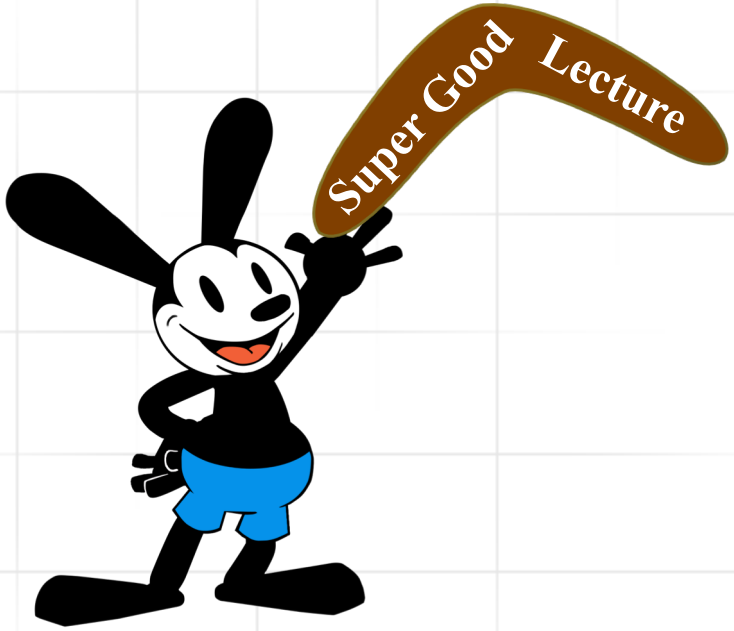
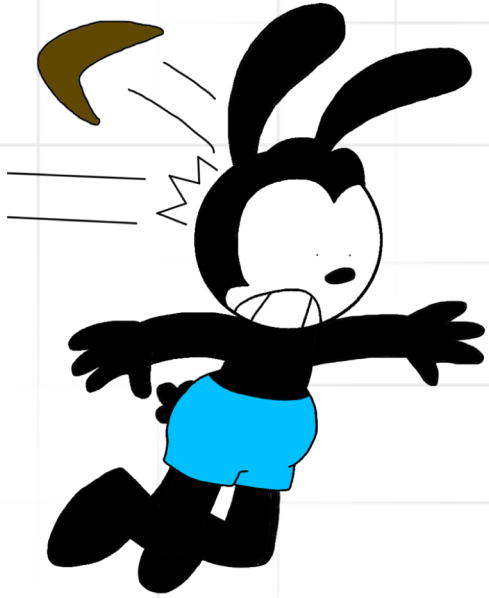
Instructional Backfires

Marily Oppezzo
PhD, MS, RD



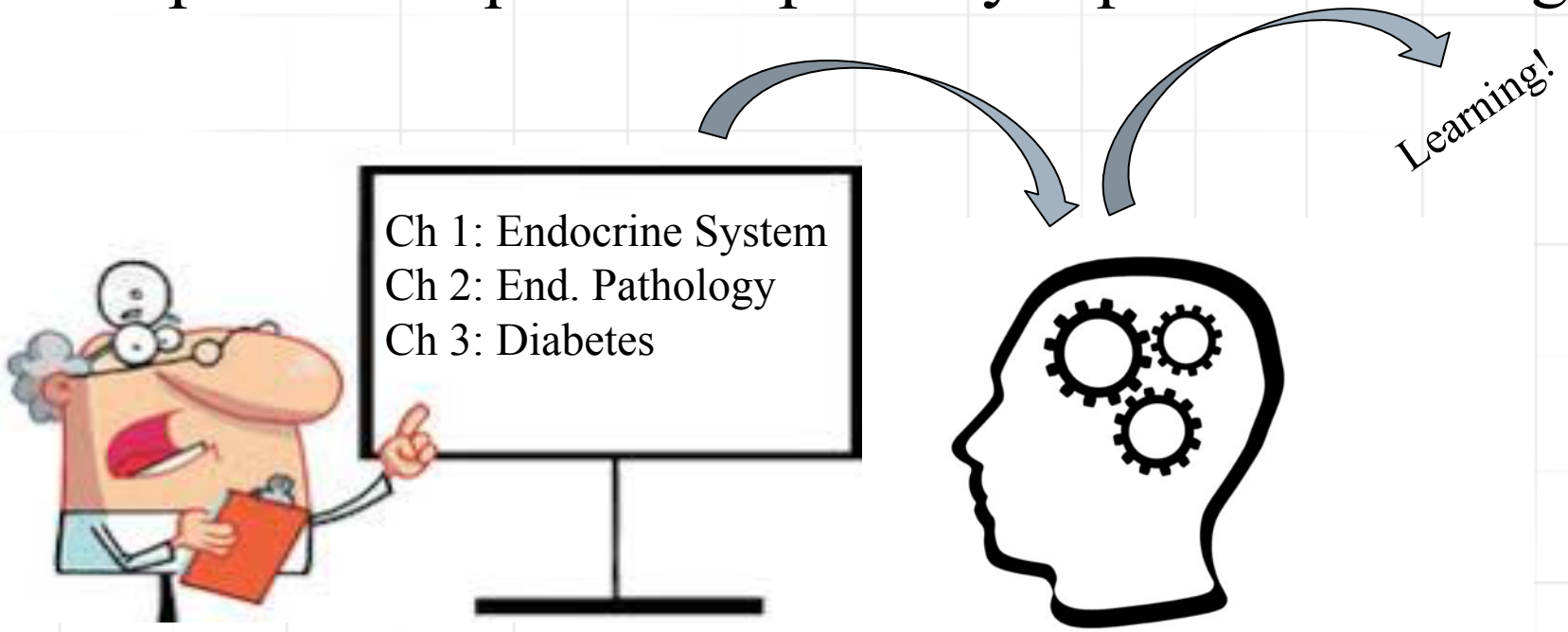


Teaching: Mistakes 101

- Scope and Sequence as primary input for learning

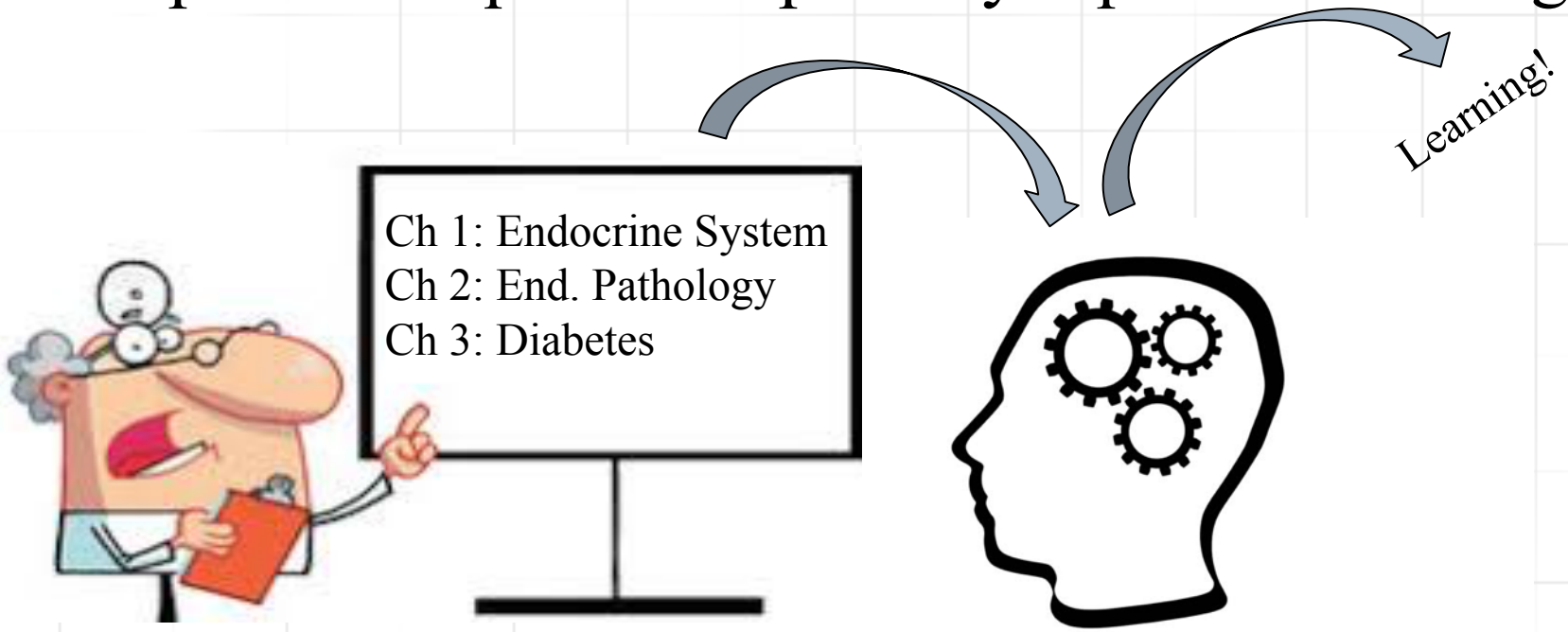
Teaching: Mistakes 101

- Scope and Sequence as primary input for learning



Teaching: Mistakes 101

- Scope and Sequence as primary input for learning



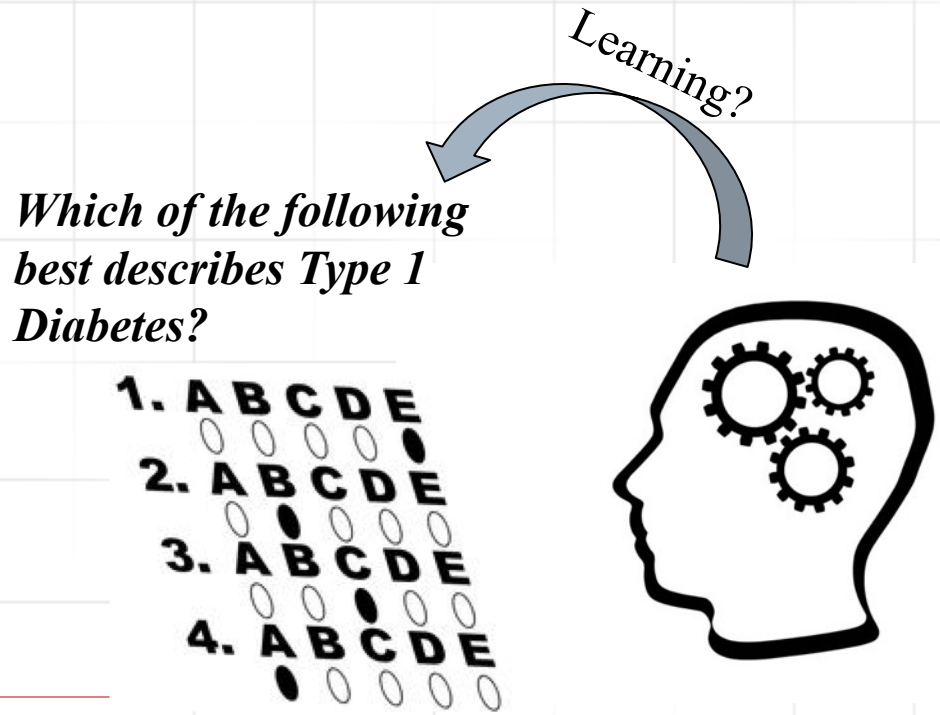
- HOW your learn is important for the output

Instructional Backfires

- Backfire 1: Assessments can fool you.
- Backfire 2: Telling to Soon.
- How do you do this?

Backfire 1

- Assessments can make students look more knowledgeable than they are.



Assessments: Recognition of Words vs Application

- Multiple choice tests involve recognition of strong verbal cues that often resemble what was said.
- But often the output of learning depends on recognizing symptoms and signs rather than words.
  - E.g. Clinical Psychologists
- Problem of Inert Knowledge
  - People fail to apply what they know
  - Do well by standard assessments, but fail to use it in other relevant situations

Study on the Hidden Value of Active Learning

- Students analyzed simplified data from classic studies of human behavior.
- They had to graph the interesting patterns in the data.
- They did this before they learned the relevant theory.

Instructions:

Graph the important patterns you see in the data.

Instructions:
Graph the important patterns you see in the data.

Background information: The data come from an experiment in which research participants tried to remember a list of words (below). Participants listened to one word per second. They did not see the list; they only listened to it. Afterward, the participants wrote down as many words as they could remember.

List of words (in the order heard): *car, sky, apple, book, cup, lock, coat, light, bush, iron, water, house, tape, file, glass, dog, cloud, hand, chair, bag*

The data: What participants wrote down (in the order written)

Participant 1: bag, hand, chair, cloud, sky, light
Participant 2: bag, chair, hand, car, sky, book, house, bush
Participant 3: hand, bag, chair, cloud, car, lock, dog
Participant 4: bag, hand, chair, dog, car, apple, sky, water, glass
Participant 5: bag, chair, car, iron, apple, cup, water, light

Instructions:
Graph the important patterns you see in the data.

Background information: The data come from an experiment in which research participants tried to remember a list of words (below). Participants listened to one word per second. They did not see the list; they only listened to it. Afterward, the participants wrote down as many words as they could remember, after they counted down from 99 by 7's.

List of words (in the order heard): *car, sky, apple, book, cup, lock, coat, light, bush, iron, water, house, tape, file, glass, dog, cloud, hand, chair, bag*

The data: What participants wrote down (in the order written)

Participant 1: car hand, sky cloud cup light
Participant 2: bag, car hand, car, sky, book, house, bush
Participant 3: car sky chair, cloud bush ıck, dog
Participant 4: car sky , chair, dog tape ɜpple cup ɴater, glass
Participant 5: sky chair, car, iron, apple, cup, water, light

Delivered the Standard Explanation

- A lecture described the relevant patterns and gave the theories that explain them.

- **Recency**: People remember the last things they hear, but only if asked to remember them right away.
- **Primacy**: People remember the first things they hear, and they tend to remember them early on.

- **An Explanation**: These are explained by the relation between working memory and long term memory…

Analyze vs Read and Summarize.

- Analyze Treatment
  - College students analyzed data for homework.
  - They made graphs of the important patterns.
- Summarize Treatment
  - Read a chapter that summarized the results and explained the theories (also for homework).
  - They wrote a 1 to 2-page summary of the chapter.
- Roughly the same time on task.

They then heard the common lecture.

- Three conditions:
  - Analyze students who heard lecture.
  - Summarize students who heard lecture.
  - Analyze students who analyzed again.
    - They looked for more patterns in the data.

- Here is their performance on a standard test a few days later.

Performance on standard test questions.

- *People tend to remember the first thing they hear better than other things.* (True/False)
  - 10 questions of this sort.

- No apparent benefit of analyzing data.
  - Summarize/Lecture → 92%
  - Analyze/Lecture → 91%
  - Analyze/Analyze → 64%

- A week later, gave a class activity that required prediction.

Performance on a prediction task.

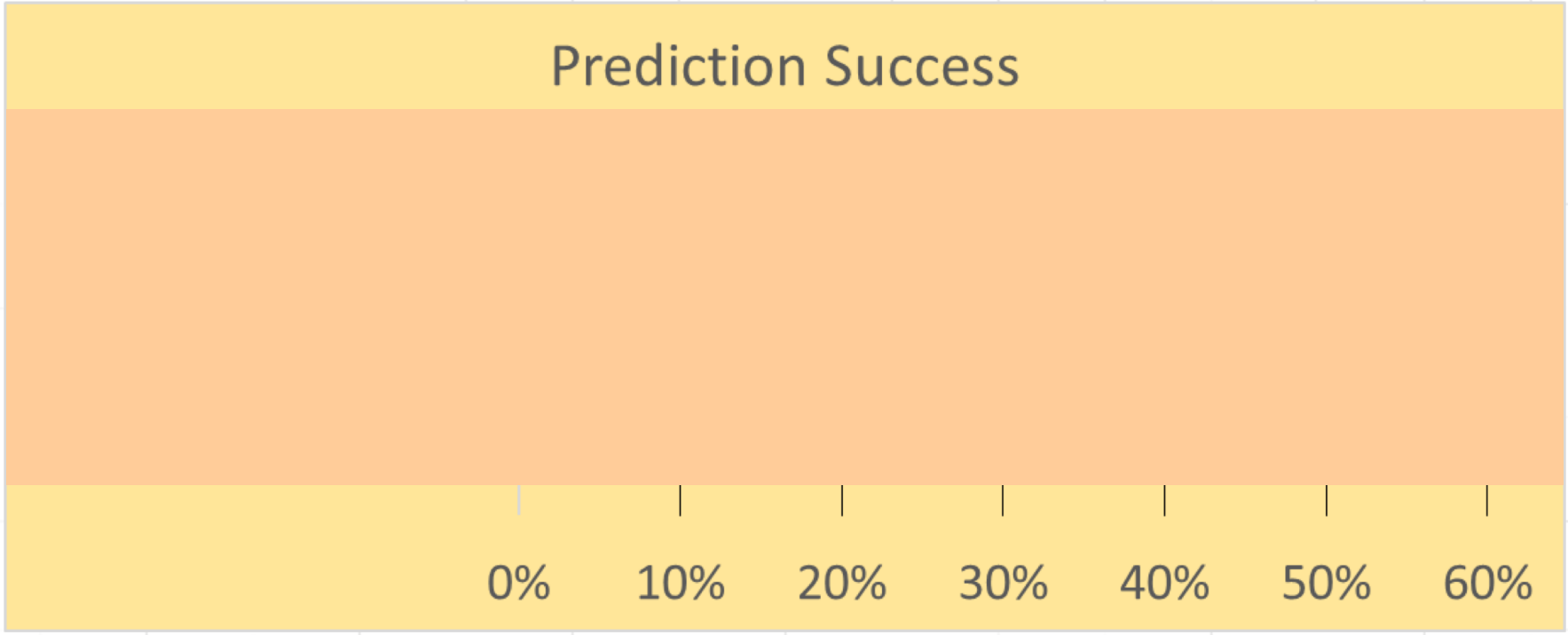
- Students received the description of a novel experiment, and they had to predict the results.
  - **"Participants read the following passage…"**

The procedure was actually quite simple. First he collected all the items into one group. He might have had to use another place due to lack of facilities. But the usual facility was going to be enough. He arranged the items into different groups. Of course one pile might have been sufficient depending on how much he had to do. It is better to do too few things at once than too many. In the short run this may not seem important but expensive complications can easily arise. Red problems are the worst…. <passage continues for another 200 words>

- **Half of the participants saw a passage title, "Washing Clothes."**
- **The other half saw the title, "Passage 3."**
- **Five minutes later, participants wrote down what they read.**

- ***Students then had to predict what participants remembered in each condition.***

Performance on prediction task.



Schwartz & Bransford. (1998) *Cognition & Instruction*.

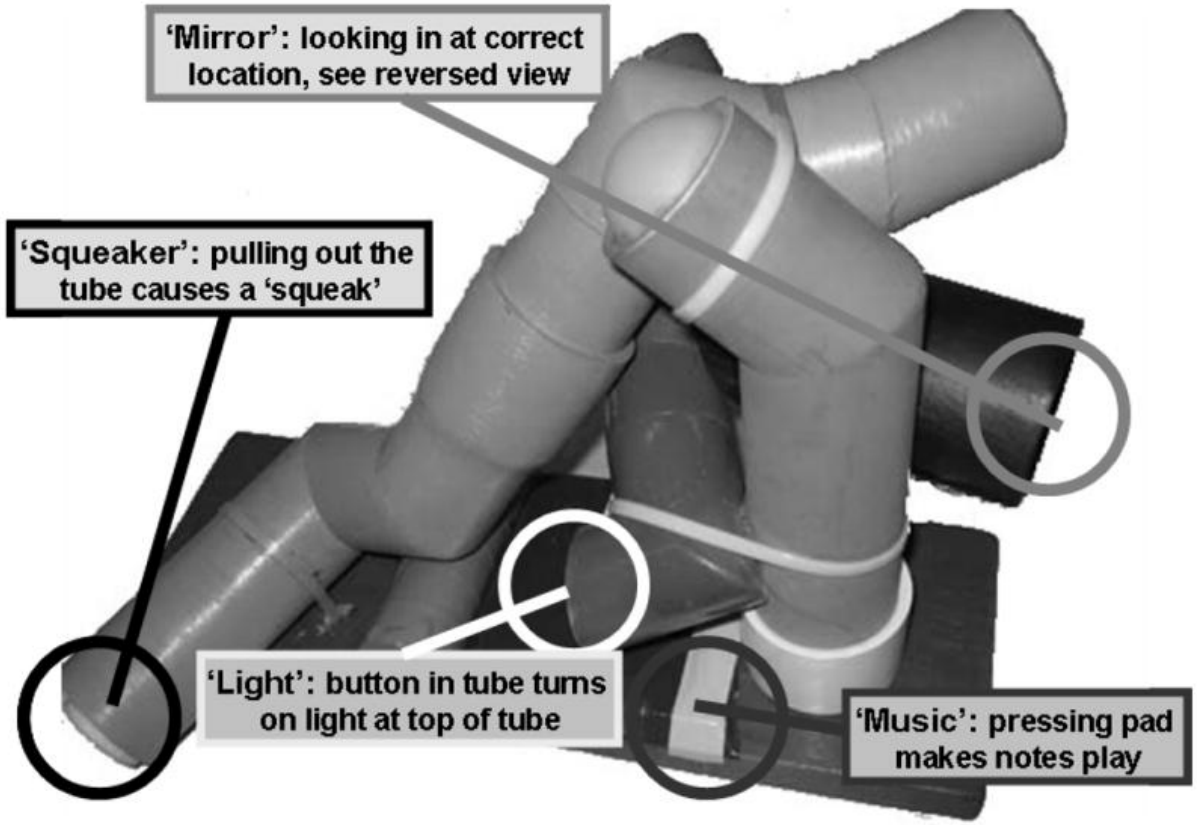
Implications.

- The wrong assessment can make instruction look better than it is.
- Most tests miss the value of active learning.
  - They provide cues that do not exist in the world.
- Active Learning Creates a "Time for Telling."
  - Students experienced the problem the theory solves.
  - Active learning gains when followed by an explanation.
- Active + Lecture (Telling) > Summarize + Lecture (Telling)
- What if you did Lecture then Active Learning?

Instructional Backfires

- Backfire 1: Assessments can fool you.
- Backfire 2: Telling to Soon.
- How do you do this?

Backfire 2:
People pay attention to what they are told.

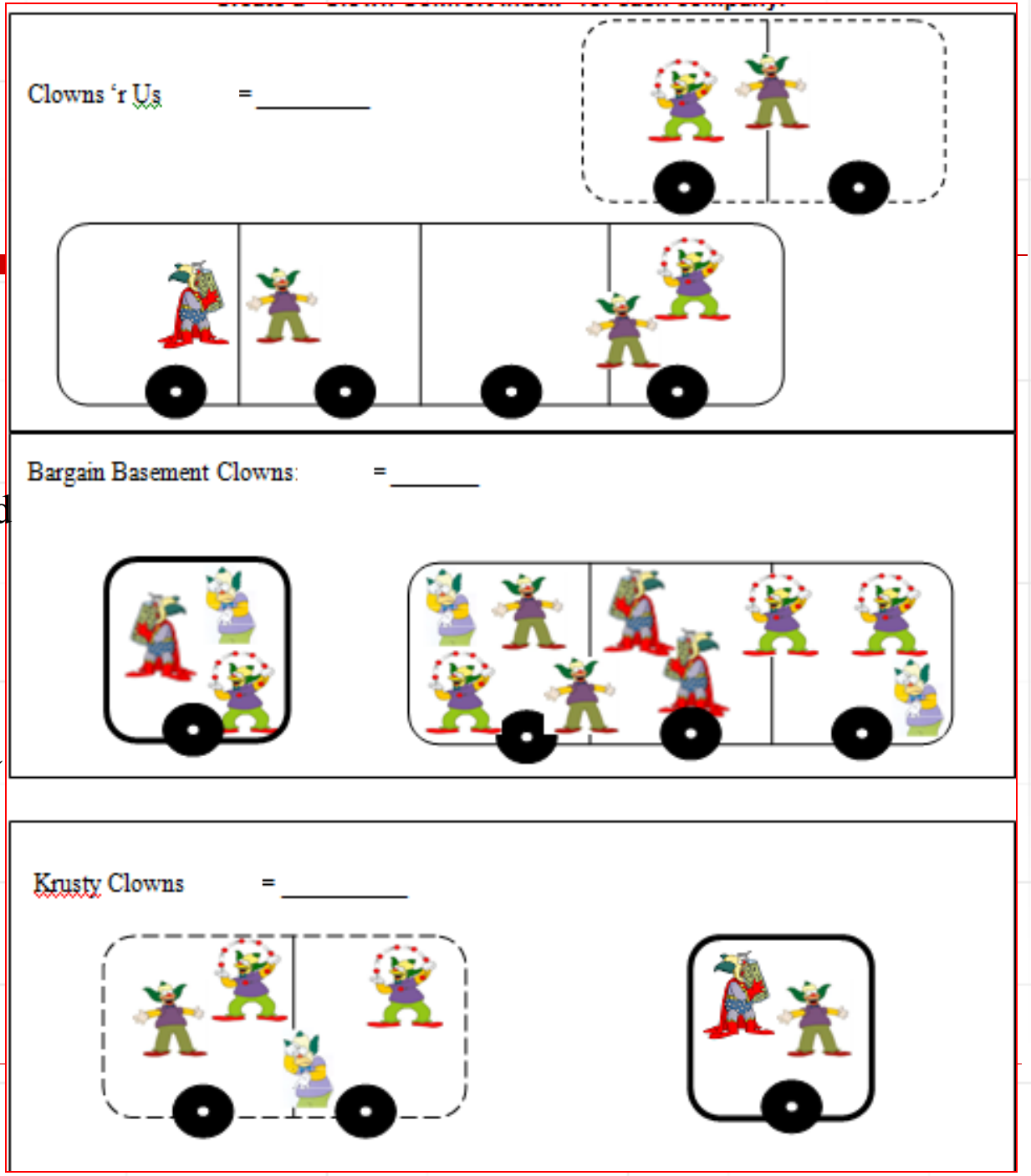


Found 60% less functions than kids told nothing

Bonawitz, E., Shafto, P., Gweon, et al. (2011). *Cognition*.

Cover story:
Companies ship clowns to events. They always crowd their clowns the same amount.

People need to know the "crowdedness index" for a company, because crowded clowns are grumpy clowns.



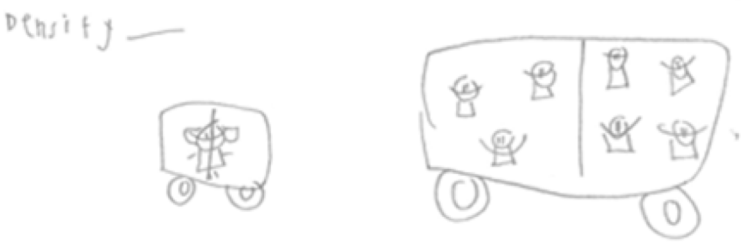
Risks of Telling First

Cathy Chase
(Teachers College)

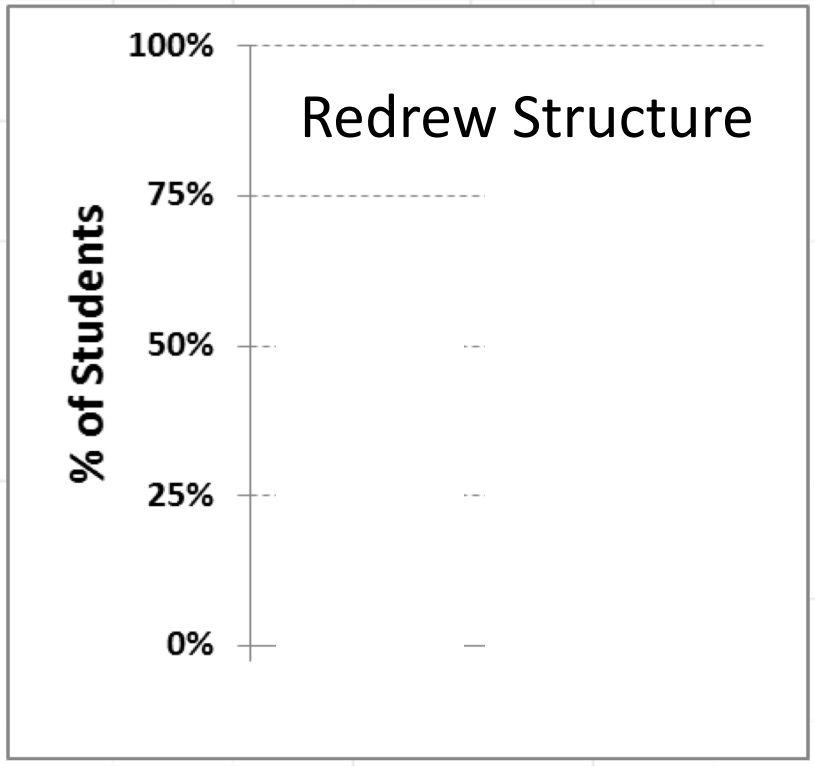
- A pair of studies in regular science classes.
  - Both had n = ~120 8th-grade students (~13 y.o)
  - Both had similar results.
  - Both targeting the "big idea" in middle school science: Ratio.
- Half 8th-graders in an active learning Inventing treatment:
  - Invent an index to determine crowdedness used by a company.
  - ~ 90% induced the rule.
- Half 8th-graders in a Tell & Practice treatment :
  - Told the density formula, and Practiced on the clowns.
  - ~95% used the rule correctly
- 24 hours later, simply asked to redraw the worksheet.

What did they see in the problems?

(A) Redrawing that misses ratio structure of density.



(B) Redrawing that reveals ratio structure of density.



What happened?

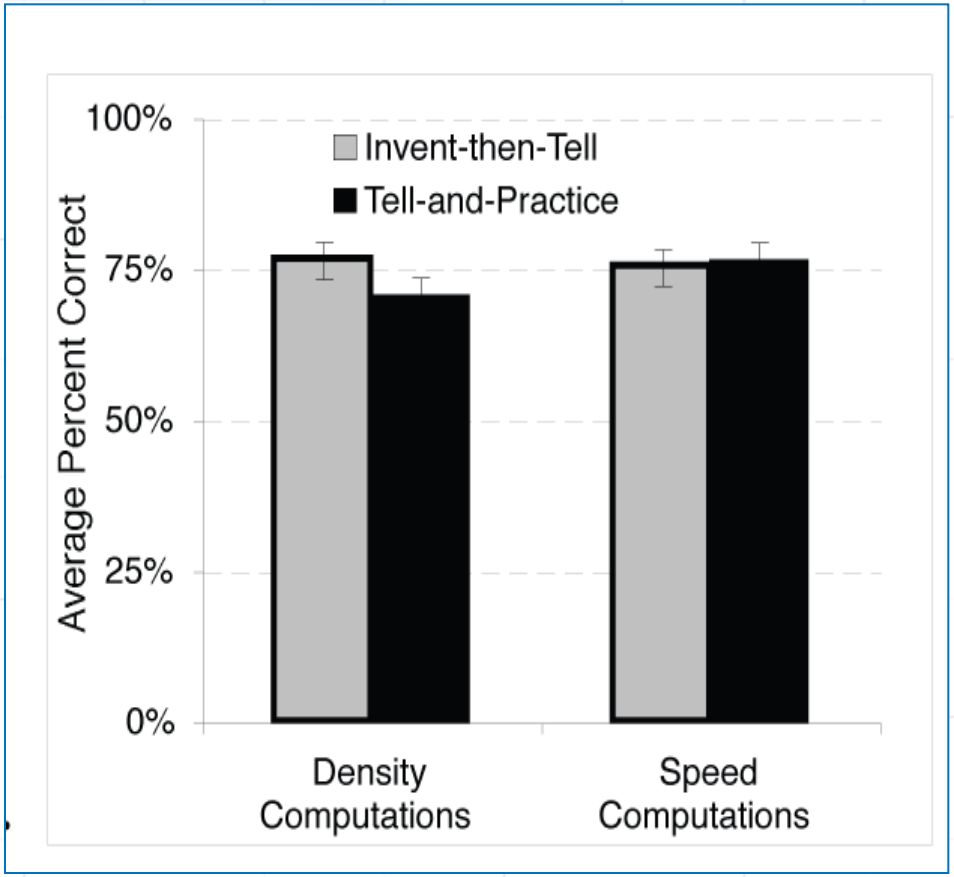
- Students paid attention to what they were told.
  - They neglected the situation they were told about.
- They thought words contained all information.
  - Never learned to recognize a ratio.

Study with clowns continued

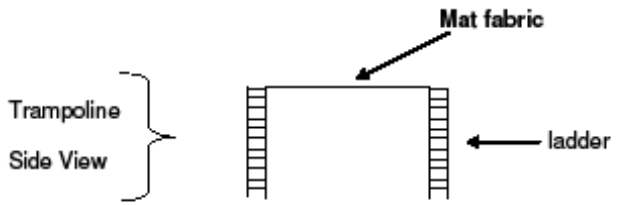
- Students completed three more problem sets as before:
  - Density as continuous variable (metal purity)
  - Speed as a discrete variable (popcorn poppers)
  - Speed as a continuous variable (car movement)
- Then everyone got the lecture on importance of ratio; speed and density formulas; other examples.
- Students did relevant word problems for 15 minutes.
  - A car went at 15mph for 2 hours, how far did it travel?

Results on standard test

- A week later: standard test
  - e.g., find speed given distance and time.
- Days later, **transfer task.**
  - **To this point the only difference was whether they had been told beforehand.**



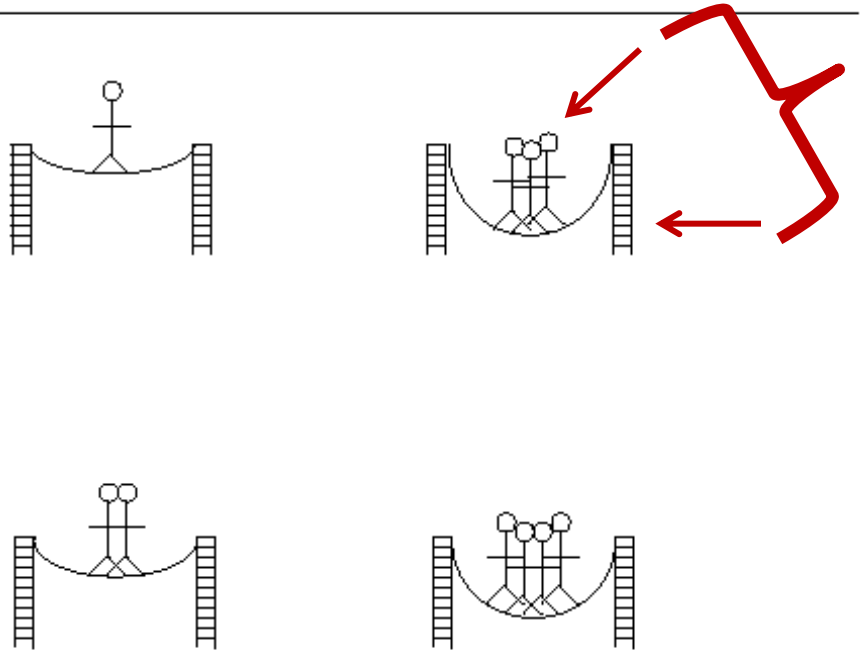
Transfer task.



Trampolines are made with mats using different fabrics.

Stiffer mats make the trampoline bouncier.

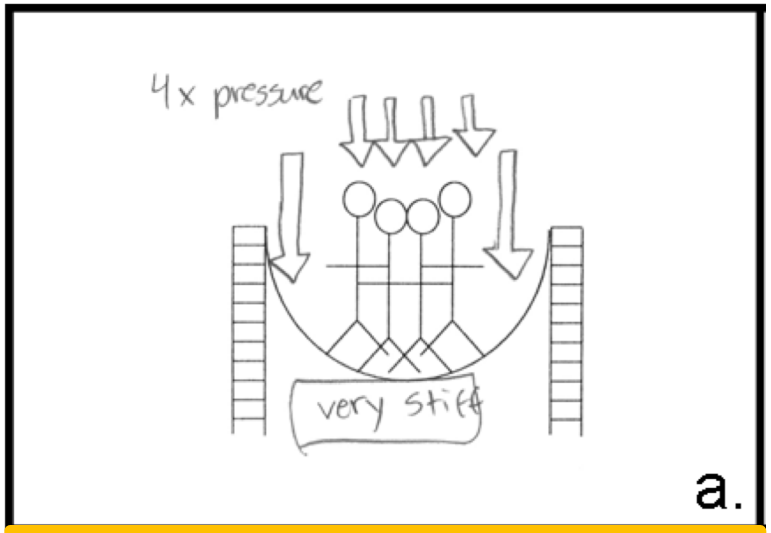
Determine the <u>stiffness</u> of the mat fabric for each trampoline.



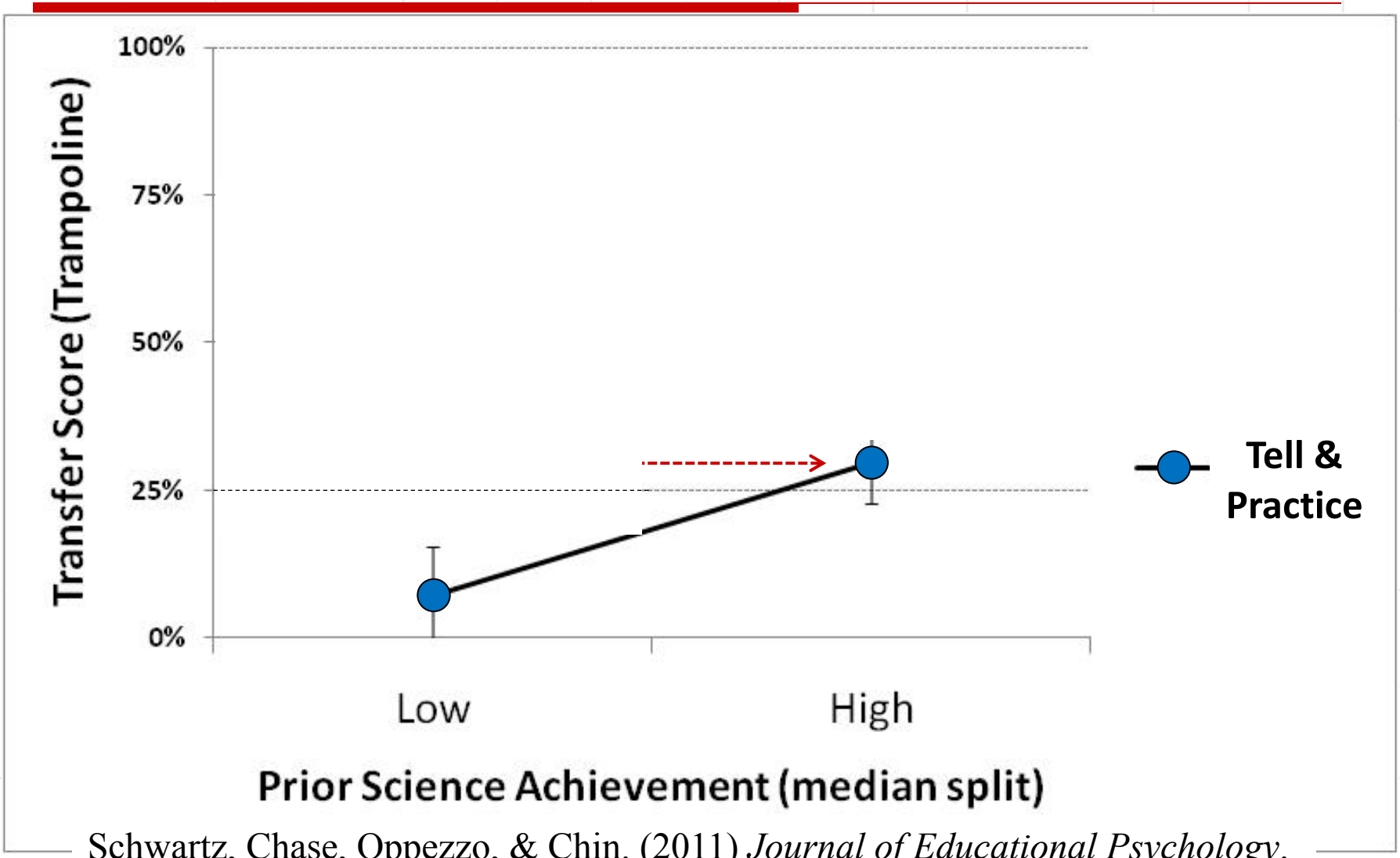
Determine stiffness of mat fabric.

<u>Spring Constant</u>
Stretch and Mass **Ratio**

Sample solutions



Address a common concern about inductive (discovery) activities.



Schwartz, Chase, Oppezzo, & Chin. (2011) *Journal of Educational Psychology*.

Recap

- As seen before standard assessments can be misleading about instruction effectiveness
  - Task that requires application of knowledge in new domain is much more revealing
- Being told first can undermine search for structure so they don't know why what they've been told is relevant.
  - Not paying attention to the situation to which it applies.
- Good instruction works for all students.

Instructional Backfires

- Backfire 1: Assessments can fool you.
- Backfire 2: Telling to Soon.
- How do you do this?

How do you make a good active learning experience?

- Lots of things
  - "authentically engaging"
  - non-rhetorical
  - complex to bind a network of *ideas* rather than *isolated facts* (no Jeopardy questions)
  - Self-contained with sufficient info to help make learning sub-goals or answer the question

Help students learn the “IF”

- People need to learn an IF and THEN
- Most lectures give the “THEN”
- Useable knowledge (to new situations) depends on the IF (conditions under which Then applies)
- People need to engage in the IF before they get to the THEN

IF **THEN**

Problem-Oriented vs Fact-Oriented Acquisition

- Uriah Fuller, the famous superpsychic, can tell you the score of any baseball game before the game starts. What is his secret?
- Fact-Oriented
  - List of facts:
    - e.g. Before any game is played, the score is zero to zero.
- Problem-Oriented
  - List of Facts presented as answers to implied questions:
    - e.g. You can tell the score of any game before it is played [2 second pause] because the score is zero to zero.

Adams, L.T. et al. (1988). *Memory & Cognition*.

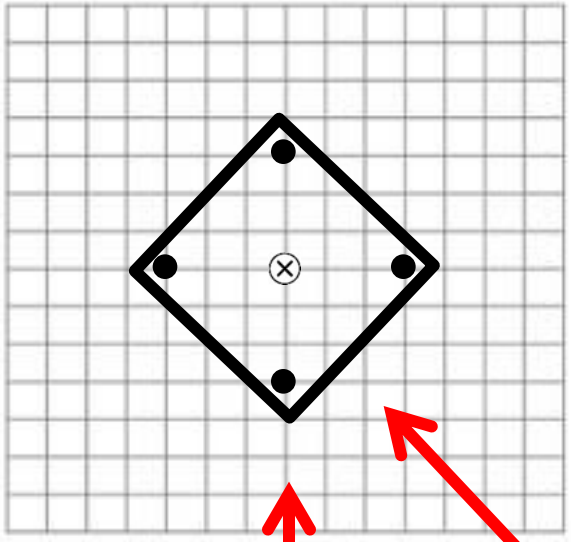
Med school does this

- Henry (5 y o) comes home from school for tea. He accidentally spills boiling water on his bare leg. His mom held his leg under cold running water, but he has burst blisters and the entire anterior side of his thigh is quite red. The dr treats the wound and asks him to come to surgery. The wound is patchy and locally covered with a whitish coating despite treatment. Part of the wound (10 cm x 10 cm) has still not completely healed after three weeks.

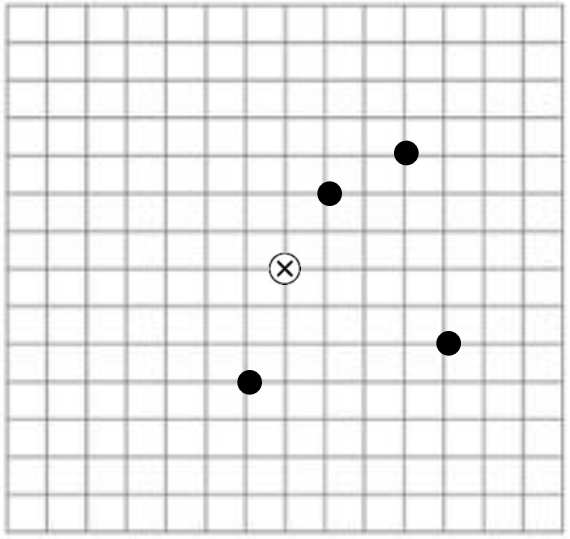
(Schmidt, 1993)

Another successful example

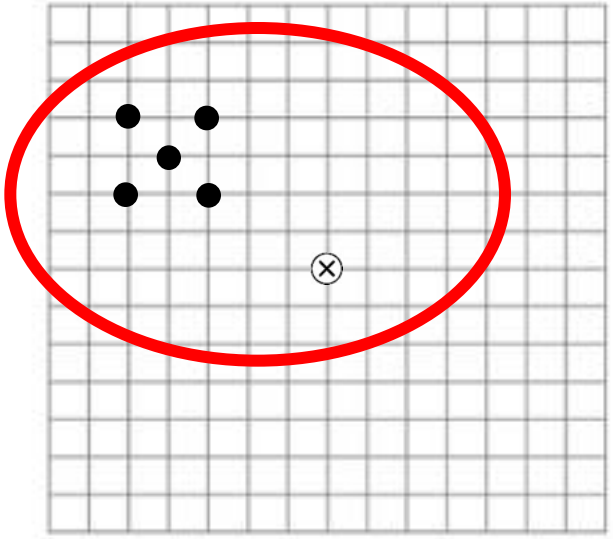
- The Adventures of Jasper Woodbury
  - Episode 1: 20 minute video where eagle is shot in the wing and needs to be rescued in a remote area!
  - Constraints and possibilities for rescue presented as story unfolds (e.g. distances, people, transport options, fuel availability, rate of travel)
  - Students have a week to rewatch case
    - build solution (rescue) to meet constraints with available resources



Fireball Pitching Company

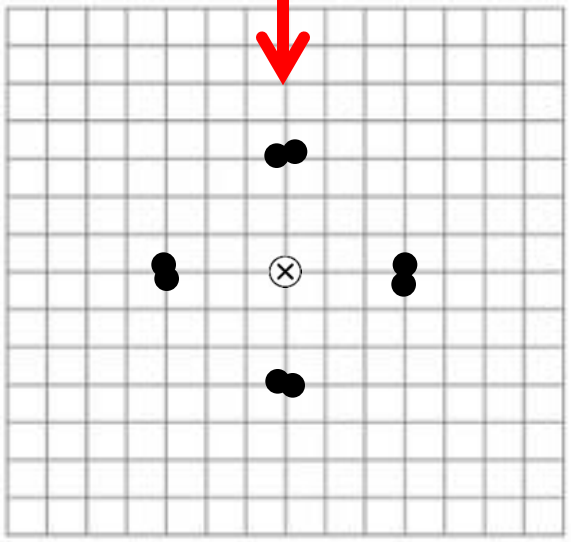


Deluxe Dingers

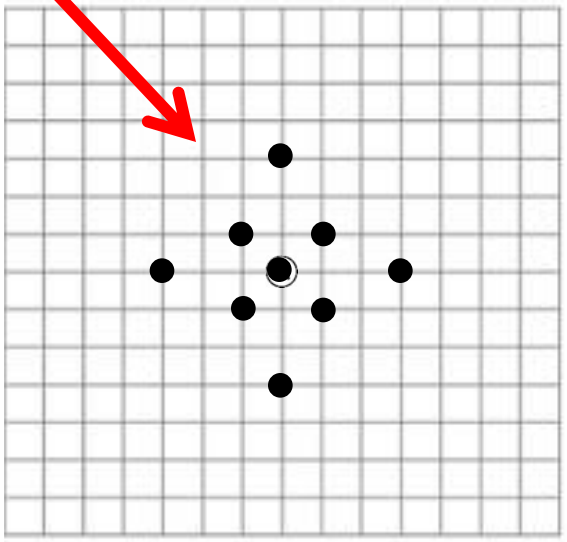


Sure Hit Machines

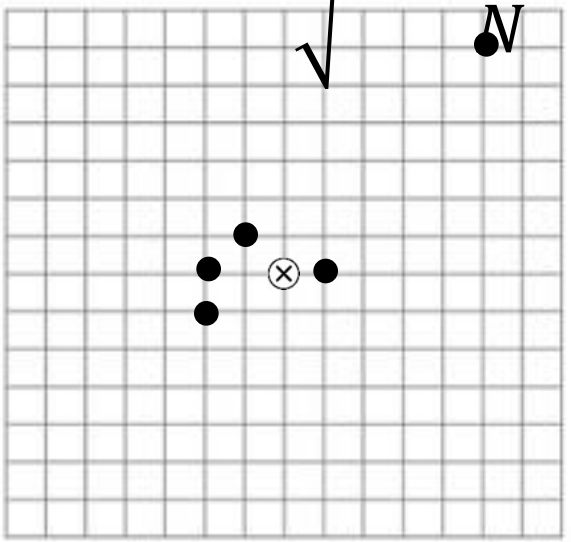
$$\sqrt{\frac{\sum(x-\bar{x})^2}{N}}$$



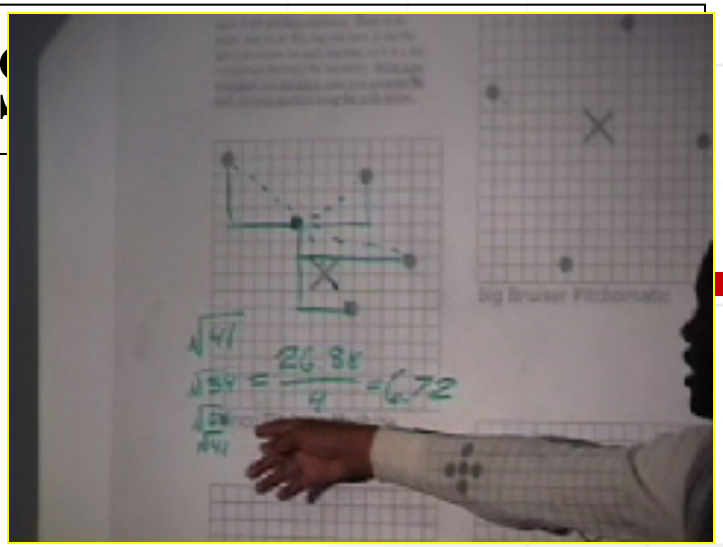
Batting Kings #436

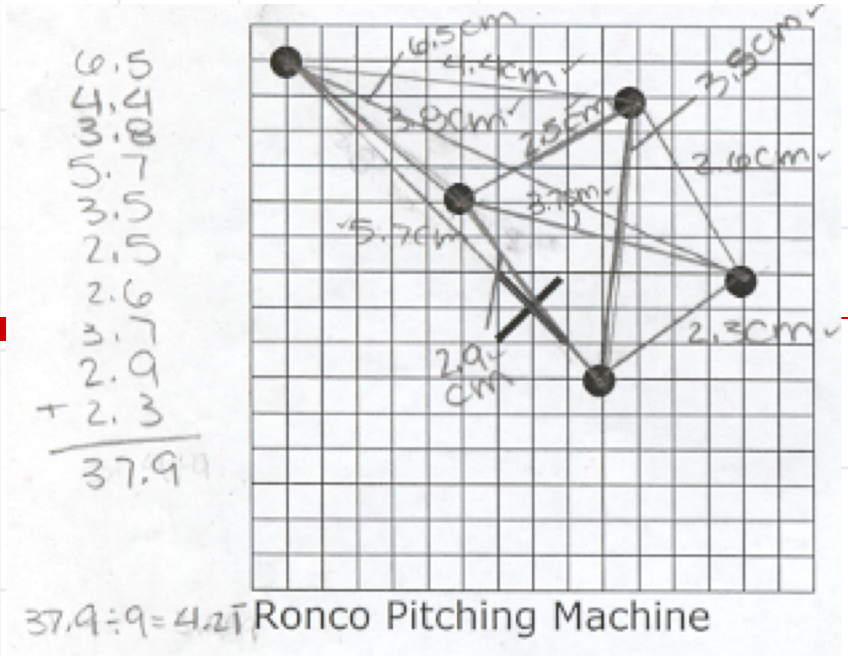


The Blast o' Rama

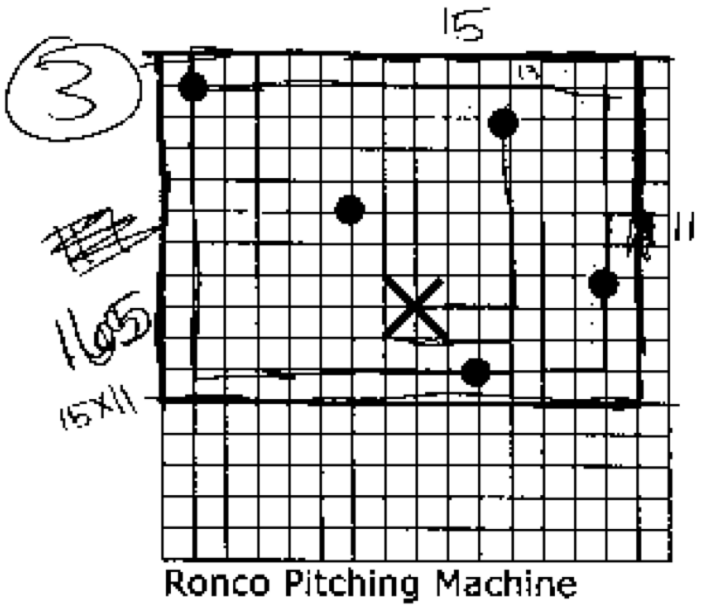


Econo Pitching Machines

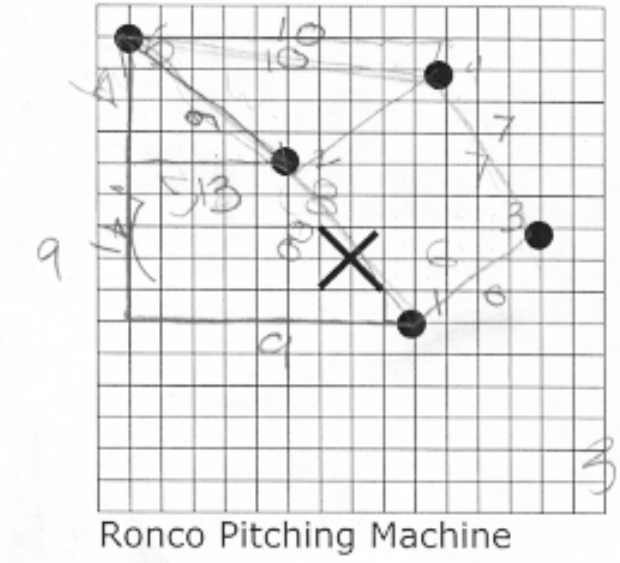




Pair-wise Distances Solution



Area solution



Perimeter Solution

Online PBL example in CME




Stanford MEDICINE | Educational Technology *Information Resources & Technology* | Teaching and Mentoring Academy

- Introduction
- Counseling Patients on E-cigarettes
  - Test Your Knowledge
    Test Your Knowledge
  - How to Navigate Patient Cases
  - Introduction: A Day in the Life
  - **Patient Case 1 - Pre-college physical**
  - Patient Case 2 - Older smoker
  - (Optional) Break: Email inquiry
  - (Optional) Break: News update
  - Patient Case 3- Perioperative check-in
  - Conclusion: The 5 A's of Intervention
  - (Optional) Visit a Vape Shop
- Course Wrap-up
- Resources and References

VIEW UNIT IN STUDIO

PATIENT CASE 1 - PRE-COLLEGE PHYSICAL

STAFF DEBUG INFO


ADVISE AGAINST USE
LACK OF CERTAINTY
LESS HARMFUL ALTERNATIVE

- ENDS
- How e-cigs work
- Types
- **Cigalikes**
- 2nd Gen
- 3rd Gen
- History
- nicotine delivery
- E-liquids
- nicotine content
- flavors
- Cytotoxicity
- E-cig prevalence

WHAT DO THE EXPERTS HAVE TO SAY?

Robert Jackler, MD
Stanford University

Maciej Goniewicz,
Ph.D, PharmD
Roswell Park Cancer Institute

Jodi Prochaska,
Ph.D, MPH
Stanford University

Suzaynn Schick, Ph.D
UC San Francisco

ADVISE AGAINST USE

LACK OF CERTAINTY

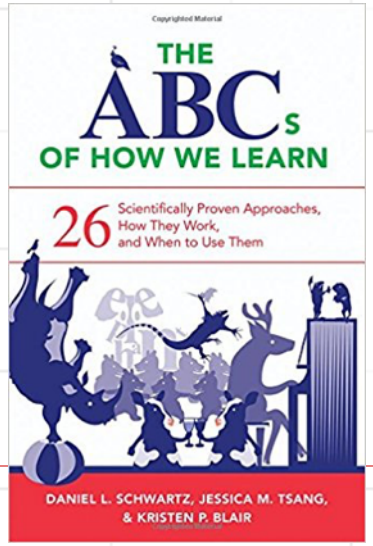
LESS HARMFUL ALTERNATIVE

Recap

- Assessments can fool you into thinking students understand.
- Telling too soon undermines usable knowledge acquisition.
- Problem-oriented acquisition prepares people to learn.
- Many ways to design the problems.
- Main point is to give the “IF” before the “THEN”

How do you tweak teaching for applied learning without adding more time on task?

- Teaching and Mentoring Academy!
  - http://med.stanford.edu/academy.html
- Educational Technology!
  - http://med.stanford.edu/edtech/about.html
- This book!



Thank you!