Piagetian and Ethnographic Influences in PER

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FACET INNOVATIONS

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Our charge

- Articulate our theoretical frameworks to show how they shape our research questions, data selection, analysis, etc.
- Appreciate and productively critique each other from a place of understanding.

My own theory and methods

- **Theory:**
  Piagetian roots, ethnographic influences
- **Analysis methodology**
- **Brief example analysis**
- **Benefits and limitations**

Theoretical "hometown"

Cognitive psychology focus:

The knowledge and thinking of the individual.

Phenomena of interest for learning:

The logic and structure of existing knowledge about physics concepts.

1. Existing knowledge can **provide a structure** that new knowledge fits into (assimilation).
2. Existing knowledge can **get in the way,** needing to be radically restructured for learning new knowledge (accommodation, misconceptions).
3. Existing knowledge can **be the material** out of which new knowledge is built (constructivism).

(e.g. Duckworth, 1996)

Piaget-style PER

Student understanding of time in special relativity: Simultaneity and reference frames *(Scherr, Shaffer, and Vokos, 2001)*

Research question: What are the conceptual difficulties that students encounter in their study of special relativity?

Claim: Students have a conceptual framework in which absolute simultaneity and the relativity of simultaneity harmoniously co-exist.

Evidence: Pattern of responses to written/interview questions indicating naïve ideas that are incompatible with correct ones.

Importance:

We need to know students' existing knowledge of physics concepts in order to design effective instructional materials.

Theoretical "new home"

Ethnography focus:

Implicit social and cultural organization of actors in a natural setting.

Phenomena of interest for learning:

The meaning of activities for participants.

1. **Participants create meaningful interpretations** of physical and behavioral occurrences.
2. Participants take action based on their interpretations – i.e., **interpretations are *causal*.**
3. Interpretations are often **invisible** to participants.
4. Though **participants treat interpretations as real,** they are open to change.

(e.g., Erickson; Schegloff; Jordan & Henderson)

Ethno-style PER

Making space for sensemaking: How learners create conditions for productive disciplinary engagement *(Scherr & Conlin, in preparation)*

Research question: How do tutorial students manage the tension between productive disciplinary engagement and the evaluation of ideas (which has negative social and affective repercussions)?

Claim: One strategy is *epistemic distancing:* reducing one's apparent stake in the knowledge being evaluated.

Evidence: Sequence of events on classroom video in which ED appears to cause (enable, foster) PDE in student interactions.

Importance: What instructors may interpret as flippancy may be better interpreted as students creating safe space for pursuing ideas. We need to know the meaning of specific experiences for students in order to interact with them appropriately.

Ethno-style PER

Understanding energy with a social embodied learning activity
(Scherr, Close, Close, Flood, McKagan, Robertson, Seeley, Wittmann, and Vokos, in preparation)

Research question: With what specific deep conceptual issues of energy do learners engage while doing Energy Theater?

Claim: Two issues are disambiguating matter flow and energy flow and theorizing mechanisms for energy transformation.

Evidence: Sequence of events on classroom video in which ET appears to cause (enable, foster) engagement with these issues.

Importance: Learning occurs through collaborative negotiation of meaning in a materially structured environment. (Contrast with: Learning is a private mental activity.)

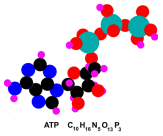
Shared interest, distinct approaches

People make sense of their experiences…

… personally, in their minds.

…socio-culturally, in their interactions with one another.

Both influence what I “see” in my data



Complexity of elementary physics concepts

Rightness of “naïve” ideas

Nonverbal communication

Regularities in and expectations for learning that are exposed by being violated

My own theory and methods

- **Theory:**
  Piagetian roots, ethnographic influences

- **Analysis methodology:**
  Interpretive analysis

Research focus is ***meaning of activities for participants.***

(Erickson, 1996)

- **Brief example analysis**

- **Benefits and limitations**

Methodological framework

1. Research documentation (blogging)
2. Identification of interests (broad research questions)
3. **Data collection**
4. Data selection and content logging
5. **Episode selection**
6. Episode transcription and captioning
7. Methodology reflection and literature
8. Narrative analysis
9. **Development and evaluation of claims**
10. Theory reflection and literature
11. Issues-oriented literature
12. Presentation; publication

What constitutes “data”?

vs.

Focused prompts constructed to pinpoint specific issues

Naturalistic observation gathered to serve many interests

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vs.

Focused prompts constructed to pinpoint specific issues

Naturalistic observation gathered to serve many interests

Episode selection

?

By what means do I select video episodes for analysis?

Episode selection

Episode selection is guided by the identification of **cases.**

instances of a phenomenon or theory that illuminate and explicate it

If I am trying to understand how Energy Theater works,
I should select episodes that richly illustrate Energy Theater,
and work to discern something universal
about Energy Theater through careful study of that episode.

(Or vice versa: Given an episode, what is it a case of?)

Cases need not be typical; they may be

- extreme
- deviant
- diverse
- influential
- revelatory
- …

(e.g., Erickson 1996; Yin 2003; Engle et al, under review)

What constitutes "data"?

What a researcher considers to be "data" depends on what kind of claim she forsees making.

Claims about the **general attributes of a population** require large N for statistical generalization.
Illustrative examples should represent the population.

Seeks reproducible patterns

Example claim:
Students who have completed tutorials in special relativity have different conceptual frameworks than those who have not.

Claims about the **universal properties of particular events** require rich cases for construction of detailed explanations.
Illustrative examples should represent the universal properties.

Seeks causal explanations

Example claims:
Students use epistemic distancing to manage tutorial tension.
Energy Theater causes learners to engage with issues X and Y.

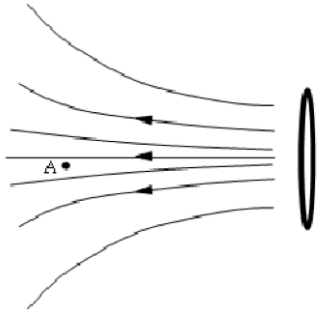
Research interests guide data collection

Research interest	*Type of data collected*
"Universals" as found in the particular details of practice	Video of the details of learner interactions
Meaning of ordinary activities to the actors	"Semi-natural" settings (classrooms)
Logic and structure of physics concepts, as revealed by novices thinking aloud	High-discourse classrooms, conceptual physics content
Reasoning that is grounded and organized by simple physics materials	Low-tech classrooms (blocks, ramps, water, etc.)

Example episode: “Kite”

I. Analogy to electric field: Wind

The point of this tutorial is to introduce *electric fields*. But instead of doing so immediately, we’ll start with an analogy to wind.



An industrial-strength fan creates the wind pattern indicated in this diagram. Someone holds a small kite at point A. Then the person holds a larger kite at that same point. In both cases, the kite directly faces the fan and therefore catches the wind.

1. In what sense is the wind stronger on the large kite than it is on the small kite?
2. In what sense is the wind equally strong at both kites?

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Example episode: “Kite”

Bridget: Does the fact that the force that the wind exerts would make the fan, I mean it would make the kite accelerate more?

Example episode: “Kite”

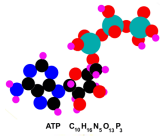
What happens in this episode?

Talk to your neighbor!

Bridget: Does the fact that the force that the wind exerts would make the fan, I mean it would make the kite accelerate more?

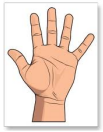
What is this episode a *case* of?*

This episode has the potential to support claims in many categories.



Complexity of elementary physics concepts

Rightness of “naïve” ideas



Nonverbal communication

Regularities and expectations for learning that are exposed by being violated

PER professionals in a regional workshop generated and passionately debated eight claims in ninety minutes.

* <u>Not:</u> *What are the important patterns that recur?*

Claims development

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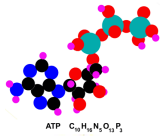

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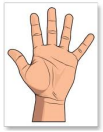

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Caleb understands that the effect on the two kites is in some sense the same.

What Caleb calls "force," we would call _____.

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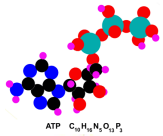

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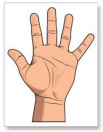

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Regularities and expectations for learning that are exposed by being violated

Caleb establishes gestures for "wind" and "kite" that are taken up by Bridget but not Deb.

Bridget purposefully excludes Caleb from her explanation by pointing and gaze.

Claims development

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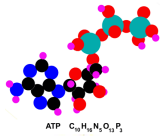

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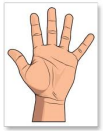

Nonverbal communication

Regularities and expectations for learning that are exposed by being violated

Deb's negation of Caleb's statement caused Caleb to contradict her.

When Deb refuted Caleb's idea without a reason, that ended the physics discussion.

A lack of explicit classroom norms for argumentation hampered physics problem solving.

Claims evaluation

Claim	*Evidence*	*Significance*
What is true about this episode?	How do you know it is true?	Why does it matter? (Placement in scholarly context)

Claims evaluation

Claim	*Evidence*	*Significance*
A lack of explicit classroom norms for argumentation hampered physics problem solving.	Unlikely in this episode	
Caleb understands that the effect on the two kites is in some sense the same.	Possibly in this episode	Could support resources theory of learning
Caleb establishes gestures for "wind" and "kite" that are taken up by Bridget but not Deb.	Likely in this episode	Could develop theory that idea uptake is indicated by gesture uptake

Benefits and limitations

Discovery-oriented: You can find out things you didn't plan to find out.

Naturalistic: takes the classroom environment as it is.

Inclusive: less risk of filtering out important data.

Labor-intensive: Video analysis takes a lot of time.

Unpredictable: Claims are emergent.

Theory-dependent,
in a field **without a theoretical consensus.**

I hope I have fulfilled the charge

- **Articulate our theoretical frameworks to show how they shape our research questions, data selection, analysis, etc.**

- Appreciate and productively critique each other from a place of understanding.