

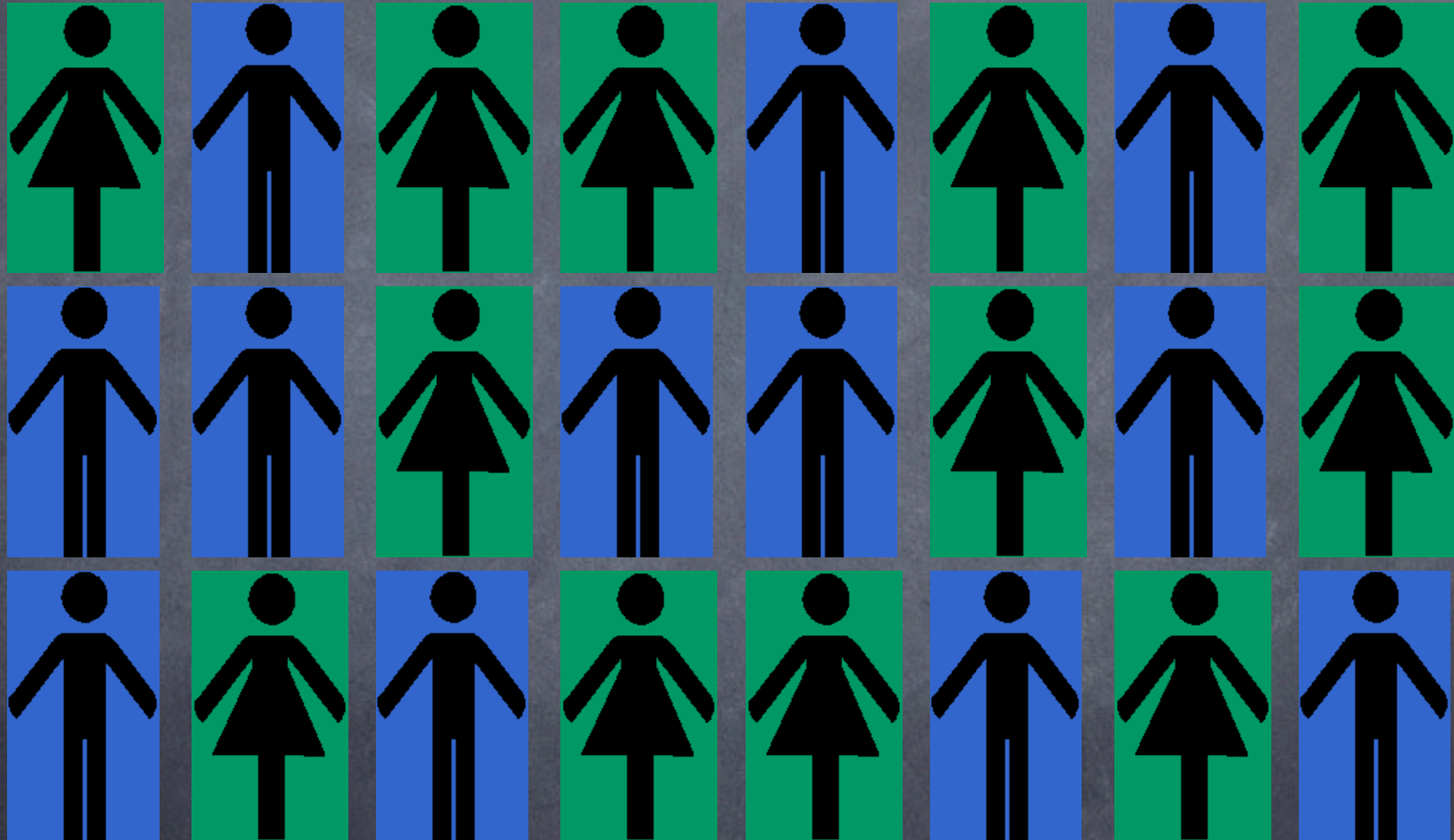
# Context, Gender, and Assessment: A Research Project

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# Why Worry about Women?

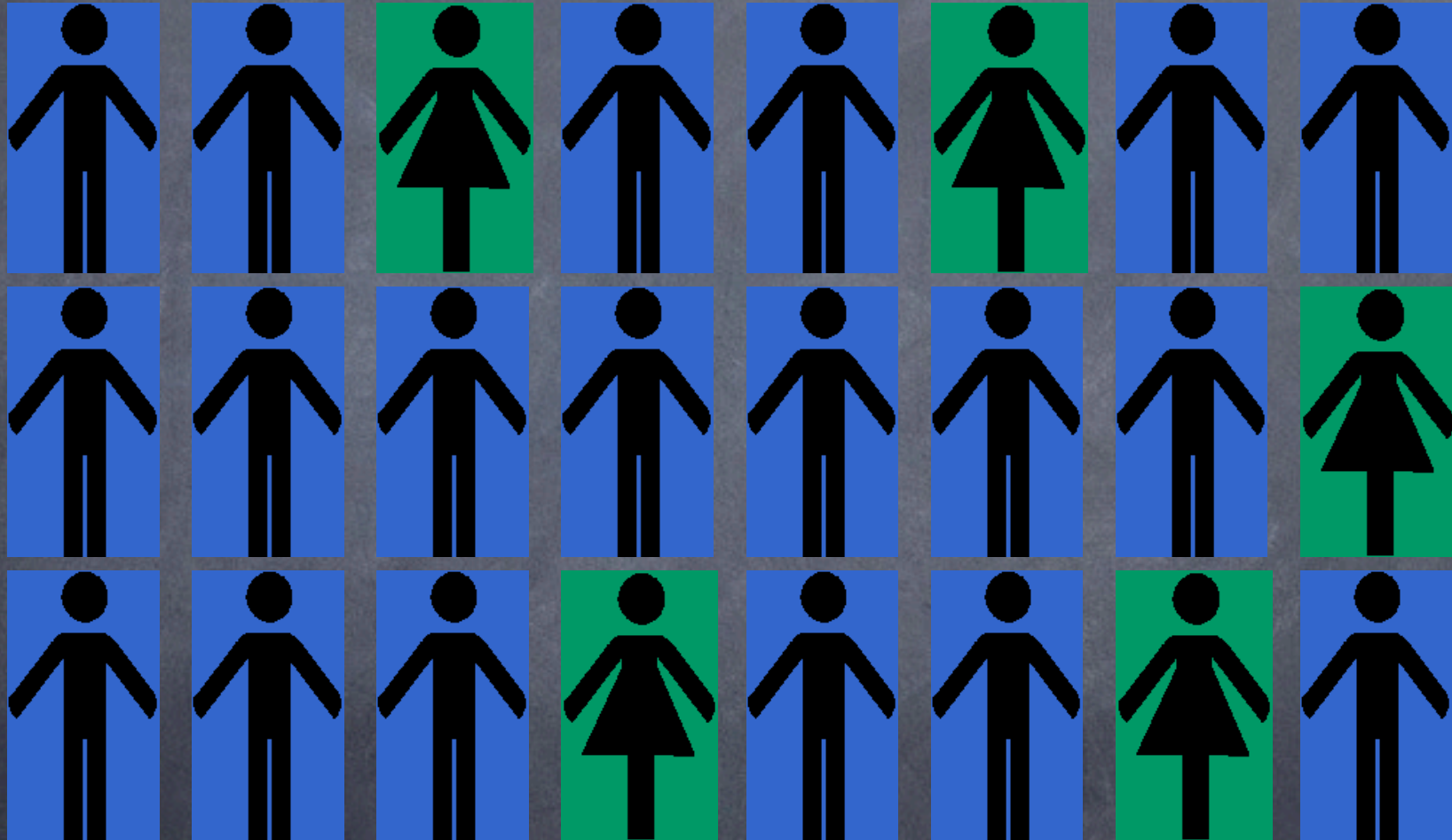
- Women receive
  - about half of all high school diplomas,
  - about half of all bachelor's degrees (57%),
  - 58% of master's degrees, and
  - 44% of doctorates
- What about physics?

# High School Physics



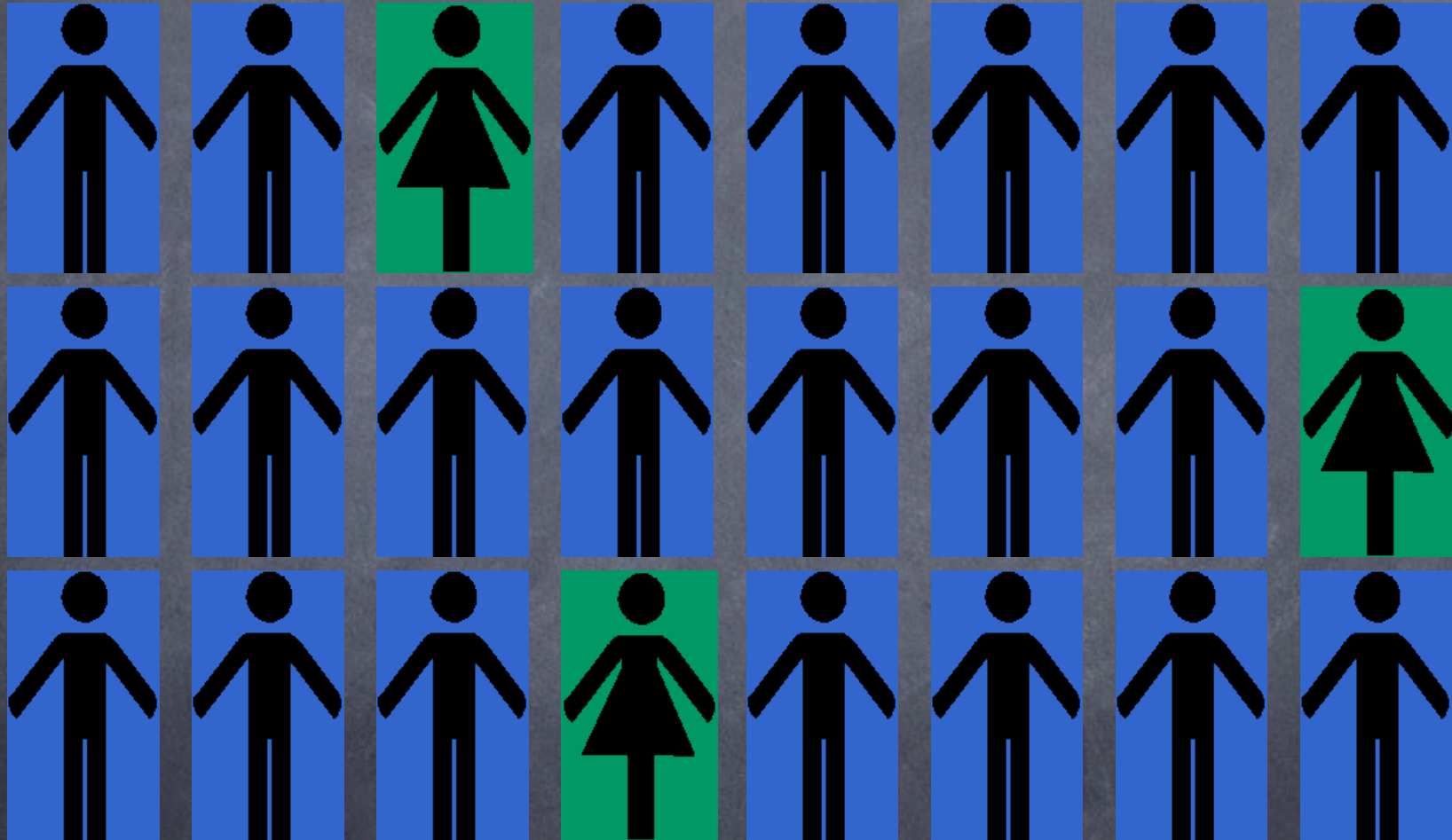
About 50% of current high school physics students are women! This is fantastic!

# Undergraduate Physics



About 20% of college physics degrees currently go to women

# Graduate Physics



Only 13% (about 1 in 8) of PhDs in physics are now earned by women

# A Shortage of Women

- Severe under-representation of women in physics
- Multiple causes: culture, bias, harassment, discrimination, and...teaching?
- Poor science teaching major factor in leaving science

# Gender and science teaching

- Problem: science classrooms are not gender-neutral
- Curriculum, Instruction, Assessment



No  
pictures of  
female  
scientists



Always calling  
on boys, using  
male examples



Male-oriented  
questions and  
contexts

# My Research

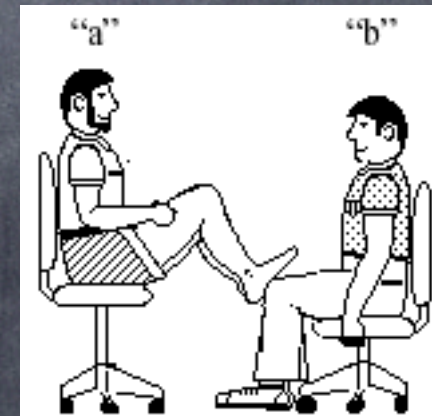
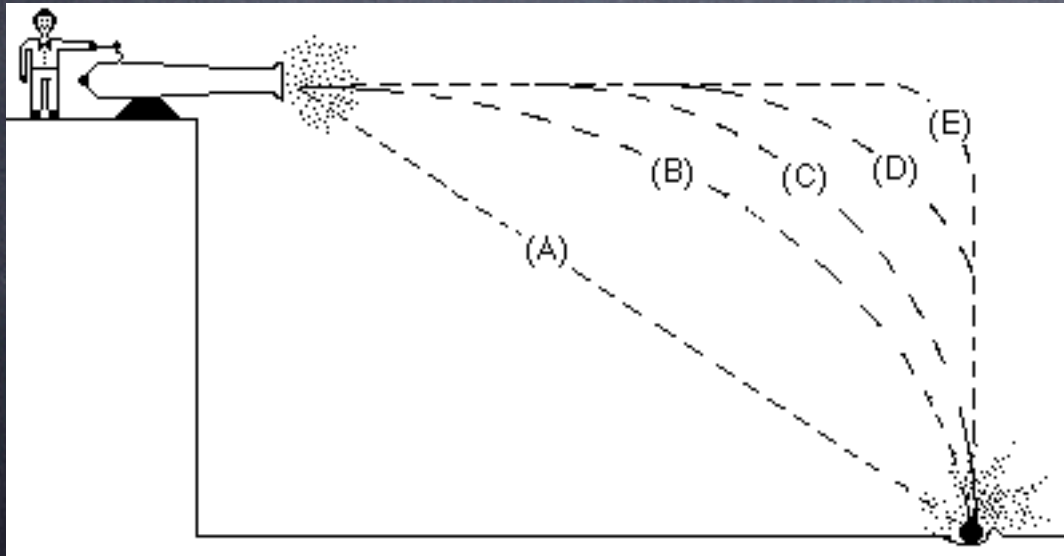
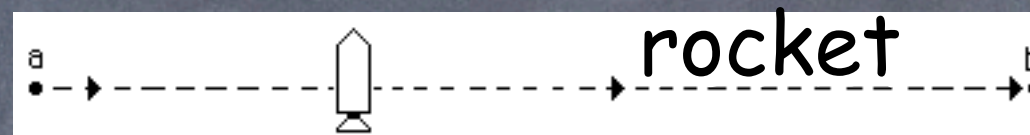
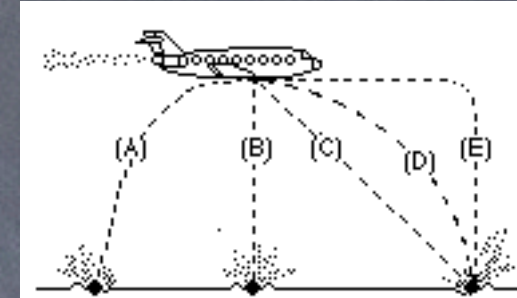
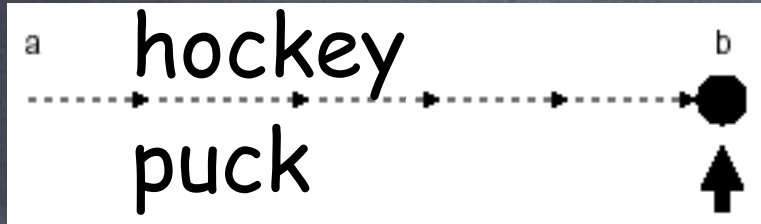
- Context, gender, science and assessment
- How does a male-oriented context affect student performance on a question?
- FCI—Conceptual physics test used nationwide
- Males score higher than females in every type of school: high school, small college, prep school, state university, research university



# Gender gap

- Why the gender gap?
  - Are males better at physics than females?
  - Do males get more out of physics classrooms than females?
  - Is test biased towards males?
- Bias? If the test is biased, how?
- Look at the test...

# Test contexts



# Test by males, for males?

- Stereotypically male contexts
- Almost every person is a male
- Written by a team of male physics education researchers
- Tested on mostly male high school students

# Hmmm...

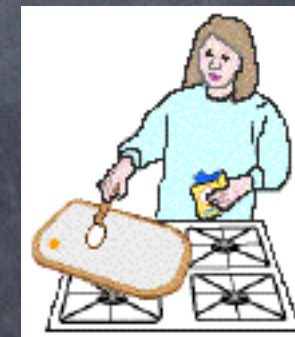
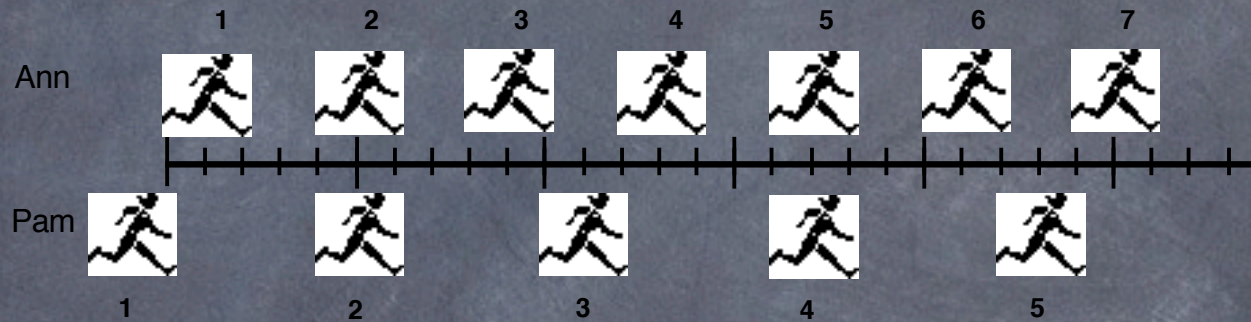
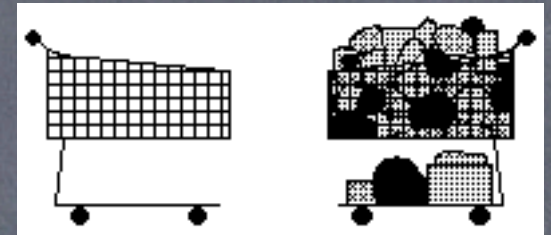
- Could these male contexts and figures be causing women to do more poorly?
- How would one test this?
- Make a test with female contexts!
- Compare performance on the versions

# Evidence for Contextual Interaction

- Translated version of the test in Thailand
- Students wouldn't answer this question!
- Cultural context completely blocked the science of the question
- Context affects performance!



# New FCI contexts



# Overall comparison

% correct UW- Group	Original	Revised
Women	21.7 (N=106)	22.3 (N=79)
Men	33.7 (N=56)	28.5 (N=71)

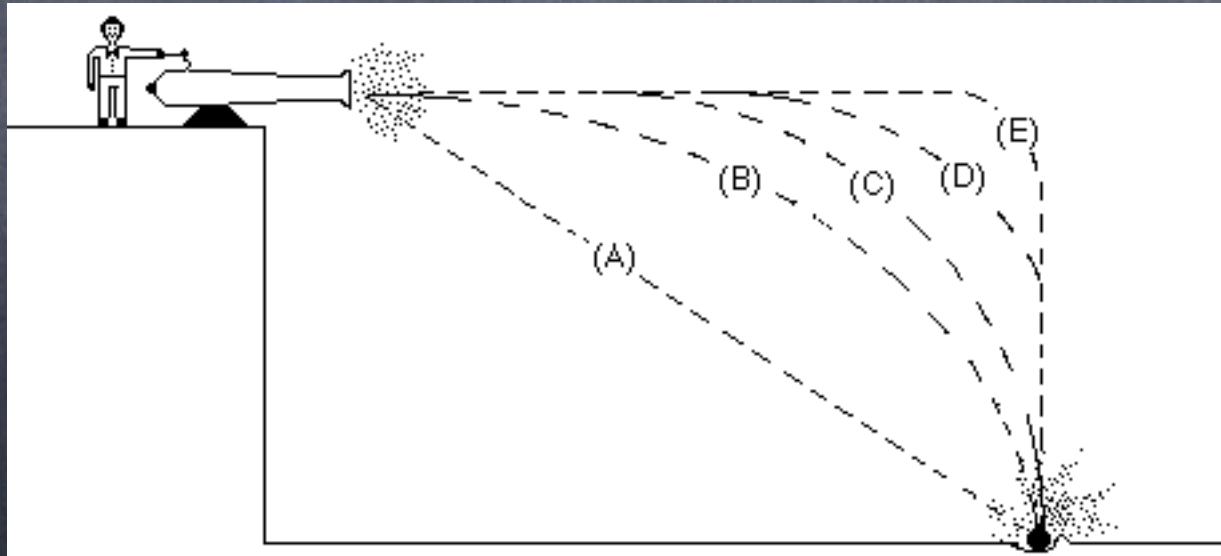
# Item by Item

- Overall, the scores did not change significantly between the versions
- Look at particular questions:
  - Cannonball to baby bowl
  - 2 males in chairs → 2 female figure skaters



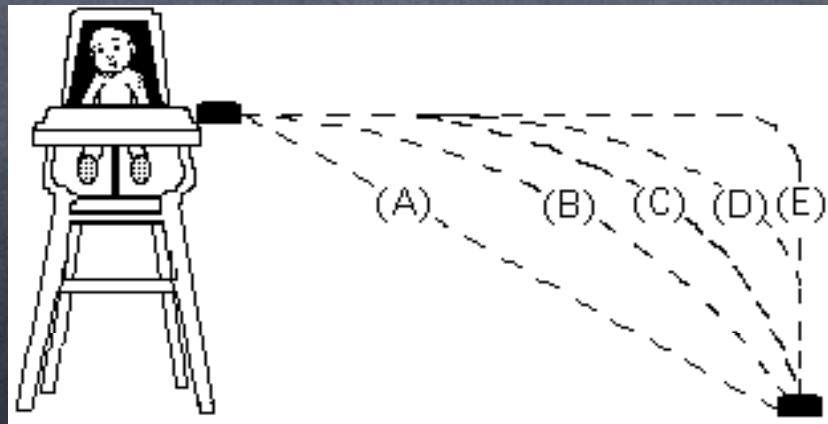
# Original Question

- A ball is fired by a cannon from the top of a cliff as shown in the figure below. Which of the paths would the cannonball most closely follow?



# Revised Question

- A baby in a high chair slides her bowl of food horizontally off the side of her flat tray with a quick push. Which path below best represents the path of the bowl?



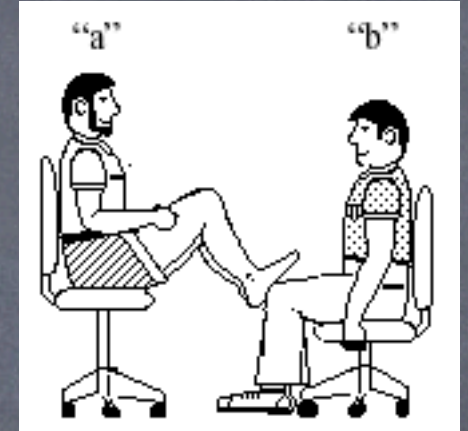
# Results-cannon/baby

% correct	Original	Revised
Women	34	51
Men	66	66

Women did much better, men did the same on the revised version. The revision decreased the gender gap.

# Original Question

In the figure at right, student "a" has a mass of 95 kg and student "b" has a mass of 77 kg. They sit in identical office chairs facing each other.



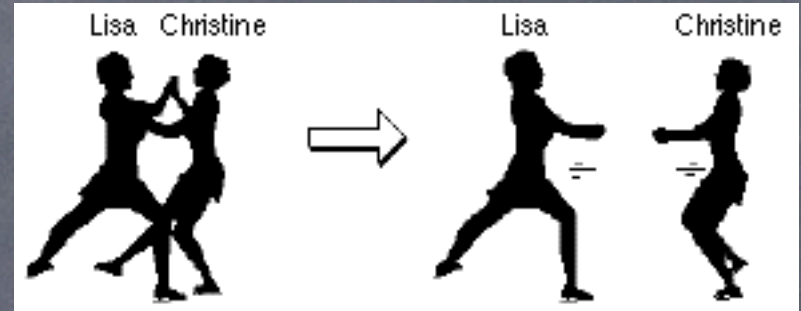
Student "a" places his bare feet on the knees of student "b", as shown. Student "a" then suddenly pushes outward with his feet, causing both chairs to move.

During the push and while the students are still touching one another:

- (a) 0 force
- (b) a on b but not b on a
- (c)  $b > a$
- (d)  $a > b$
- (e)  $a = b$

# Revised Question

Two figure skaters, Lisa who has a mass of 95 kg and Christine who has a mass of 77 kg, are standing on the ice with Lisa's hands braced against Christine. Lisa suddenly pushes off of Christine, causing them both to move.



During the push and while the skaters are still touching one another:

- (a) 0 force
- (b) a on b but not b on a
- (c)  $b > a$
- (d)  $a > b$
- (e)  $a = b$

# Results-skaters

% correct	Original	Revised
Women	5	10
Men	23	17

Women did better on the revised version, men did worse on the revised version. This revision decreased the gender gap, but at a significant cost.

# Original Question

- Two metal balls are the same size but one weighs twice as much as the other. The balls roll off a horizontal table with the same speed. In this situation:
- (a) both balls hit the floor at approximately the same horizontal distance.
- (b) the heavier ball hits the floor at about half the horizontal distance than does the lighter ball.
- (c) the lighter ball hits the floor at about half the horizontal distance than does the heavier ball.
- (d) the heavier ball hits the floor considerably closer to the table than the lighter ball, but not necessarily at half the horizontal distance.
- (e) the lighter ball hits the floor considerably closer to the table than the heavier ball, but not necessarily at half the horizontal distance.

# Revised Question

- Two oranges, one of which weighs twice as much as the other, roll off of a kitchen table with the same speeds. In this situation,
- (a) both oranges hit the floor at approximately the same horizontal distance.
- (b) the heavier orange hits the floor at about half the horizontal distance than does the lighter orange.
- (c) the lighter orange hits the floor at about half the horizontal distance than does the heavier orange.
- (d) the heavier orange hits the floor considerably closer to the table than the lighter orange, but not necessarily at half the horizontal distance.
- (e) the lighter orange hits the floor considerably closer to the table than the heavier orange, but not necessarily at half the horizontal distance.



# Results-oranges

% correct	Original	Revised
Women	25	18
Men	25	37

Women did worse on the revised version, men did better on the revised version. This revision increased the gender gap!

# Research Conclusions

- Context does affect performance
- No consistent gender changes—yet!
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# Further research

- Check reliability of test with original
- Check reliability by gender
- More data; more revision
- Eventual goal: a gender-neutral test (gender gap?)
- Overall goal: better physics instruction for women