

Where to find the mind: Identifying the scale of cognitive dynamics

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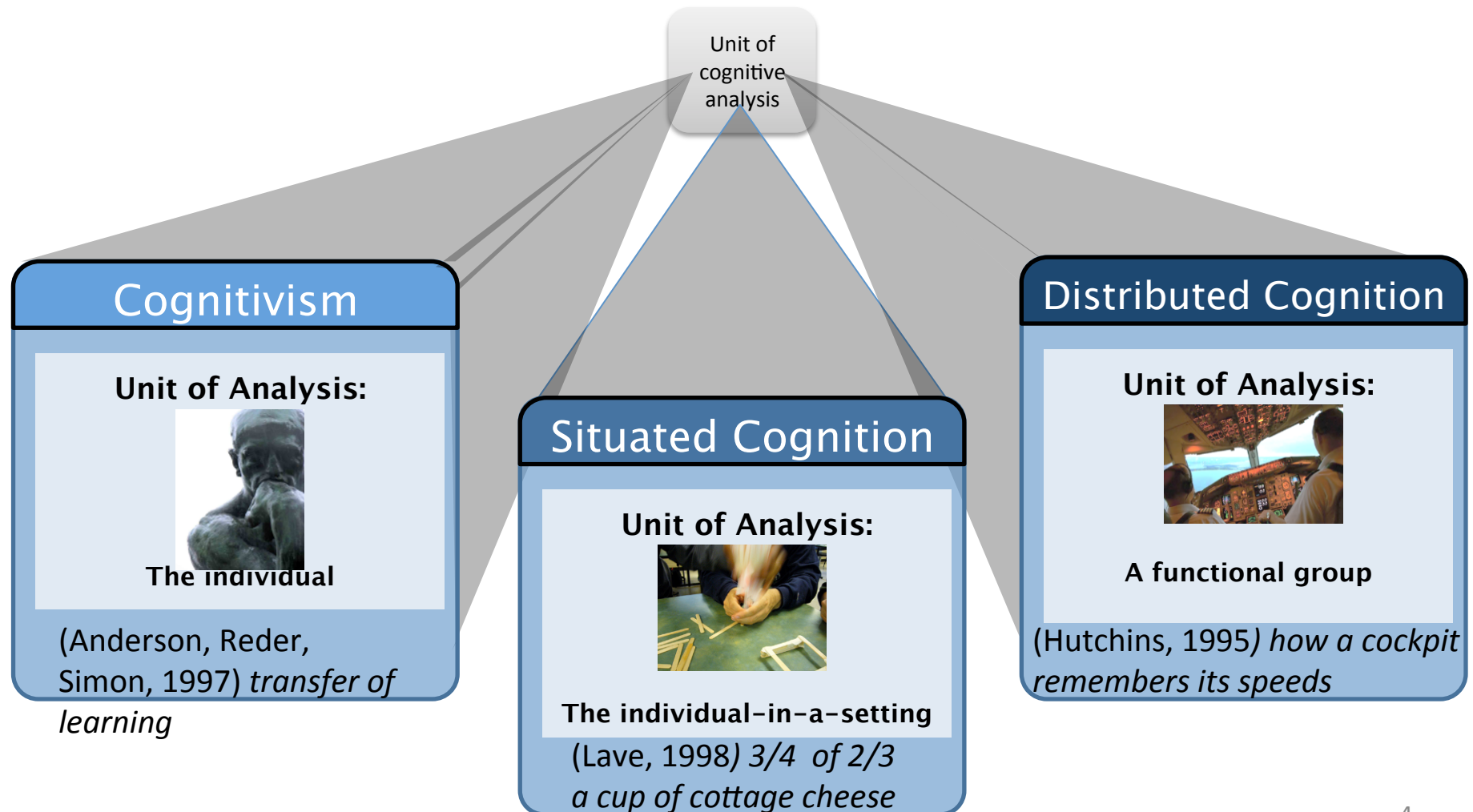
Outline

- WHERE IS THE MIND?**
- MULTI-SCALE MODELS OF MIND**
- EMPIRICALLY TRACKING THE COGNITIVE UNIT**

Act I

WHERE IS THE MIND?

Cognitive science has diverged over where to find the mind



How serious are these divisions?

The divisions are ontological:

what is the thing that is thinking?

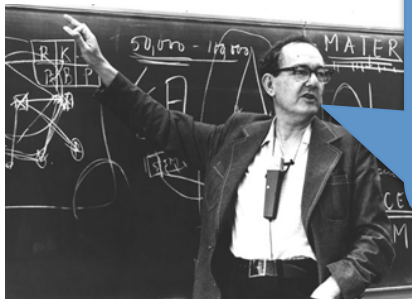
The divisions are epistemological:

what is the phenomenon we should study?

...pretty serious.

Researchers have disagreed over whether and how to resolve the debate

“The central issue is then not that of adjudicating a dispute between opposing perspectives. Instead, it is to explore ways of coordinating **[complementary]** perspectives in mathematics education.” (Cobb, 1994)



“the situated position has not shown that it provides the right theoretical or experimental tools for understanding social cognition” (Anderson, Reder, & Simon, 1997)



“The situative perspective can provide a broader framework for understanding and improving educational practice.” (Greeno, 1997)

That the perspectives are “**incommensurable** rather than incompatible...means a possibility of their peaceful coexistence.” (Sfard, 1998).



Act II

CLAIMS:

**THESE PERSPECTIVES CAN BE
CONTINUOUS.**

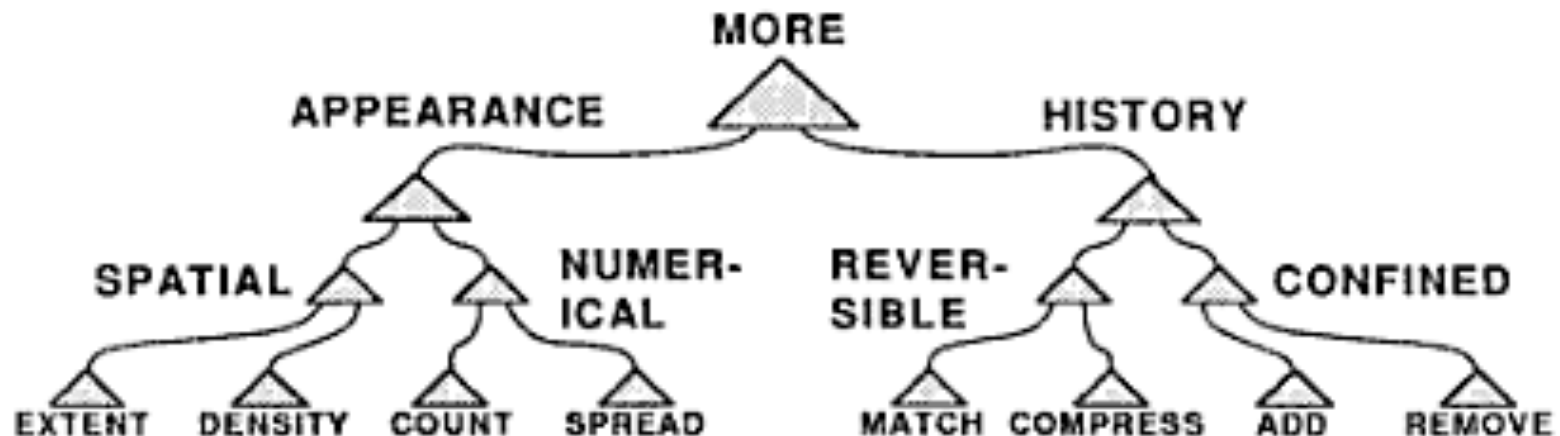
**THE SCALE OF THE COGNITIVE UNIT CAN
SHIFT DYNAMICALLY FROM INDIVIDUAL
TO SITUATED AND/OR DISTRIBUTED.**

An example of a multi-scale model of mind:

The “society of mind” (Minsky, 1987):

- The mind is a society of “agents”
- Each agent, in turn, can be a society comprised of a set of agents.

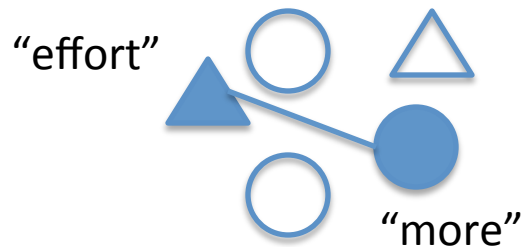
Example: the society of “more”



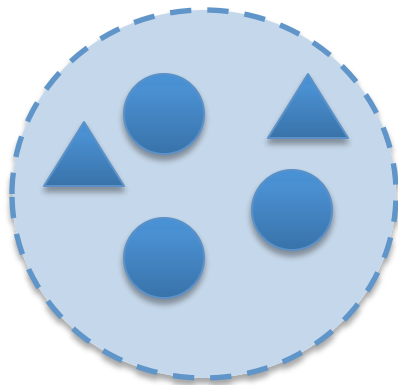
Resource-based models of mind

- Minsky's "society of mind"
- diSessa's "knowledge in pieces"
- Dennett's "pandemonium" model
- Thelen & Smith dynamics systems

Resources: a multi-scale dynamic ontology of mind



Resources—multi-scale cognitive elements which may or may not be activated in a given situation



Locally coherent patterns of resource activation may become resources in their own right

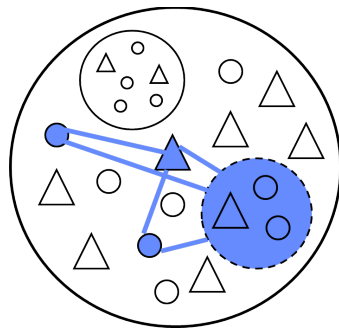
"more effort means more effect"

(Hammer et. al, 2005)

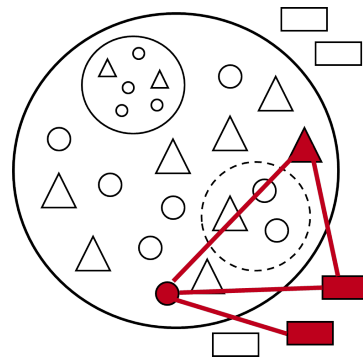
Q: “Where is the mind?”

Q: “Where is the mind state?”*

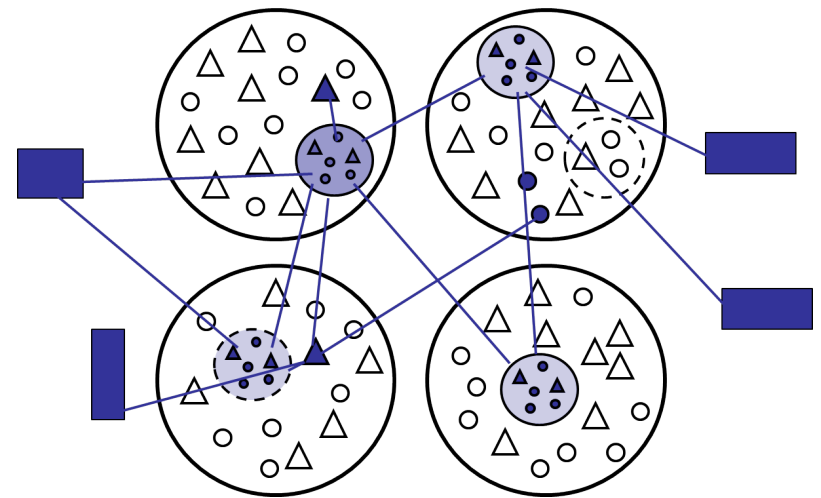
A: “Where the resources are activated.”*



I'm thinking...

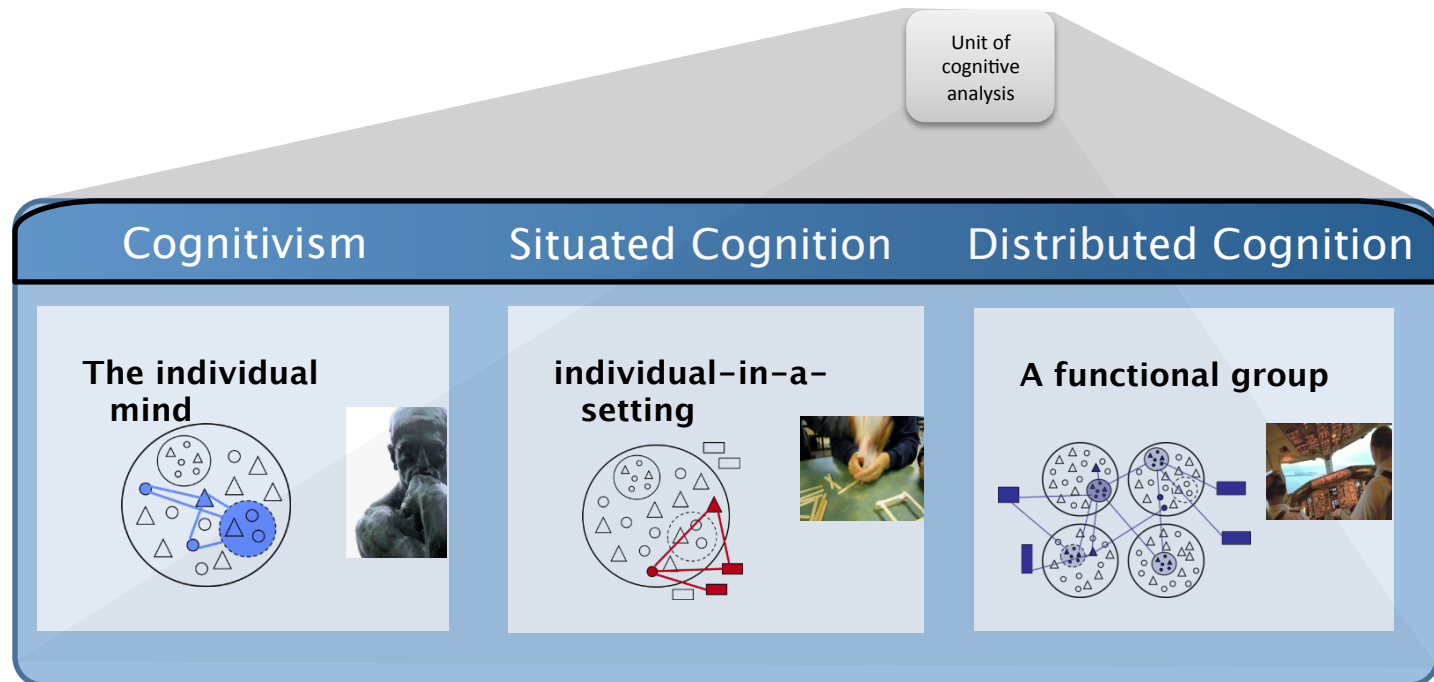


Resources in the
environment



Group work!

A multi-scale model of mind can theoretically unify various perspectives

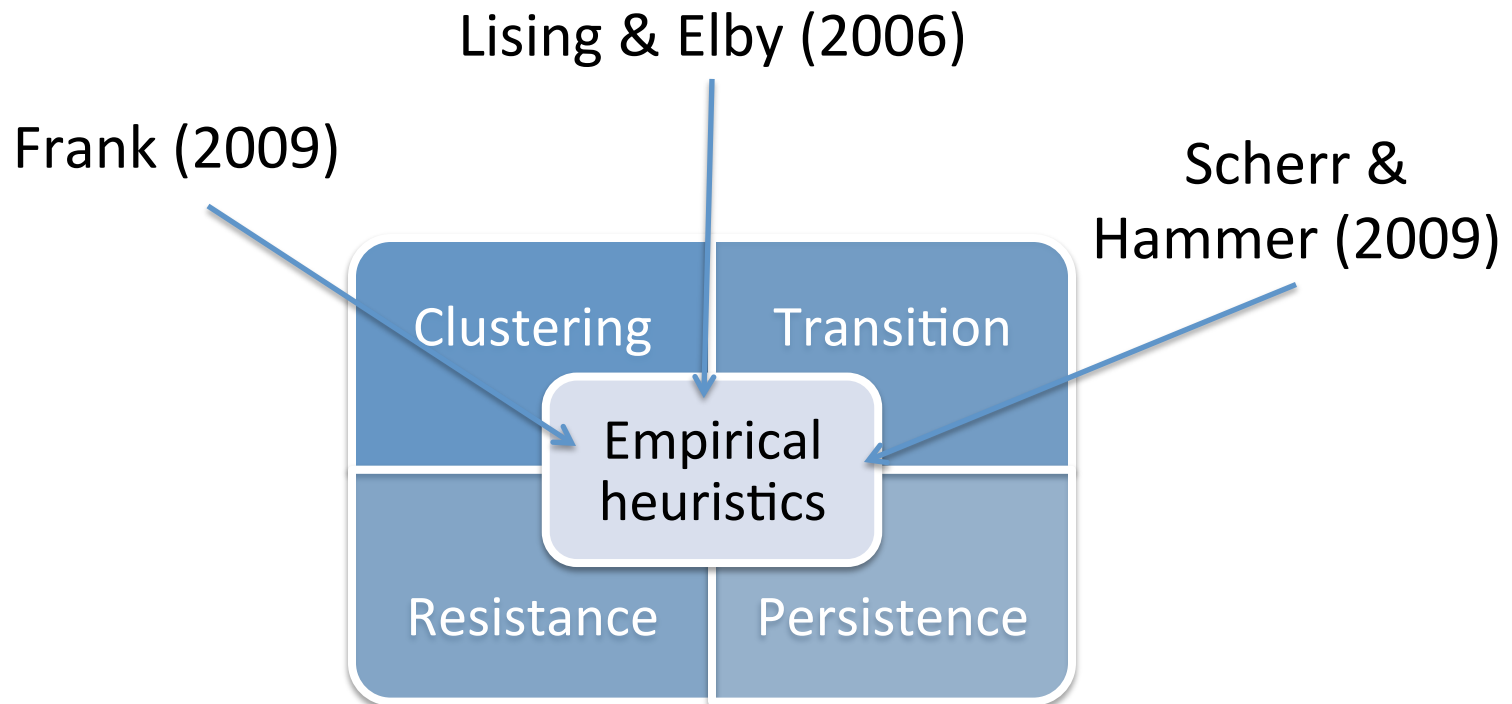


Now, is there a way we can inform the decision *empirically*?

Act III

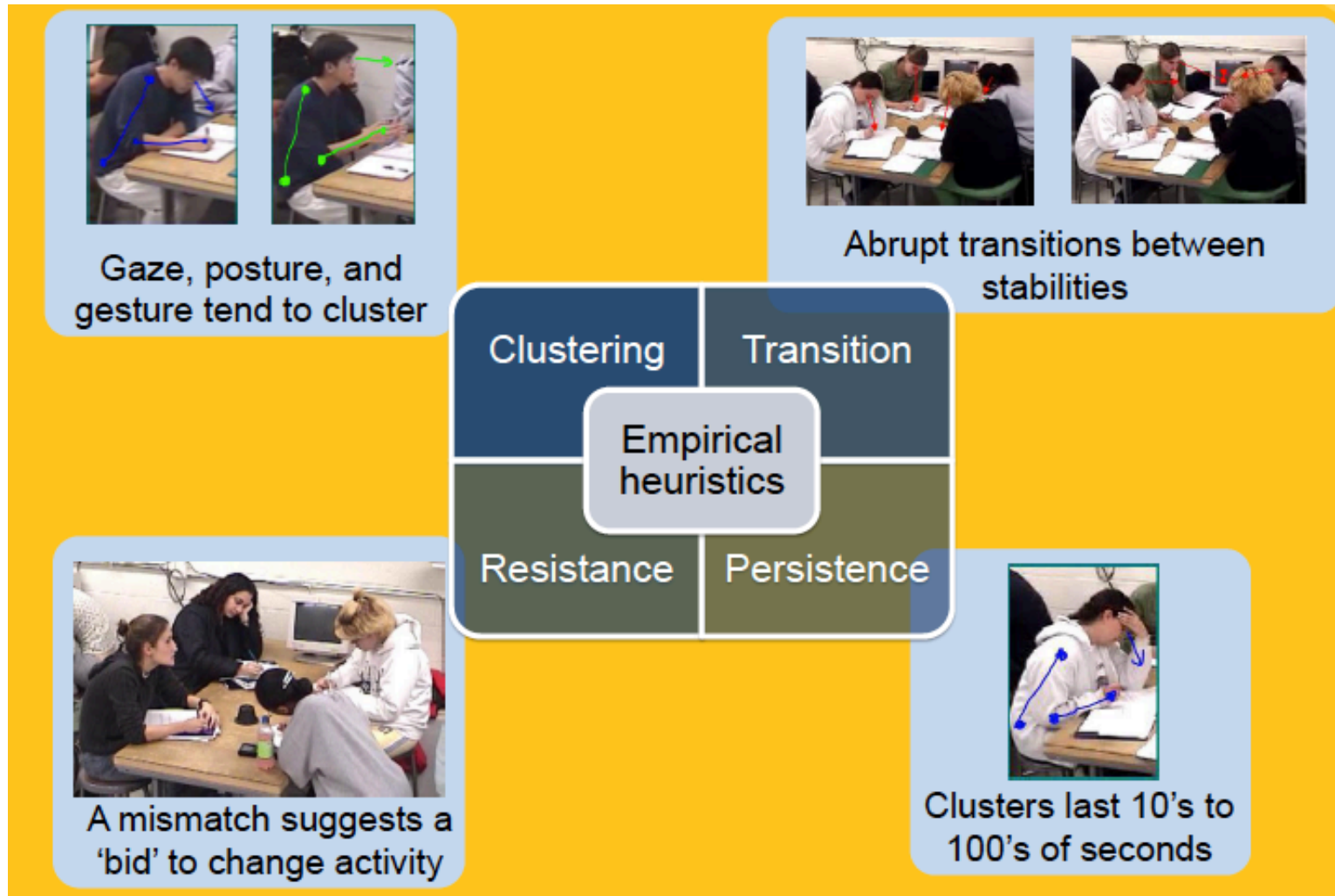
EMPIRICALLY TRACKING THE COGNITIVE UNIT

Sources of video data

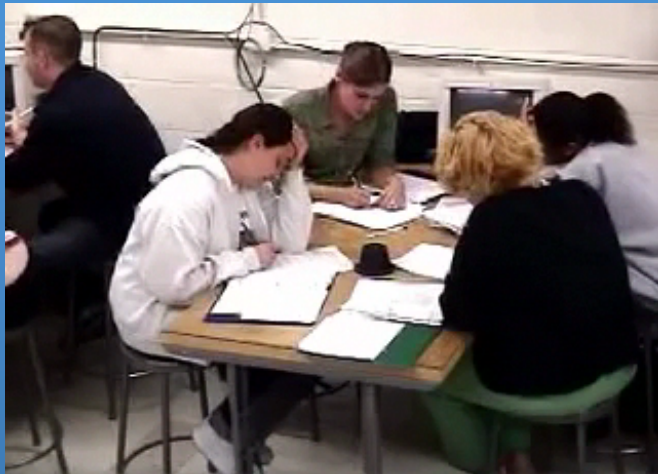


Introductory algebra-based physics tutorials,
Mostly junior life sciences majors

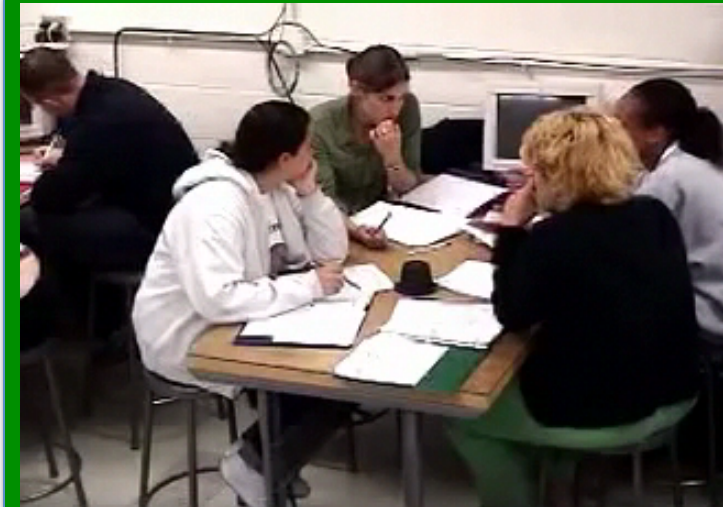
How do we empirically determine the locus of stability & dynamics?



Example of multi-scale cognitive dynamics: individual & group *framing*



Blue behavior cluster



Green behavior cluster

Student's sense of 'what is going on here'

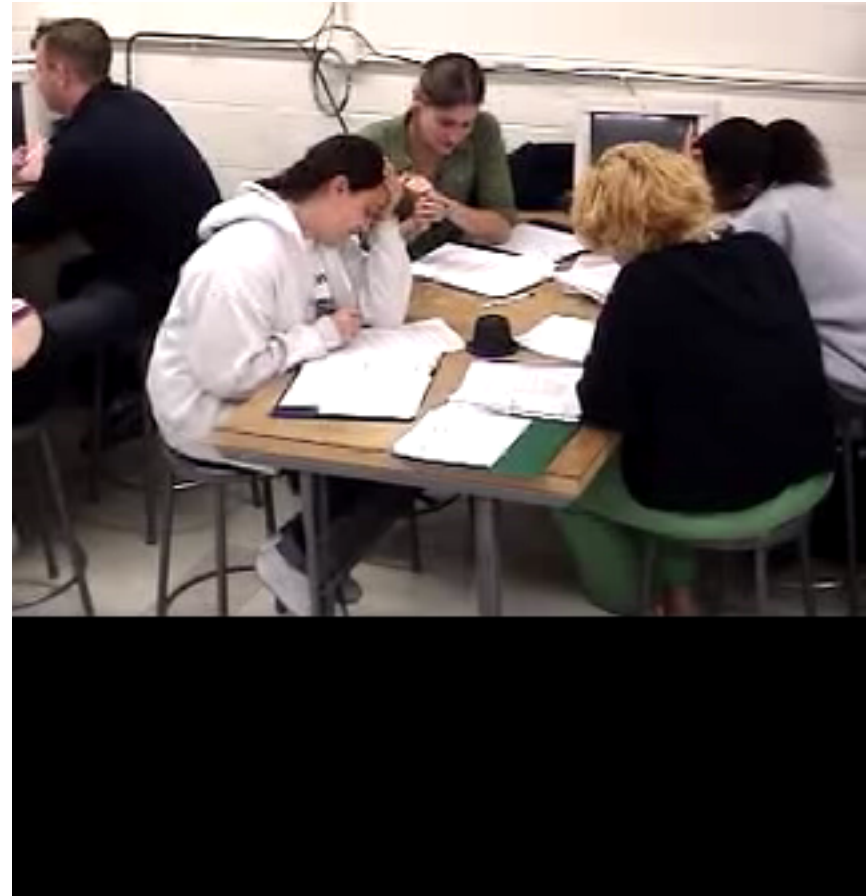
Scherr & Hammer (2009)

Example of group level framing

Newton's 3rd law tutorial:

Refining intuition

A. The truck slows down by 5 m/s. Intuitively, how much speed does the car gain during the collision?



Example of group level framing

5 m/s, that's its what?
Acceleration, or
velocity?

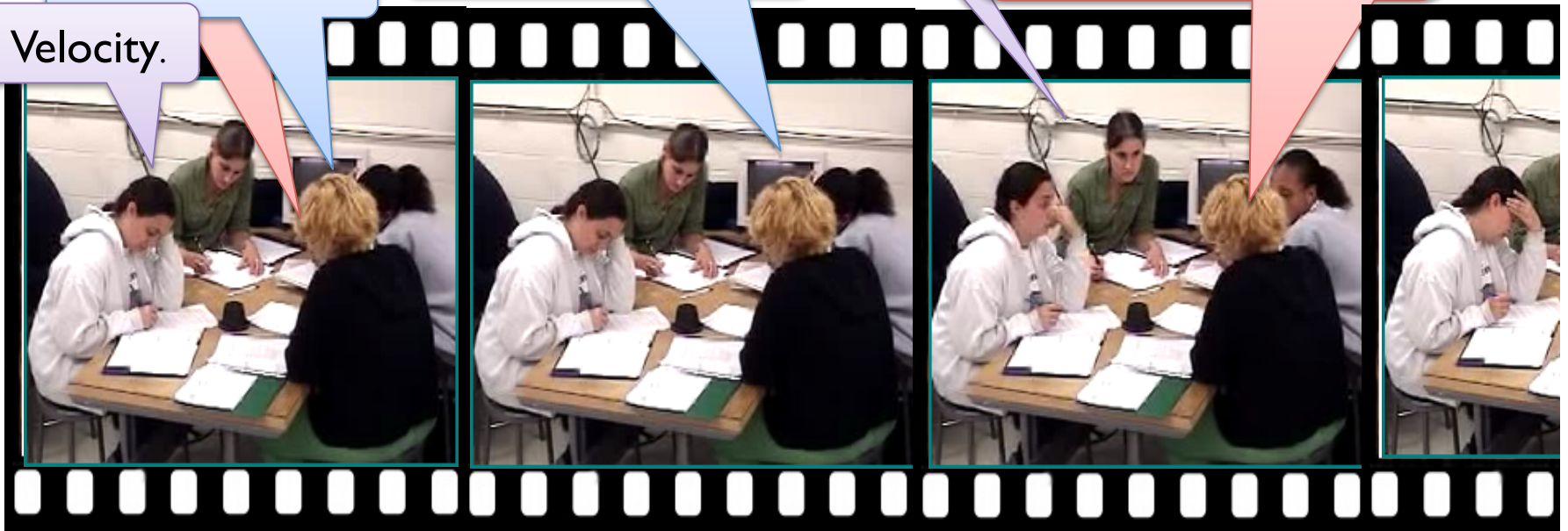
Speed. Velocity.

Velocity.

So the car gains ten
meters per second?

I guess.

What did he say in class?
Like, if something's touched,
the velocity or something
was changed?



Behaviors & utterances indicate group as “filling in the worksheet”

Example of group level framing

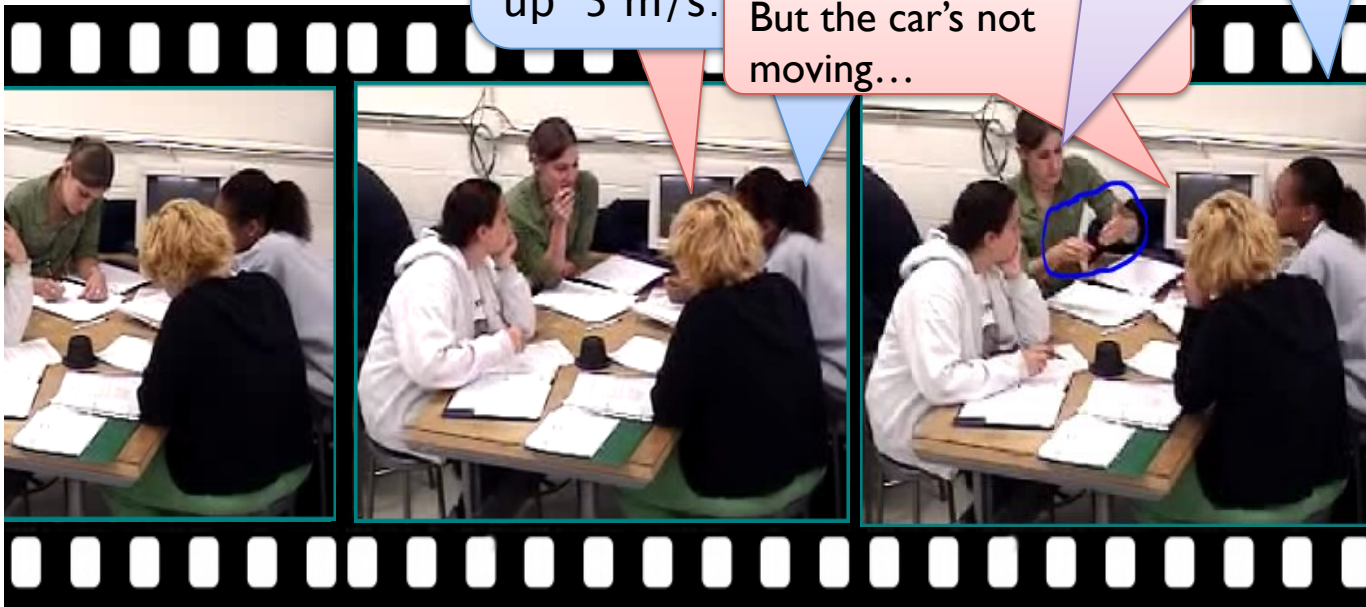
I hate that word, “intuitively.”

See, intuitively I'd think that it'd slow down, I mean speed up 5 m/s.

If the truck is slowing down then I guess the car has to be speeding up.

Cause like it goes kshh.

But the car's not moving...



Group abruptly transitions to “Having a discussion”

Example of group level framing

The *group* abruptly and synchronously transitions between two ways of framing the tutorial

The filmstrip consists of six frames showing a group of students at a table. The first three frames show students focused on their worksheets. The last three frames show the group engaged in a discussion, with one student pointing at a worksheet. Speech bubbles are overlaid on the frames, capturing the students' utterances.

Utterances from the filmstrip:

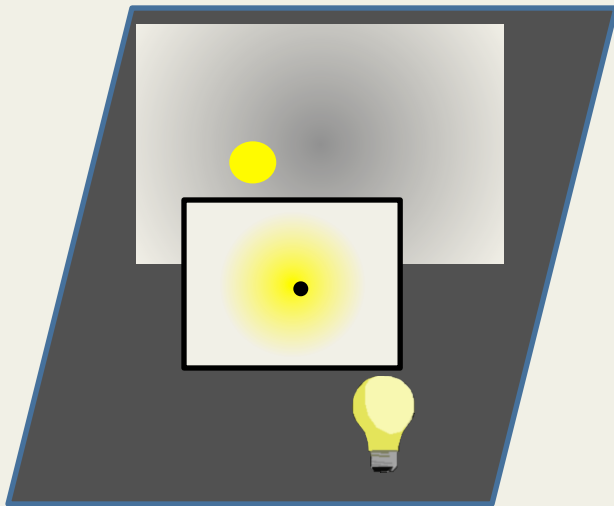
- m/s, that's its what? acceleration, or velocity?
- Speed. Velocity.
- Velocity.
- the car gains ten meters per second?
- I guess.
- What did he say in class? Like, if something's touched, the velocity or something was changed?
- I hate that word, "intuitively."
- See, intuitively I'd think that it'd slow down, I mean speed
- it is slowing down.
- If the truck is slowing down then I guess the car has to be speeding up.
- Cause like it goes kshh.

Behaviors & utterances indicate group as "filling in the worksheet"

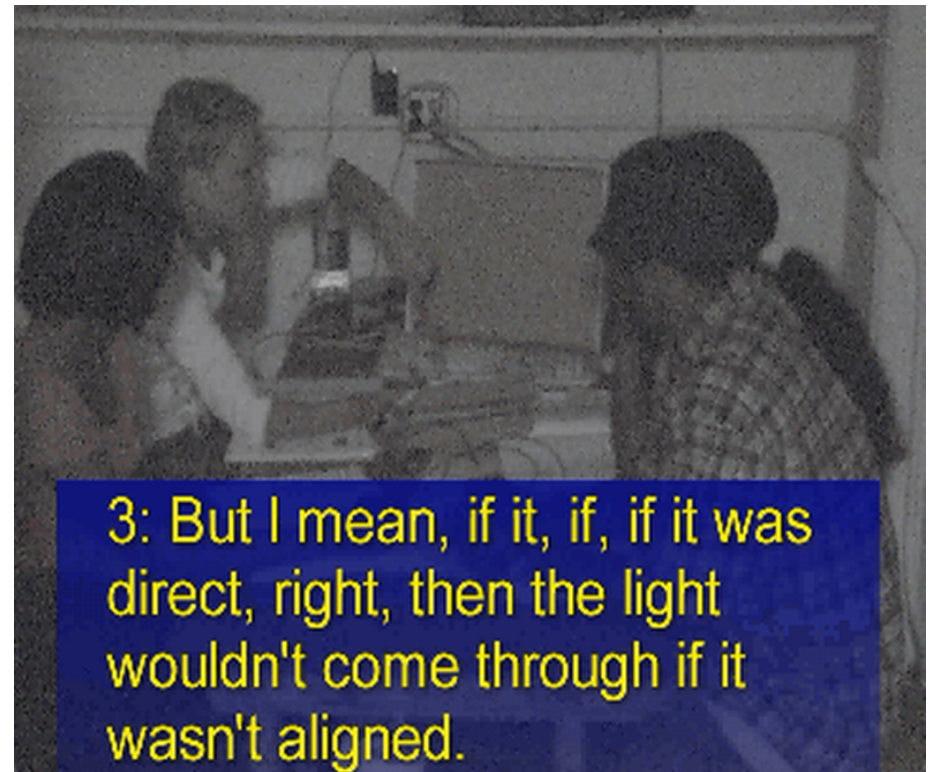
Group abruptly transitions to "discussing the collision"

Example of individual level framing

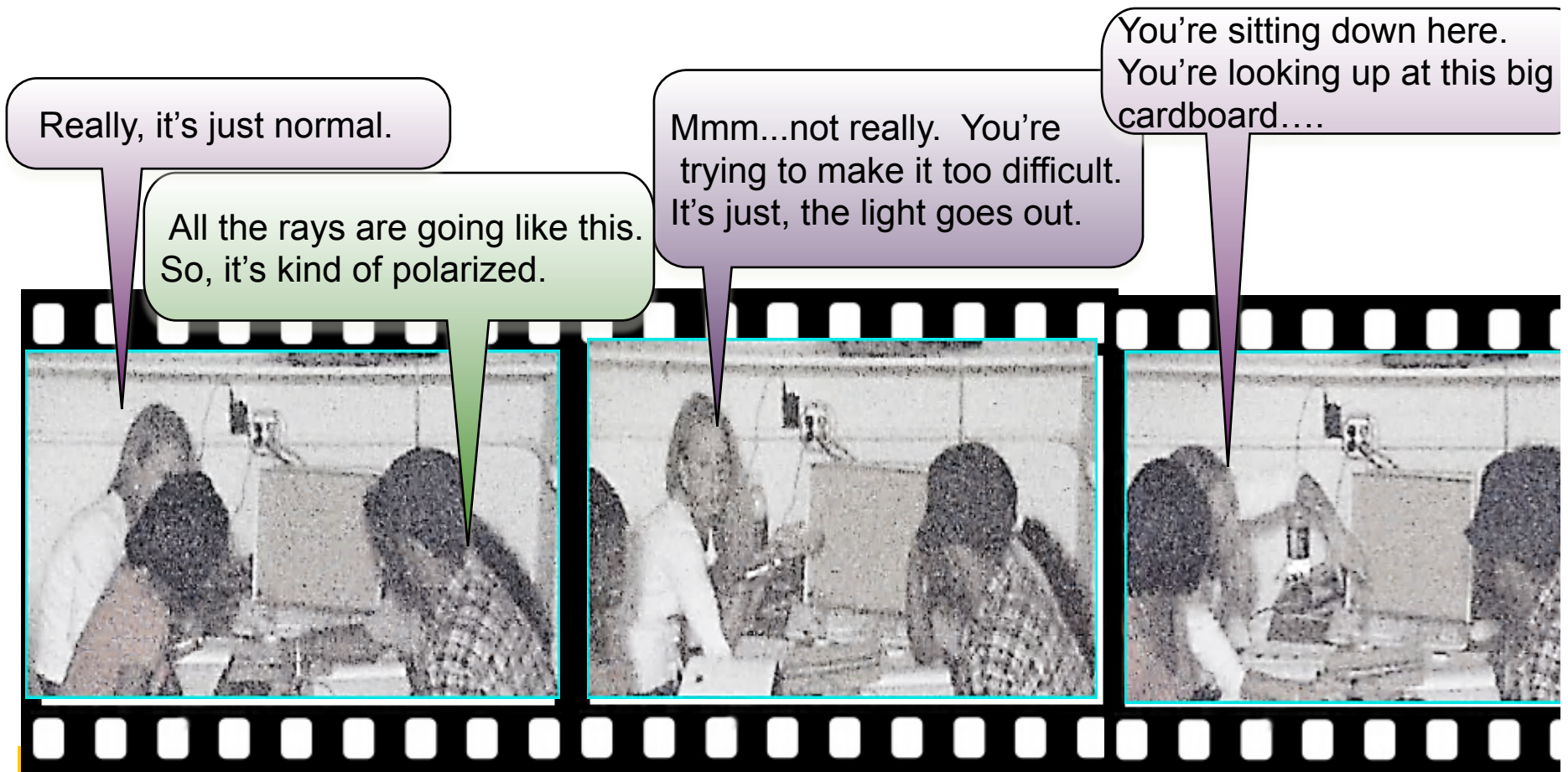
“A Model for Light” tutorial:



“What do your observations suggest about the path taken by light from the bulb to the screen?”

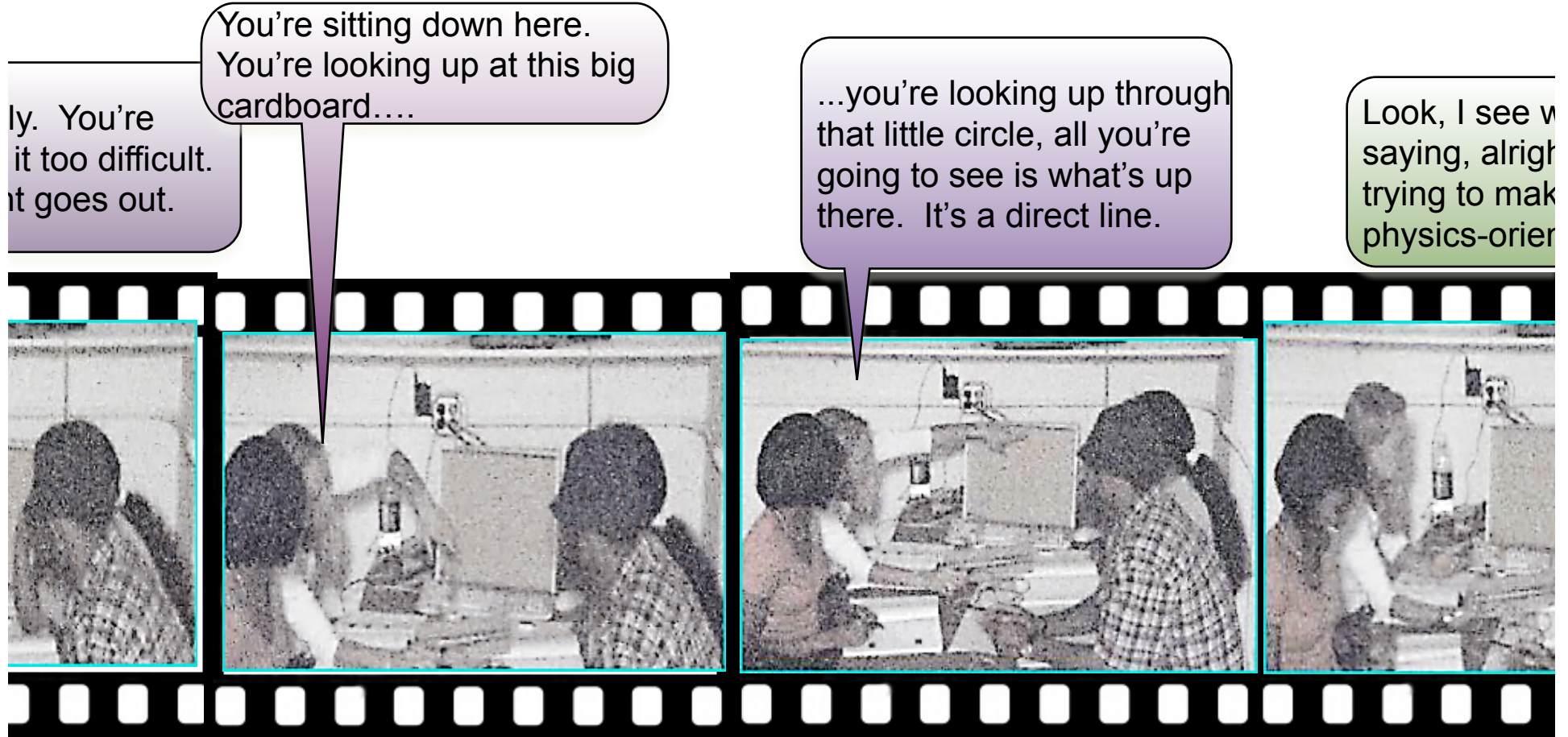


Example of individual level framing



Jan and Veronica disagree not only on the physics content, but also on what it means to be 'physics-oriented'

Example of individual level framing



Jan and Veronica disagree not only on the physics content, but also on what it means to be 'physics-oriented'

Example of individual level framing

you're looking up through
at little circle, all you're
ing to see is what's up
ere. It's a direct line.

Look, I see what you're
saying, alright? I'm just
trying to make it, like,
physics-oriented.

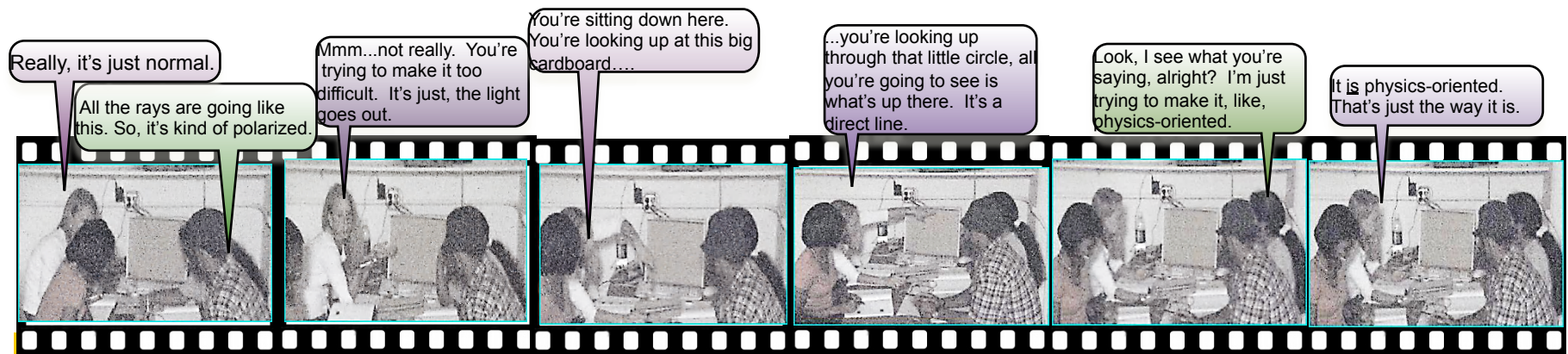
It is physics-oriented.
That's just the way it is.



**Jan and Veronica disagree not only on the physics content,
but also on what it means to be 'physics-oriented'**

Example of individual level framing

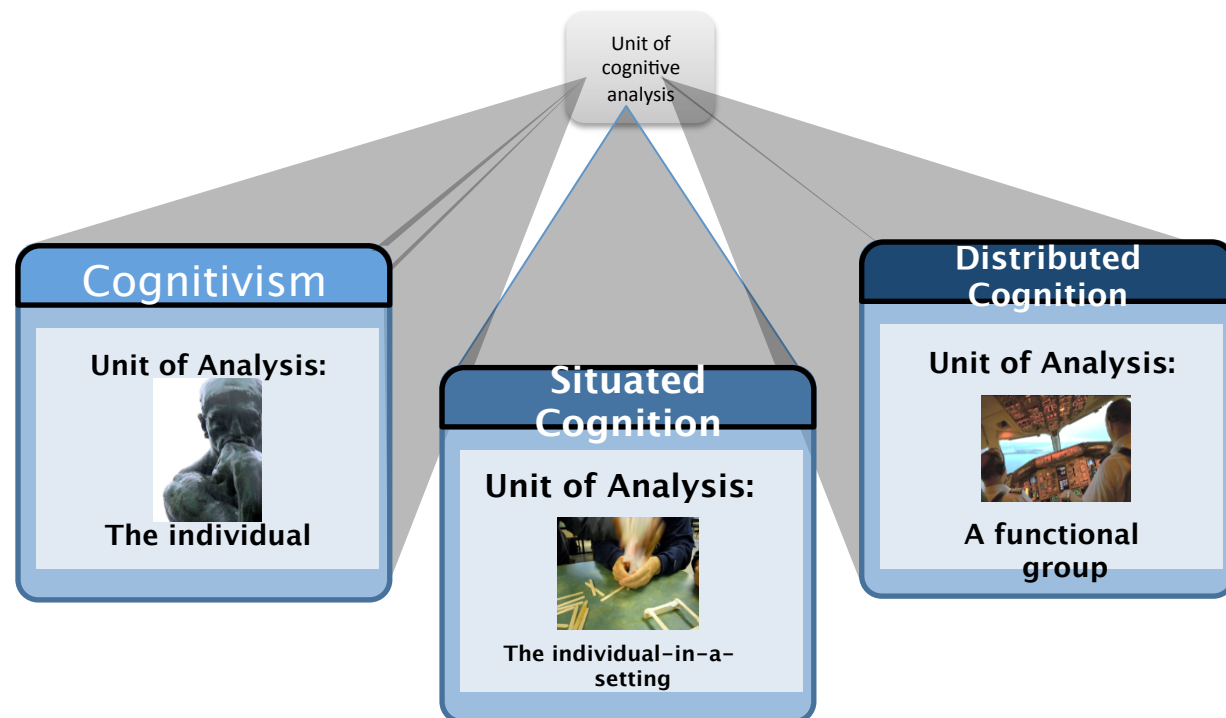
The *individuals* are activating distinct patterns of epistemological resources



Jan and Veronica disagree not only on the physics content, but also on what it means to be 'physics-oriented'

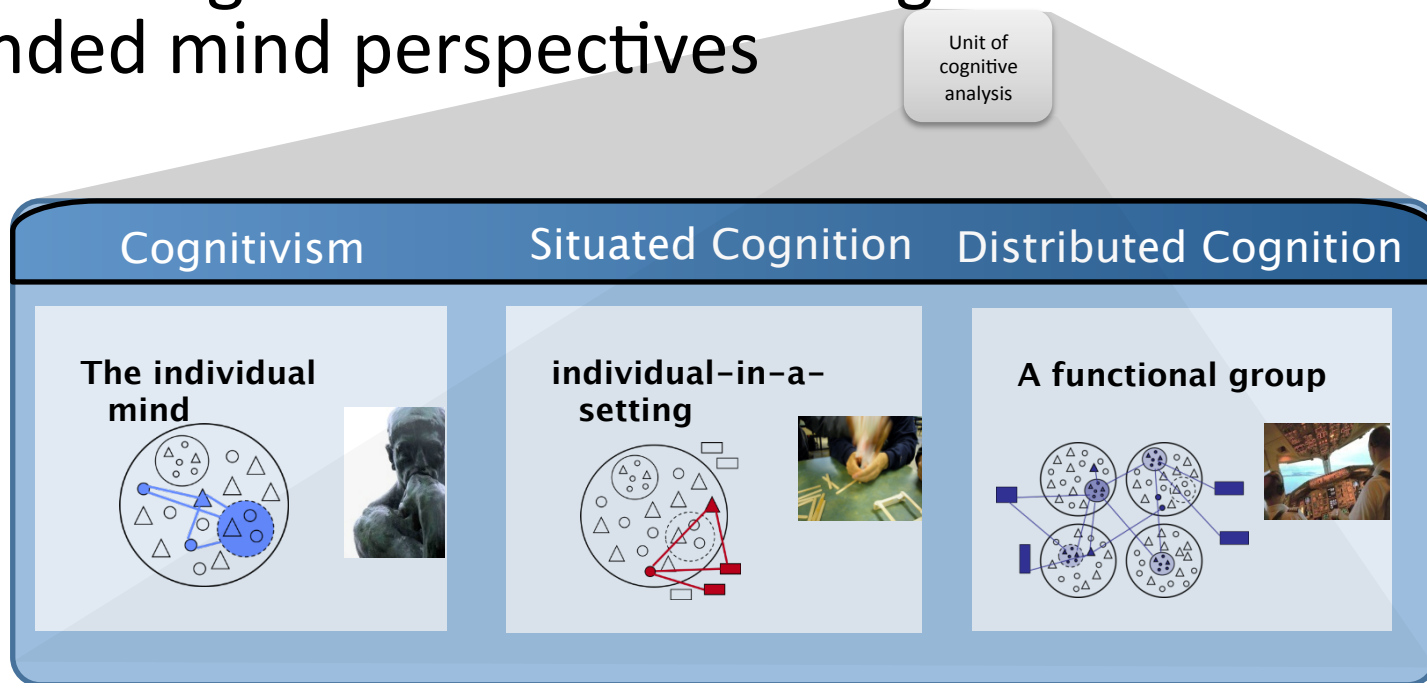
Summary

Point #1: cognitive research has been divided on how to answer the question “Where is the mind?”

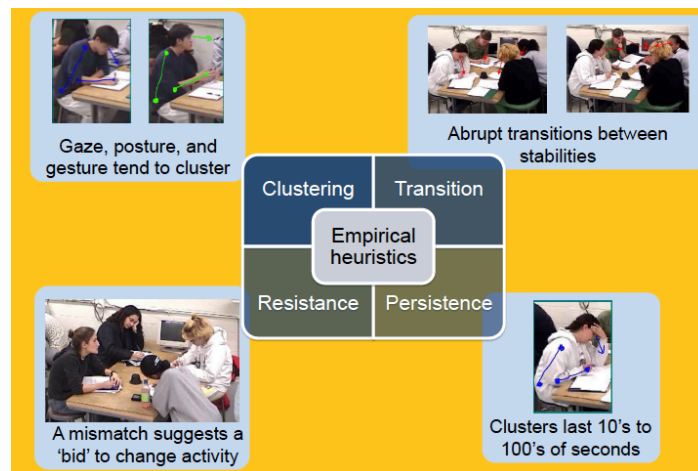


Summary

Point #2: thinking of mind as a multi-scale complex dynamic system can provide ontological and epistemological unification of cognitivist and extended mind perspectives



Summary



Point #3: The complex systems model of mind affords empirical heuristics to inform “Where to find the mind”

Now what?

- Research
 - A common language amongst researchers...
- Ethical
 - ...mention supreme court decision, blame for oil spill as hinging on the unit of cognitive agency?
- Important next questions
 - s?

Acknowledgments

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