Manual rotation experience on mental rotation strategies

Julia X. Li, Linda B. Smith, Susan S. Jones, & Karin H. James

Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN 47405

Introduction

- Children develop a preference for categorizing objects by shape around 2- to 3- years of age (Landau, Smith, & Jones, 1988), but shape recognition can be affected by the orientation of the object. Recognition of an object across changes in viewpoint involves forming a shape-constant representation.
- By viewing multiple perspectives of the same object, adults can form orientation-invariant object representations (Tarr & Pinker, 1989), and active manipulation of 3-D structures facilitates object recognition (James, Humphrey, & Goodale, 2001).
- How do children develop shape-constant representations, and how does active manipulation influence categorization across orientation transformations?

Experiment 1

**Participants:**
- Adults (M = 22.7 yo)
- 6 + yo (M = 8.0 yo)
- 5 yo (M = 5.5 yo)
- 4 yo (M = 4.3 yo)
- 24.0-42.0 mo (M = 32.4 mo)

**Procedure:**

All participants received 3 blocks of trials (see Figure 1). In each block, participants were first familiarized with an exemplar object labeled with a novel name (e.g. dax). For the Test block trials, participants were presented with two object choices (orientation-match & geometric shape-match) and asked to select the one that was also labeled with the novel name. The Baseline block measured participant’s ability to categorize objects based on orientation (defined by the object’s axis of elongation). All participants successfully categorized by orientation when there wasn’t a shape similarity choice. Block order, pair order, and exemplar orientation were counterbalanced.

Participants were separated into two conditions: active and passive. In the active condition, participants were given the exemplar objects to freely manipulate, whereas in the passive condition, participants only viewed the stationary exemplars from behind a Plexiglas screen.

**Results:**

- Selection by Orientation

*Figure 1. Examples of stimuli and trials used in Experiment 1.*

Experiment 2

**Participants:**

- 24.0-42.0 mo (M = 33.1 mo)

**Procedure:**

Exp. 2 presented the same Test blocks from Exp. 1, but used two new Baseline blocks that measured children’s ability to categorize objects when only shape was varied. All participants were successful at categorizing by shape in the Baseline trials, but attended more to the orientation-match objects in the Test trials.

**Results:**

- Selection by Orientation

*Figure 2. A 30-month-old child selecting the orientation-match choice.*

Experiment 3

**Participants:**

- 24.0-42.0 mo (M = 33.9 mo)

**Procedure:**

Baseline and Test blocks from Exp. 1 were used in Exp. 3. Exp. 3 consisted of 4 conditions: active and passive (same as Exp. 1) & active and passive rotation. In the active rotation condition, children were shown how to rotate the exemplars and then asked to mimic the actions. In the passive rotation condition, children only watched the experimenter rotate the objects.

**Results:**

- Selection by Orientation

*Figure 3. New Baseline blocks used in Exp. 2.*

**SUMMARY**

- Children who actively rotated the exemplars selected the shape-match choice significantly more than children in the passive rotation and no rotation conditions.

Experiment 1 Results (continued)

Exp. 1 demonstrates a significant linear correlation between age and orientation categorization. Young children (24-42 mo) categorize objects by orientation, and with increasing age, participants categorize objects more by shape.

Older children and adults also categorized objects more by shape after actively exploring the exemplars.

When orientation is not a factor, 24-42-month-olds categorize objects based on shape similarity. However, they still prefer to select the orientation-match in the Test blocks for both experiments.

**Experiment 3**

In Exp. 1, older children and adults categorized objects by shape more often in the active condition. For Exp. 3, we instructed 24-42 mo children to manipulate the exemplars in different orientations to observe how guided active experience affects object categorization.

**Participants:**

- 24.0-42.0 mo (M = 33.9 mo)

**Procedure:**

For further information, please contact: Julia Li, JXL1@indiana.edu

**References:**


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