A STUDENT’S JOURNEY THROUGH LEARNING: HOW CAN COGNITIVE PSYCHOLOGISTS HELP?

Yana Weinstein
University of Massachusetts Lowell
@AceThatTest

www.learningscientists.org
Part 1
• Science Communication (aka: how Twitter changed my life)

Part 2
• How can (and can’t) cognitive psychologists help education?
• Two myths about cognitive psychology

Part 3
• The big 2: retrieval practice and spacing
• FAQs about the big 2
• How can teachers help?
One evening...

Dr. Yana Weinstein
@doctorwhy

I've decided I'm going to be a vigilante evidence-based practice for education evangelist on Twitter.

5:59 PM - 21 Jan 2016
Watertown, MA

Dr. Yana Weinstein @doctorwhy · Jan 21
@doctorwhy if you have no idea what that means, it means I'm going to look for people Tweeting about their schoolwork, & help them study.

Dr. Megan Smith @DrSmithRIC · Jan 21
@doctorwhy we need a good hashtag for the mission
The next day...

@AceThatTest is born!

Learning Scientists
@AceThatTest FOLLOWS YOU
Here to help you learn more. Unlike most similar organizations, we are NOT trying to sell you products. @doctorwhy
@doctorwhy

It worked surprisingly well!

@AceThatTest

Jacinda @Shadesxjay · Jan 22
@AceThatTest I read over my notes and underline keywords. I may even rewrite them sometimes.

Learning Scientists @AceThatTest · Jan 22
@Shadesxjay Very interesting! Re-reading/underlining is a common strategy, but we know from research there’s a more effective way to study.

Learning Scientists @AceThatTest · Jan 22
@Shadesxjay If you just turn try to test yourself on the information, you are likely to remember a lot more on a later test!

Jacinda @Shadesxjay

@AceThatTest nice. Thank you for the advice!! I got all weekend to try it!

6:23 PM · 22 Jan 2016
But...what are we doing???

Saved by a science communication expert!

Twitter is not enough. You need long-form communication and a forum for discussion. Start a blog!
Our first blog post

Learning Scientists @AceThatTest · Feb 5
OUR FIRST BLOG POST: "Communication Breakdown Between Science And Practice In Education" tinyurl.com/learningsci

Spread the word! SCIENCE
Huge response!

Though not all positive.
Welcome to the politics of education.

- Progressive vs. traditional
- You must hate children!
- Do you have children?
- Have you even MET a child, like ever??
- Randomized controlled studies are stupid
- Who needs, research anyway?

Tweet by Mark Barnes: "@markbarnes19 · 41s
@doctorwhy @DrSmithRIC we don't have time for journals and studies. We need right-now solutions from real practitioners. #HackLearning"
“What do you do?”

I apply Cognitive Psychology to Education.
Goal of my research

[Help teachers] help students study better.
Cognitive psychology applied to education

- Memory
- Attention
- Perception

Learning strategy
Teaching strategy
How cognitive psychologists can’t help

- We can’t tell you…
  - exactly how much information your students are going to remember
  - which “solutions” will “fix” all your classroom problems
  - what methods are “proven” to work (NB: science doesn’t prove anything!)
How cognitive psychologists can help

- We can try to:
  - Find converging evidence for learning strategies based on cognition
  - Investigate reasons why these strategies work
  - Come up with *flexible* guiding principles
Myth #1 about cognitive psychology

cognitive psychology is the same as neuroscience
Myth #2 about cognitive psychology

we only collect data in labs, with meaningless materials

“much education research takes the form of collecting data on people’s ability to learn nonsense”

Carol Black

Former film-maker, now educational activist
The lab to classroom model

**Basic Laboratory**
in the lab with simple materials
(e.g., word lists, nonsense syllables)

**Applied Laboratory**
in the lab with relevant materials
(e.g., textbook chapters, video lectures)

**Applied Classroom**
in the classroom with relevant materials
(e.g., teachers altering their instruction)

convenience sample

population of interest
How cognitive psychologists can help

- By trying to answer your questions about how students learn, in a controlled study
A student’s journey through learning
Key Principles: The Big 2

1. Retrieval practice

1. Spacing and interleaving
Retrieval Practice (early research)
Retrieval Practice (later research)
Spacing Effect

Interleaving
2 for the price of 1!

retrieval practice + spacing = distributed practice
BUT...hot off the press...don’t take anything for granted – nothing is “proven”!

Distributed Practice and Retrieval Practice in Primary School Vocabulary Learning: A Multi-classroom Study

NICOLE A. M. C. GOOSSENS¹,²*, GINO CAMP²,¹, PETER P. J. L. VERKOEIJEN¹,³, HUIB K. TABBERS¹, SAMANTHA BOUWMEESTER¹ and ROLF A. ZWAAN¹

¹Erasmus University Rotterdam, Rotterdam, the Netherlands
²Open University of the Netherlands, Heerlen, the Netherlands
³Avans University of Applied Sciences Breda, the Netherlands

Summary: Distributed practice and retrieval practice are promising learning strategies to use in education. We examined the effects of these strategies in primary school vocabulary lessons. Grades 2, 3, 4, and 6 children performed exercises that were part of the regular curriculum. For the distributed practice manipulation, the children performed six exercises distributed within 1 week (short-lag repetition) or across 2 weeks (long-lag repetition). For the repetition type manipulation, children copied a part of the description of a word (restudy) or recalled the description (retrieval practice). At the end of each week, the children received a cued-recall vocabulary test. After 1 to 11 weeks they received a multiple-choice vocabulary test. Both on the cued-recall test and on the multiple-choice test no benefits of long-lag repetition and retrieval practice were found. These results put into question the practical value of long-lag repetition and retrieval practice in real-life primary school vocabulary lessons. Copyright © 2016 John Wiley & Sons, Ltd.
The many benefits of frequent quizzing

- **Direct benefits:**
  - Retrieval causes learning
  - Spacing delays forgetting

- **Indirect benefits:**
  - Extrinsic motivation
  - Feedback to teacher
  - Feedback to learner

Blog Post: [Concept Map: What Does Retrieval Practice Do?](#)
FAQ (1) Which quiz format should I use?

Megan Smith compared the following practice quiz formats in 4 experiments:

- Multiple-choice
- Short-answer
- Hybrid (short-answer followed by multiple-choice)
- None (re-read)

Blog Post: I'm A Teacher Who Loves Quizzing; But Does Quiz Format Matter?
FAQ (1) Which quiz format should I use?

IT DOESN’T SEEM TO MATTER

Blog Post: I’m A Teacher Who Loves Quizzing; But Does Quiz Format Matter?
Quiz format: Which should you use?

<table>
<thead>
<tr>
<th>Quiz Format:</th>
<th>Multiple-Choice</th>
<th>Short Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term retention</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>Ease of item creation</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Ease of grading</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

Blog Post: [How To Write Good Multiple-Choice Questions](http://example.com)
FAQ (2) When in a lesson should retrieval practice occur?

At-the-end

Interleaved

$S$ = 1 slide  $T$ = 1 short-answer question
FAQ (2) When in a lesson should retrieval practice occur?

Blog Post: I'm A Teacher Who Loves Quizzing: But Where Should The Quiz Questions Go?
# Question placement: Which should you use?

<table>
<thead>
<tr>
<th></th>
<th>Interleaved</th>
<th>At the end</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term retention</strong></td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td><strong>Performance during learning</strong></td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td><strong>Ease of implementation</strong></td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>
FAQ (3) Should students answer practice questions, or make up their own?

Blog Post: [How To Study A Textbook: A Researcher’s Perspective](#)
But what about time efficiency?

![Graph showing long-term retention against study time for Read, Answer, and Generate tasks. The graph indicates that generating requires more time for the same level of retention compared to reading and answering.]
Should students make up their own practice questions?

<table>
<thead>
<tr>
<th>Strategy:</th>
<th>Answer</th>
<th>Generate &amp; Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Performance</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>Time Efficiency for Student</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Time Efficiency for Teacher</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>

Please give students lots of practice questions to answer.
What do you tell your students?

By the time they make it to university, do they know how to study?
Do university students quiz themselves?

How much did you engage in each strategy?

- Rereading notes or textbook
- Restudying something that is not clear in order to
  Concentrating on the parts I know least well
- Distinguishing main points and details
- Summarizing the course material
- Practicing recall (self-testing)
- Doing practice problems
- Making outlines or review sheets
- Rehearsing (repeating over and over) the material
- Integrating different sources (book, notes, . . .)
- Memorizing something I do not understand
- Underlining or highlighting the most important parts
- Skipping over parts I think the teacher will not ask
- Thinking of real life examples
- Studying with a group of students
- Skipping parts I do not find important
- Connecting course material from different courses
- Using mnemonics (acronyms, rhymes, etc)
- Skipping parts I do not understand
- Using flashcards

Not as much as they reread.

Weinstein, Lawrence, Tran, & Frye (unpublished pilot data)
Do university students space their learning?

No way!
Why don’t students practice retrieval and space their learning as much as we would like?

- It takes effort
- It takes time
- It feels hard
- They don’t have the right resources
- They just don’t know it’s good for them
The problem

% of teacher training textbooks that cover the two big cog psych principles

- spacing
- retrieval practice
- none

Learning About Learning Report (2016)
Blog post: We Need to Rewrite the Textbook on How to Teach Teachers
How can teachers help?

- Use the big 2 in your own teaching practice
- **Tell** students why you are doing this
- Encourage students to use these strategies independently
- Keep engaging with the research — BUT come to the panel after the break to hear about pros & cons!
Sources of information (or pressure?)

- Self
- Peers
- Students
- Parents
- Leaders
- Politicians
- Research
Thank you to these teachers & more!

Carl Newman
@carilnewman9526 FOLLOW YOU

Bryan Penfound
@BryanPenfound FOLLOW YOU

Dawn Cox
@MissDCox FOLLOW YOU

Cristina Milos
@surreallyno

Bodil Isaksen
@BodilUK FOLLOW YOU

Colleen Young
@ColleenYoung FOLLOW YOU

Dan Williams
@FurtherEdagogy FOLLOW YOU

Caroline Creaby
@CarolineCreaby FOLLOW YOU