Gender Differences in Student Responses to Physics Conceptual Questions Based on Question Context

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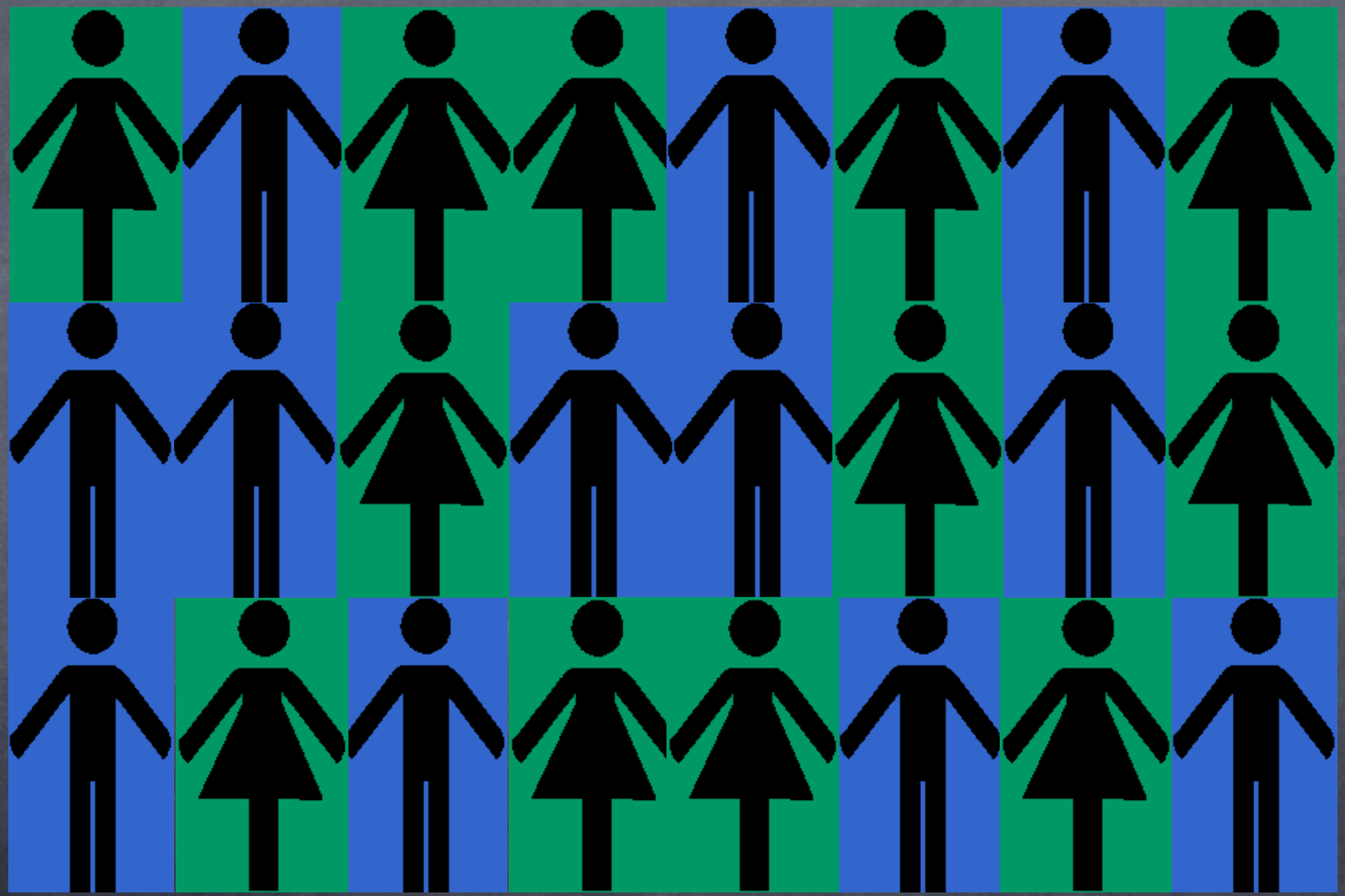
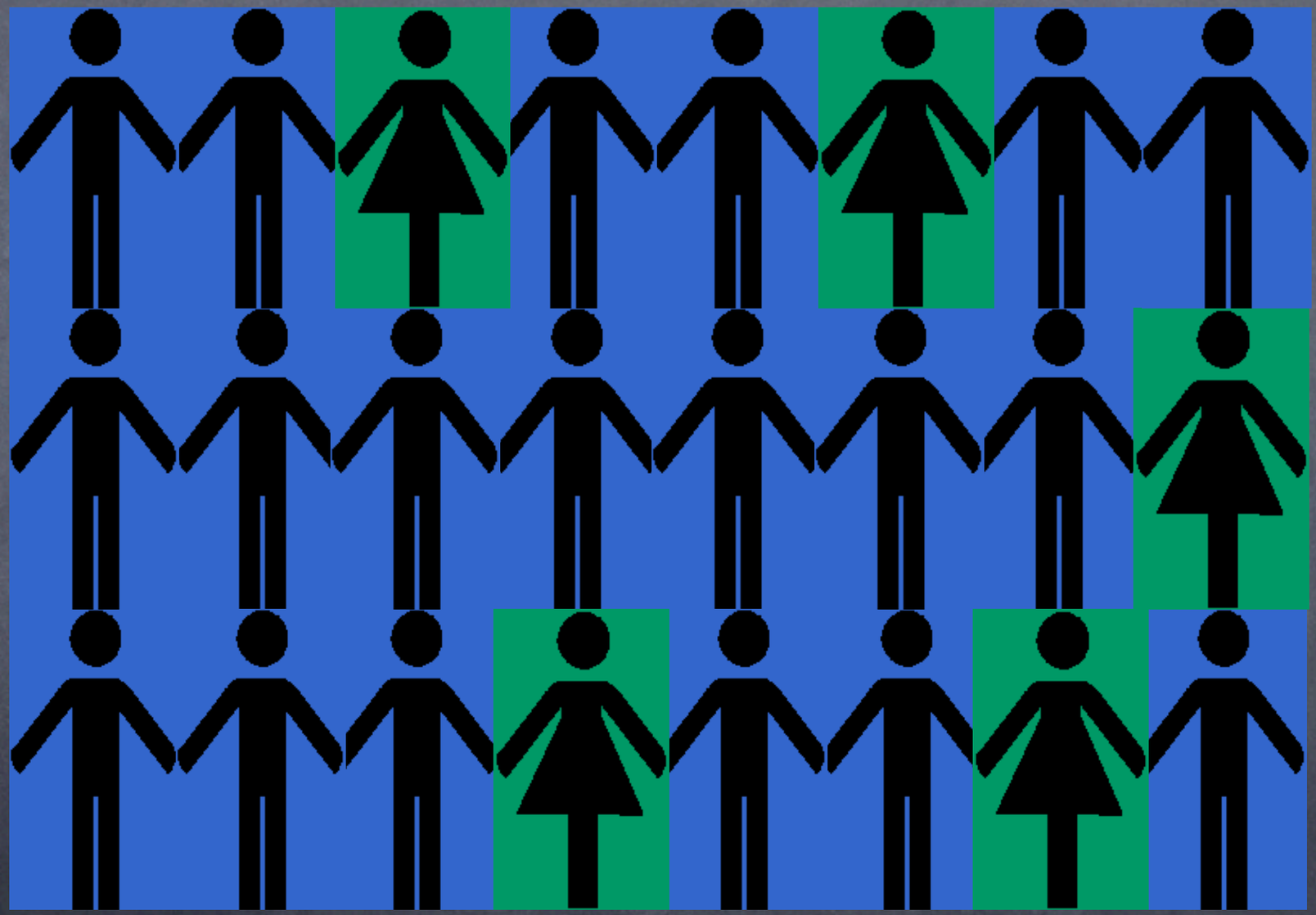
Overview

- Under-representation of women in physics
- Physics classroom as problem?
- Testing and context
- Force Concept Inventory
- Contexts of FCI
- Study & results
- Conclusions

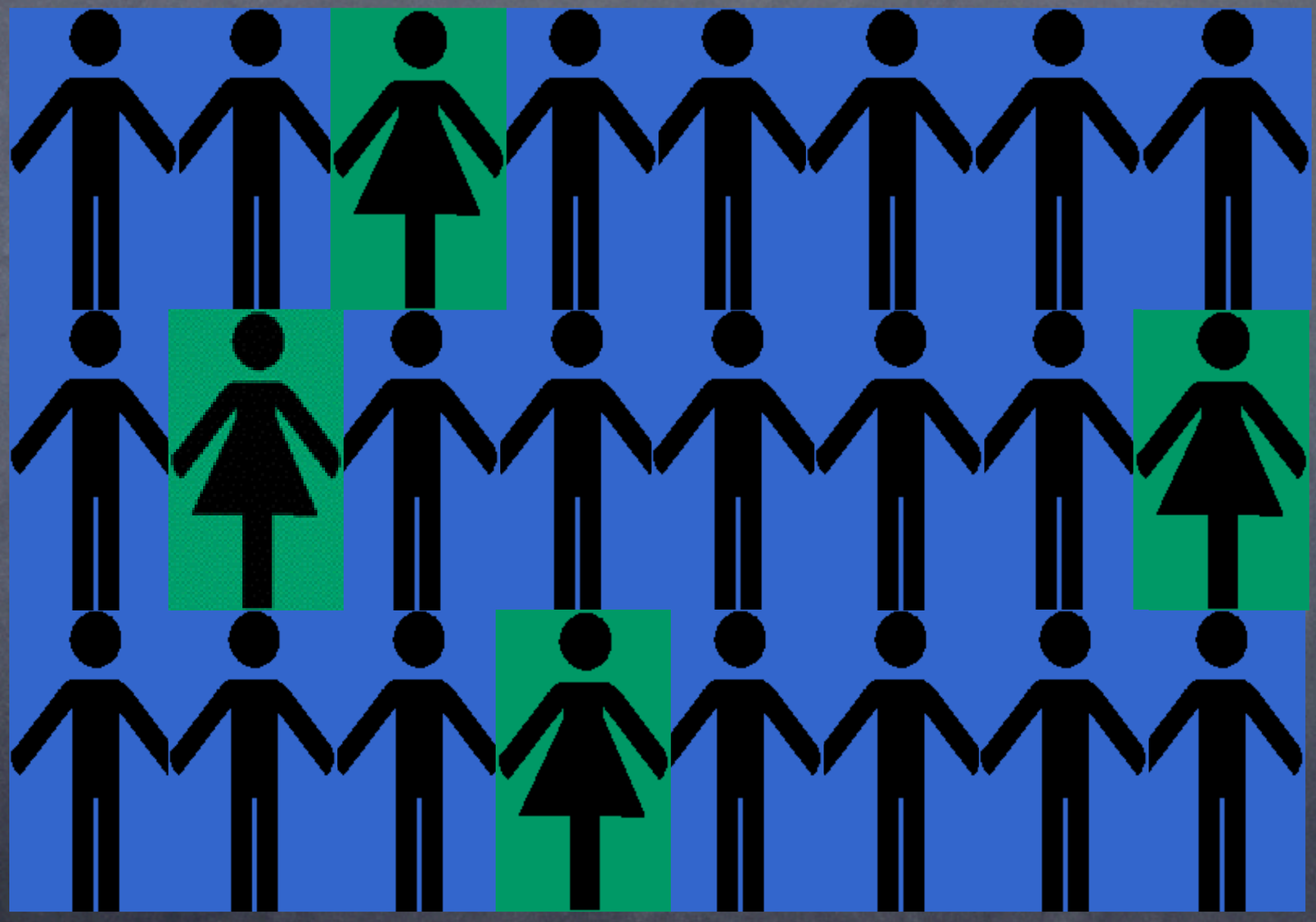
High School Physics



Undergraduate Physics



Graduate Physics



- Does physics education promote or hinder women's participation in physics?

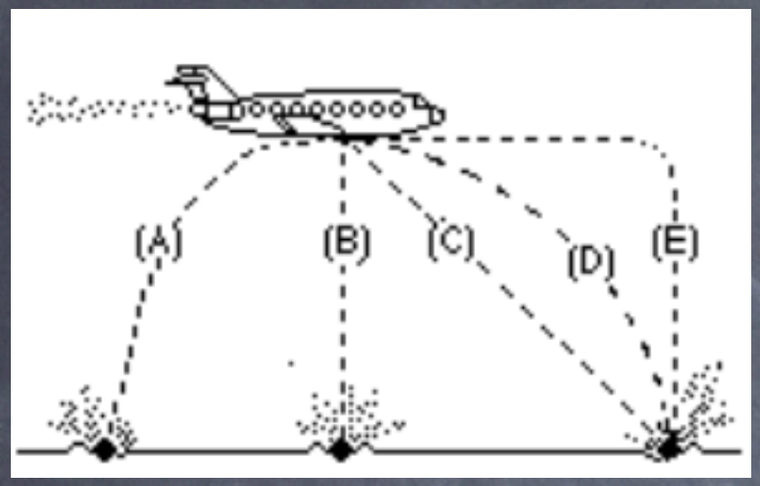
Physics Problems & Contexts

- Rennie and Parker (1993, 1996, 1998): contexts can affect student response on questions
- Enderstein & Spargo (1998) found changing contexts changes student answers
- Stewart, Griffin, and Stewart (2007) discovered that changes in context or figures or level of abstractness causes up to 10% difference in correct responses

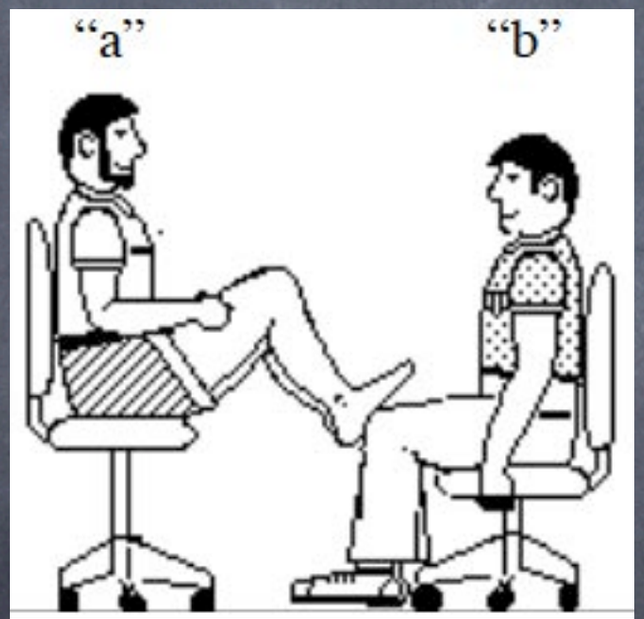
Force Concept Inventory

- 30 question multiple choice
- Conceptual introductory physics
- Wrong answers based on research on common misconceptions
- Used across the country (HS, 2-yr, 4-yr colleges & universities)
- Has gender gap in performance favoring males
- Background differences do not account for gap

a large truck collides with...

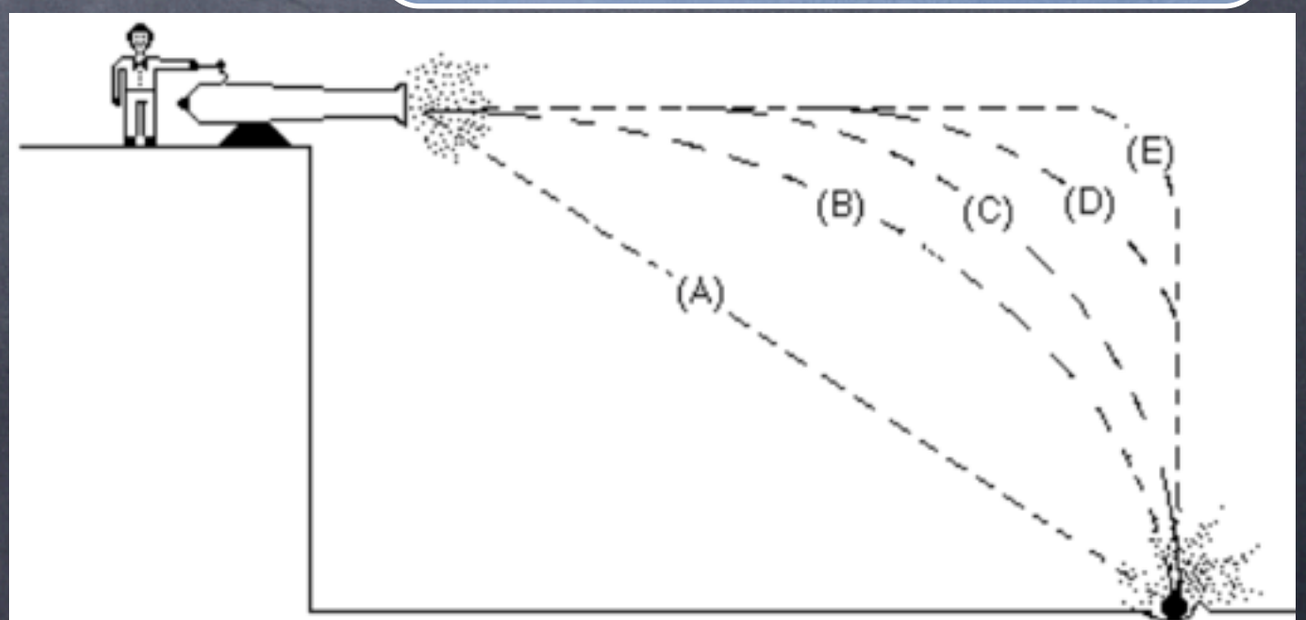


a hockey puck sliding with constant speed...



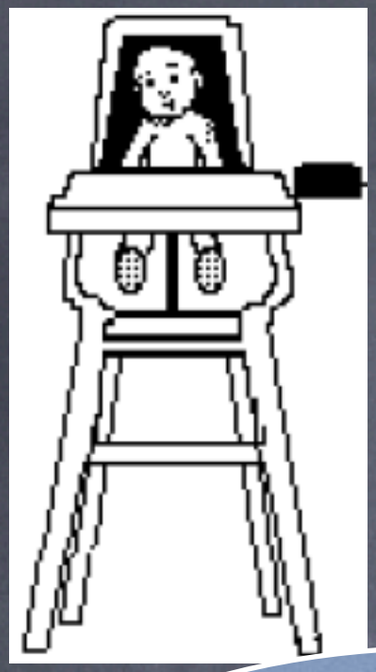
a boy throws a steel ball..

a boy swings on a rope...

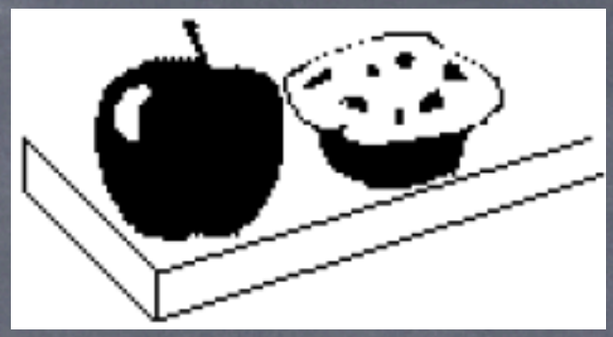


Context and gender

- Original FCI: stereotypically male contexts
- Do contexts play a role in gender gap?
- Revised FCI: stereotypically female contexts

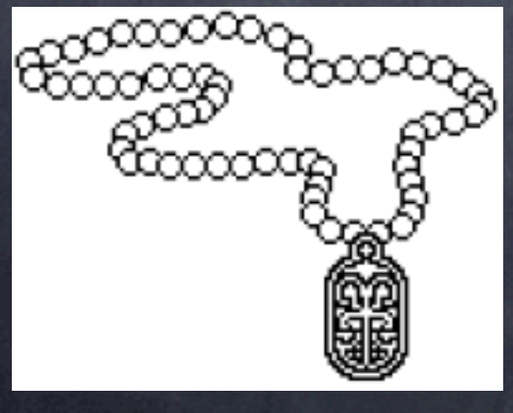


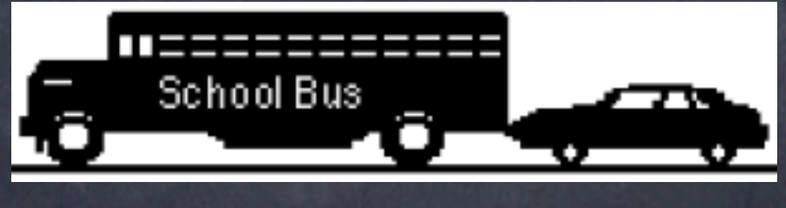
a very full shopping cart collides with...



a girl throws a teddy bear...

a pat of butter slides with constant speed...





Original FCI vs. Revised FCI
Avg. % correct

	Original FCI	Revised FCI
Pre-instruction*	30.5	35.3
Post-instruction	46.1	43.9

Original FCI vs. Revised FCI Avg. % correct by gender

	Original FCI	Revised FCI
Women Pre-instruction*	23.5	29.4
Men Pre-instruction*	34.3	39.4
Women Post-instruction	35.6	38.0
Men Post-instruction	50.1	48.4

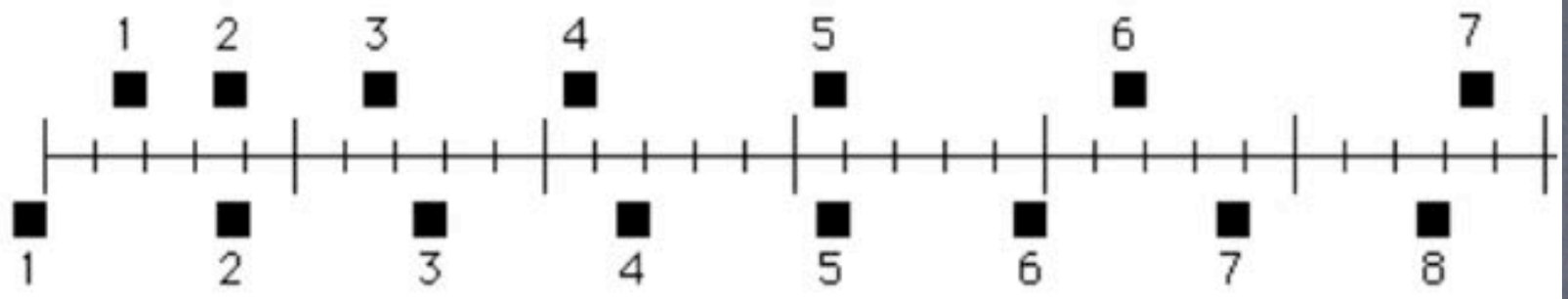
Results

- Overall no harm done with revision but no help either on post-test; pre-test shows improvement for both men and women
- Individual questions show large variety in patterns

Question 19

Original version

19. The positions of two blocks at successive 0.20-second time intervals are represented by the numbered squares in the figure below. The blocks are moving toward the right.

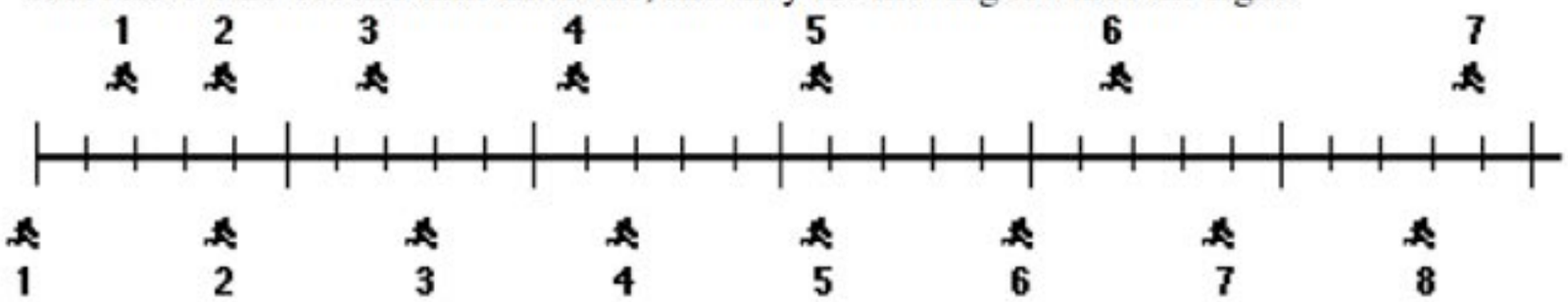


Do the blocks ever have the same speed?

(A) No.
(B) Yes, at instant 2.
(C) Yes, at instant 5.
(D) Yes, at instants 2 and 5.
(E) Yes, at some time during the interval 3 to 4.

New version

19. The positions of two joggers, Ann and Pam, are shown below. The joggers are shown at successive 0.20-second time intervals, and they are moving towards the right.



Do the joggers ever have the same speed?

(A) No.
(B) Yes, at instant 2.
(C) Yes, at instant 5.
(D) Yes, at instants 2 and 5
(E) Yes, at some time during the interval 3 to 4.

Positive Changes
Avg. % correct on Q19

	Original FCI	Revised FCI
Women Pre-instruction*	32	48
Men Pre-instruction*	42	58
Women Post-instruction*	34	52
Men Post-instruction	50	61

Question 4

Original version

A large truck collides head-on with a small compact car. During the collision:

(A) the truck exerts a greater amount of force on the car than the car exerts on the truck.

(B) the car exerts a greater amount of force on the truck than the truck exerts on the car.

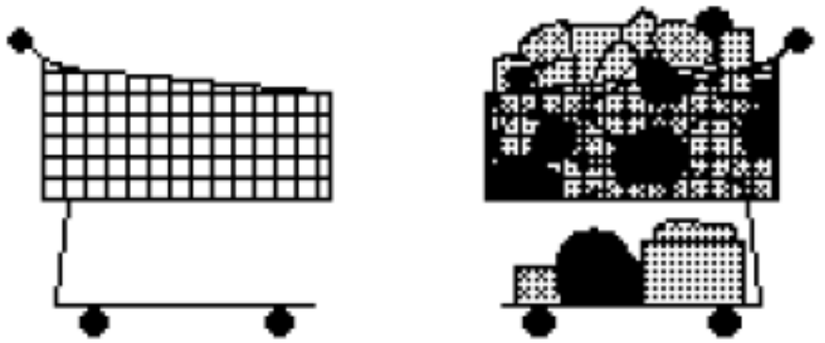
(C) neither exerts a force on the other, the car gets smashed simply because it gets in the way of the truck.

(D) the truck exerts a force on the car but the car does not exert a force on the truck.

(E) the truck exerts the same amount of force on the car as the car exerts on the truck.

New version

Imagine a head-on collision between a very full shopping cart and an empty cart. Both carts are moving very quickly. During the collision,



(A)the full cart exerts a greater amount of force on the empty cart than the empty cart exerts on the full cart.

(B)the empty cart exerts a greater amount of force on the full cart than the full cart exerts on the empty cart.

(C)neither exerts a force on the other, the empty cart gets smashed simply because it gets in the way of the full cart.

(D) the full cart exerts a force on the empty cart but the empty cart doesn't exert a force on the full cart.

(E) the full cart exerts the same amount of force on the empty cart as the empty cart exerts on the full cart.

Neutral Changes
Avg. % correct on Q4

	Original FCI	Revised FCI
Women Pre-instruction	16	12
Men Pre-instruction	15	18
Women Post-instruction	34	23
Men Post-instruction*	39	26

Overall changes

- Pattern of small positive changes on pre-test: nearly half of 30 questions show improvement with revision
- Small negative changes on post-test for men, neutral for women
- Overall score not affected

Goals/Future Research

- Understand how contexts can affect question responses
- Create gender-neutral tests

Thank you!