



Students' Performance on Similarity Rating and Case Reusability Tasks

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Funded in part by the NSF grant DUE – 06185459

Motivation

Prior Research Chi (1981)

- Novices categorize problems using surface features (i.e. facial similarities)
 - Experts categorize problems using deep structure (i.e. principle similarities)
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Our Goal

Investigate if a strategy that focuses explicitly on problem comparison can get students to recognize similarities/differences in deep structure rather than surface features



Research Questions

- To what extent do students focus on facial/principle, similarities and differences between problems?
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- How does students' focus on facial/principle, similarities and differences change with a treatment based on contrasting cases?

Methodology

- **Participants:** Algebra-based physics (N=10)
- **Treatment:** 8 weekly group learning interviews
 - Focused on compare, contrast and case re-use tasks
 - Protocol finalized only in Week 4.
- **Assessment:**
 - 2 Individual Interviews – 50 minutes each
 - 1st : BEFORE finalized Group Learn. Int. protocol
 - 2nd : AFTER Four Group Learn. Int. finalized protocol
 - **Tasks:**
 - **Similarity Rating Task** ← **Focus of Talk**
 - Case Reusability Tasks

Similarity Rating Task: Pairing Problems

4 Categories of Pairing

- Facial **S**imilarity (**FS**)
- Facial **D**ifference (**FD**)
- Principle **S**imilarity (**PS**)
- Principle **D**ifference (**PD**)

	FS	FD
PS	A	B
PD	C	D

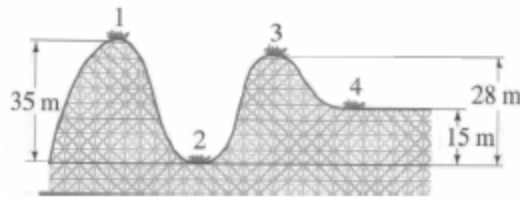
Students are given 8
problem pairs in the
order of

A A B B C C D D

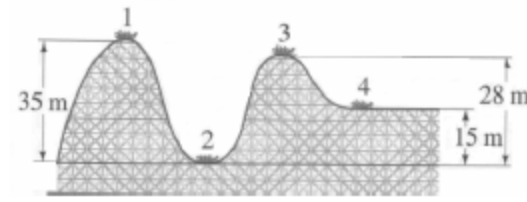
A: Pairs are **FS** and **PS**
B: Pairs are **FD** and **PS**
C: Pairs are **FS** and **PD**
D: Pairs are **FD** and **PD**

Type A

Facial Similarity (FS) & Principle Similarity (PS)



An 800 kg roller coaster shown in the figure above is dragged up to point 1 where it is released from rest. Assuming the track is frictionless; calculate the speed at point 3.

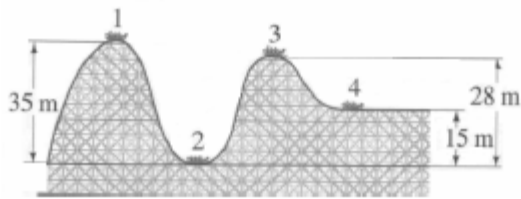


A roller coaster shown in the figure above will be moving with a velocity of 22 m/s at the exact moment it hits point 2. Assuming the track is frictionless; calculate the speed at point 4.

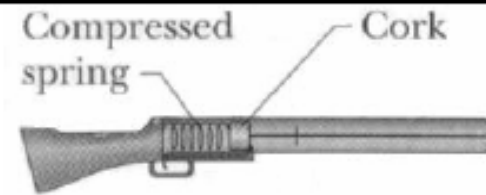
- **Facial Similarity (FS)** : Both Roller Coasters.
- **Principle Similarity (PS)** : Conservative system

Type B

Facial Difference (FD) & Principle Similarity (PS)



An 800 kg roller coaster shown in the figure above is dragged up to point 1 where it is released from rest. Assuming the track is frictionless; calculate the speed at point 3.

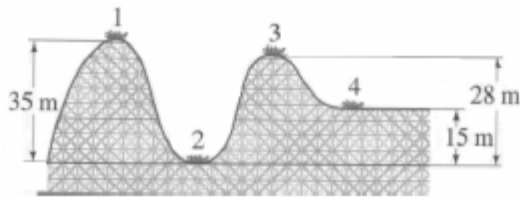


A 0.10 kg bullet is loaded into a gun tilted upward at a 30° angle from the horizontal, compressing a spring (spring constant is 6400 N/m) a distance of 0.20 m. When the trigger is pulled, the spring is released, and the bullet leaves the spring at the spring's relaxed length at a speed of 50.5 m/s. The bullet travels a distance of 0.60 m before exiting the barrel of the gun. What is the speed of the bullet as it leaves the gun?

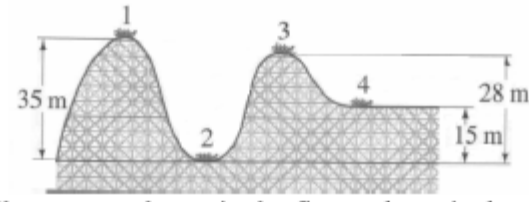
- **Facial Difference (FD)** : Roller Coaster vs. Gun
- **Principle Similarity (PS)** : Conservative system

Type C

Facial Similarity (FS) & Principle Difference (PD)



An 800 kg roller coaster shown in the figure above is dragged up to point 1 where it is released from rest. Assuming the track is frictionless; calculate the speed at point 3.

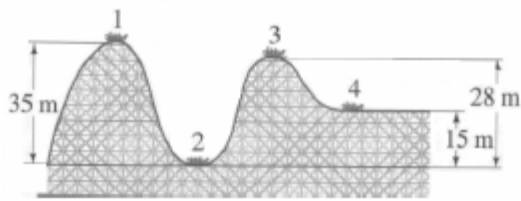


An 800 kg roller coaster shown in the figure above is dragged up to point 1 where it is released from rest. The work done by friction in going from point 1 to point 3 is 4800 J. Calculate the speed at point 3.

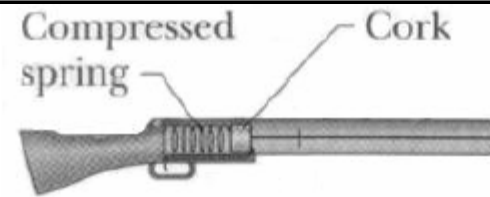
- **Facial Similarity (FS)** : Both Roller Coasters
- **Principle Difference (PD)** :
Conservative vs. Non-Conservative

Type D

Facial Difference (FS) & Principle Difference (PD)



An 800 kg roller coaster shown in the figure above is dragged up to point 1 where it is released from rest. Assuming the track is frictionless; calculate the speed at point 3.

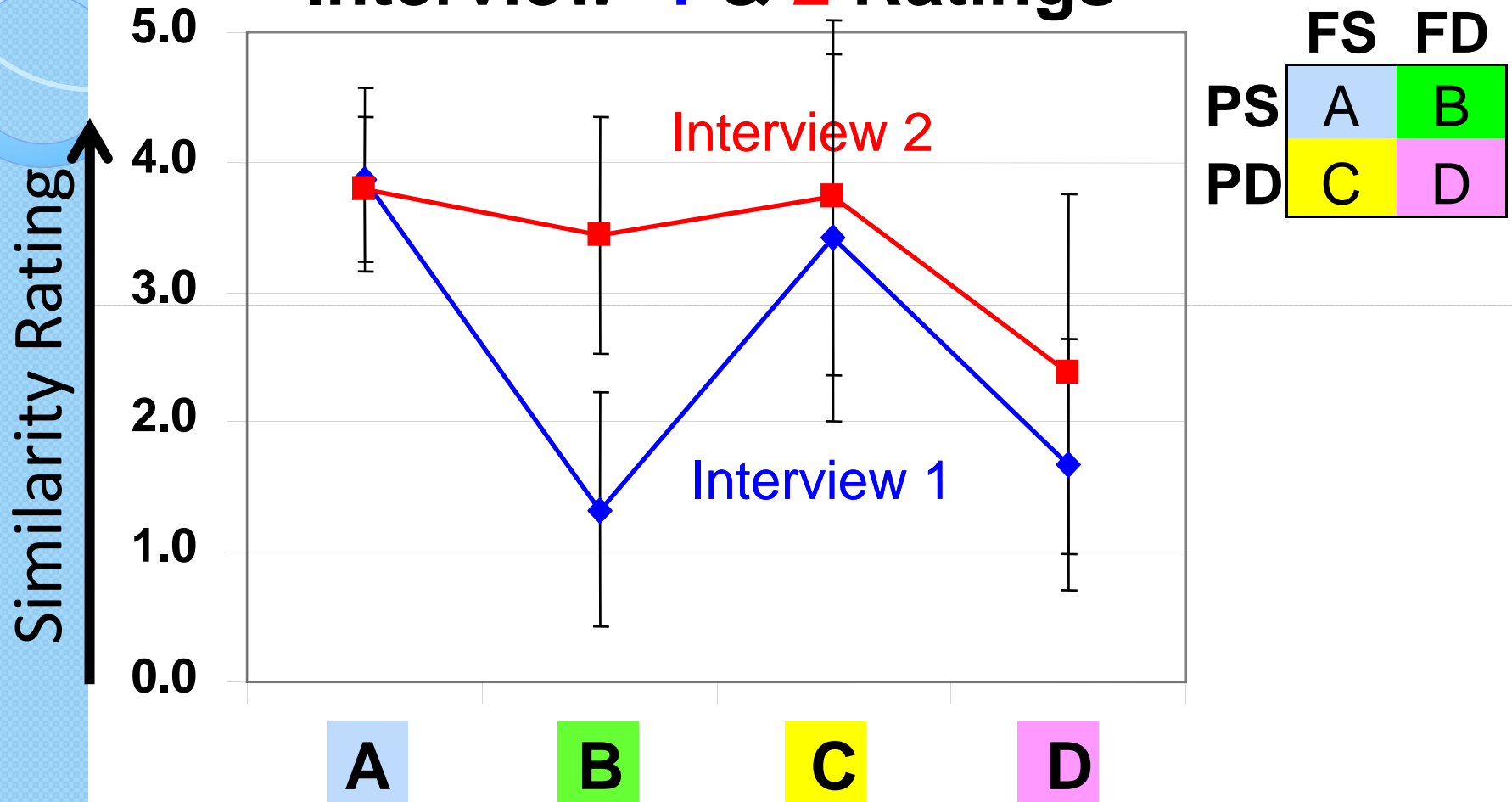


A 0.10 kg bullet is loaded into a gun compressing a spring (spring constant is 6400 N/m) a distance of 0.20 m. When the trigger is pulled, the spring is released, and the bullet leaves the spring at the spring's relaxed length. The bullet travels a distance of 0.60 m before exiting the barrel of the gun. The coefficient of kinetic friction between the bullet and the barrel is 0.10. What is the speed of the bullet as it leaves the gun?

- **Facial Difference (FD)** : Roller Coaster vs. Gun
- **Principle Difference (PD)** :
Conservative vs. Non-Conservative

Results

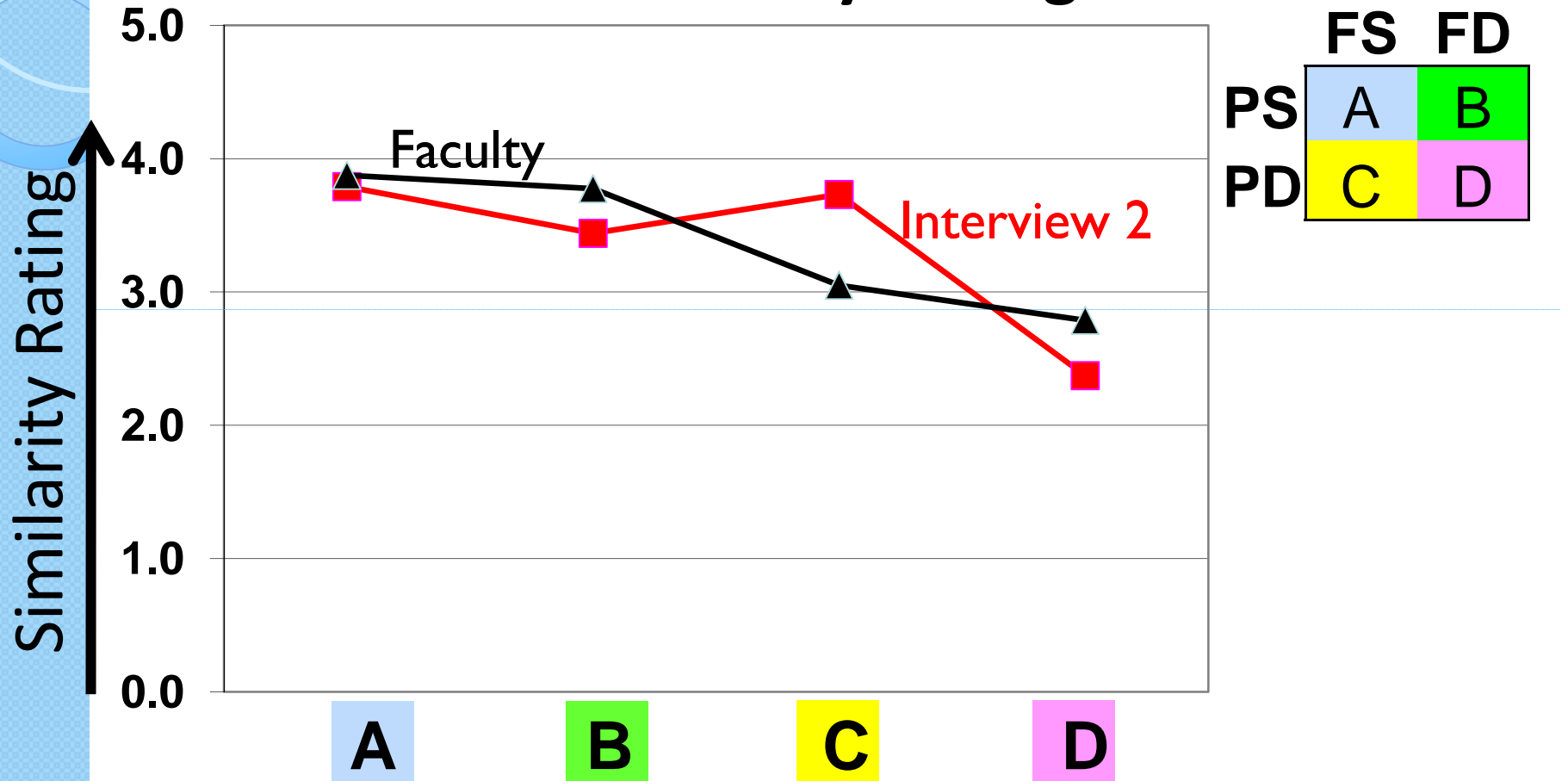
Interview 1 & 2 Ratings



Differences between **B** & **C** in **Interview 2** negligible compared to Differences between **B** & **C** in **Interview 1**

Results

Interview 2 & Faculty Ratings



Students' end-semester ratings for problem types A, B and D are similar to faculty ratings.

Summary

- To what extent do students focus on **Facial Similarity** and **Facial Differences**?
 - Students rate Facial Similarities higher overall for **1st Interview** and **2nd Interview**.
 - Students rate Facial Differences lower overall for **1st Interview** and **2nd Interview**.
- To what extent do students focus on **Principle Similarity** and **Principle Differences**?
 - Students **seemingly unfocused** on **Principle Differences** or **Principle Similarities** given problems with **Facial Differences** during **1st Interview**.
 - Students **begin to focus** on **Principle Differences** or **Principle Similarities** given problems with **Facial Differences** during **2nd Interview**.



Thank You
