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Luck vs Control: A Process of Test Development for Introductory Physics

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Long range motivation

- Do students have an “internal” or “external” locus of control?
- Do physics classes affect students’ locus of control?
- Does a student’s locus of control influence his/her success in a physic course?

“Bowler”



“Craps Shooter”



This slide is not what this talk is about but it does express our long term motivation!

Rowe, Mary B. (1974) Relation of wait-time and rewards to the development of language, logic, and fate control. *Journal of Res. Sc. Tch.* Vol. 11, No.4

Locus of Control (LoC) is measured by using the Rotter test.

It was developed by Julian Rotter.

(Ref.: Rotter, J. B. (1966). Generalized expectancies for internal vs. external control of reinforcement. *Psychological Monographs*, 80 (Whole No. 609).)

Two major divisions of the Rotter scale address ‘personal locus of control’ and ‘social/political locus of control’

**The ‘personal locus of control’ consists of ten items.
This is the scale we investigated**

The Rotter I-E (internal – external) scale has a long history of use from the 1960s to the present.

- **But – It was unacceptable to our physics professors. They felt the questions invaded students' privacy and were irrelevant to a physics course.**

- Example:**
- a. Children get into trouble because their parents punish them too much.**
 - b. The trouble with most children nowadays is that their parents are too easy with them.**

So – We decided to write a New Rotter survey based on situations in a physics class

To test our modifications we gave a class of physics students an original and modified version randomly mixed in the **same document.**

Calibration

- **Compared our student results on the original test with results from the literature**
- **Compared our student results on the original with results from the modified version**

Rotter I-E personal scale – Examples

Note: Each item has two choices – one indicates “internal” the other indicates “external” locus of control

9. a) I have often thought that what is going to happen will happen.
- * b) Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.
10. * a) In the case of the well prepared student there is really if ever such a thing as an unfair test.
- b) Many times exam questions tend to be so unrelated to course work that studying is really useless.

* Internal Locus of Control

Ref.: Rotter, J. B. (1966). Generalized expectancies for internal vs. external control of reinforcement. *Psychological Monographs*, 80 (Whole No. 609).

Original vs New Physics Questions

Original

- a. Many of the unhappy things in people's lives are partly due to bad luck.
- b. People's misfortunes result from the mistakes they make

Physics

- a. Not getting a correct solution to a physics problem is partly due to bad luck.
- b. The errors that people make in solving a problem are due to their own mistakes.

Original

- a. Many times I feel that I have little influence over the things that happen to me.
- b. It is impossible for me to believe that chance or luck plays an important role in my life.

Physics

- a. Many times I feel that I have little influence over the **quality of data I gather in a physics lab.**
- b. It is impossible for me to believe that chance or luck plays an important role in **the quality of the data I gather in a physics lab.**

The original survey had placebo or “filler” questions that we also put in a physics context. 7

Comparison of results: Original Rotter vs Physics Rotter

- **Factor analysis provided a method to compare results from the “Original Rotter” and “Physics Rotter” forms of the survey.**

Original Rotter I-E survey - 10 personal items

Developed in the 1960s

Historical - general results over two decades

(Done by a number of different people)

- **1 main scale (control) I-E – splits into components (subscales)**
 - **All items load**

- **2 subscales**
 - Academic**

 - General Fate and Luck**

Original Rotter I-E survey

New Population

1201 physics students in 2003 (N = 310)

- **1 main scale (control) I-E; 9 items – splits into components (subscales)**
 - 1 item does not load (only item that mentions fate)
- **3 subscales**
 - Academic**
 - Bad luck**
 - Good luck**

Factor structure similar to the old population and similar for Females and males

Physics Rotter I-E survey
New Population –
Male physics students in 2003 (N = 110)

- **1 main scale (control) I- E; 7 items – splits into components (subscales)**
- **2 subscales**

Academic (grading)

General luck (prob. Solving, lab data)

3 items did not load on the main scale
groups (2 items loaded together)
fate (1 item)

Physics Rotter I-E survey
New Population –
Female physics students in 2003 (N = 200)

- **1 main scale (control) I-E; 8 items – splits into components (subscales)**
- **3 subscales**

Academic (grading)

Luck

Lab

1 lab item & 1 group item don't load

Conclusions and Next Steps

- **Good first attempt**
- **Substantially replicated the structure of the Rotter I-E scale using physics context**
- **Next: Continue the process – re-write a “Physics Rotter” survey**
- **Use revised survey to continue search for answers to:**
 - Do physics classes affect students’ locus of control?**
 - Does a student’s locus of control influence his/her success in physics classes?**

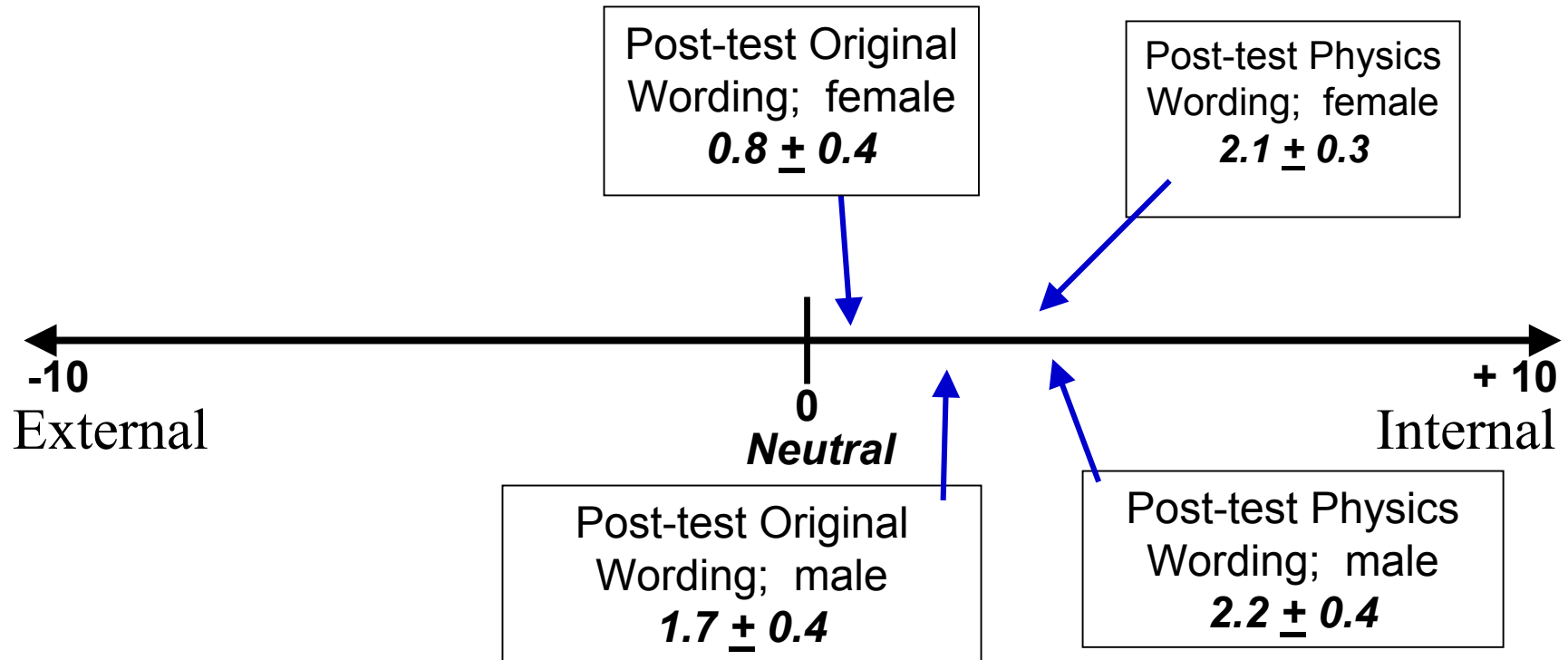
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Just Because You Were Curious!

On the 10 items that were changed between pre-test and post-test:
Female & Male students in Phys1201



Not Valid: Includes items that do not load on the main scale!

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