

They didn't mean it *that* way: Exploring the effect of context

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Does context matter?¹

- What resources are activated in questions with surface item contextual differences?
- We explored this question within the domain of physiology in conjunction with the Framing and Resources theoretical framework. Our specific research question was...
- **Do students answer anatomy and physiology questions differently?**

- Aim:
 - Clarify student cognition and knowledge
 - Inform assessment and testing
 - Expand understanding of resource activation

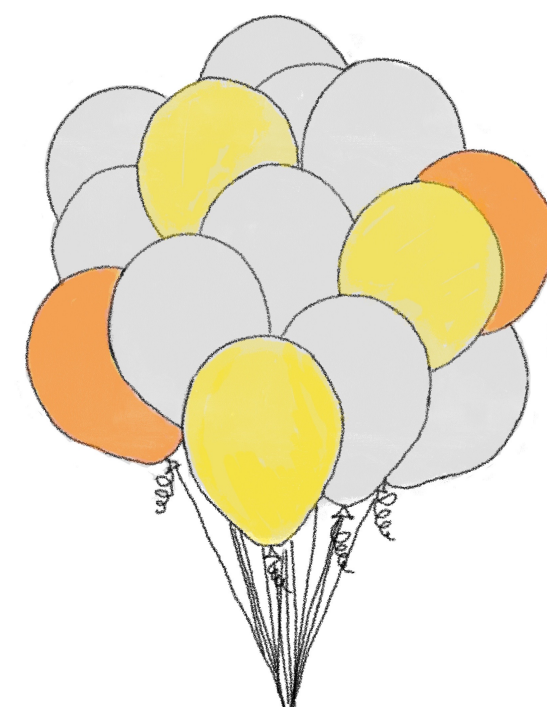
Misconceptions

- Pre-existing
- Stable
- Specific
- Incorrect



Resources

- Activated
- Dynamic
- Standalone
- Neutral



Boars and humans and fluids...oh my!

The following questions ask you about the physiology of a **wild boar**.



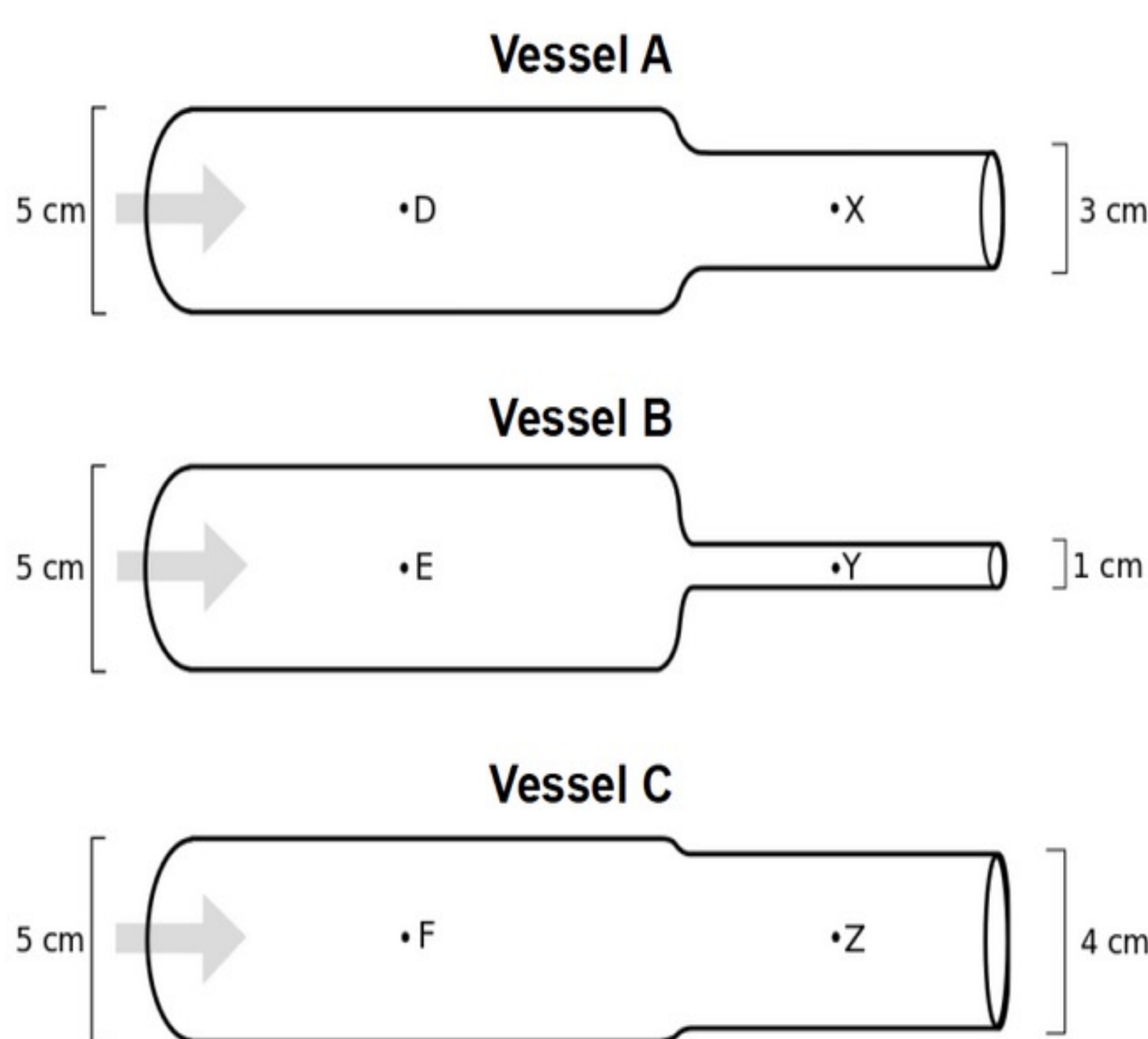
n = 124

The following questions ask you about the physiology of a **human**.



n = 120

“The figure below shows three different blood vessels (A, B, and C) from a **human/wild boar** with blood flowing through them (designated by the gray arrow on the left). The volume of blood entering the left end of the blood vessel every second is the same in Systems A, B, and C. The pressure in the **human/wild boar** blood is the same at points D, E, and F. The **human/wild boar** blood viscosity is very low. The diameter on the left end of each blood vessel is the same (5 cm).”

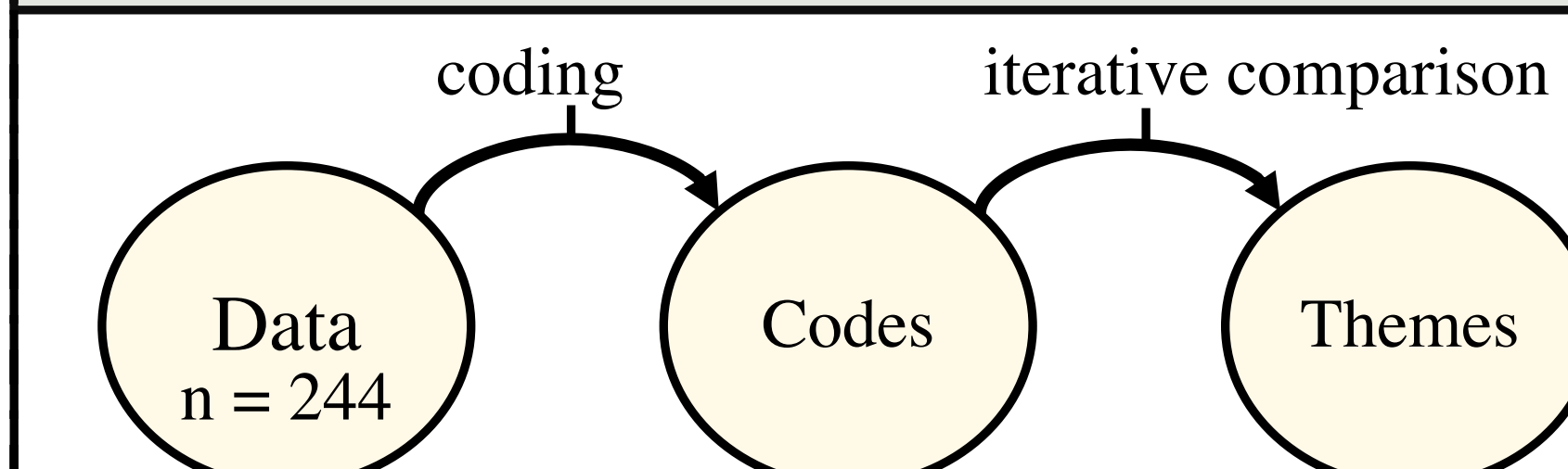


- 1 Order the speed of the blood coming out of the right end of the human's blood vessels A, B, and C. Please choose from the following.
 1. B > A > C
 2. C > A > B
 3. A = B = C
 4. Other: _____
 Please explain your reasoning: _____

- 2 Fluid Flow Rate
- 3 Pressure
- 4 Resistance

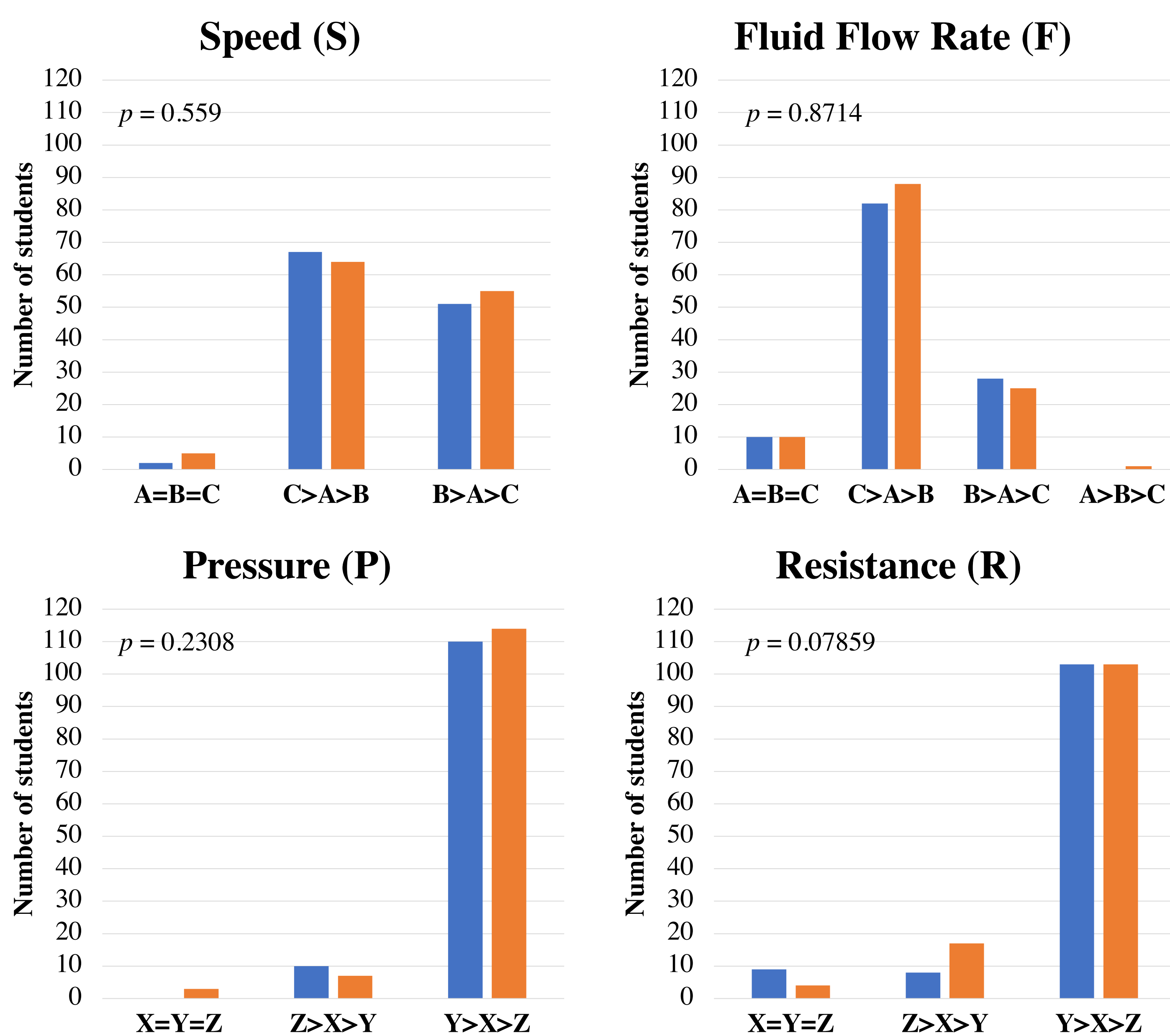
Survey was given to students at NDSU post-instruction on fluid dynamics and administered via Qualtrics in Spring 2022.

Thematic Analysis^{2,3}



Students' ranking is similar across versions, but what about resources?

Human Wild boar



A Fisher's Exact test revealed no statistically significant difference between forced choice distributions across versions on all four fluid dynamics questions (Bonferroni corrected p-value = 0.0125).

Student Explanations

CODE: Size and speed

- “The **larger** the diameter of the vessel is, the **faster** it will go”
- “The vessel is **larger** so blood can move through it **faster**.”

CODE: Teleological

- “Vasoconstriction causes more restriction, which **makes** the blood move slower”
- There **needs** to be greater pressure for Vessel B to pump out the blood for the smaller diameter”

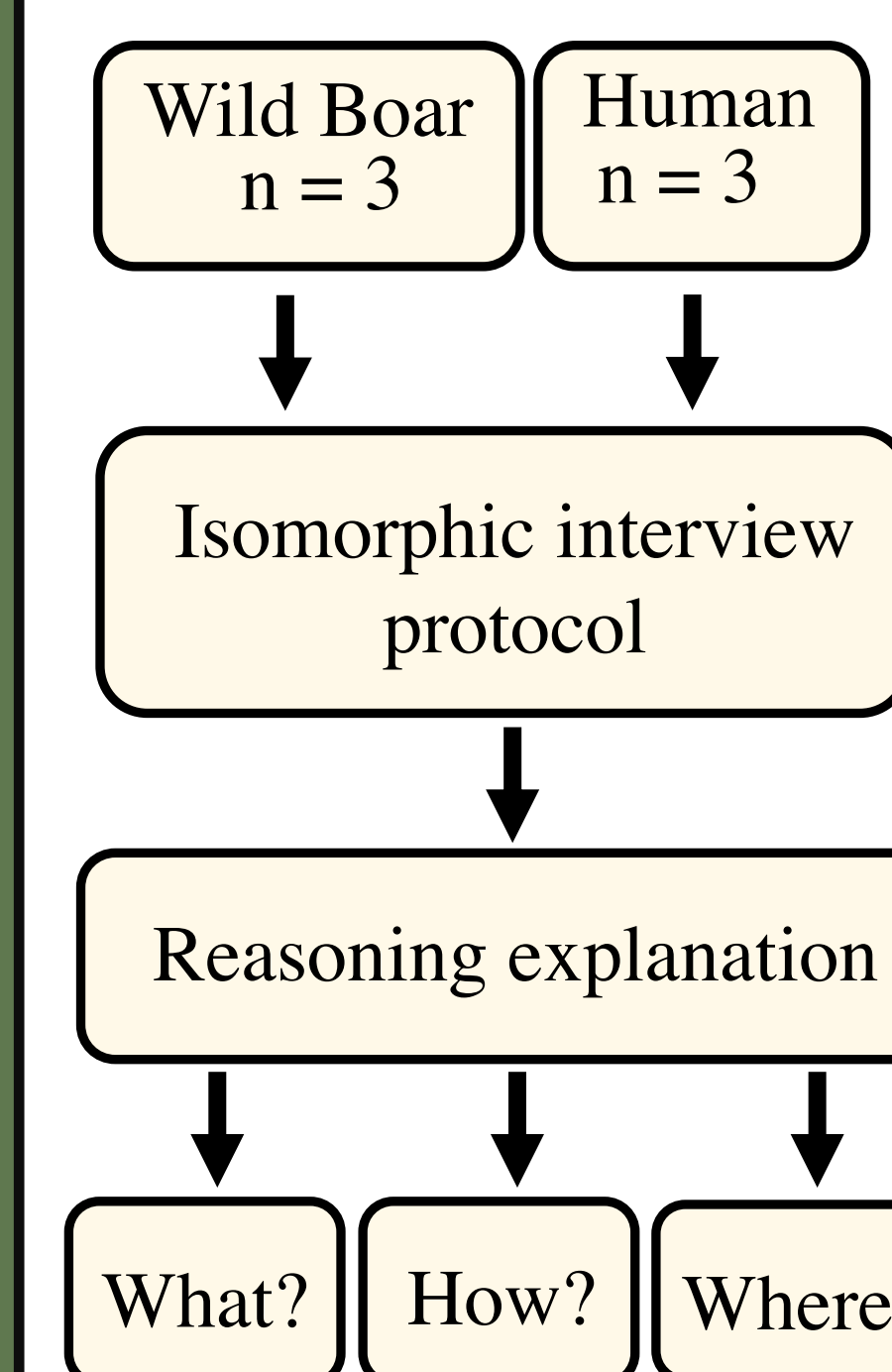
CODE: Unclear

- “I chose Vessel B because as you move across the **wild boar's** body it continues to get **smaller and smaller**”
- “I feel like C would **have to** lose the most blood first so it would come out faster”

While we observed patterns in student reasoning, we were limited in our ability to make claims about student reasoning.

Clarifying resources via interviews

- Semi-structured, think-aloud interviews
- n = 6 students
- Various undergrad universities
- In-person and remote



- 1) While data from force-choice responses suggests students answer similarly across versions, previous work suggests student reasoning may still be impacted by context⁴.
- 2) Initial data from our pilot interviews suggests students access different resources when reasoning about fluid dynamics.
- 3) Future research should consider survey modification to better elucidate resource activation, while surveying students of varying educational backgrounds (i.e., novice and expert).

Pseudonym: River, Year: Senior, Major: Chemistry
Taken Anatomy and Physiology: Neither

Question	Answer	Initial Explanation	Follow-up Explanation
Speed	BAC	Smaller opening	Garden Hose and thumb
Fluid Flow Rate	BAC	Larger area	4x times as large
Pressure	YXZ	Smaller area	Tapered shape
Resistance	YXZ	Same as P	Proportionality of P and R

Pseudonym: Phoenix, Year: Senior, Major: HDFS
Taken Anatomy and Physiology: Both

Question	Answer	Initial Explanation	Follow-up Explanation
Speed	CAB	Flow & area proportional	Poiseuille's Law; Physiology Class
Fluid Flow Rate	BAC	Intuitively same as S	S and F are equal, only different units
Pressure	YXZ	Fluid interaction	Lymph formation; Poiseuille's Law
Resistance	YXZ	R relation to diameter	Same as before

References
1. Hammer et al., (2005) Resources, framing, and transfer. *Transfer of Learning from a Modern Multidisciplinary Perspective*.
2. Rosala, M. (2019). How to analyze qualitative data from UX research: Thematic analysis. NN-Nielsen Norman Group.
3. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*.
4. Slominski, T., Christensen, WM, Buncher, JB, and Momsen, J. The role of context and framing on student reasoning about fluid dynamics. *CBE-Life Sciences Education*. In review.