Empathizing with energy: Understanding physics by identifying with hypothetical entities

AAPT Summer Meeting, Portland, OR
July 21, 2010
How scientists build meaning together

A study of how a group of physicists talk about their research.

Figure 7.1 Phase transitions in a diluted antiferromagnet (based on Grest et al., 1986)

Two centers of grammar

The physicist:

We lowered the field.

I’m amazed by his measurements.

The physical system:

The system is in the paramagnetic regime…

Then it crosses to the domain state.

The system may never have the time to experience those random fields.
Indeterminate grammatical constructions

When I come down, I’m in the domain state.

Why don’t I go to the long-range ordered state…?

Here when you reach this point we are in the domain state.

• Animate subjects
• Present tense
• Inanimate predicates

These constructions are ubiquitous.

Nobody is confused.
Everybody does it, a lot
Why do we talk like this?

By using indeterminate constructions as a linguistic heuristic, …

Indeterminate construction
• Observable grammatical phenomenon

…scientists constitute an empathy with entities they are struggling to understand. (Ochs, 1996)

Blended identities
• Hypothetical inner experience
Blended identities
Blended identities

The "simple" harmonic oscillator

It literally wanted to return to the equilibrium position!
Why do we talk like this?

Such a referential poetics allows interlocutors to symbolically participate in events from the perspective of entities in worlds no physicist could otherwise experience. (Ochs, 1996)
When do we talk like this?

…Indeterminate constructions seem… especially suited to the activity of thinking through research problems together. (Ochs, 1996)
When do we talk like this?

…We cannot stress strongly enough that the pervasive context for the emergence of indeterminate constructions is participants’ orientation to a visibly available graphic representation.

(Ochs, 1996)
Instructional design principle

Behavior of scientists in their natural habitat → Directed behavior for science students

Formally incorporating into instruction
Energy Theater is designed to promote symbolic participation in physical events from the perspective of energy.
What value in instruction?

Claim:
Symbolic participation through blended identities allows for much greater access to conceptual learning.

(Today’s) evidence:
Sophisticated graphic displays designed by elementary teachers beginning to learn about energy.
Describe what happens to the energy.
$X = \text{person}$

$g = \text{gravitational}$

$k = \text{kinetic}$
When learners pretend to be the energy, they generate more complex diagrams.
Copying the lab key, or: How to apply the Algebra Project to science teacher professional development
Thursday 10:30 – 12:00, Session 2D