Operant Learning in 3-month-old Infants is Facilitated by Congruent Visual and Tactile Information

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Background

• Intersensory integration refers to the ability to combine information from different sensory modalities to form a unified perceptual world.
• This unity is aided by the detection of amodal cues (cues that are not specific to any one sensory modality, i.e., intensity, shape, rhythm).
• Previous studies have shown that infants can detect amodal dimensions (e.g., Bahrick & Pickens, 1994). For example, both Rose (1994) and Steri (1993) have shown that infants can detect the amodal dimension of shape across visual and haptic modalities.
• Recently, developmental researchers have begun to address the functional significance of amodal cue detection. For example, Bahrick and Lickliter (2000) found that 5-month-old infants were able to discriminate between two rhythms when the rhythms were presented in two modalities but not when they were presented in only one modality, suggesting that amodal cues may facilitate learning.

Purpose of Study

• To determine if detection of amodal cues will facilitate operant learning in human infants.
• To test this, infants learned to kick to make a mobile of cylinders move while either holding a cylinder, a brick, or no object. It was predicted that infants who held a cylinder while looking at a mobile of cylinders would show facilitated learning because the amodal dimension of shape was processed both haptically and visually.

Participants

34 3-month-old infants participate in this study:
Experimental: n = 9 infants (4 females, 5 males); M age = 97.3 days (± 3.5); M SES = 55.7 (± 6.7)
Control 1: n = 12 infants (6 females, 6 males); M age = 97.4 days (± 3.4); M SES = 54.8 (± 5.8)
Control 2: n = 8 infants (3 females, 5 males); M age = 104.7 days (± 3.8); M SES = 60.0 (± 9.2)
Control 3: n = 9 infants (4 females, 2 males); M age = 97.6 days (± 5.4); M SES = 43.5 (± 3.8)

Apparatus

A cylinder measures 8 x 1.5 cm. The cylinder is presented on a motorized conveyor belt. The belt moves at 2.5 cm per second around a 360° arc with 45° semi-circle. A rubber band maintains the cylinder vertically. A computer screen displays a mobile of cylinders and a brick. The mobile of cylinders is presented on the right side of the screen, the brick on the left. A lever is presented below the mobile of cylinders. The lever is a 5-cm bar with a 3-cm handle. The handle is 1 cm thick and 1 cm wide. The handle is placed at a 90° angle to the bar. The bar is 1.5 cm thick and 1.5 cm wide. The bar is 5 cm long. The handle is 1.5 cm long. The lever is placed on the right side of the screen. A lever is presented below the mobile of cylinders. The lever is a 5-cm bar with a 3-cm handle. The handle is 1 cm thick and 1 cm wide. The handle is placed at a 90° angle to the bar. The bar is 1.5 cm thick and 1.5 cm wide. The bar is 5 cm long. The handle is 1.5 cm long. The lever is placed on the right side of the screen.

Procedure/Design

Experimental Group

Visual (cylinders) Tactile (cylinder)

Learn to kick to make cylinders move while holding a cylinder. Amodal dimension of shape is processed both visually and haptically and is congruent across modalities.

Control Group 1

Visual (cylinders) Tactile (none)

Learn to kick to make cylinders move while not holding an object. Amodal dimension of shape is not available.

Control Group 2

Visual (cylinder) Tactile (brick)

Learn to kick to make cylinders move while holding a brick. Amodal dimension of shape is processed visually and haptically but is not congruent across modalities.

Control Group 3

Visual (large cylinders) Tactile (brick)

Learn to kick to make larger cylinders move while holding a brick. Serves as a control group to ensure that infants can visually process the global features of the mobile’s cylinders.

Learning session

Control 1: no object 
Experimental: (Control Group 2 & 3)

Baseline (3 min) Acquisition (9 min) Test (3 min)

Compared kick rates

Compared kick rates

Results

A 4 (Group) x 2 (Phase) ANOVA revealed a significant Group x Phase interaction, F(3, 32) = 4.41, p = .01. See Figure 1. LSD tests revealed no significant differences in baseline kicking among any of the groups. Only infants who held the cylinder and the brick showed a significant increase in kicking between baseline and test.

Discussion

• The results of the current study suggest that infants given congruent amodal information show facilitated operant learning and are in agreement with Bahrick and Lickliter’s (2002) Intersensory Redundancy hypothesis.
• The results also suggest that the congruent amodal information need not be directly perceived (the object was not held during test) for the facilitated learning to be observed.
• Preliminary results also suggest that the presence of incongruent amodal information inhibits learning in comparison to infants who received no amodal information.

References


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