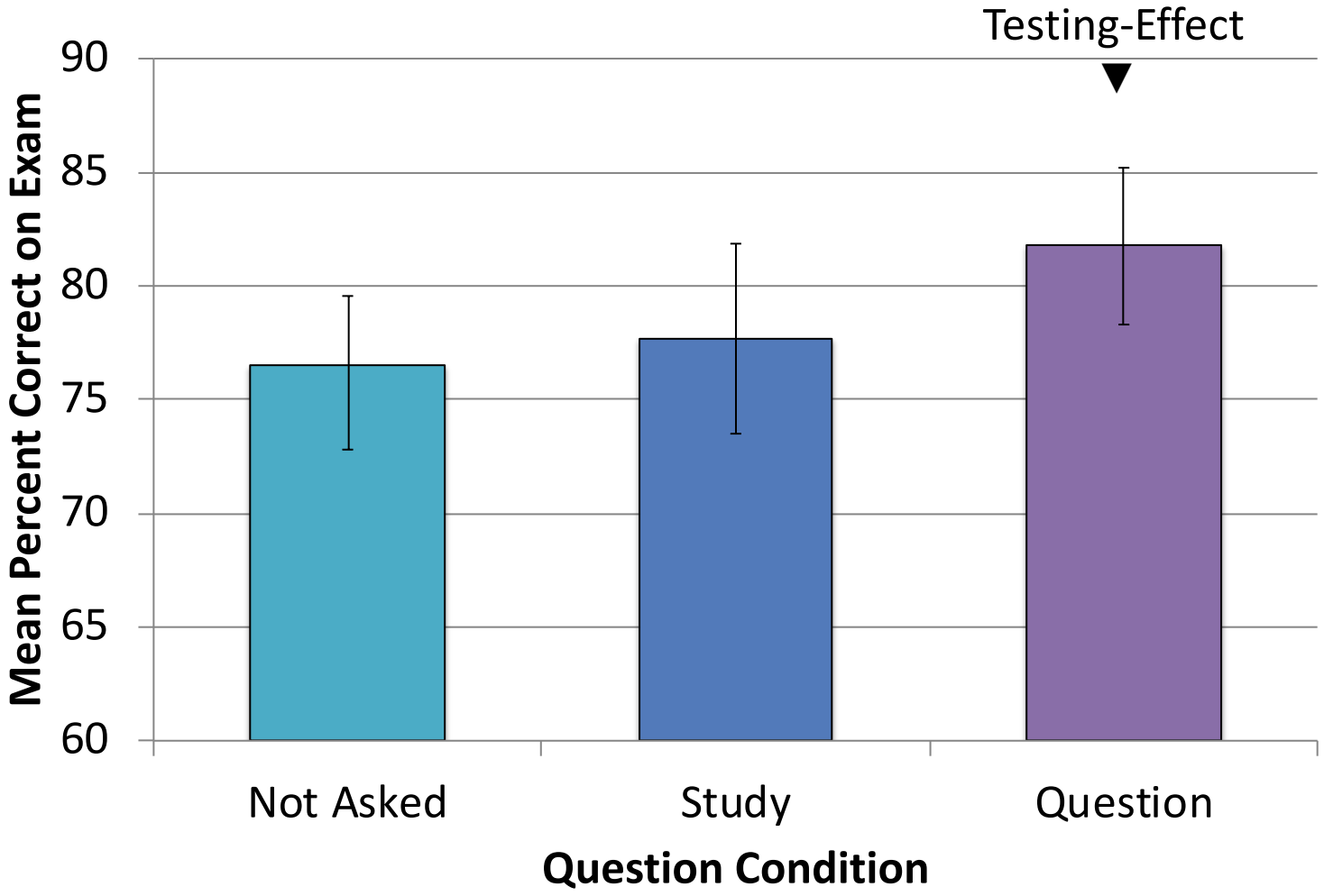


Exam Question When we see a child demonstrate difficulty with actions during a task, when he is “doing something” we:	You observed Robby as he cut out a picture as part of a project in his kindergarten class. What would you consider when you interpret your observations of Robby’s difficulties during your performance analysis of his cutting task?
a. Assume that there is a problem and can focus on that for further evaluation b. Document the difficulty in performing these actions for future goal writing c. Consider if the difficulties result in safety concerns or the need for assistance from another person d. Consider if the difficulties are typically seen for a child of that age	a. Robby’s fine motor development. b. If Robby needed support from his teacher or you had concerns for how safely he was using the scissors. c. The difficulty Robby had when cutting so you can use this information to write your goals for Robby. d. How Robby’s performance compared with that of other children in the class.

Comparing Question Conditions

RESULTS

Midterm Exam



Error Bars: 95% CI

Self-Explanation:
Making sense and meaning of new information

A Reading Learning Activity in an Introductory Biology Course

N = 148

Overson, Benassi, Kordonowy, Richardson, In process

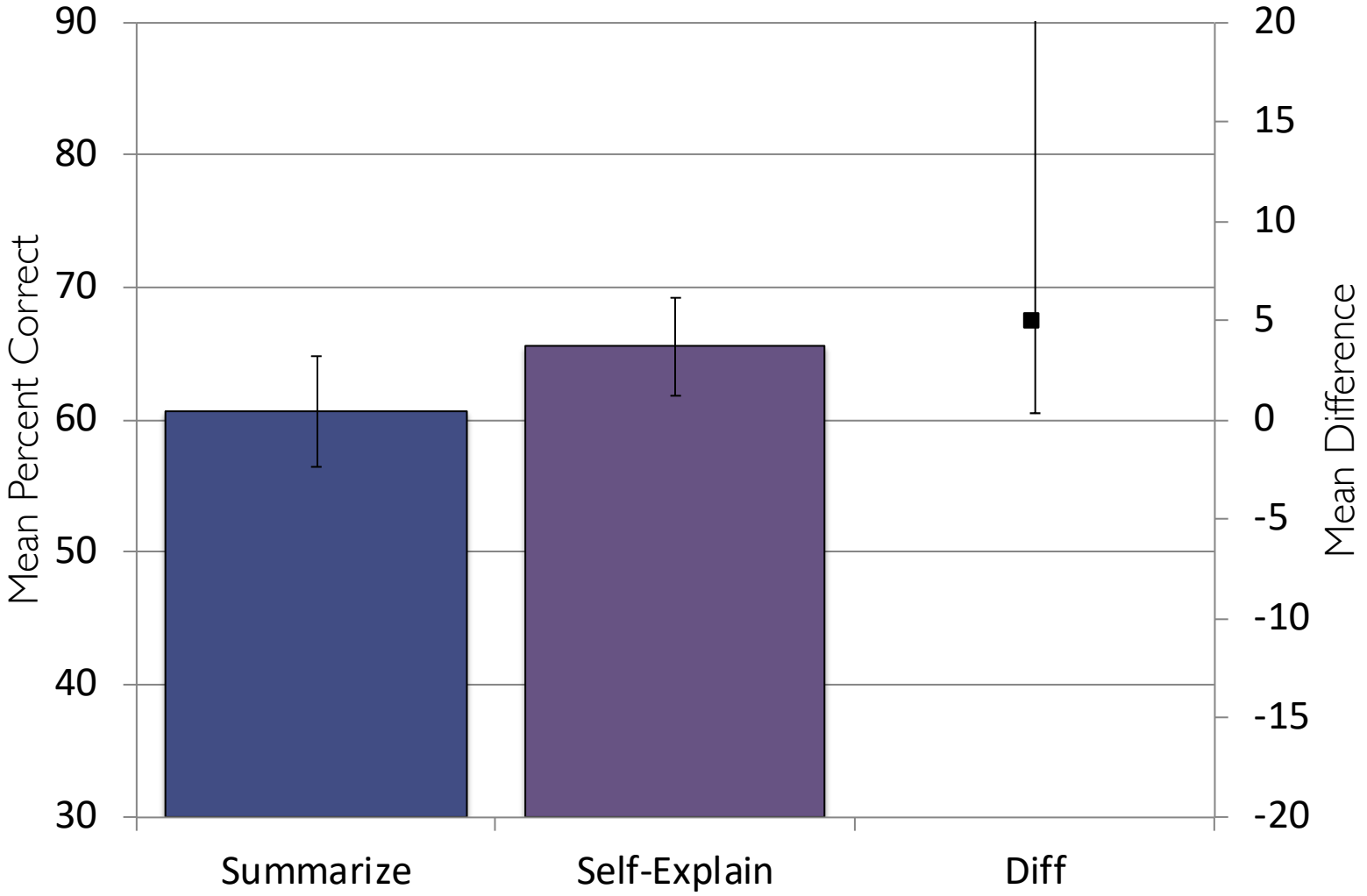
Self-explanation

- Constructive learning strategy
- Self-monitoring of evolving understanding
  - Review new material
  - Relate information to prior knowledge
  - Generate questions based on new understanding
- Mechanism
  - Identification of gaps in learning
  - Helps modify flawed, existing mental models

Student Learning Activity

- Read textbook chapter
- Responded to prompts after each chapter section
  - Describe the information that is new to you
  - How do these ideas work with what you already know?
  - Why do these ideas work together? Provide an example
  - List two "I wonder" questions you have as a result of reading this section
- Random assignment to one of two groups
  - Self-explanation group
  - Summary group

Summarize versus Self-explain Reading Activities



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Spacing: Distributing Study Practice

Course-based replication of Kornell (2009) lab experiment

Course: Introductory Biology

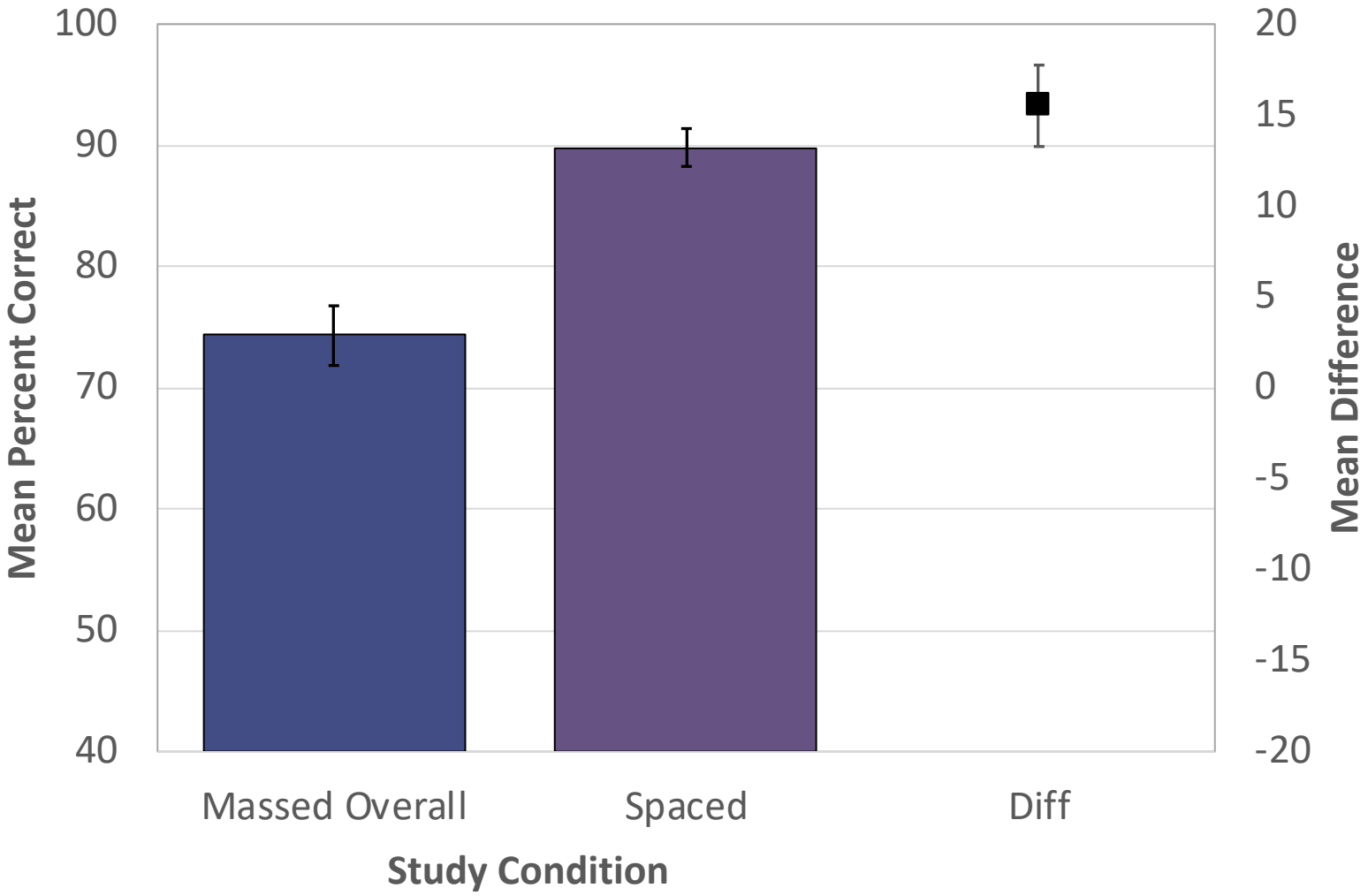
N = 176

Overson, Hall, Kordonowy, Pyburn, & Benassi, In preparation

Spacing vs. Massing
Introductory Biology Course

- 176 Students who completed all 4 flash card study days
- Within-subjects design
- 32 items to be studied randomly assigned to a condition
  - Spacing/Massing
  - Massing questions randomized to Study Day
    - (1, 2, 3, or 4)
- Students completed study sessions on 4 consecutive days leading up to the exam

Massed Versus Spaced Practice Overall



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Teaching Students to Use and Transfer Effective Study Strategies:

The Student Cognition Toolbox

Original Cognitively-Based Study Skills Module

STUDENTS:

- reported on study strategies they typically use when studying for an exam
- viewed a cognitively-based study strategies slideshow
- compared their reported strategies with those on the module
- composed a 6-point plan for studying for next exam

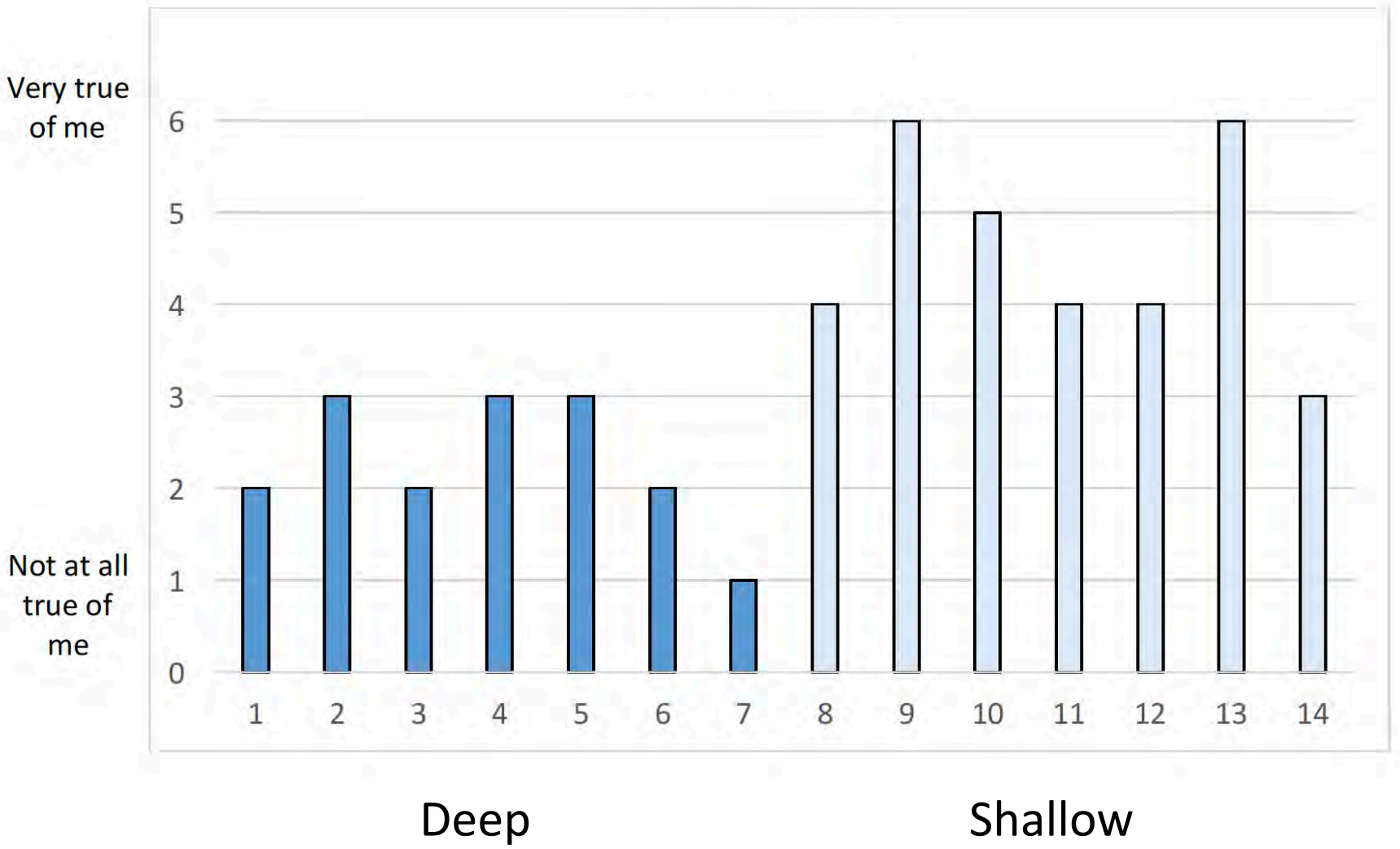
THE STUDY BEHAVIOR INVENTORY

Deep

I space out my study sessions in the time leading up to the exam
I relate what I am reading for the course to classroom sessions
I test myself on course materials without referring to my course materials or notes, etc.
I plan effectively for study time between classes
I summarize in my own words information I learn from my study
I explain concepts to a classmate/friend
I create outlines, charts, diagrams, or tables, etc., to organize and help me see patterns in course information

Shallow	I ask a classmate/friend to help me understand course material
	I focus most of my studying to the time just prior to an exam
	I ask my professor or TA to help me understand course materials
	I read the required course materials more than once
	I highlight and/or underline the most important information in my reading
	I take care to organize my lecture notes
	I try to learn the more difficult material first, when time is limited prior to an exam

EXAMPLE STUDENT REPORTS


Very true of me
Not at all true of me
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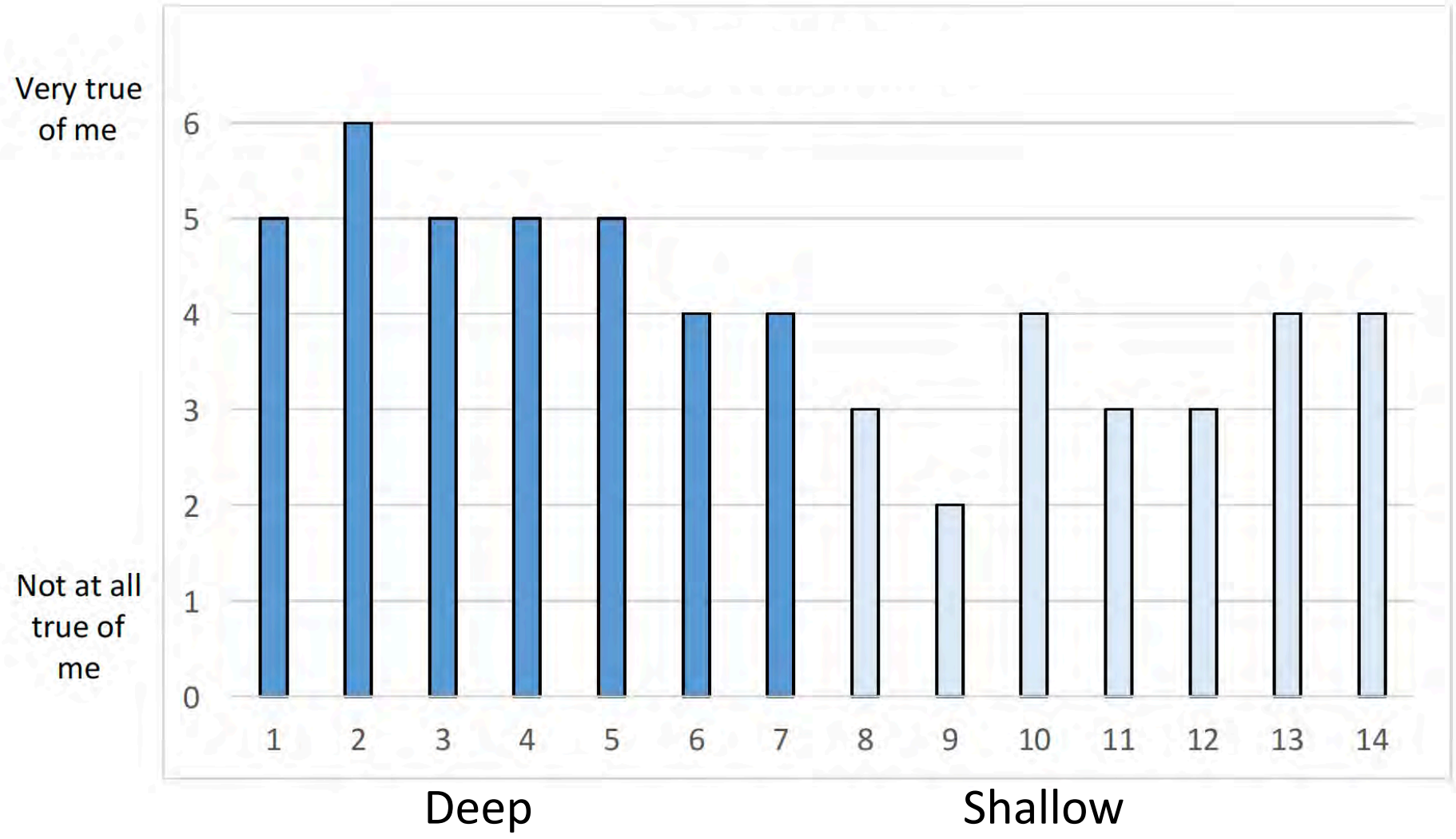
Deep
Shallow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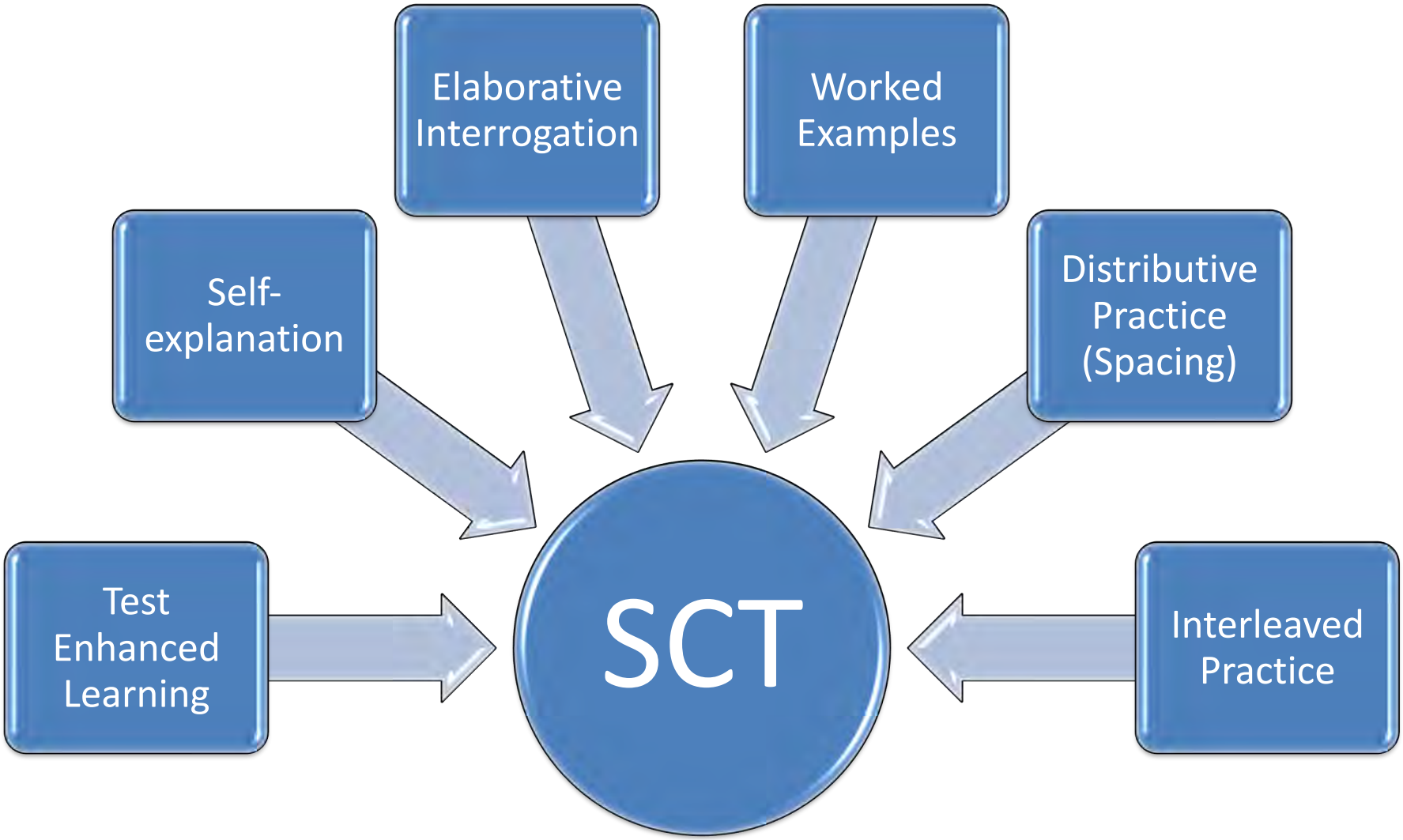
Deep
Shallow

The Student Cognition Toolbox

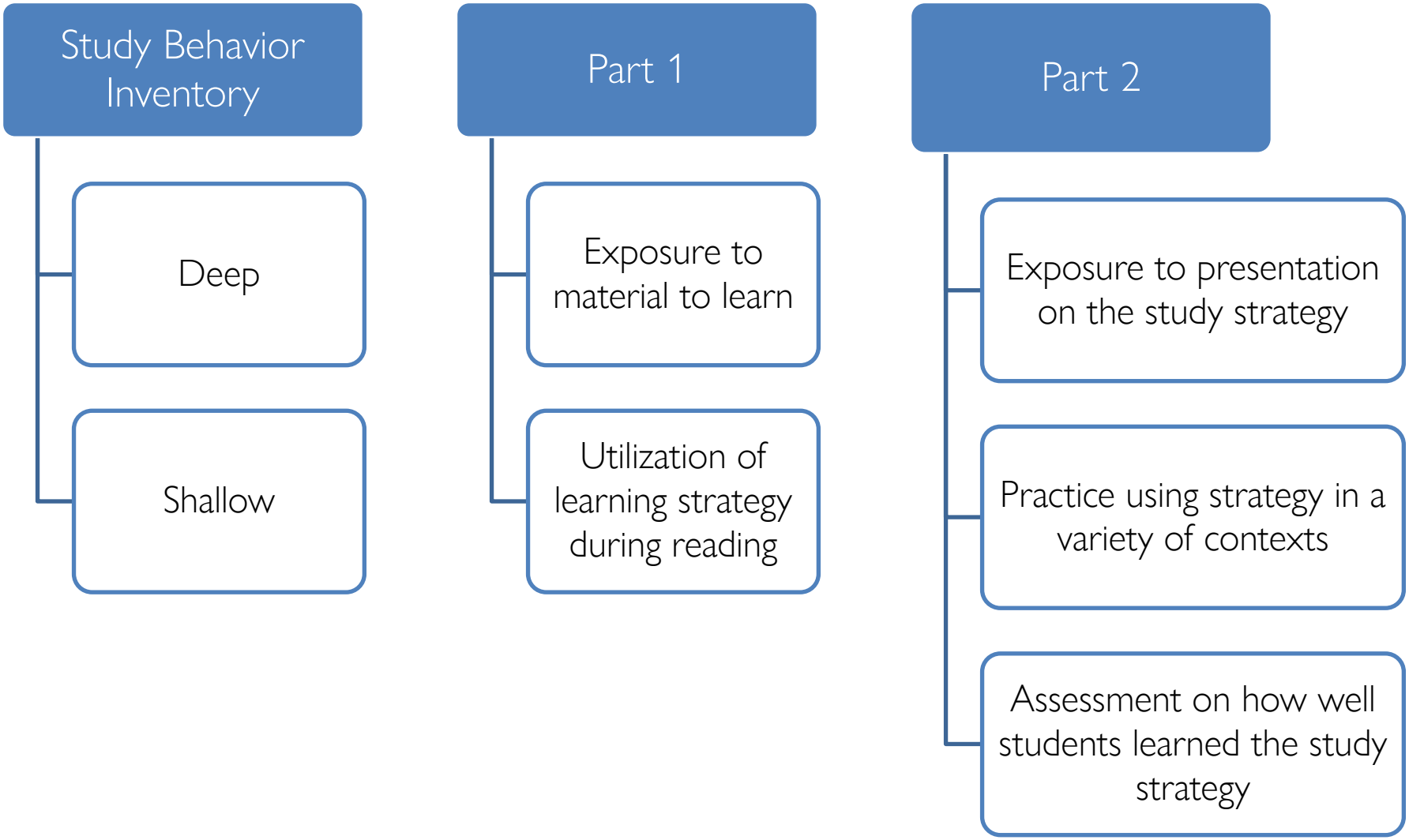
Advantages of the SCT

- Integrate with existing Academic Support Services
  - First-year orientation
  - Academic Success programs
  - First-year seminars for majors
  - Peer Assistance programs
- Provide for students experiential evidence of the learning benefits of using each strategy
- Can be used by teachers in an existing course
- Can be used by students on their own as independent learners

STUDENT COGNITION TOOLBOX
STUDY STRATEGIES


Elaborative Interrogation
Worked Examples
Self-explanation
Distributive Practice (Spacing)
Test Enhanced Learning
SCT
Interleaved Practice

General Module Template



A Quick Tour of SCT Unit on Spaced Practice

Part 8 / Section I

LEARNING OBJECTIVES

- Describe spaced practice
- Identify learning circumstances appropriate for spaced practice
- Apply spaced practice to study material

Part 8 / Spaced Practice Description

LEARNING OBJECTIVES

- Describe spaced practice
- Identify learning circumstances appropriate for spaced practice
- Apply spaced practice to study material

Spaced practice described:

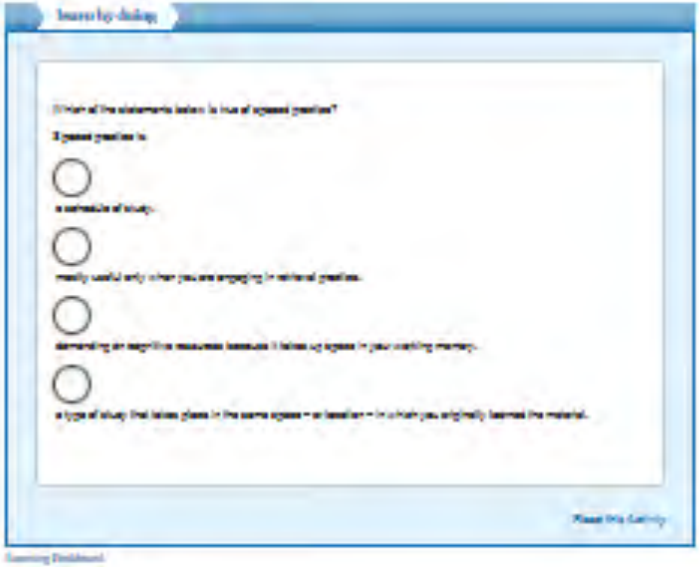
Spaced practice is a study strategy that enhances the learning and retention of course material through separating study sessions across time. Rather than studying an item repeatedly without interruption (that is massed practice), spaced practice involves studying an item or concept across different times in the same learning session (for example, by going through a deck of flashcards at least twice) and/or across different learning sessions.

Spaced practice is easy to use and can be applied in a variety of ways throughout any course. Simply put, spaced practice is a schedule of studying.

Spaced practice is not limited to one kind of practice and can include restudying material, retrieving information from memory, or practicing skills. For example, after class material has been read and/or discussed, instead of consuming all of your study and consuming all of your time in a single study session, with spaced practice you can study that material for short periods of time across different days. In this way, each study session is broken up into smaller periods of time to spread out your practice. Spaced practice can even occur within the same day, as with the flashcard example, above.

In many cases, an instructor may build spaced practice into the class by presenting the same material across different classes. This may take the form reviewing previous information before or during each class period. Overall, spaced practice can improve your ability to retain different kinds of information, such as declarative knowledge (for example, facts), procedural knowledge (for example, skills or abilities), and other academic requirements (for example, using rules or making classifications).

Why is spaced practice effective? Spaced practice does not overwork your attention like massed practice does – you do not get as fatigued while studying. This allows for greater focus and less "mind wandering" during studying. Spaced practice also provides multiple opportunities to recall the study material from long-term memory, which facilitates future attempts (such as with exams!) at recalling the study material. In fact, in some cases, the more difficult it is for you to successfully recall the information during study, you will notice a greater improvement in your ability to recall that information in the future. In addition, spaced practice decreases students' "feeling of knowing" where they believe they know the course material, but really do not. When learning is massed in one session, this can lead to the illusion that the information is known because the material has been repeated frequently over one period of time. However, the knowledge is frequently not as strongly held in memory as students think. Spaced practice does not produce false "feelings of knowing" that are common with massed practice, allowing for more efficient and effective study practices.



Learning Dashboard

Part 8 / Spaced Practice Video: Student Perspective

For a student perspective, watch the following video on spaced practice:

learn by doing

How might you use spaced practice?

When studying for an exam you:

- study all of your material to-be-learned in one space of time
- use all of your cognitive "space" to try to learn the material
- answer practice quiz questions every other day
- set aside a single space of time to review the most challenging material before you move on to easier material

Reset this Activity

Part 8 / Spaced Practice Checkpoint

You will now be asked to answer some questions about spaced practice.

When you click on the checkpoint, it will open in a new tab. Do not close this current tab while you are completing the checkpoint. Once you complete the checkpoint, you should return to this tab to continue with the remainder of this Module.

checkpoint

Spaced Practice Checkpoint

Learning Dashboard

Part 8 / Reflecting on Spaced Practice

You have almost completed the study strategy Module for spaced practice. This study strategy is an excellent tool for reviewing many different types of course material.

Answer the following short answer questions to complete the spaced practice Module.

MY RESPONSE...

Answer the following questions regarding spaced practice:

Describe the information about the study strategy that is new to you.

Submit and Compare

How does this study strategy differ with or is it the same as how you studied before you read the module?

Submit and Compare

Additional Videos

Click here for the first additional video on spaced practice.

Click here for the second additional video on spaced practice.

Further Readings and Information

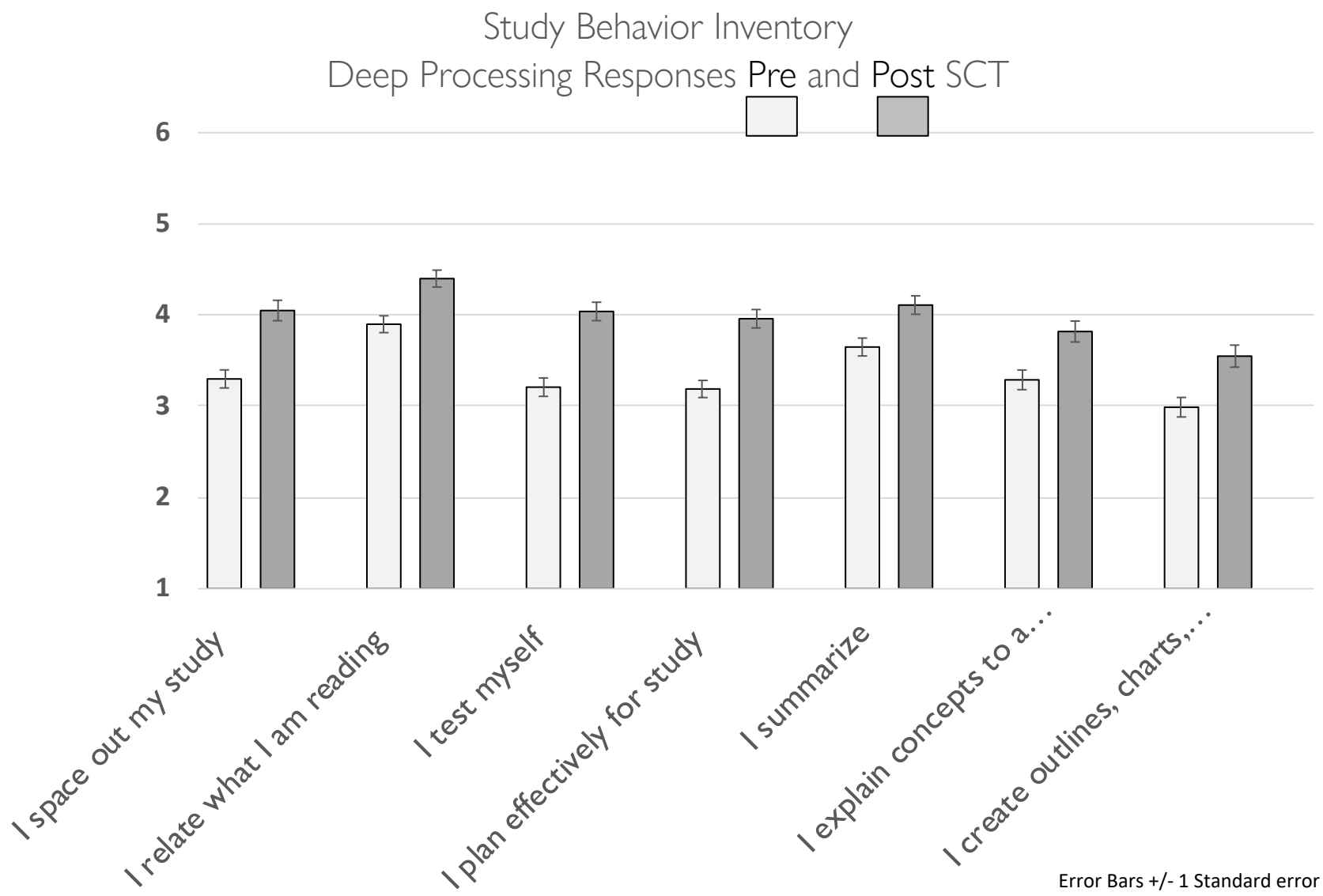
Click here for a poster that describes spaced practice.

Click here for a document that describes how to use spaced practice to boost learning.

Some Preliminaries

- Initial deployment of SCT: biology, chemistry, statistics, introductory psychology, PLTL Mentors
- Main focus was on obtaining feedback in terms:
  1. students' performance on formative and summative assessments
  2. Students' comments on the SCT

SOME INITIAL RESULTS


Study Behavior Inventory
Deep Processing Responses Pre and Post SCT
6
5
4
3
2
1
I space out my study
I relate what I am reading
I test myself
I plan effectively for study
I summarize
I explain concepts to a…
I create outlines, charts,…
Error Bars +/- 1 Standard error

Predicting Post-Instruction Study Behavior Deep Processing from Pre-Instruction Deep Processing and Mean CheckPoint Quiz Scores[a]

Model		Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Partial
1	(Constant)		5.97	.001		
	SBI Pre Deep	.55	7.07	.001	.55	
2	(Constant)		2.54	.012		
	SBI Pre Deep	.51	6.76	.001		.53
	CPQ Mean Score	**.23**	**3.03**	**.003**	**.31**	**.27**

a. Dependent Variable: SBI Post Deep

Model 1 R^2 = .30
Model 2 R2 = .35

Predicting Exam 2 Scores Controlling for Exam 1 Scores and Mean CheckPoint Quiz Scores[a]

Model		Standardized Coefficients			Correlations	
		Beta	t	Sig.	Zero-order	Partial
1	(Constant)		5.021	.001		
	Exam1	.570	9.180	.001	.570	.570
2	(Constant)		3.916	.001		
	Exam1	.466	7.594	.001		.499
	CPQ Mean	**.318**	**5.18**	**.001**	**.471**	**.366**

a. Dependent Variable: Exam2

Model 1 R^2 = .33

Model 2 R2 = .42

Student Cognition Toolbox Project Team

- Catherine Overson (PI)
- Victor Benassi (Co-PI)
- Lauren Kordonowy
- Elizabeth Tappin
- Meghan Stark
- Christopher Williams

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