# Visual Cueing and Feedback Influencing Undergraduate Students' Reasoning Resources on Conceptual Physics Problems

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## Abstract

Research has demonstrated that attentional cues overlaid on diagrams and animations can help students attend to the pertinent areas of a diagram and to facilitate problem solving. In this study we investigate the influence of visual cues and correctness feedback on students' ability to activate and coordinate the cognitive resources that they currently possess. The participants (N=90) were enrolled in an algebra-based physics course and were individually interviewed. During each interview students solved four problem sets each containing an initial problem, six isomorphic training problems, and a transfer problem. The cued conditions were given visual cues on the training problems, and the feedback conditions were told whether their responses (answer and explanation) were correct or incorrect, but the interviewer did not distinguish whether the source of their incorrectness was because of their explanation, or their answer. We found that the combination of both correctness feedback and visual cueing, were the most effective means to assist participants in not only the activation of the proper reasoning resources to successfully solve the problems, but also in the coordination of those resources.

## What is Visual Cueing?

Method of facilitating a learner to attend to specific visual information.

## Rationale

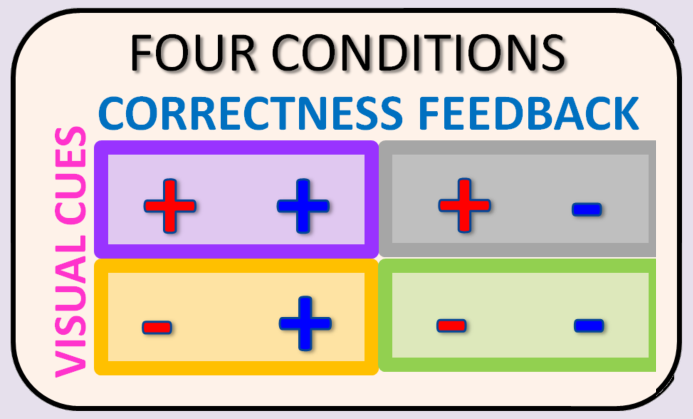
- Many students have difficulties in physics problem solving even after completing a physics course.
- Particular difficulty is utilization of the cognitive resources that they currently possess.

## Research Questions

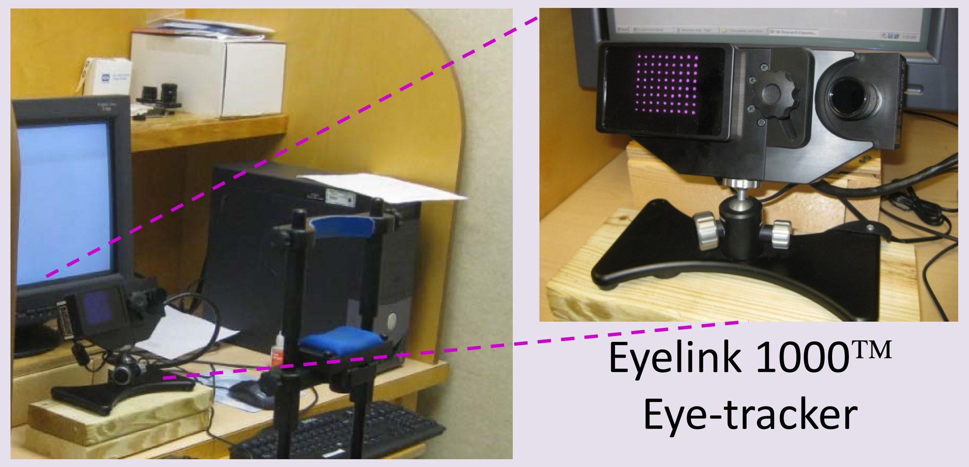
- To what extent can visual cueing and correctness feedback train students to correctly reason through conceptual physics problems?
- To what extent can students who have been thus trained correctly reason through a different subsequent (transfer) problem with neither cues nor feedback ?

## Methods

- Algebra-based introductory mechanics course (N=90).
- Individual eye-tracking interviews lasting about 50 minutes.
- Students randomly assigned to one of four conditions.

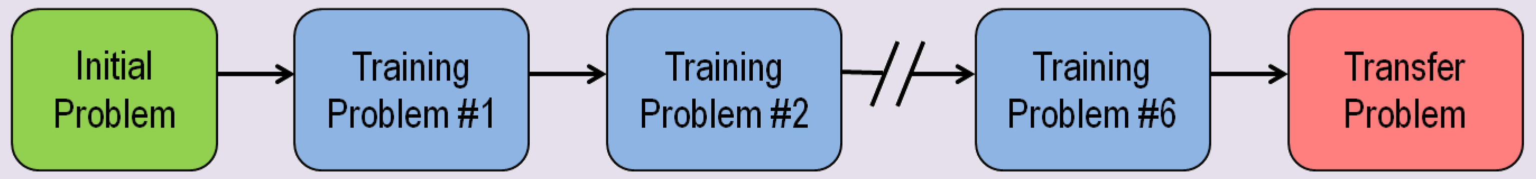



- CUED conditions saw colored shapes overlaid on the *TRAINING* problem diagrams for 8 seconds at a time.
- FEEDBACK conditions were told if their responses (answer & explanation) were correct, but no further information was provided.

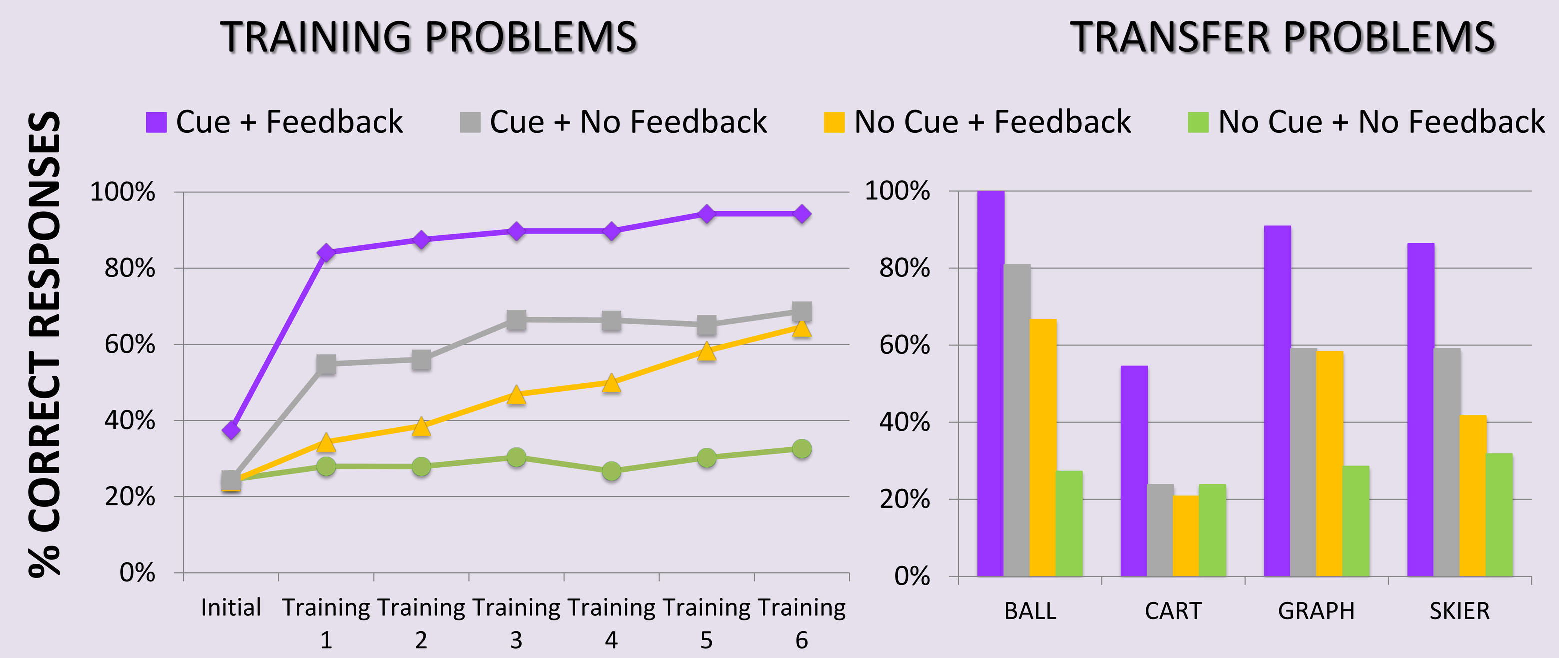


Eyelink 1000™ Eye-tracker

Each condition completed four problem sets, each of which:
- Started with an initial problem
- Followed by six training problems
- Ended with a transfer problem




## Results

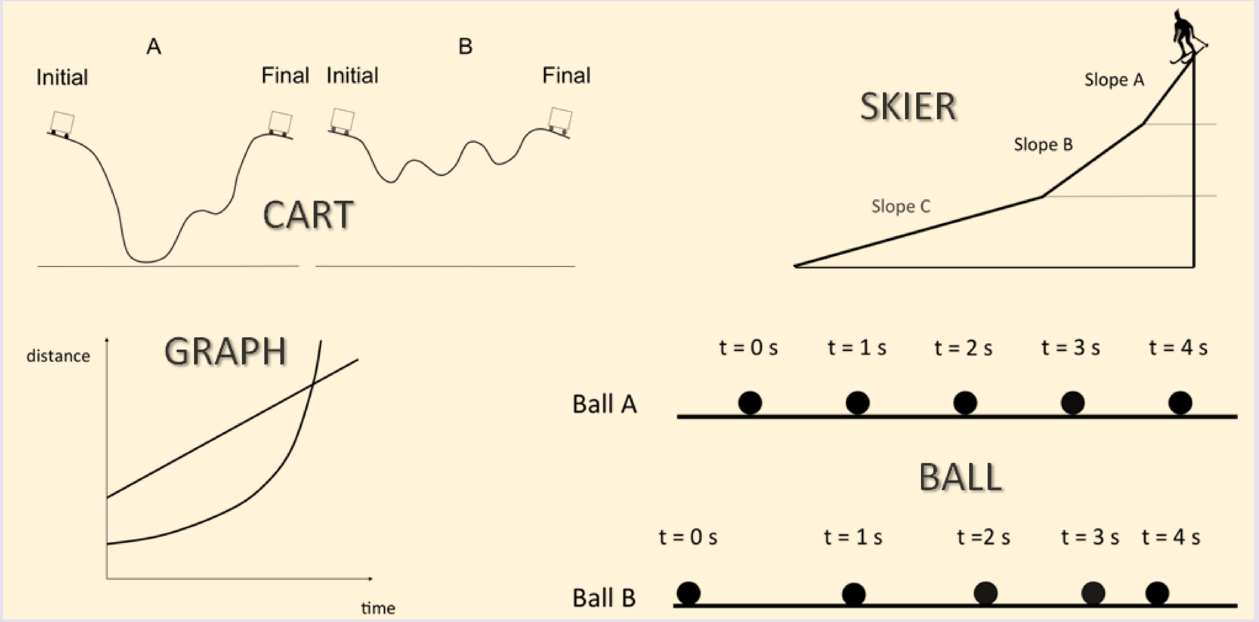



## Conclusions & Future Work

- Across all problem sets, we found that the combination of cueing and feedback promotes the greatest performance on the training problems as well as on the transfer problems.
- Further investigation into the effectiveness of visual cueing and correctness feedback in other contexts should be undertaken.
- The applicability of visual cueing and correctness feedback for online learning environments will be explored.

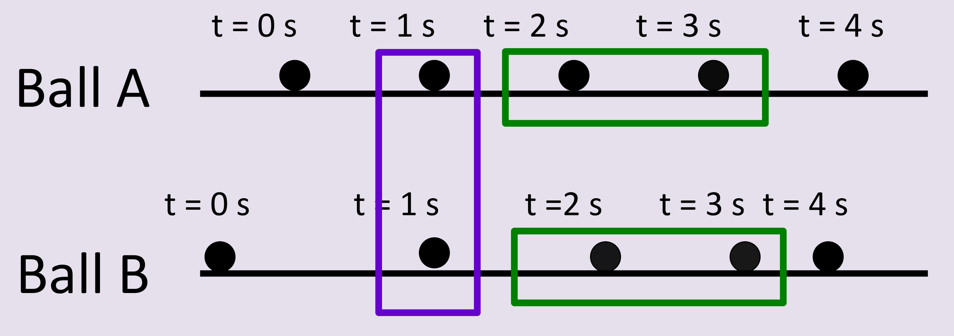
## Materials Used

Four problem sets




Two balls roll along the paths shown. A snapshot of the position of the balls is taken every second. At what point in time does Ball B have the same speed as Ball A?

### INITIAL PROBLEM

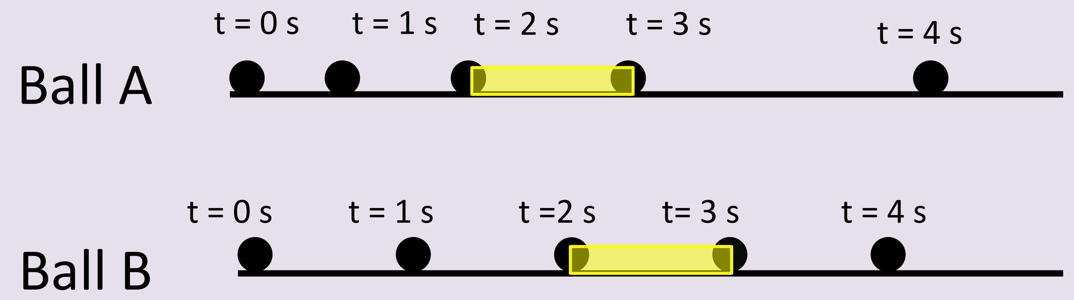



Area Associated With Common Misconception

Area Relevant to Correctly Solving Problem

Two balls roll along the paths shown. A snapshot of the position of the balls is taken every second. At what point in time does Ball B have the same speed as Ball A?

### TRAINING PROBLEM




Visual Cue sequentially shades the distance between adjacent snapshots, to remind students to compare distances for the two balls.

Ball A begins riding down in an elevator at the same time as Ball B is dropped from the roof of an adjacent building. A snapshot of the balls is taken every second. At what point in time does Ball B have the same speed as Ball A?

### TRANSFER PROBLEM