



The Dependence of Instructional Outcomes on Individual Differences: An Example from DC Circuits

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INTRODUCTION

- Contrary to popular belief, there is little evidence of consistent learning styles (e.g., kinesthetic, etc.) and interactions between learning style preferences and instruction[1,2]
- Any pre-instruction characteristic of students can be used, including physical preconceptions.
- When not limited to “learning styles,” there has been evidence of aptitude treatment interactions [3]

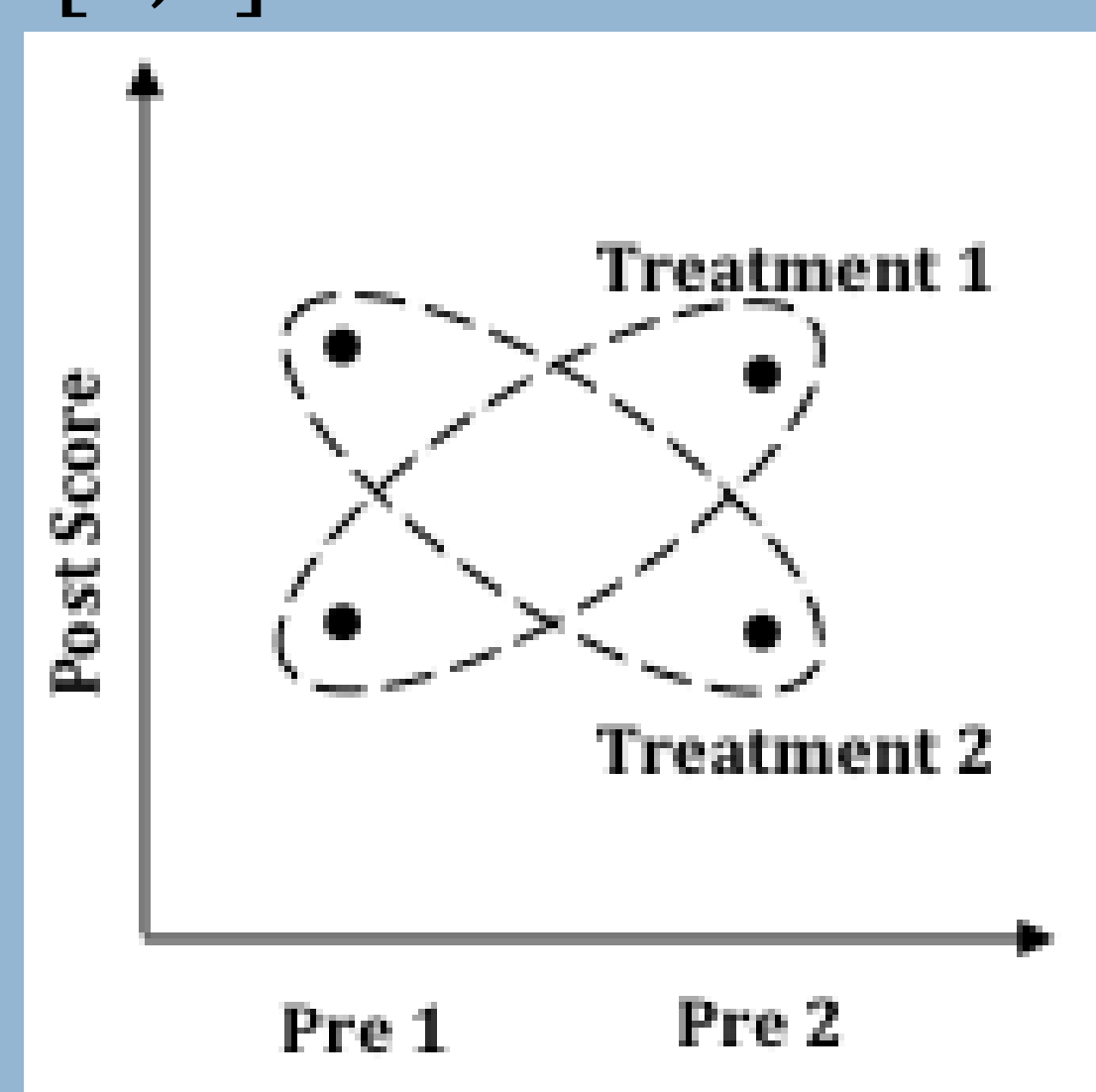
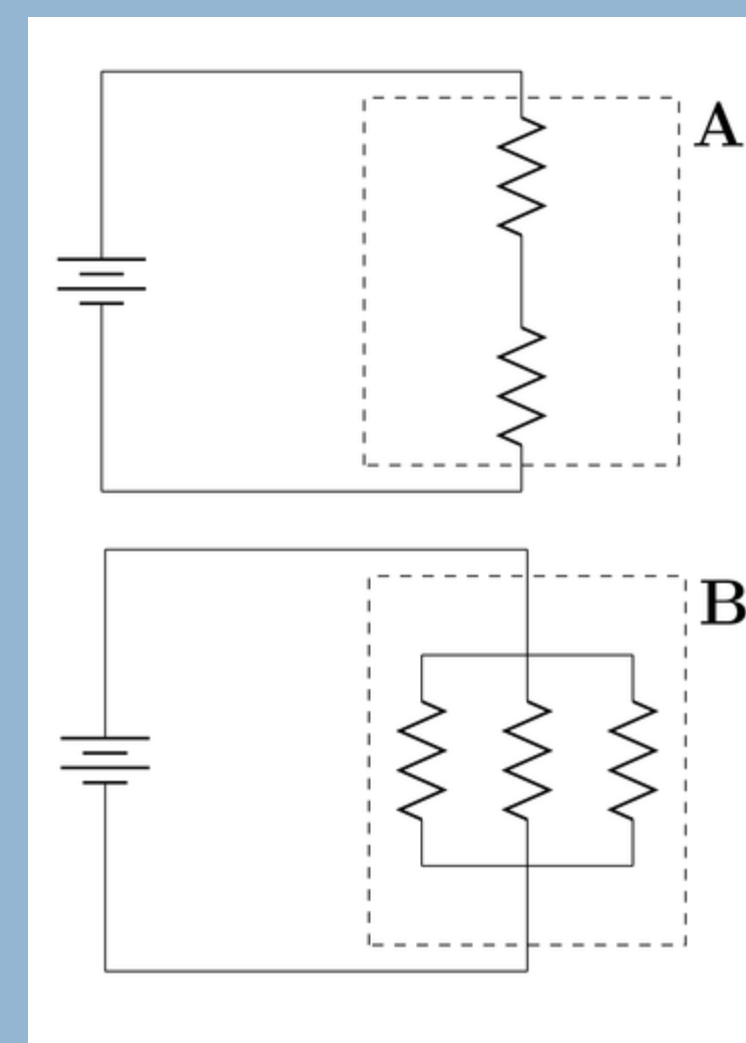


Figure 1: Possible preconception/instruction interaction.

INDIVIDUAL DIFFERENCES: POWER



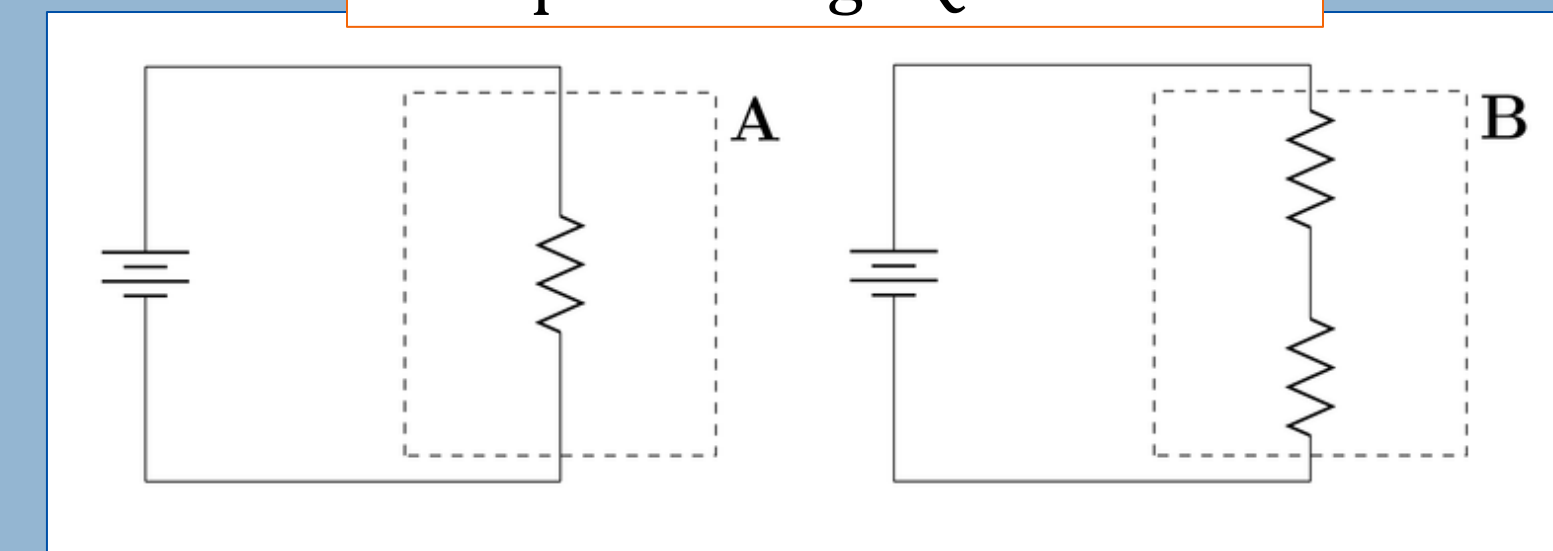
- Students were asked “Which circuit dissipates more power?” on a series of 3 questions. (2 equal voltage, 1 equal current)
- Students answer uniformly (3/3).
- Again, students have differing preconceptions which might interact differently with instruction.

Consistent Responses	Proportion of Students:
Correct	10%
More Resistance/Less Power	20%
More Resistance/More Power	20%

DIFFERENTIATED INSTRUCTION

- Given opposing preconceptions, differing materials were designed to supplement DC circuit instruction.

Equal Voltage Question



- Voltage

Condition:

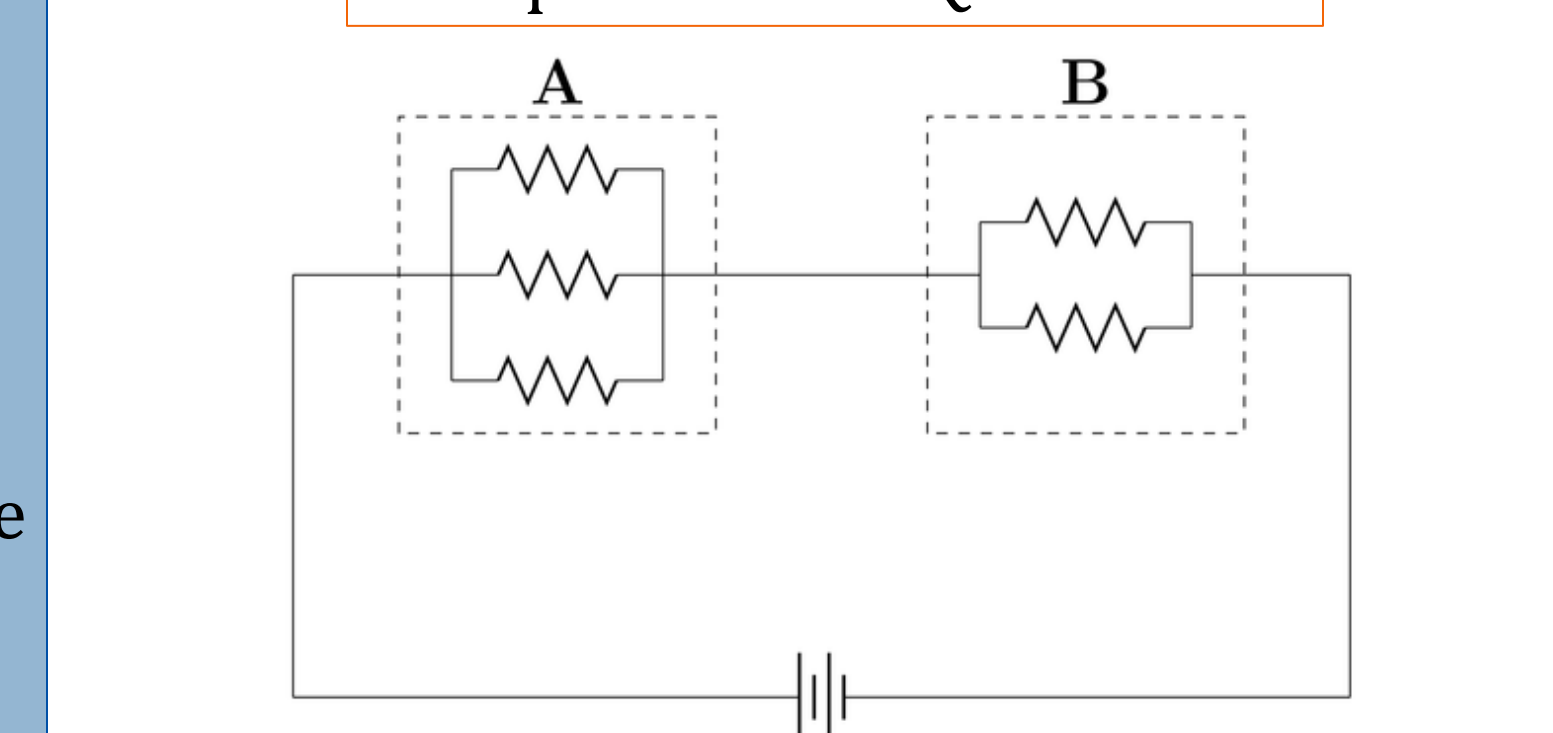
- 10 Equal Voltage
- 6 Equal Current
- Addresses More Resistance/More Power Response

- Generic

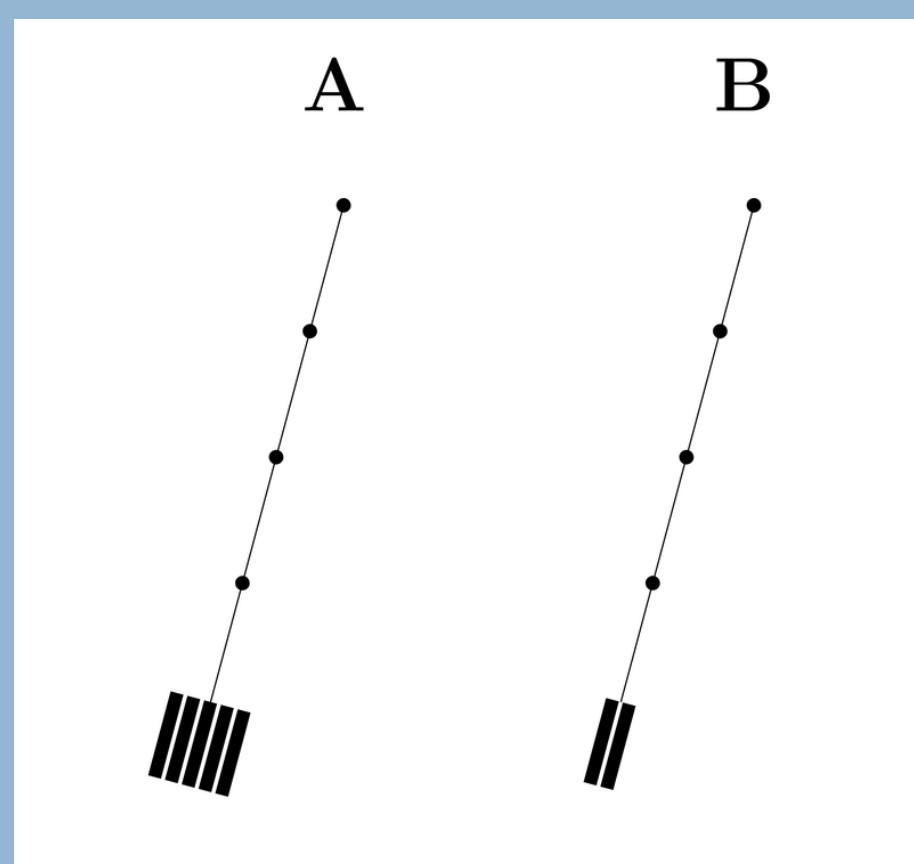
Condition:

- 8 Equal Voltage
- 8 Equal Current
- Meant as inclusive practice for all students.

Equal Current Question



INDIVIDUAL DIFFERENCES: PENDULUMS

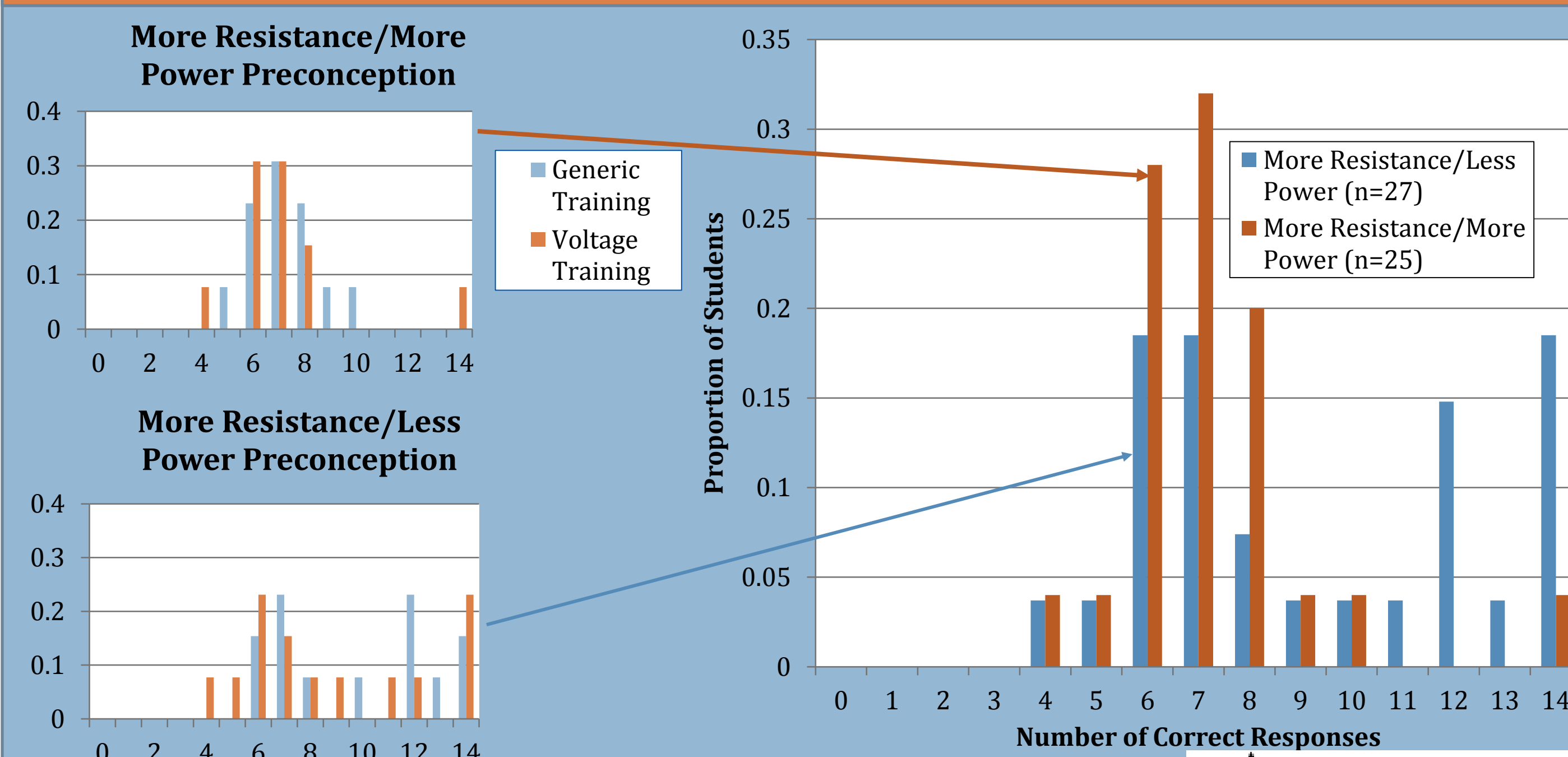


- Students were asked “Which pendulum has a longer period of oscillation?” with 6 different “equal-length” questions.
- Students answered very consistently (at least 5/6)

Consistent Responses	Proportion of Students:
Correct	55%
More Mass/Longer Period	30%
More Mass/Shorter Period	10%

- Consistent response patterns suggest that students have differing preconceptions (or aptitudes) which might interact differently with instruction.

DIFFERENTIATED INSTRUCTION: RESULTS



- Neither preconception experienced significant differences between conditions.
- Combining across practice conditions, More Resistance - Less Power preconception was more susceptible to training (medians 8 & 7, $p=0.04$)
- Although there was not an “interaction,” there was a “main effect” of preconception.

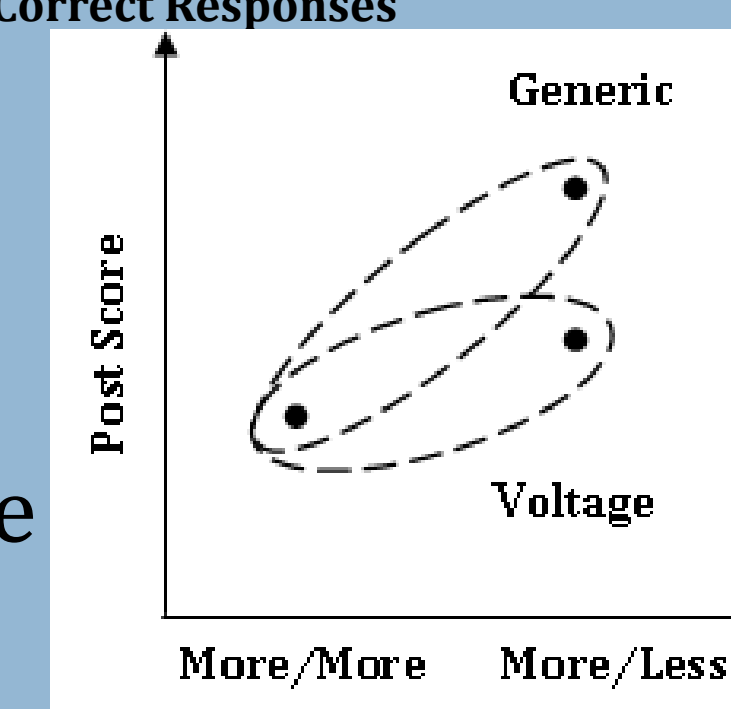


Figure 2: Hint of interaction for power instruction.

IMPLICATIONS

- Different preconceptions are affected differently by instruction
- Did not observe a cross-over interaction (like the one shown in Figure 1), but did hint at interaction like the one shown in Figure 2.
- Instruction potentially interacts differently with different preconception.
- Students’ prior knowledge must be accounted for when designing instruction.
- Further study of preconception/instruction interactions is warranted.

REFERENCES

- [1] H. Pashler, M. McDaniel, D. Rohrer, and R. Bjork, Psychol Sci Publ Interest 9, 105 (2008).
- [2] P. Kohl and N. Finkelstein, Phys Rev ST Phys Ed Res 4, 010111 (2008).
- [3] L. J. Chronbach and R. E. Snow, Aptitudes and Instructional Methods: a Handbook for Research on Interactions (Irvington Publishers, Inc., New York, New York, 1977).