Determining How Context Matters in an Algebra-Based Physics Class

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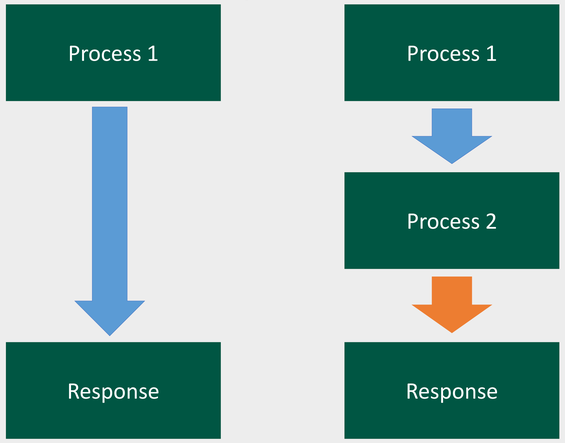
Motivation

- Life science majors must take physics
  - MCAT[1]
- Focus more on reasoning[2]
  - Classes focus on breadth instead of depth[1]
  - Students want more biological examples[1,3]

Dual-Process Theory of Reasoning[4]

- Process 1: Fast, intuitive, develops mental model
  - More familiar context = More accurate mental model
- Process 2: Slow, deliberate, overrides output Process 1
  - More relevant context = higher motivation to think about problem more



Research Question

How does altering context of physics questions affect student reasoning?

Methods

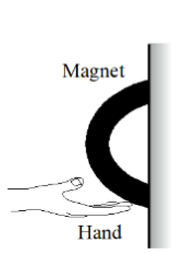
- Took physics problems with intuitively appealing incorrect answers and changed context
- 2 semesters
  - Fall 2024 (N = 148)
  - Spring 2025 (N = 78, ~83% life-science majors)
- Half received physics context, half received life-science context
- Analyzed student reasoning

Task Details

Physics Context (Magnet)

A magnet weighing 1 N is placed on the side of a refrigerator. A hand pushes upward with 0.5 N of force but the magnet does not move. Is the friction force exerted on the magnet by the refrigerator door upward, downward, or zero?

a) Upward
b) Downward
c) Zero
d) Not enough information given to answer the question



Life-Science Context

Most geckos can stick to walls through millions of hairs on their toes called setae. Imagine you observe a gecko weighting 1 N on the side of a wall. You push the gecko up with 0.5 N of force, but the gecko does not move. Is the friction force exerted on the gecko by the wall upward, downward, or zero?

a) Upward
b) Downward
c) Zero
d) Not enough information given to answer the question

Results

Fall 2024

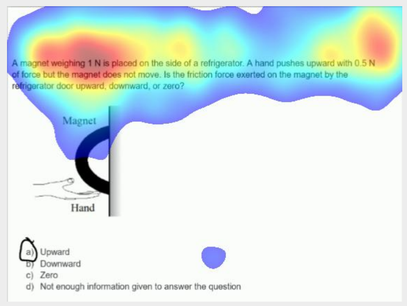
	Magnet (N = 72)	Gecko (N = 76)
Upward	39%	37%
Downward	44%	46%
Other	4%	6%
No Reasoning	12%	11%

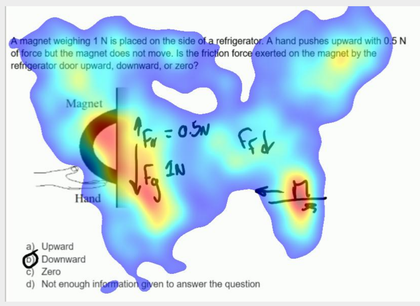
Spring 2025

	Magnet (N = 38)	Gecko (N = 40)
Upward	39%	30%
Downward	50%	60%
Other	11%	5%
No Reasoning	0%	5%

Discussion/Future Work

- Similar results between contexts
  - Successful transfer between contexts
- Next step:
  - Interviews with eye tracker





NSF DGE #2329292

Citations:

1. *"Rounding off the cow: Challenges and successes in an interdisciplinary physics course for life science students", Dawn C. Meredith and Jessica A. Bolker*
2. *"Application of Bloom's Taxonomy Debunks the MCAT Myth", Alex Y. Zheng, Janessa K. Lawhorn, Thomas Lumley, Scott Freeman*
3. *"Reinventing physics for life-science majors", Dawn C. Meredith and Edward F. Redish*
4. *"Dual Process Theories of Higher Cognition: Advancing the Debate", Jonathan St. B. T. Evans and Keith E. Stanovich*