Belief vs. “Understanding”: Why Do Students “Split” on the FCI?*

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Outline

- Review of prior study
- Motivation for the interview project
- Interviews (subjects and protocol)
- Patterns in the interview data
- Summary / future ideas

Original Research Questions

- Do students taking standardized physics tests really believe the answers they put down?
- What happens when students are asked to distinguish their belief and understanding?
- Are there gender effects?

Our FCI Study

"Please **circle** the answer **you really believe**.

Please draw a **square** around the answer **you think scientists would give**."

The Student Task - Splits

4. A large truck collides head-on with a small compact car. During the collision:

(A) the truck exerts a greater amount of force on the car than the car exerts on the truck

(B) the car exerts a greater amount of force on the truck than the truck exerts on the car

(C) neither exerts a force on the other, the car gets smashed simply because it gets in the way…

(D) the truck exerts a force on the car but the car does not exert a force on the truck

(E) the truck exerts the same amount of force on the car as the car exerts on the truck

Major results we noticed

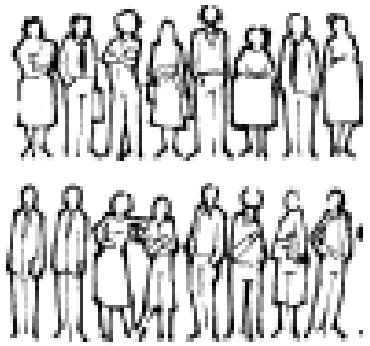
- The average split rate was 24%, and the split rate had a huge range (up to 90%).
- Women split more than men.

What can we learn from interviews?

- Why do they say they split? Are they following my directions?
- Maybe the number of splits can tell us something about a student's epistemology.
  - Are low splitters authority driven and resistant to bringing in their own ideas?
  - Are high splitters "relativists" who see no need to reconcile competing ideas?

Answer Key to Previous Slide

- They split for a variety of reasons, one of which is they don't follow the letter of my instructions.
- Many low *and* high splitters believe they can reconcile in the context of tutorials.
  - Number of splits alone *won't* tell you much. Splits do NOT mean they think the physicist is wrong or that multiple answers are equally valid!



Subjects

Nine students were interviewed for a half hour each:

- They were in our introductory algebra-based mechanics class
- I tried to interview both high and low splitters.

General Protocol

- (Background questions about previous physics experience)
- How do you know someone is an expert? (*)
- What do you do when experts disagree? (*)
- How do you know when you understand something? (*)

Questions marked (*) from Belenky,

Women's Ways of Knowing

Specific Protocol

- Here was the task we gave. Before going into it, did it seem to make sense that we were asking you to do this? Why or why not?
- (for frequent splitters) Why do you believe the answer you circled? Why do you think scientist would give the square answer? Is it worrisome that there's a difference? Do you think the scientist could be convinced to see your point of view? What would it take? Do you think you could be convinced of the scientist's view?

Key Data Patterns

- People who don't split don't see why one would: "*Why wouldn't I believe the answer a scientist would say?*"
- "Beliefs" often correspond to a student's intuition!
- Often, a "split" acted as a "hedge," a way to indicate your two top choices without having to pick only one.
  - **Corollary: We did not see cases where a split indicated a belief that both answers are equally true.**

Other Data Patterns

- Student's "scientist answers" often reflected the belief that scientists "make things complicated."
- What they thought of as "understanding" varied:
  - Sometimes inconsistent with behavior!

Why Split?

Christine: It was confusing in a lot of them, because if you're looking for the *right* answer…

I: Mmmhmm.

C: You know, what you believe, then you're gonna assume that the scientist is gonna give a right answer too. So, if you're really confident in your answer, it seems sometimes repetitive.

Splits as confidence indicators

Emily: "Yes. And then for the ones where my circle and square were on different choices, I thought maybe it was just my intuition-based answer, so then a scientist might say something different because it wouldn't… they would be basing their answer on… facts, I guess."

“Sarah” on relativism

“Sarah”, a low-splitter, discussed her opinion on questions she *might* split on.

I: Would that be worrisome to you…? That there was a difference between those two things?

S: Yeah!

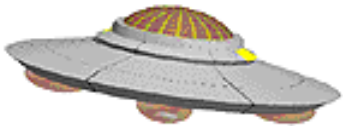
I: Why is that?

“Sarah” on relativism

S: Well just because then I wouldn’t know which was correct, or anything, and I’d wanna know which one was, you know? There can’t be two different answers. Well, I know that… I know that there’s two different ways… if you can explain things and support your answers, I know there can be two different answers, but I would prefer to be saying the same thing.

Scientists Confuse Things

Christine: It is true, if you listen to a scientist talk, a lot of times, you don't understand everything, and so if I didn't understand everything in the answer, it seemed like a plausible scientist explanation.



Future Plans

- For future implementations, reword the question so:
  - they **circle** the answer that makes *intuitive sense* to them
  - they **square** their *scientist answer*

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