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Undergraduate Students' Accuracy & Confidence in Detecting Errors in Biological Models Related to GPA

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INTRODUCTION

- Modeling-based instruction is a technique to facilitate student learning of complex, biological systems. In many ways, modeling is science (Windschitl et al 2008).
- Recent research and theory suggests that error checking and inhibition might be especially important in developing accurate understanding of scientific concepts in higher education (Mason & Zaccoletti, 2020).
- Student grade point average (GPA) has been shown to predict student ability to accurately detect errors in models (Whalen & Shelley, II, 2010).
- Previous work at UNL found variation in neural patterns related to model interpretation (Clark et al 2020). By understanding how students identify errors in models, this will pave the way to initiating better teaching methods, such as how material is taught and what types of models are better for student learning.

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METHODS

- Students were recruited in the second of two introductory life-science courses, mostly freshman and sophomores. 34 students underwent a functional Magnetic Resonance Imaging (fMRI) scan and indicated whether the biological model had an error, as well as if they were confident in their response. GPA is that incoming upon starting the course.
- Trials included models of evolution, genetics, physiology, and ecology in randomized order and each model has 1 correct and 2 incorrect versions. After the scan, students indicated where errors existed on printed models and were allowed to change their responses.
- Accuracy was defined as the participant successfully detecting an error when one was present, or successfully determining there was no error in a correct model.

Research Questions

1. Does students' abilities to Accurately detect errors relate to their GPA?

2. Which concepts affect student ability to Accurately and Confidently detect errors?

DATA ANALYSIS 1

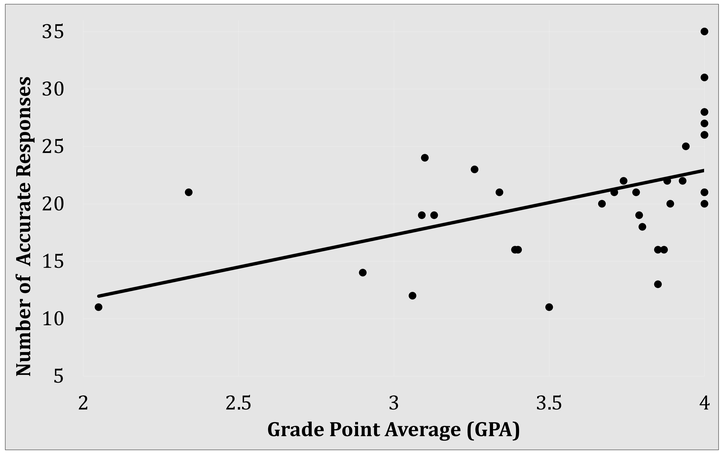


Figure 1. Number of accurate responses (36 total) related to student GPA

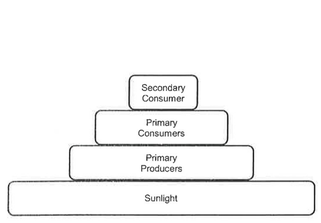
- **Students with higher GPA's tend to more frequently respond accurately; y= 5.6159x + 0.4552, R^2= 0.249, p=0.002 (Fig. 1)**
- **Student's confidence in their responses (data not shown) was unrelated to GPA (p= 0.457)**

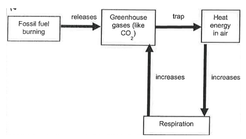
DISCUSSION

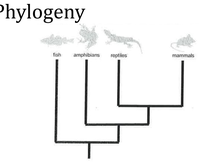
- GPA was positively related to accuracy but was unrelated to confidence (Fig. 1)
- Subject areas affected students' accuracy and confidence
  - Students were more accurate on ecology & evolution models (Fig. 2)
  - Students were more confident in ecology models and less confident in physiology models (Fig. 2)
- Variation in student ability and subject area competency can provide teachers with places to focus and improve science understanding.
- Similar to the work of Clark et al 2020, this study gives merely a foundation on how certain principles affect the neural aspects of how students engage in reasoning about biology.

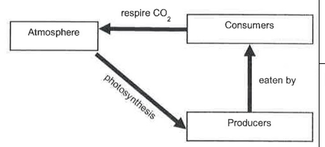
DATA ANALYSIS 2

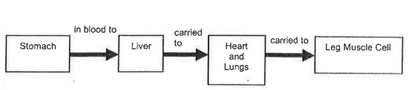
Accurate Response		Inaccurate Response	
Confident (n=29)	**Not Confident (n=14)**	**Confident (n=22)**	**Not Confident (n=8)**
Energy Pyramid	Climate Change	Carbon Cycle	Blood Flow
Animal Phylogeny			Fat Burning











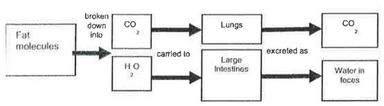


Figure 2. Top models for each combination of accuracy & confidence. The number of students (*n*) in which each scenario occurred is included under each combination to show what amount placed the specific models at the top.

- Students fell into 4 categories of accuracy and confidence, and the majority of the participants' responses were recorded as both accurate and confident (50.24%)
- Out of 1,254 total responses, 824 were accurate (65.7%) and 942 (75.1%) were confident

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