

Teaching Critical Thinking: A Cognitive Perspective

Daniel Willingham
University of Virginia

NITOP

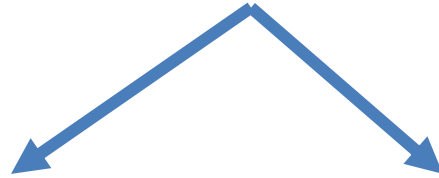
January 3, 2020

Outline

- What critical thinking looks like
- Why it's hard to teach
- Ideas to address the challenge

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Critical Thinking



Choosing to engage cognitively when others don't.

When you think, thinking well.



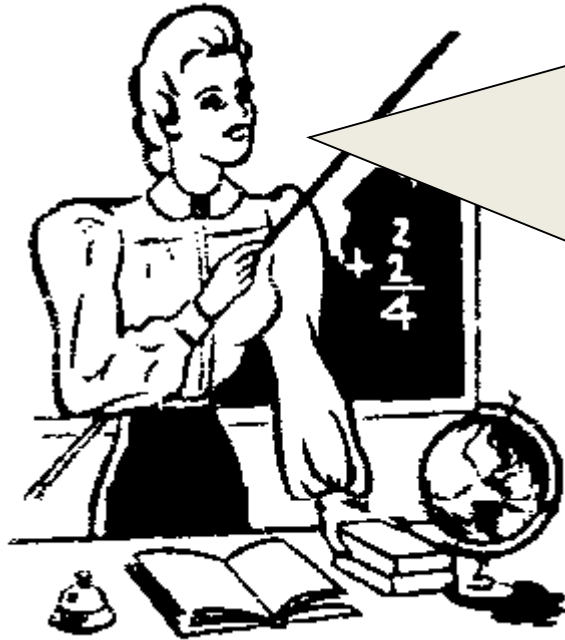
Can we teach students to think
like psychologists?

What “thinking well” looks like:

Intertwined with
content knowledge.

Scientific reasoning

1. Scientific concepts: laws of motion, structure of matter, evolutionary theory, etc.
2. Thinking scientifically: developing a model, deriving hypotheses from the model, gathering and interpreting data, revising the model



Anomalous results are very important.

Experiments need a control group.

Theories should be as simple as possible, but no simpler.

Choose data analytic techniques that are appropriate to your data.

Anomalous results are important

Are these results
anomalous?

I don't know. I didn't
really have a prediction.



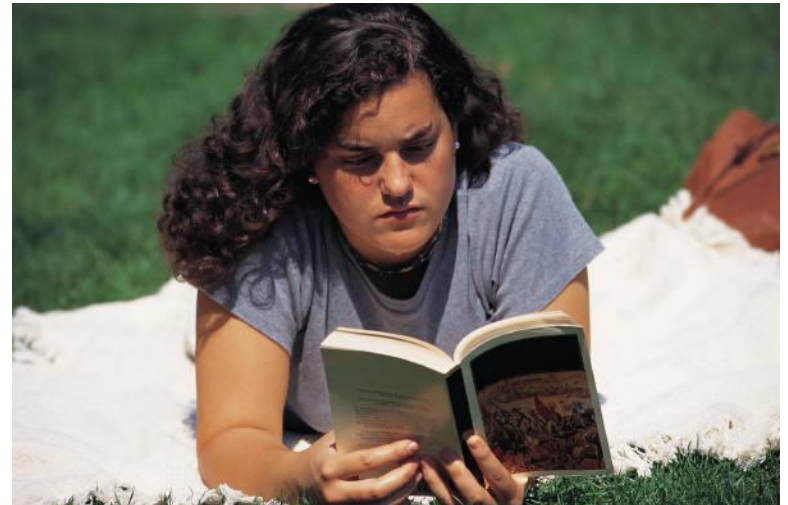
Design an experiment

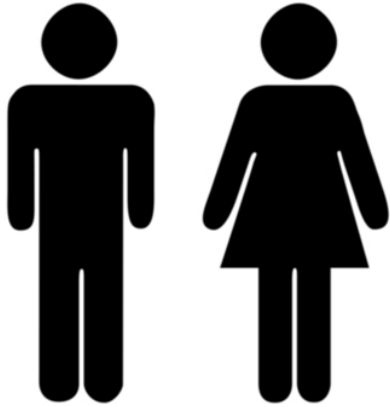




I'm supposed
to have a
*control
group.*

Design an experiment





Even for EXPERTS, critical thinking is domain-specific

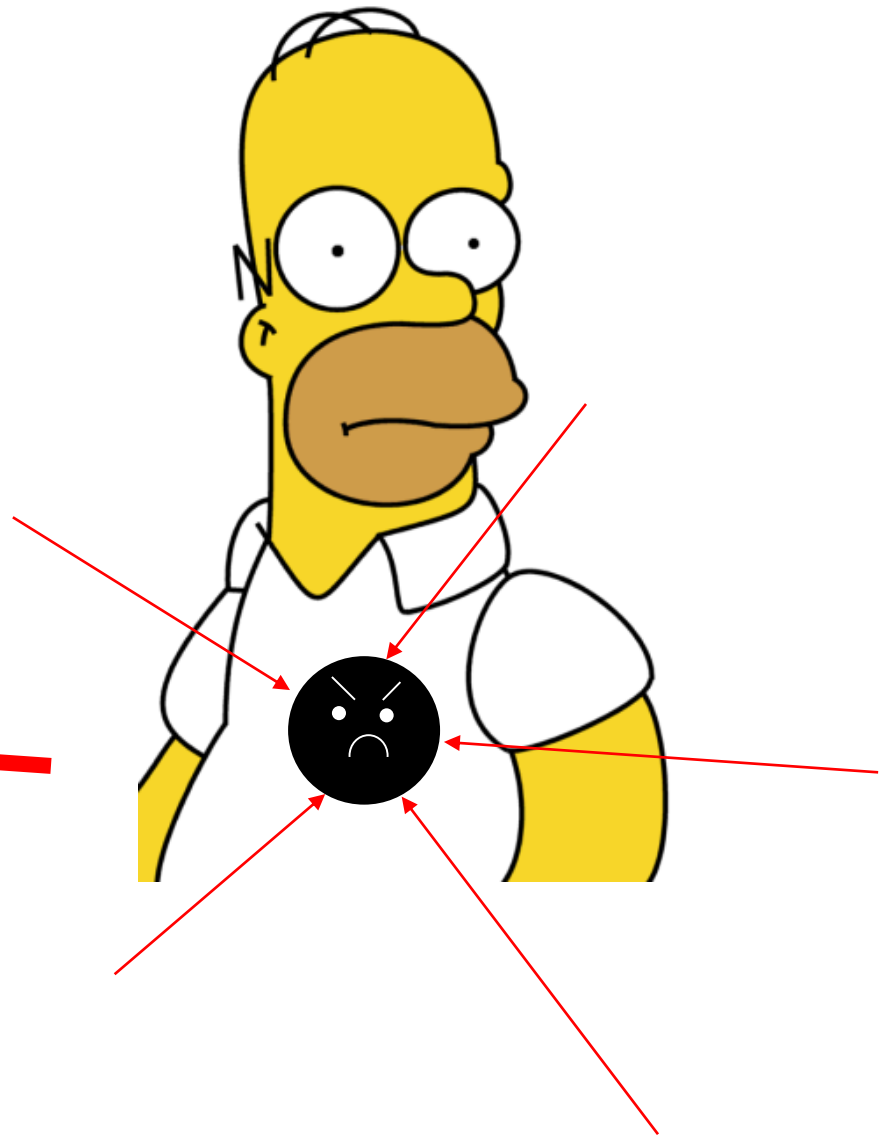
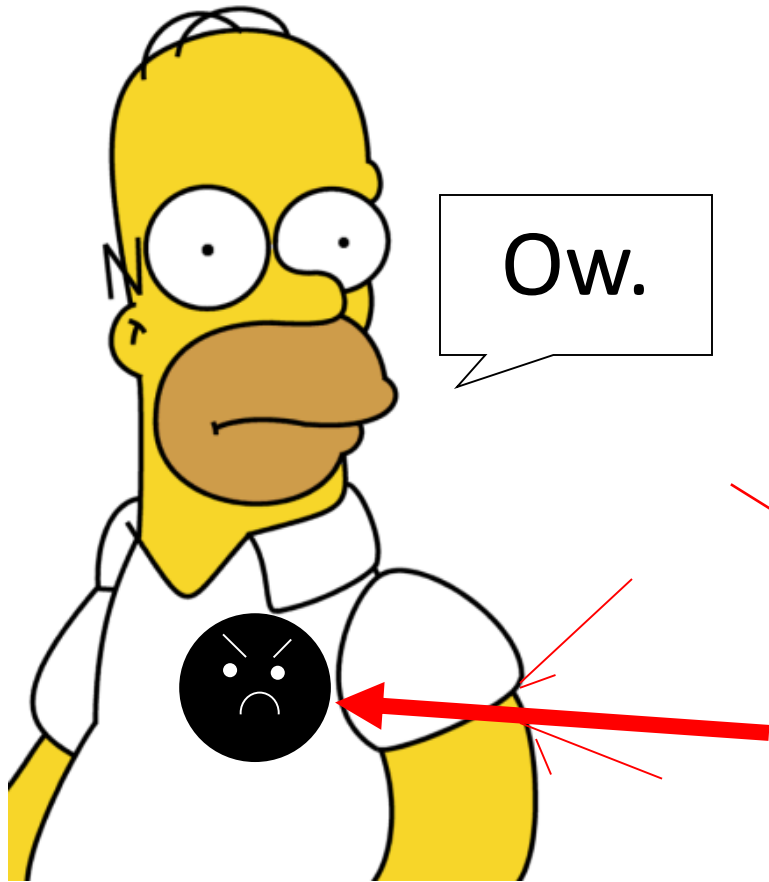
- Neurologists do not diagnose cardiac cases well (Rikers, Schmidt, & Boshuizen, 2002).
- Technical writers specializing in instruction pamphlets for home electronics don't write newspaper articles well (Kellogg, 2018).
- Philosophers are no less susceptible than average adults to being swayed by irrelevant features of problems like question order or wording (Schwitzgebel & Cushman, 2015)

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Surface vs. Deep Structure

Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either. What type of procedure might be used to destroy the tumor with the rays, and at the same time avoid destroying the healthy tissue?



A dictator ruled a small country from a fortress. The fortress was situated in the middle of the country and many roads radiated outward from it, like spokes on a wheel. A great general vowed to capture the fortress and free the country of the dictator. The general knew that if his entire army could attack the fortress at once it could be captured. But a spy reported that the dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to be able to move troops and workers about, however, any large force would detonate the mines. Not only would this blow up the road, but the dictator would destroy many villages in retaliation. A full-scale direct attack on the fortress therefore seemed impossible.

The general, however, was undaunted. He divided his army up into small groups and dispatched each group to the head of a different road. When all was ready he gave the signal, and each group charged down a different road. All of the small groups passed safely over the mines, and the army then attacked the fortress in full strength. In this way the general was able to capture the fortress.

**If people have JUST FINISHED READING
the story, solution rate only goes to 35%.**

Deep: disperse forces to
minimize collateral damage &
converge at the point of attack.

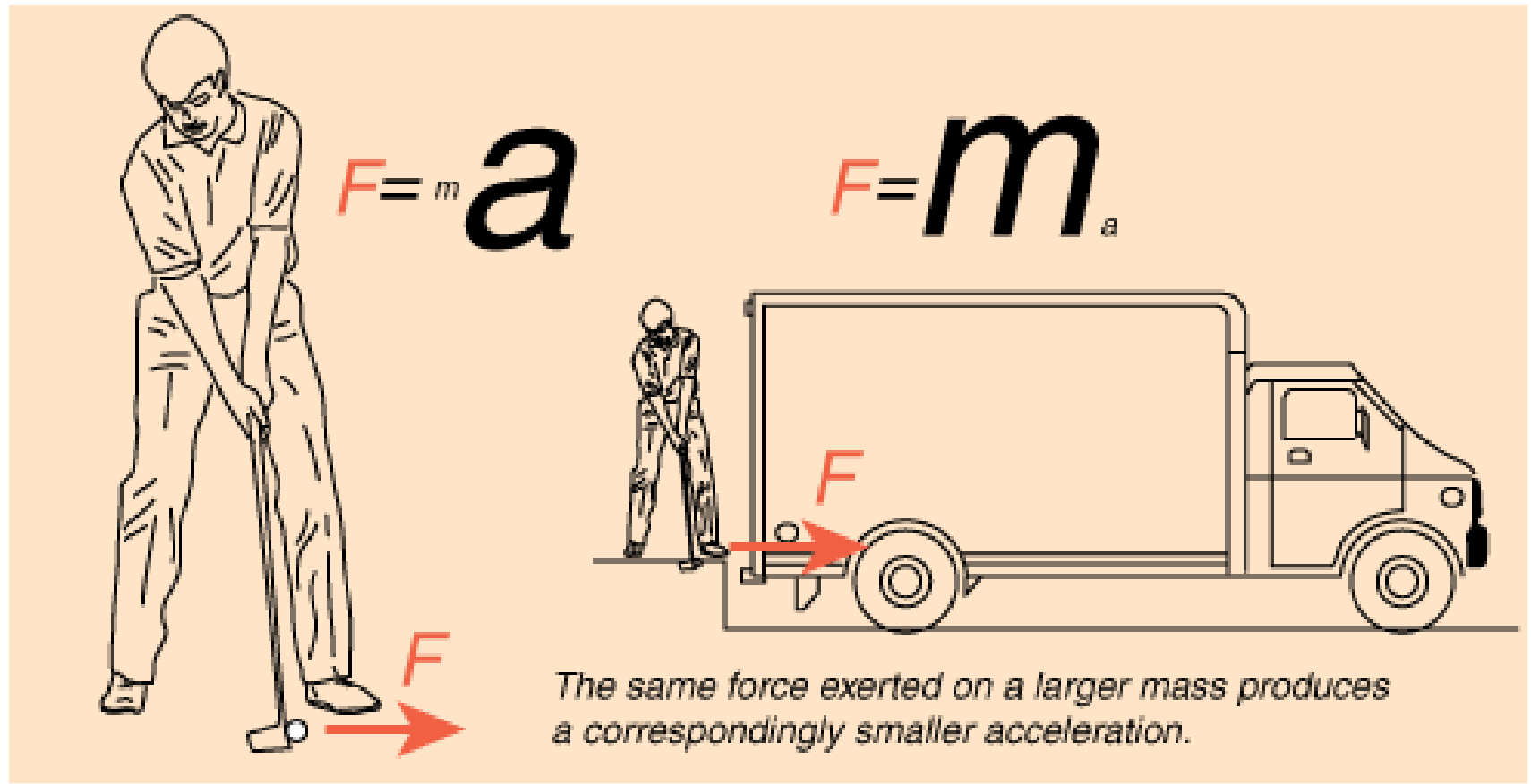
Surface: rays, tumors, hospitals,
doctors, stomachs, operations,
body tissue. . . .

Surface: armies, roads, dictators,
castles, spies, mines, retaliation

Why not *teach* the deep structure
from the start?

Abstractions are hard to understand

$$f = m * a$$



Teaching critical thinking is hard because critical thinking happens at the deep level. But when I teach, problems are inevitably instantiated at a surface level.



Start of
semester



End of
semester

Below are four cards. Each card has a letter on one side and digit on the other side. You are to verify whether or not the following rule is true: If there is a vowel on one side, there is an even number on the other side. You should verify this rule by turning over the minimum number of cards.

A

2

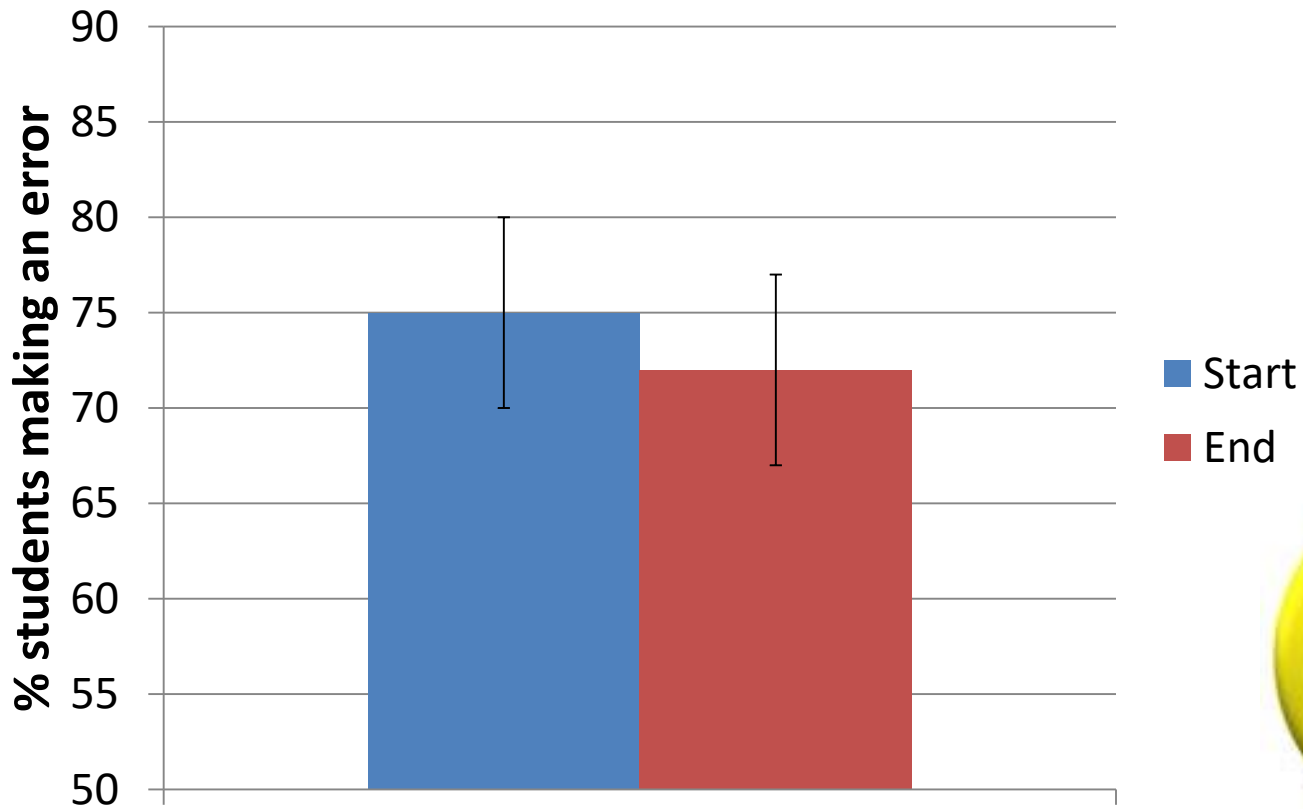
X

3

Start of semester



End of semester

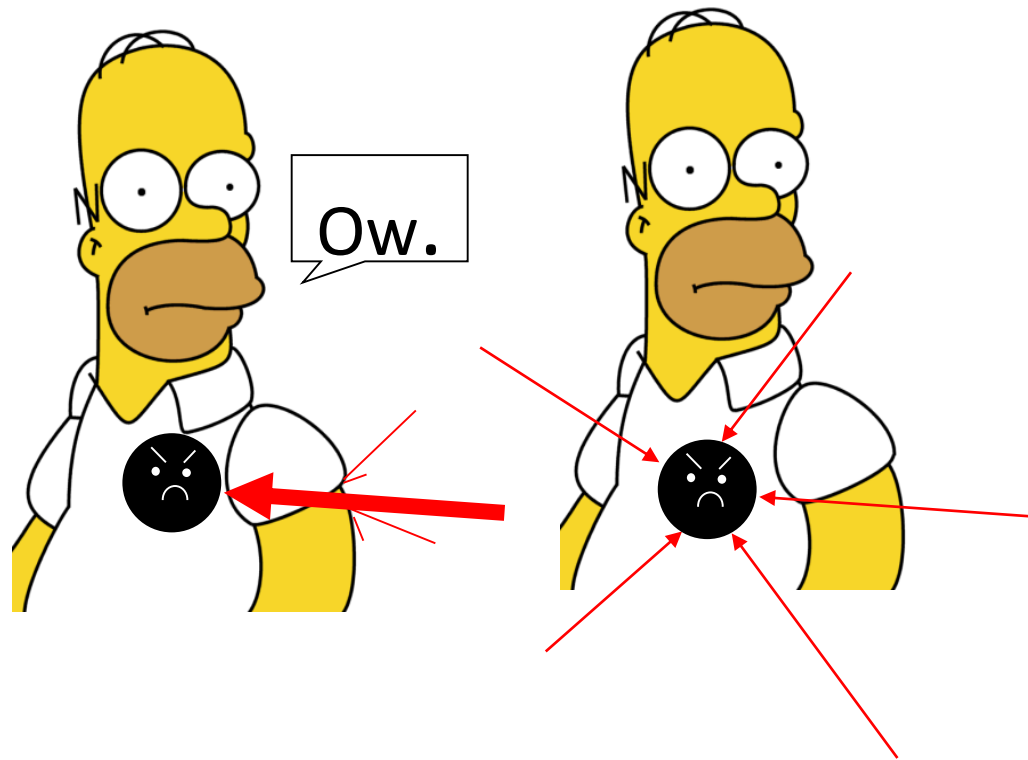


Holyoke et al., 1986

Motivation: why is this so hard?



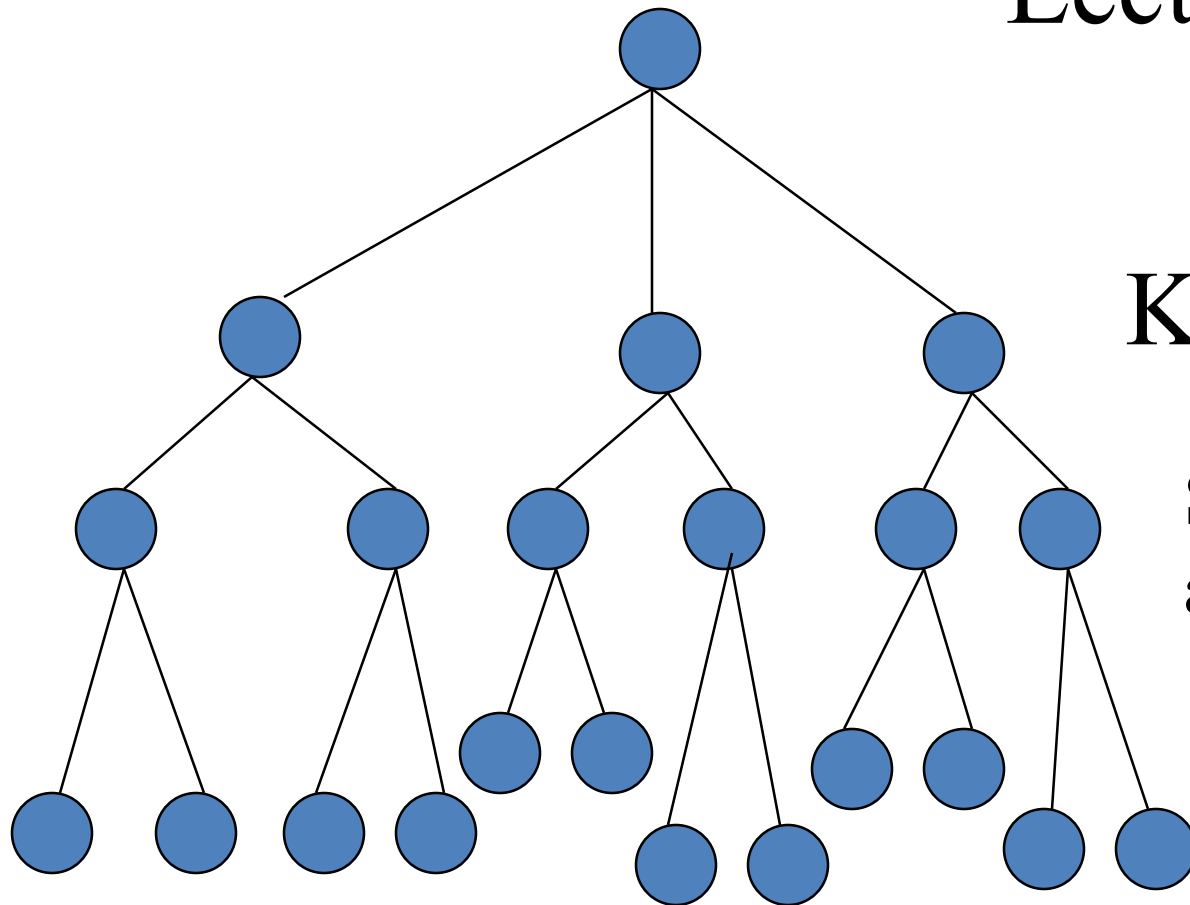
Thinking is slow, effortful, and unreliable.



If we can avoid thinking, we usually do.



What do students get out of class?



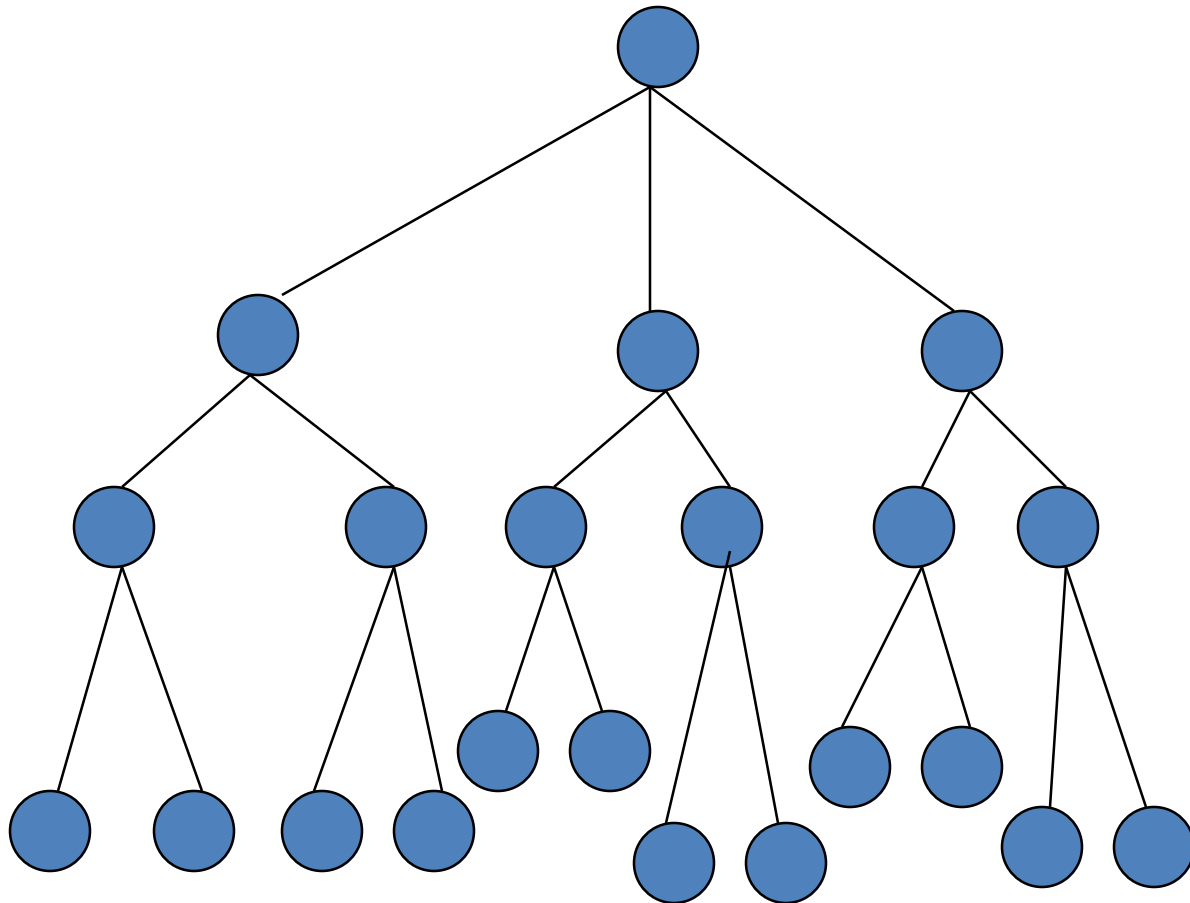
Lecture (or chapter)
topic

Key conclusions

Supporting exps, logic,
anecdotal evidence

Details of exps, tying
examples to principles

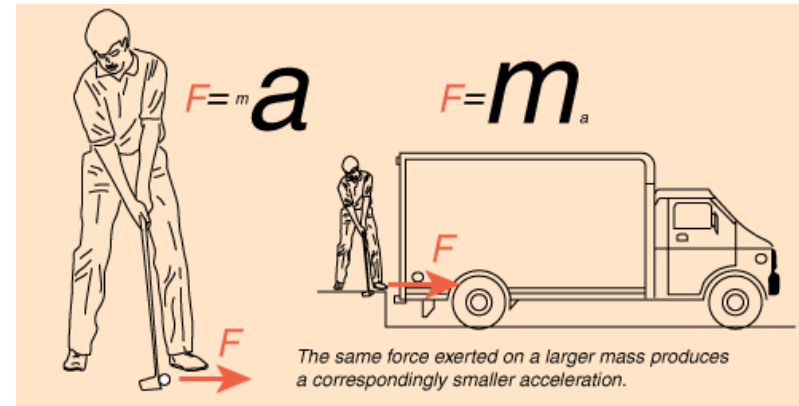
Connections tend to be 'bushy'.



Students tend to focus here.

Why do they do that?

That's the part
they
understand



Most already
believe that
*that's the
bargain.*

Construal of what schooling is.

Let's dig deeper. .
Why do you suppose
Asch set up
the
experiment
that way?

Will this be
on the
test?



Students don't engage deeply because

- (1) humans are biased not to think if they don't have to
- (2) they focus on facts (not deep structure) because facts are comprehensible
- (3) they focus on facts because of testing

Outline

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- **Why it's hard to teach**
- Ideas to address the challenge

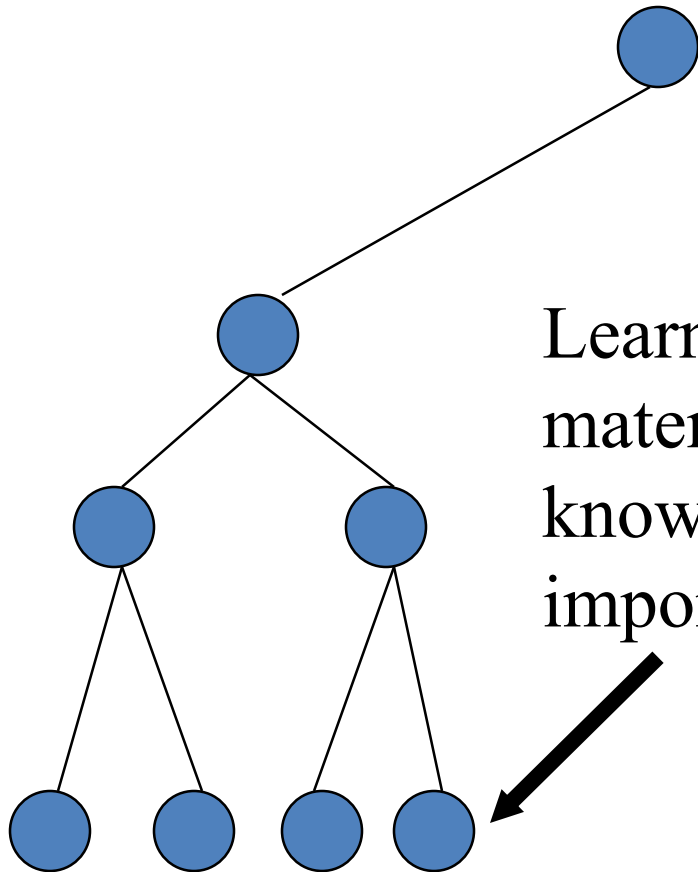
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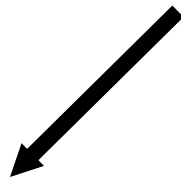
Three time scales

- During class
- Across years
- Across many years

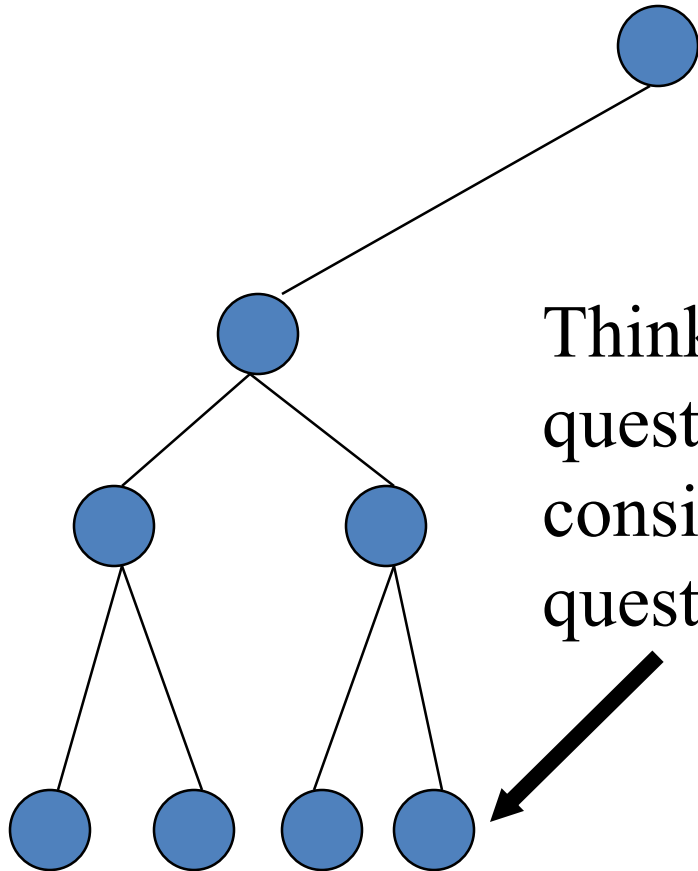
During class: directing attention to deep structure



Learning this material without knowing why it is important is boring.



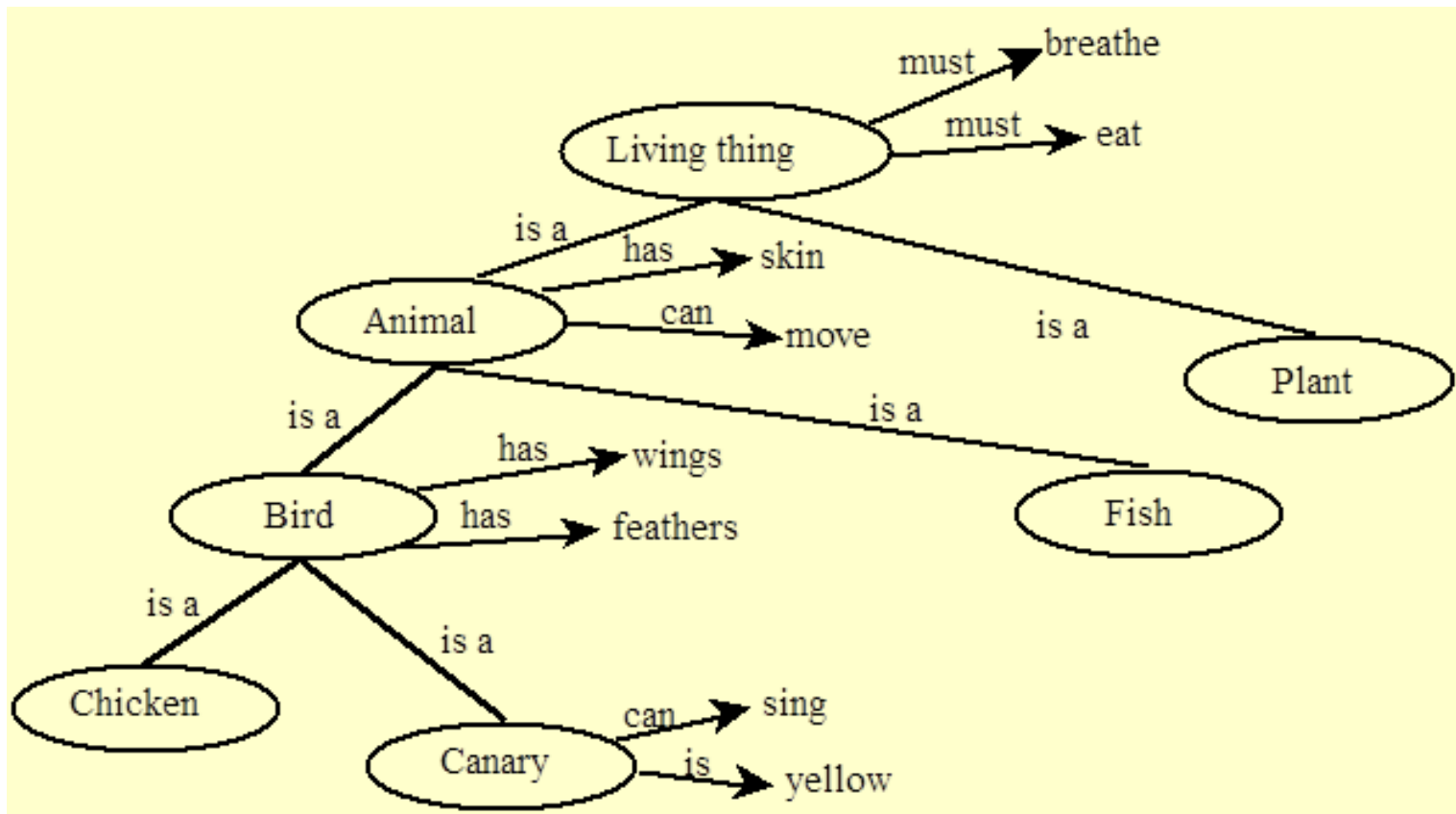
One potential solution



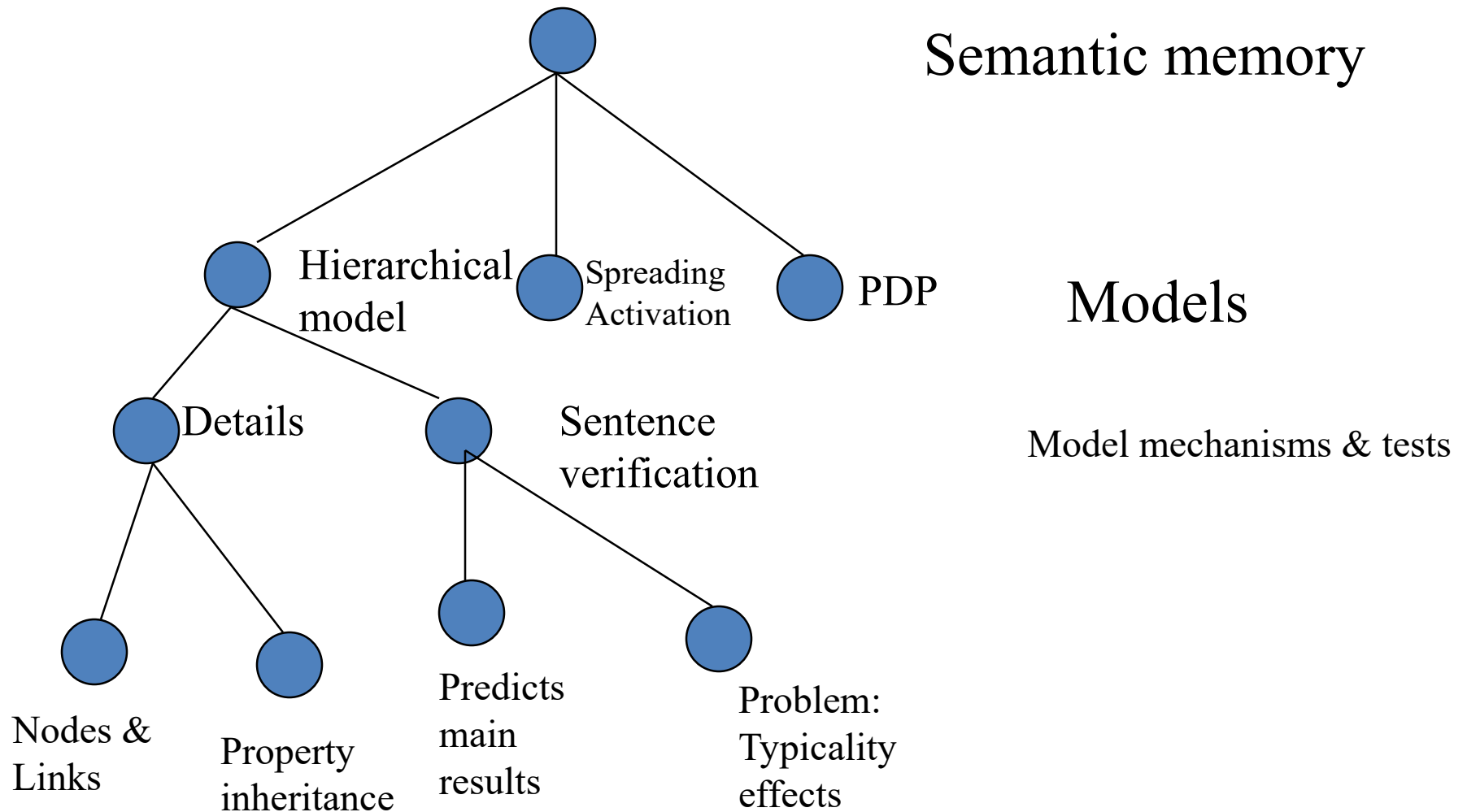
Think of this as the answer to a question, and expend considerable effort to explain the question.

Example--what not to do

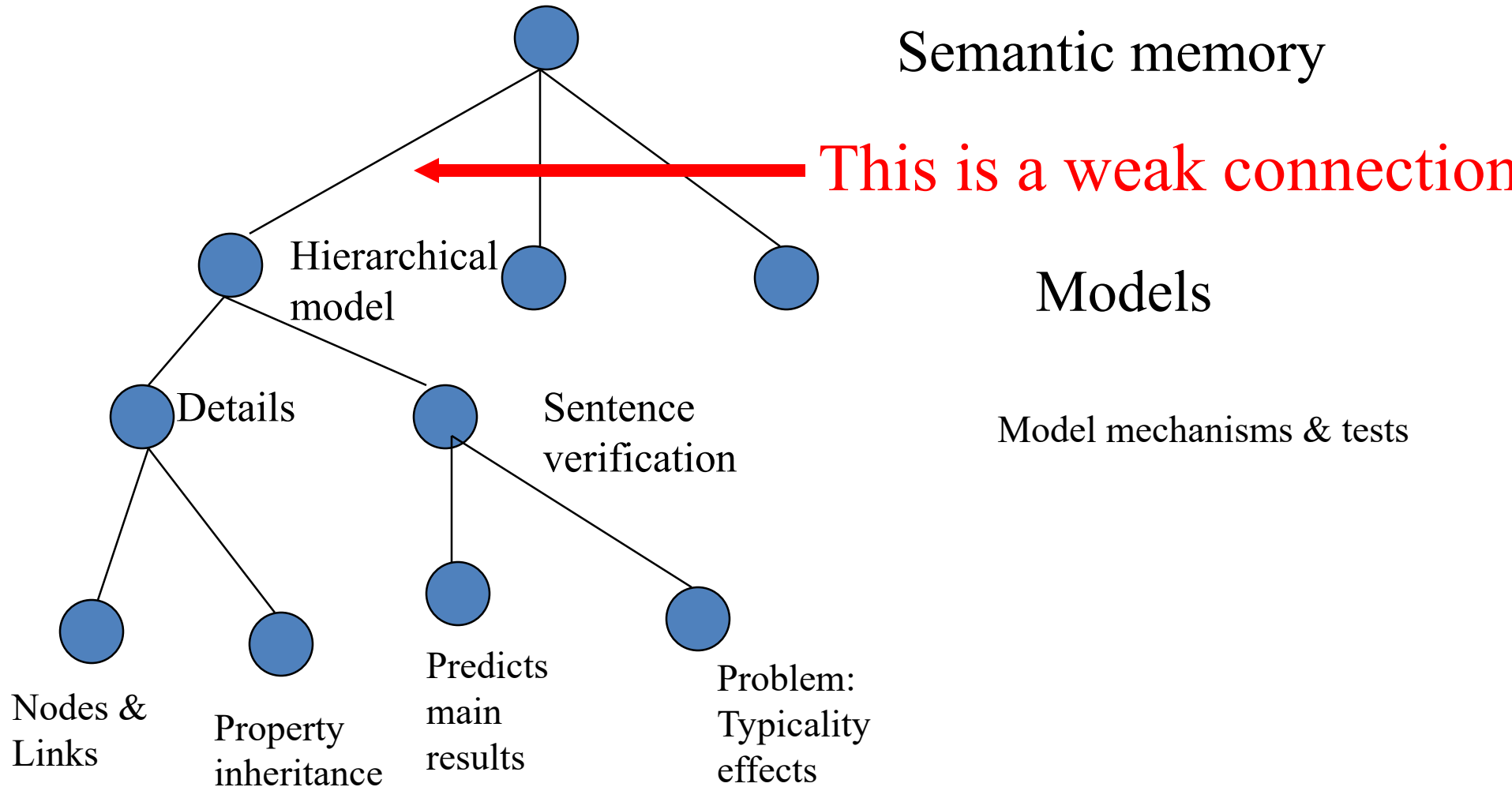
“Semantic memory is your knowledge about the world. How is it organized?”



Example--what not to do



Example--what not to do



Starting question: how does the human memory system know what information to provide, if it doesn't have the right information?

Three time scales

- During class—directing attention to deep structure.
- **Across years—creating experts**
- Across many years—creating culture

The surface/deep structure problem

What challenges/problems come up again and again in psychology?

Which ones do you want your students to recognize so that they *don't have to think critically?*

Across many years
School culture:
WHY ARE YOU HERE?

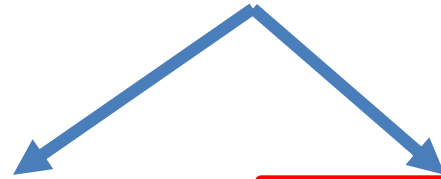


What can be done to foster a communal sense “this is who we are?”

- **Symbols**
- **Heroes**
- **Rituals**
- **Rules**

Summarize

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 - Lessons invite thinking about connections
 - Plan across curriculum to build expertise

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- Ideas to address
 - Lessons that invite solving problems
 - School culture of intellectual pleasure

willingham@virginia.edu

www.danielwillingham.com

twitter: DTWillingham

facebook.com/DTWillingham