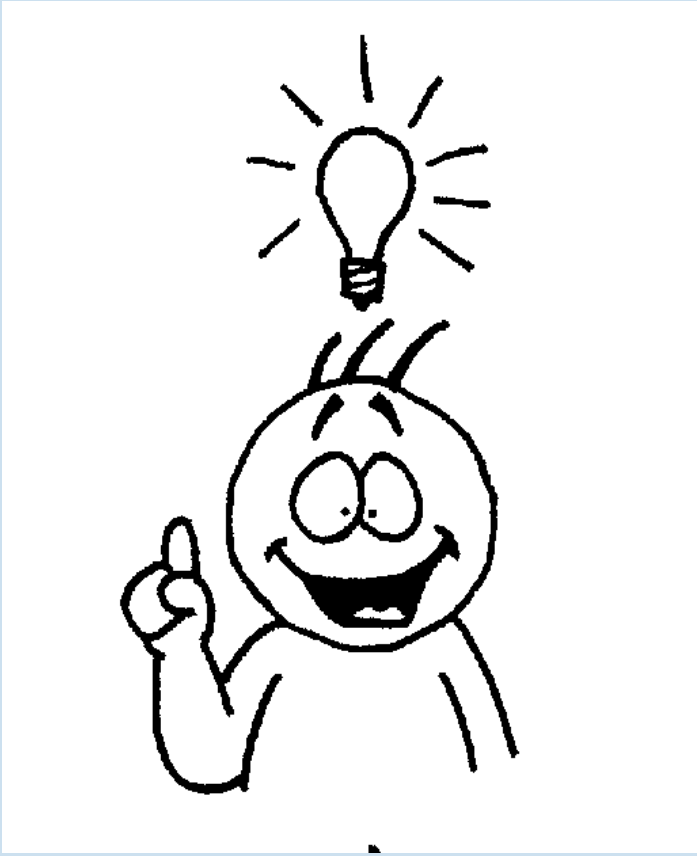
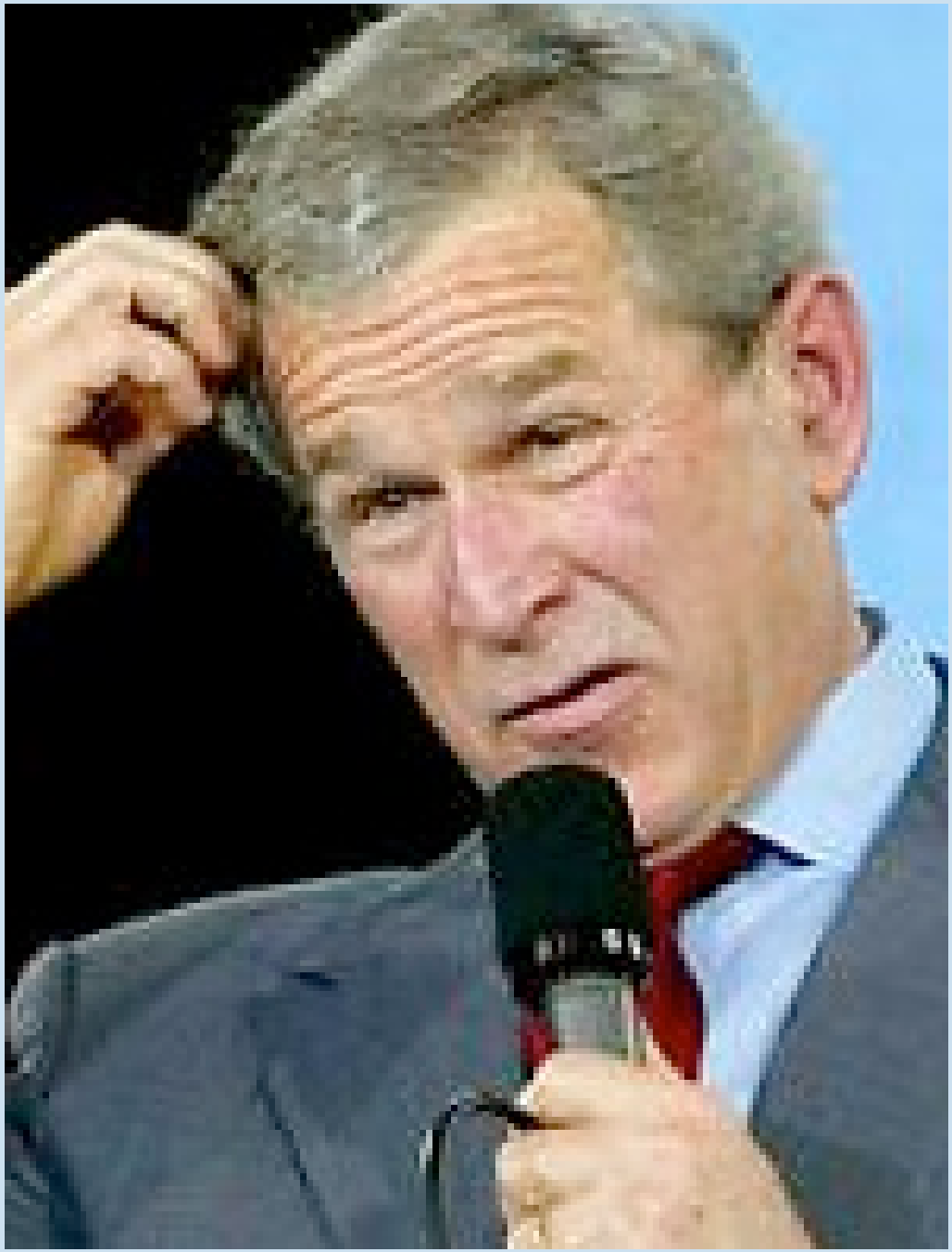
Using research to improve education



Jessica Watkins
Eric Mazur
December 1, 2006



Introduction

Unskilled and Unaware of It:

How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments

Kruger and Dunning, (1999). *J. Personality and Soc. Psych.* **77**(6).

Introduction

Less skilled individuals…

- overestimate their ability
- can’t recognize competence
- only gain insight by becoming more competent

Kruger and Dunning, (1999). *J. Personality and Soc. Psych.* **77**(6).

Introduction

Humor

Students ranked 30 jokes based on humor

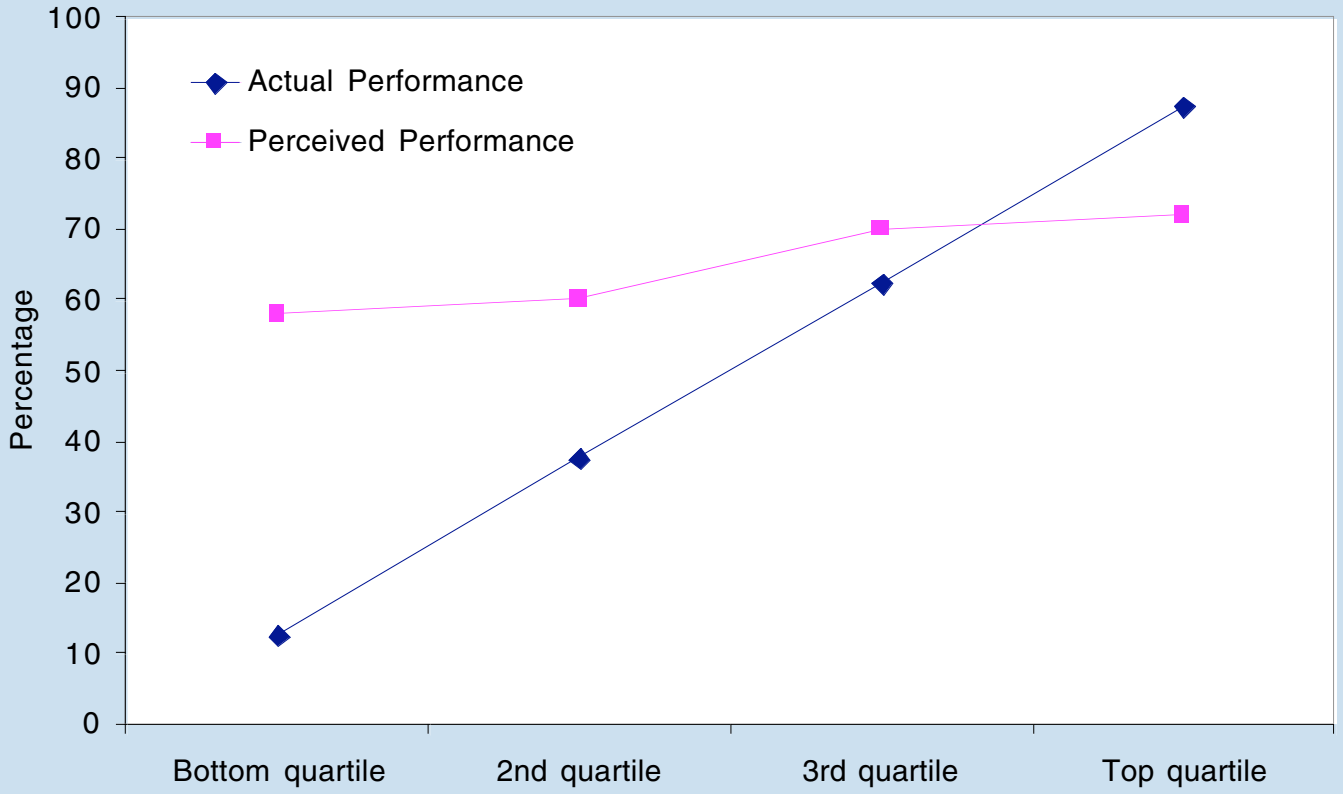
Expert rankings from professional comedians

Ranked own “ability to recognize what’s funny” with that of the average student using % ranking

Kruger and Dunning, (1999). *J. Personality and Soc. Psych.* **77**(6).

Introduction

Humor



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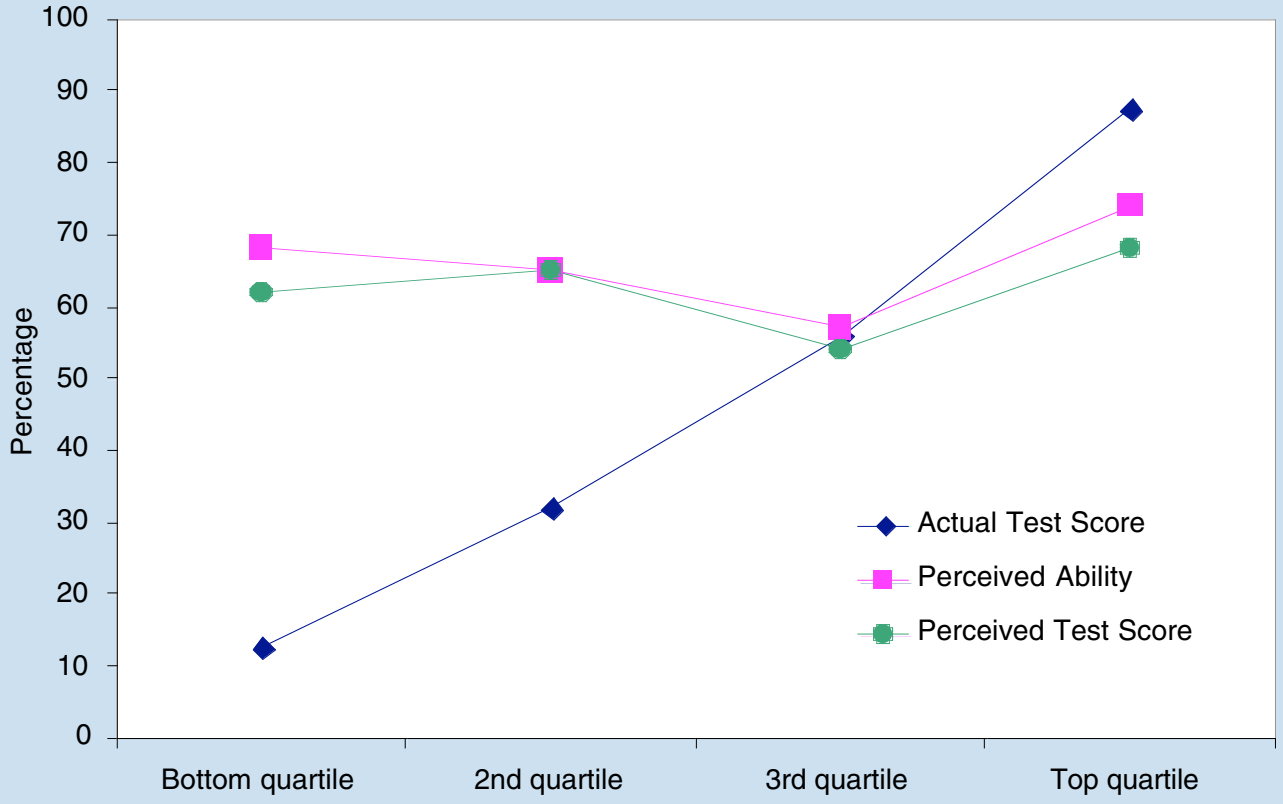
Introduction

Logistical Reasoning



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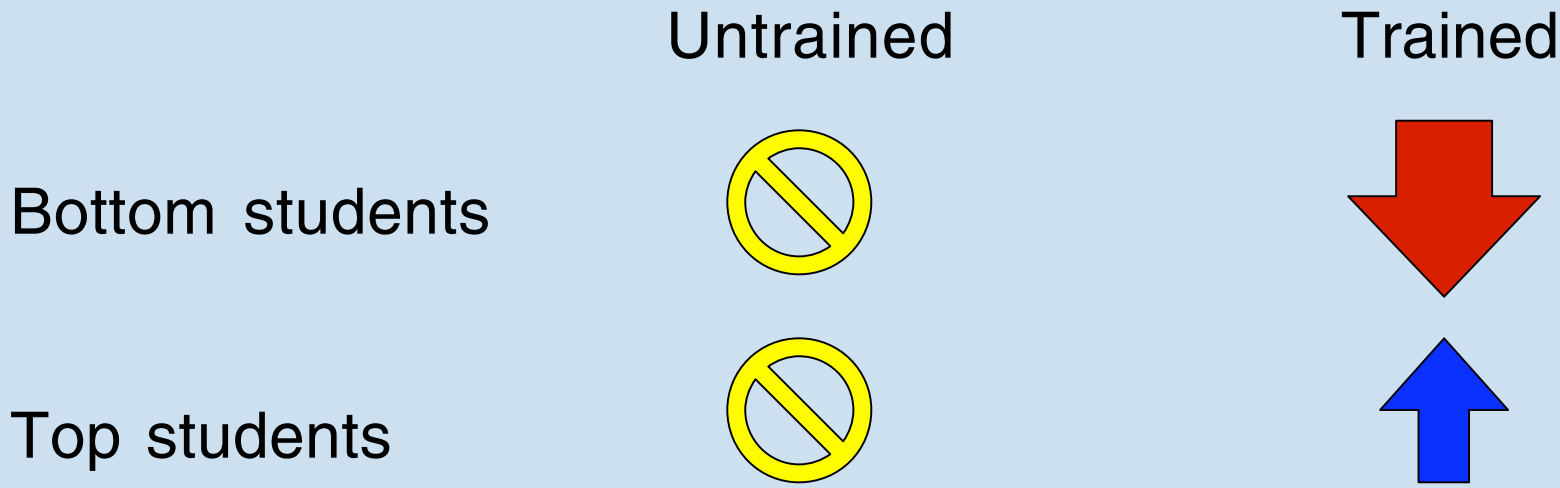
Introduction

Logistical Reasoning

1) Trained half of participants
2) Re-rated their performance



Kruger and Dunning, (1999). *J. Personality and Soc. Psych.* **77**(6).

Introduction

Less skilled individuals overestimated ability

More knowledge = better evaluate own ability

Outline

- Qualitative results
- Quantitative results
- Implications for teaching

Qualitative results

Introductory physics course at Harvard

Mostly pre-medical students

Approximately 100 students enrolled

Interactive teaching

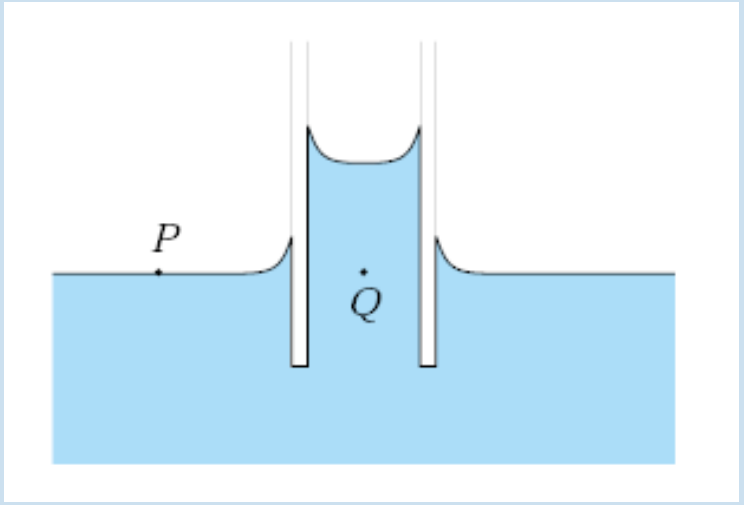
Qualitative results

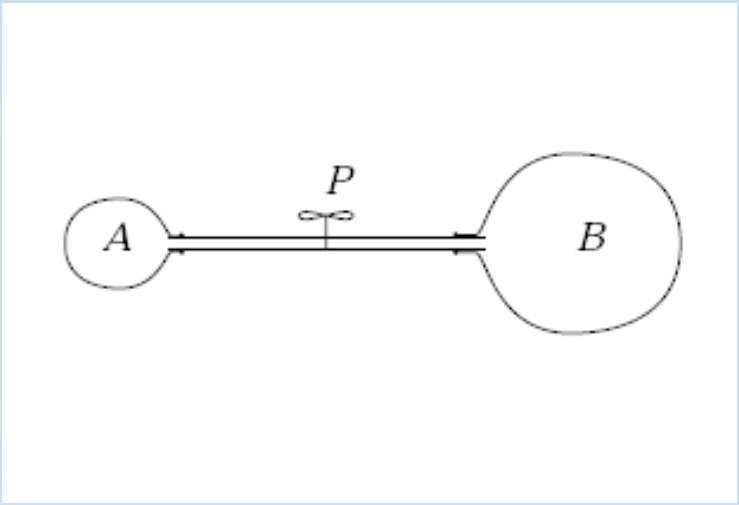
- Analysis of pre-class reading assignments
- Two questions on subject material
  - Not easy, must have some understanding
  - Not graded, get credit for effort
- One question asking:

"Is there anything you found difficult or confusing in the reading?"

Qualitative results

1. Consider a capillary rise of a liquid in a glass tube. How does the pressure at point P at the surface of the liquid compare to the pressure at point Q at equal height?





2. Two identical balloons are connected to a tube as shown below. Balloon *B* is inflated more than balloon *A*. Which way does the air flow when valve *P* is opened?

Qualitative results

3. Please tell us briefly what points of the reading you found most difficult or confusing. If you did not find any part of it difficult or confusing, please tell us what parts you found most interesting.

Qualitative results

1. Capillary action is due to the cohesion between water molecules, and the adhesion of water to the surface of the glass tube. Negative pressures can result from the cohesive forces of water. At the same height, the pressure inside the tube is much less due to negative pressures.

2. The air flows from high pressure to low pressure. The fully blown up balloon has higher pressure than the 1/2 blown up balloon. So the air flows from the fully blown balloon to the half filled balloon.

3. Nothing was difficult or confusing. The sections on the surfactant in the lungs and the heart as a pump were interesting because they relate physics to biology.

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WRONG

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Qualitative results

1. The water rises because of an interaction between the water and the walls of the tube, which creates an upward force which causes the water to rise… The pressure at the point inside the tube must be the same as the pressure at the point of equal height outside the tube, because if there was a pressure difference, then there would be a net flow of water.

2. Laplace's law tells us that it requires a greater pressure difference to maintain a small sphere than a larger one. So, the pressure in the small balloon must be greater, and the air will flow from the small balloon into the large one.

3. I found the explanation of Laplace's law to be inadequate, and while I can understand the conclusion drawn, I don't understand the reasoning which led to the conclusion.

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Qualitative results

Coding of responses

- Q1 and Q2: correct/incorrect
- Q3: confusion on topic of Q1/Q2

Correlate confusion with correctness

Qualitative results

capillarity	correct	incorrect
confused	44%	56%
not confused	25%	75%

Laplace	correct	incorrect
confused	49%	51%
not confused	21%	79%

Qualitative results

Students who are confused
may actually understand the material….

…students who are NOT confused
may not understand at all!

Quantitative results

Use the following scale to rate your comprehension of the concept of _____

1 - I am totally lost (I really have no clue at all)
2 - I am pretty confused -- many things don't make sense to me
3 - Some aspects confuse me, but it's beginning to make sense
4 - I understand it mostly, but I still have some questions
5 - I think I have a solid grasp of the concept

Quantitative results

Electrostatics

Gauss' Law

Potential Difference

Capacitance

Magnetic Interactions

Ampere's Law

Lenz's Law

Interaction of Electric and Magnetic Fields

Quantitative results

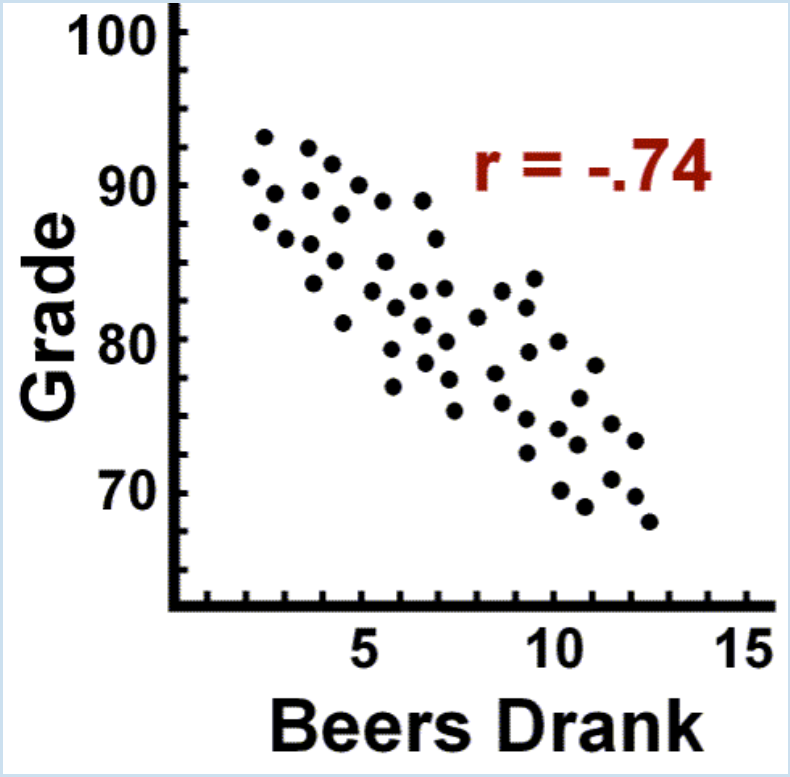
Students rate their understanding throughout the learning process

2x{
- Pre-class reading
- Lecture
}
- Tutorial
- Homework
- Exams

Compare rating with understanding

Quantitative results

Indicates strength and direction of a linear relationship



www.uwsp.edu/psych/stat/7/correlat.htm

Quantitative results

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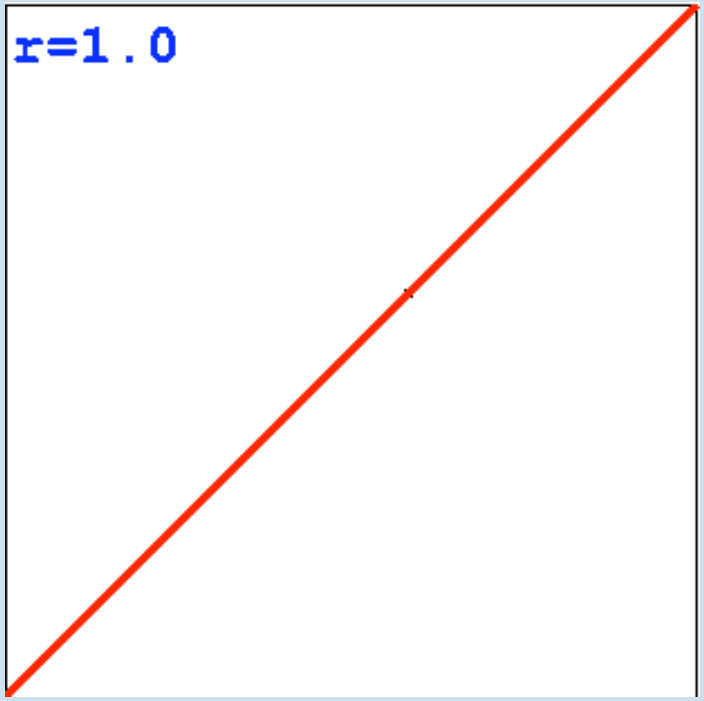

http://noppa5.pc.helsinki.fi/koe/corr/cor7.html

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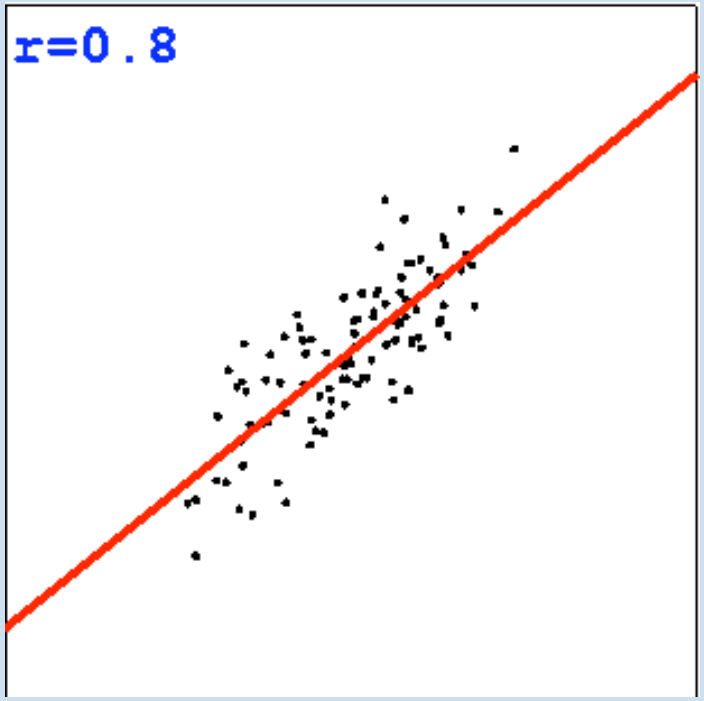

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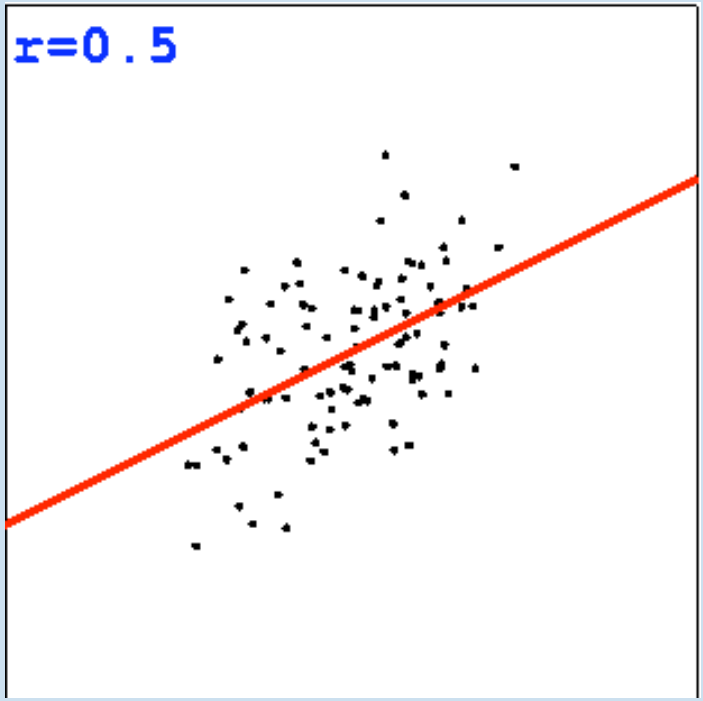

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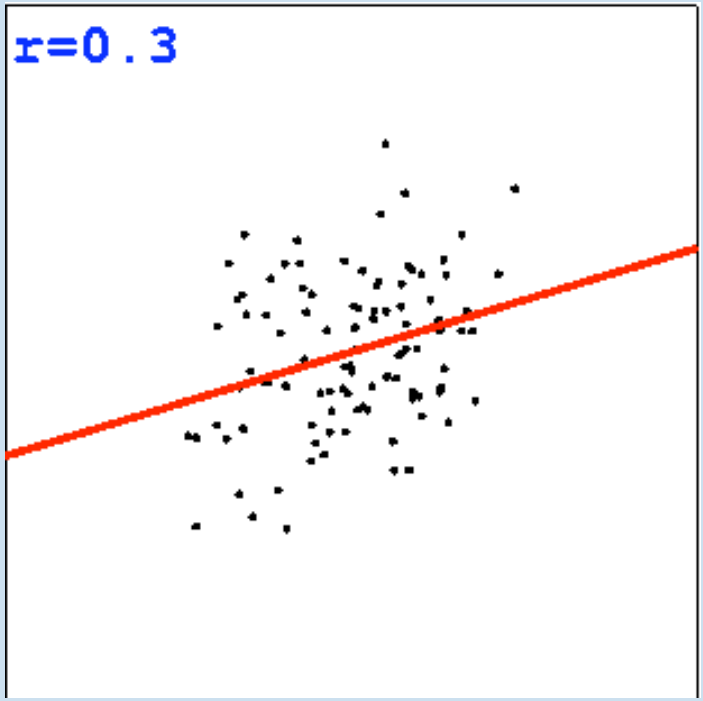

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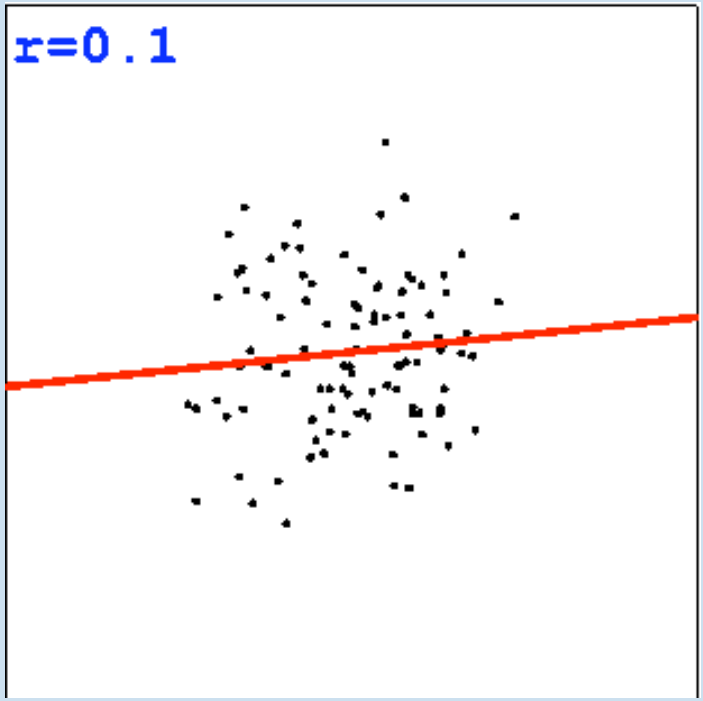

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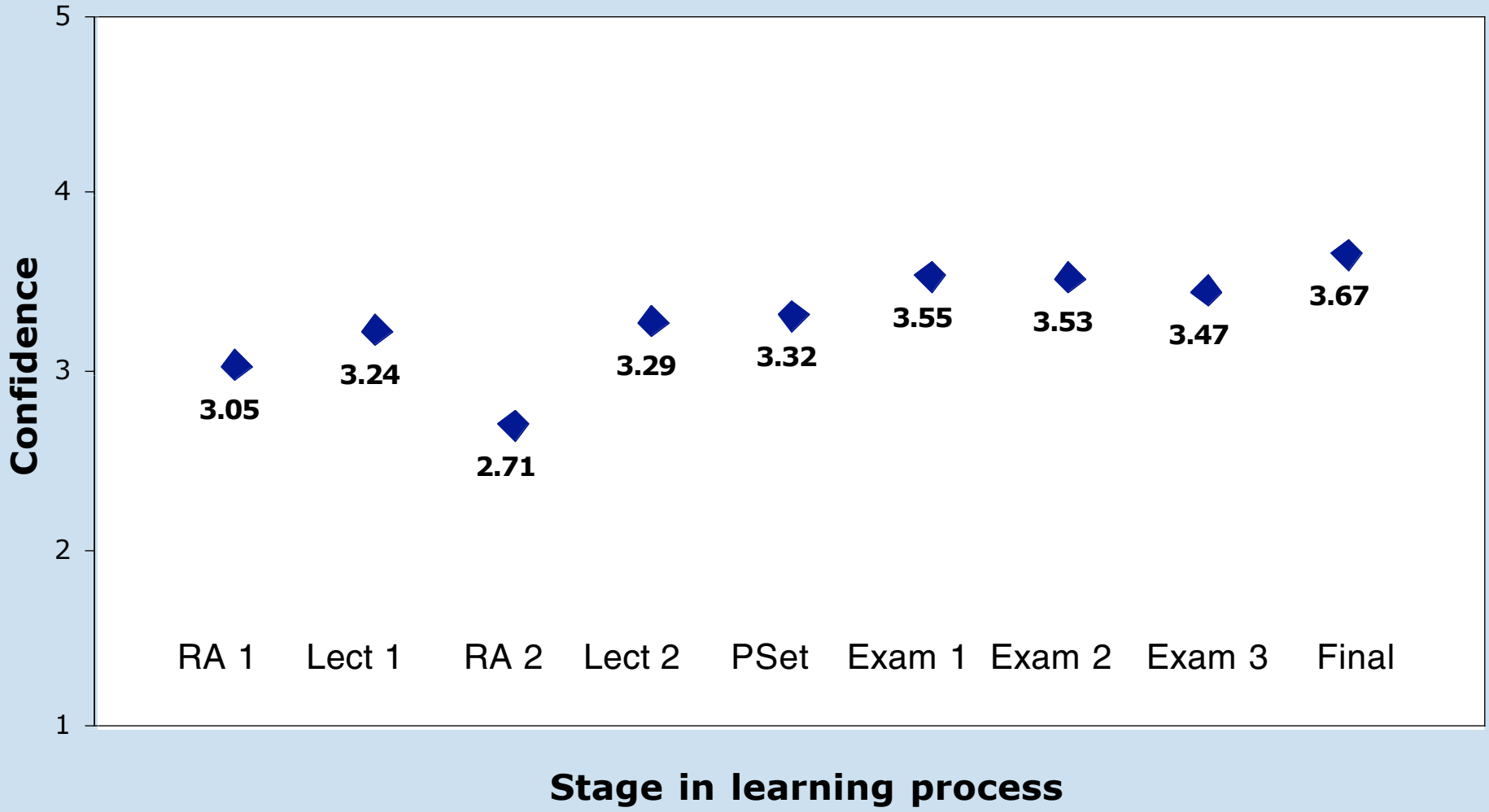

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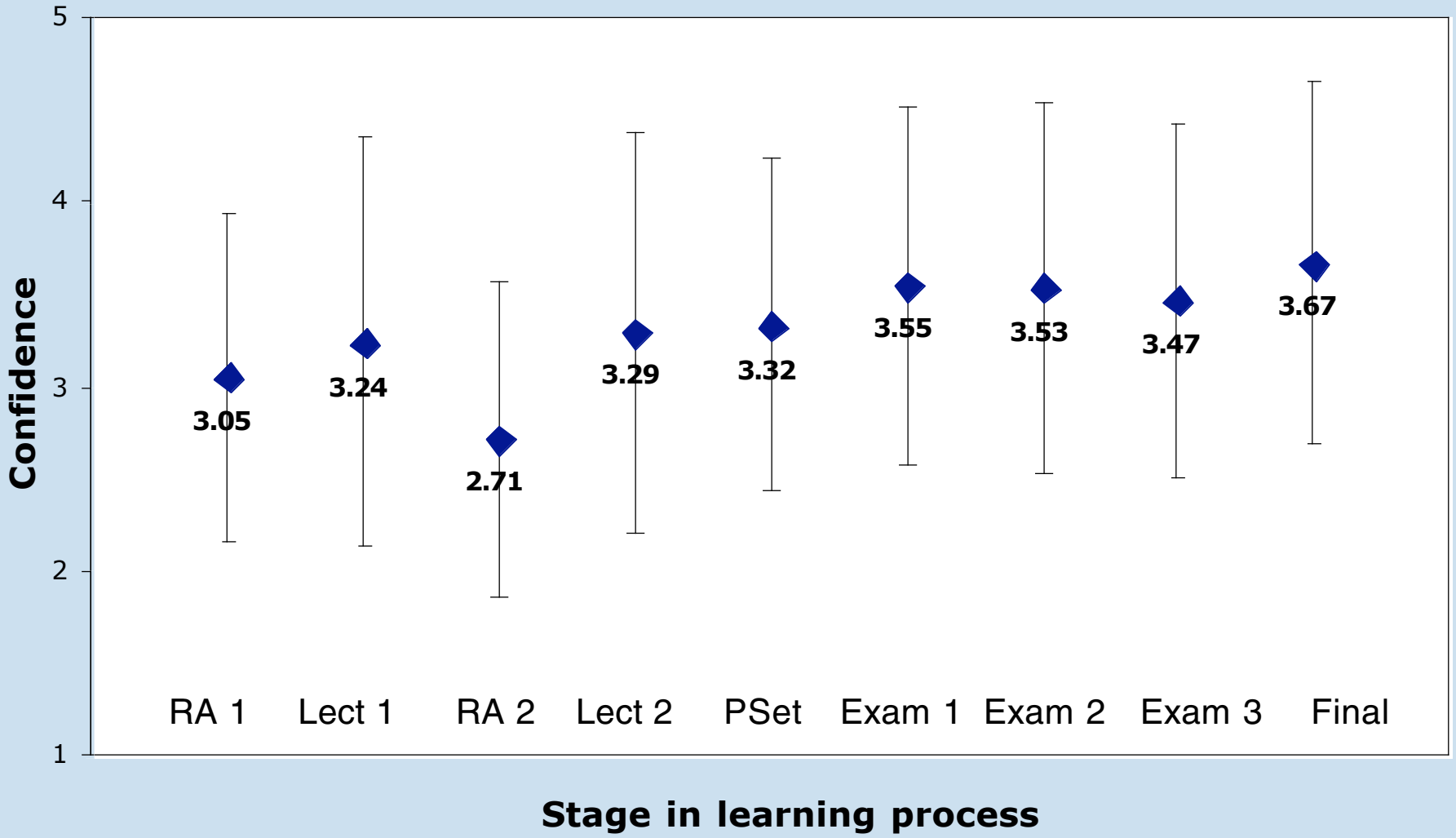

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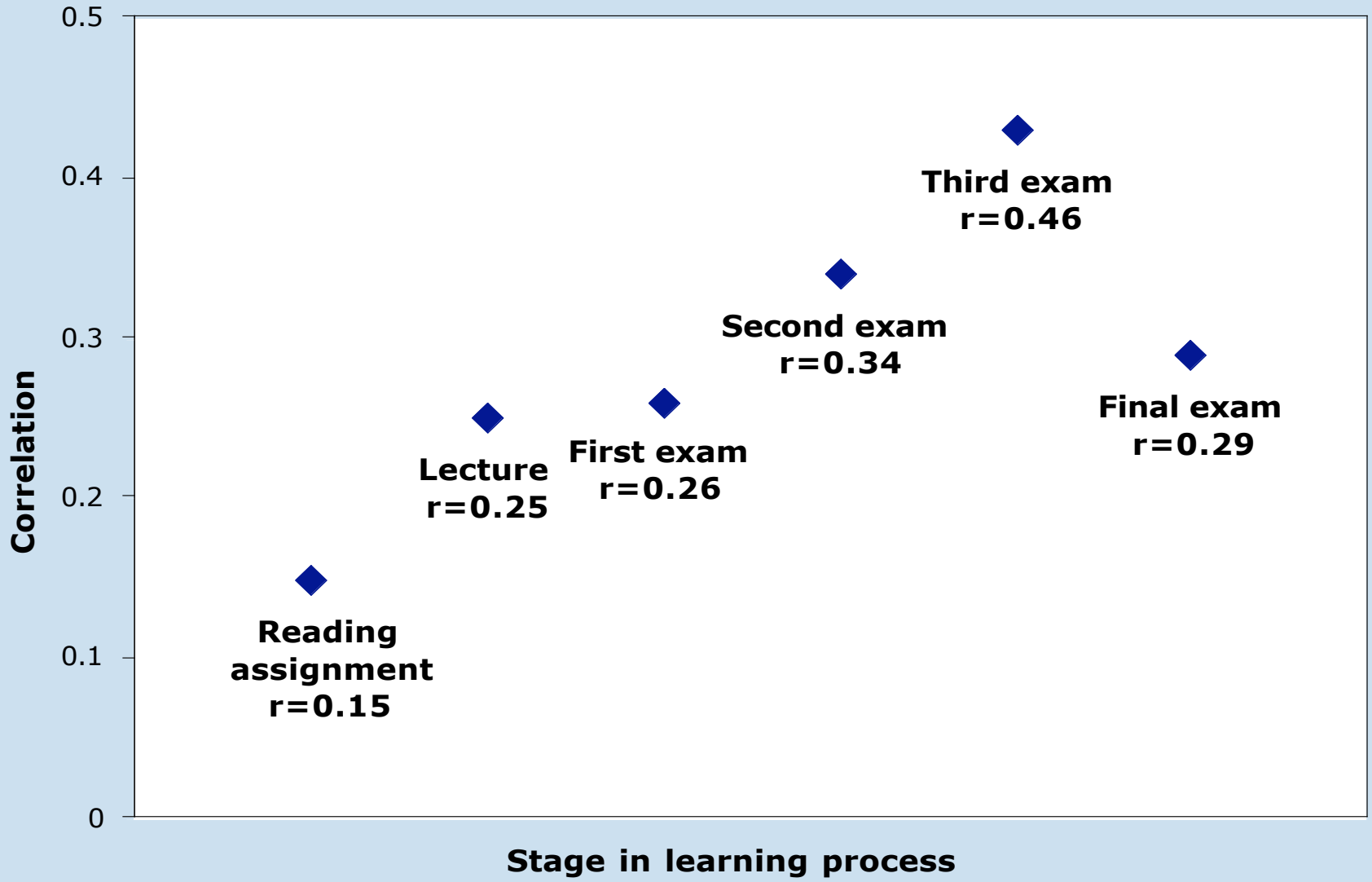


Quantitative results

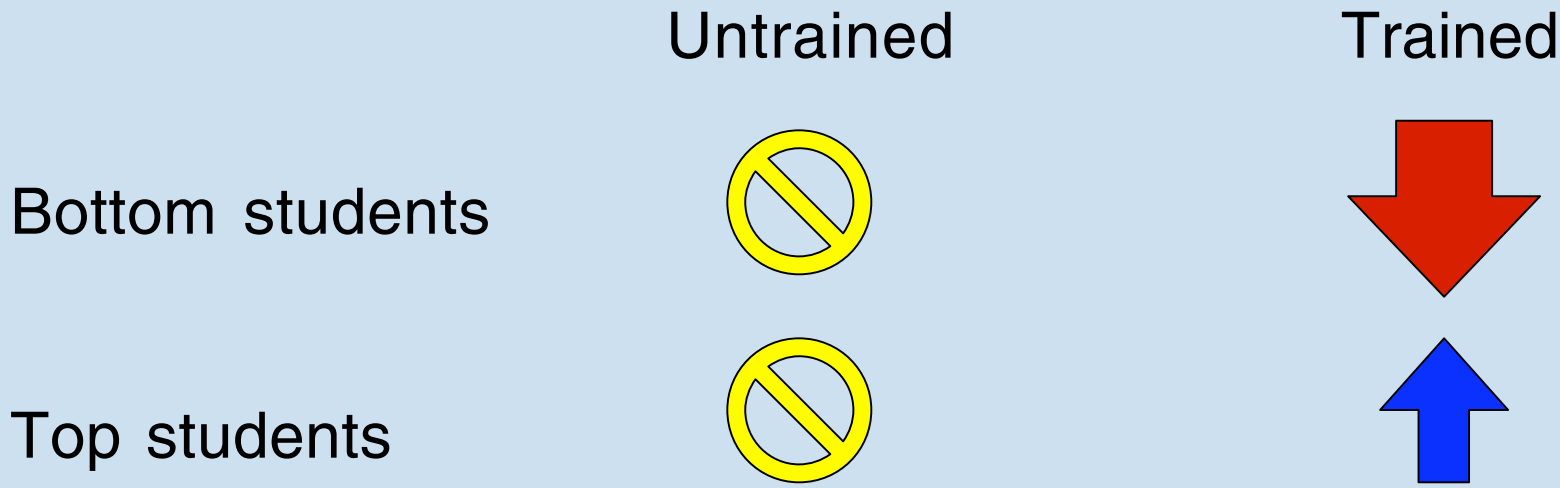
Students are not good at evaluating their own understanding,

BUT, they get better with greater knowledge and more feedback!

Introduction

Logistical Reasoning

1) Trained half of participants
2) Re-rated their performance



Kruger and Dunning, (1999). *J. Personality and Soc. Psych.* **77**(6).

Implications for teaching

What do these results mean for teaching?

Implications for teaching

Anecdotal evidence of resistance to new teaching methods

Study on student feedback to innovations…

- Mostly positive
- Still, some students thought they didn't need the "hassle"

Villanesor, M., Etkina, E, (2006). *PERC proceedings 2006.* Syracuse, NY

Implications for teaching

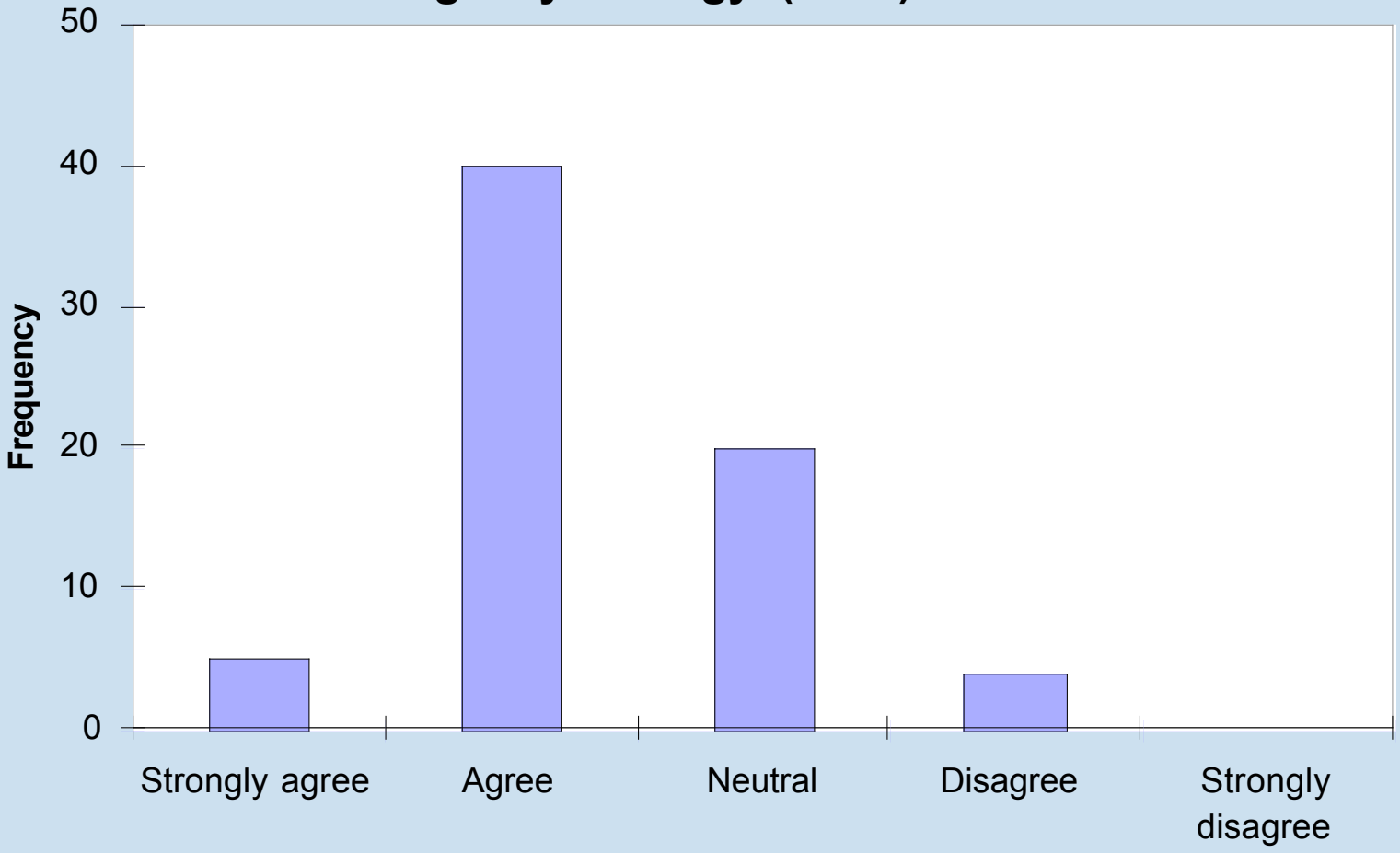
"I hated this class when it first started. I hated going to lecture, I hated going to lab."

"I actually learned a lot in lab this semester."

Villanesor, M., Etkina, E, (2006). *PERC proceedings 2006.* Syracuse, NY

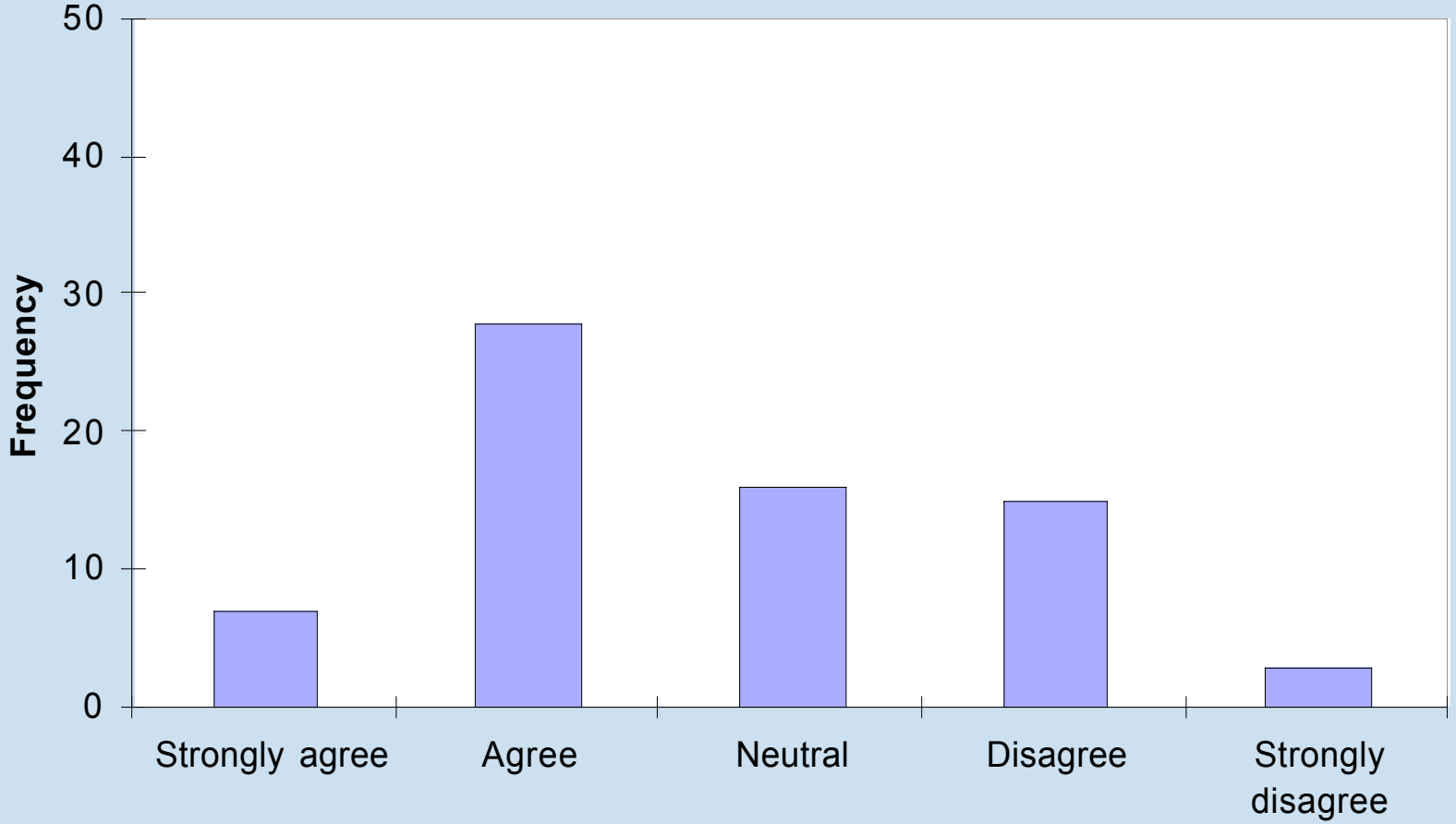
Implications for teaching

When implementing new teaching methods, if students tell me that it is not working, I will change my strategy. (n=69)



Implications for teaching

If I believe that a new teaching method will negatively affect my student evaluations of teaching, I am more hesitant to use it. (n=69)



Summary

Student feedback *can* be flawed…

Need research to help evaluate our traditional assessments!

Summary

Confusion…

- does not correlate with understanding
- is not (necessarily) the result of poor teaching
- is part of the learning process

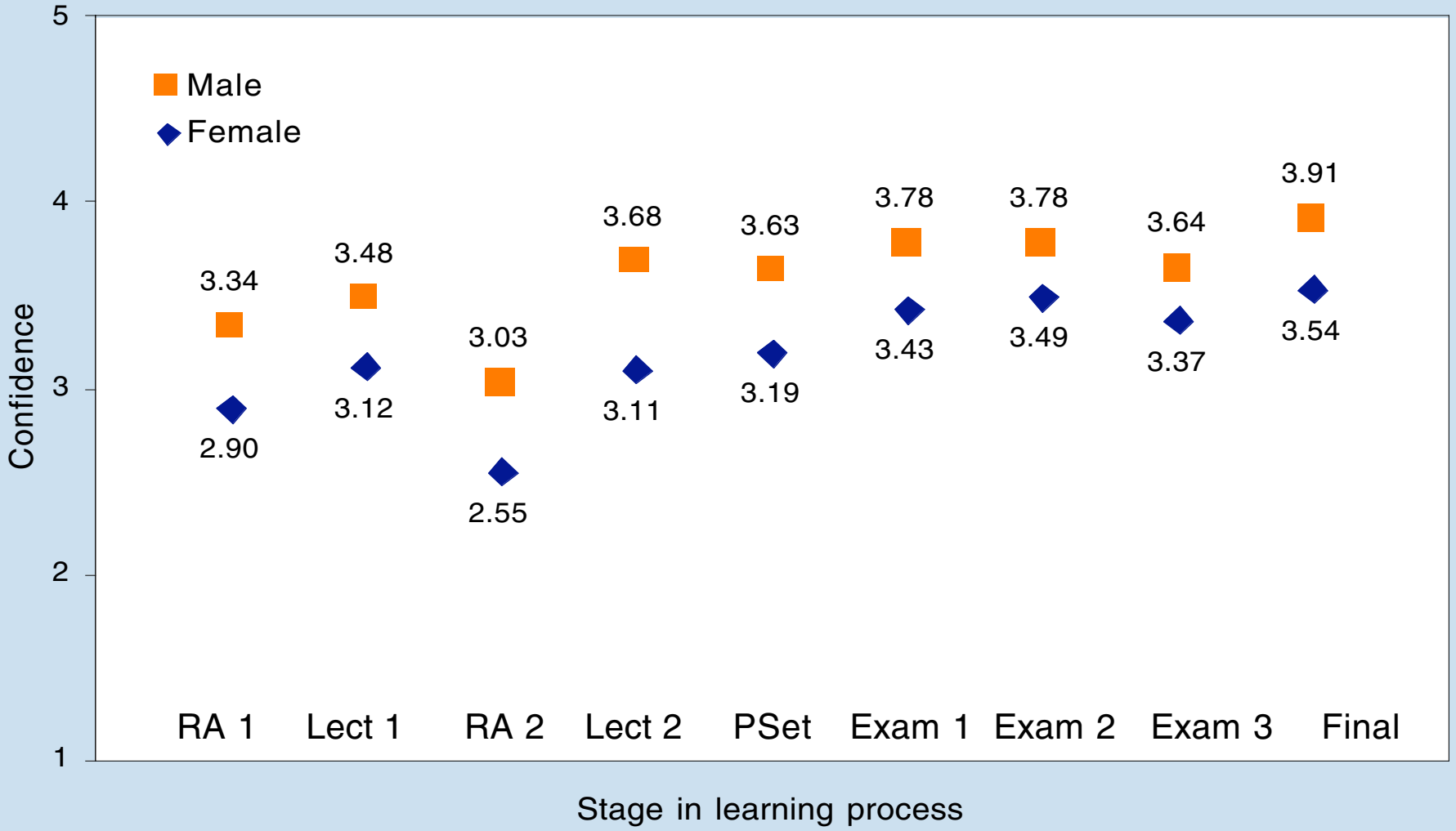
Lack of confusion could be lack of understanding

Thank you

Mercedes Lorenzo
Jessica Rosenberg
Doug Van Wieren
Martin Vogt
Mazur Group

mazur-www.harvard.edu

Quantitative results



Quantitative Results