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# Effects of Visualization on Familiar Motion Problems

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## Introduction

Kaiser, Jonides, and Alexander (1986) claimed that people can reason more appropriately about the curvilinear motion problems when they are related to familiar experiences than when they are not. It is, thus, predicted that visualizing the familiar experience of the motion will lead to the correct response for the curvilinear motion problem. However, Hubbard (1996) hypothesized that the visualization strategy for the curvilinear motion problem leads to the incorrect curvilinear impetus response.

To differentiate these two opposite theoretical predictions, the effects of visualization have to be subjected to empirical test. The problem used by Kaiser et al. (1986) was modified and three instruction groups were prepared: The water group predicted a path of water spouting from a spiral tube. Besides the path prediction, the hose-analogy group was reminded of the experience of using a garden hose, and the visualization group visualized the scene in which water spouted from a garden hose.

## Method

### Participants

Eighty-four female college students without college-level physics education were randomly and evenly assigned to one of three instruction groups (i.e. water, hose-analogy, and visualization groups).

### Materials and Procedure

Each participant received a booklet, where a schematic diagram of a spiral tube and one of the three instructions were printed to describe the problem. Nine alternative paths were also printed. Among those paths, one was the correct straight path. Four were curvilinear impetus paths that curved inwardly, and the other four were centrifugal force paths that curved outwardly. Participants selected the path that matched their prediction.

## Results and Discussion

Performance significantly differed across the three groups ( $\chi^2 L(4) = 17.31, p = .002$ ). Percentage of curvilinear impetus responses in the visualization group was smaller than those in the other two groups. This finding clearly disagrees with Hubbard's hypothesis (Hubbard, 1996). The visualization and water groups responded more correctly than the hose-analogy group. Although there was little difference between the visualization and water group, the results might agree

with the prediction by Kaiser et al. (1986). Because percentage of correct responses in the visualization group was larger than those in the hose-analogy group, and it might be higher than those in previous studies which reported that 37 - 46 % of participants without formal physics training predicted the correct path for the abstract curvilinear motion problems (e.g., Kaiser et al., 1986; McCloskey & Kohl, 1983). The difference between the visualization and hose-analogy groups suggests that not recalling but visualizing the familiar experience is responsible for the effects of visualization.

In conclusion, we can say that visualizing the familiar experience leads to the correct response rather than the incorrect curvilinear impetus response for the curvilinear motion problems.

Table 1: Percentage of Participants Choosing Correct, Curvilinear Impetus, and Centrifugal Force Responses.

Instruction	Response		
	Correct	Curvilinear impetus	Centrifugal force
Water	64	18	18
Hose-analogy	36	50	14
Visualization	68	11	21

*Note.* There were 28 participants in each group.

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