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 Streri (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 = 97.5 days (*SE* = 3.0); *M* SES = 69.7 (*SE* = 6.7)

Control 1: n = 12 infants (8 females, 4 males); *M* age = 97.4 days (*SE* = 3.6); *M* SES = 54.8 (*SE* = 5.9)

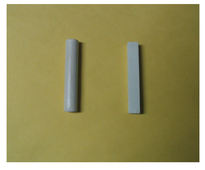
Control 2: n = 9 infants (3 females, 6 males); *M* age = 104.7 days (*SE* = 3.6); *M* SES = 60.0 (*SE* = 9.2)

Control 3: n = 6 infants (4 females, 2 males); *M* age = 97.6 days (*SE* = 5.4); *M* SES = 49.5 (*SE* = 3.8)

Apparatus

A computerized apparatus, analogous to Rovee-Collier's (1969) mobile procedure, measured kicks and controlled presentation of reinforcement (movement of the mobile). See Kraebel, Fable, & Gerhardstein (2004) for mechanical details.

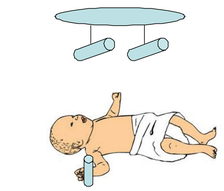
A padded arm shield prevented infants from processing the held object visually and orally. The shield is 63 cm in length and 19.5 cm in height. The aperture measures 10 x 8 cm.



The cylinder measures 8 x 1.5 cm. Holding times during acquisition:
Cylinder: *M* = 385 s (*SE* = 39.9)
Brick: *M* = 303 s (*SE* = 25.4)
Brick(w/lg cyl): *M* = 255 s (*SE* = 47.5)
A 1-way ANOVA between groups on *M* holding time was not statistically significant, $F(2,21) = 3.0$, $p = .07$. All groups held the objects greater than 90 s – the minimum time required to process shape haptically (Streri, 1993).

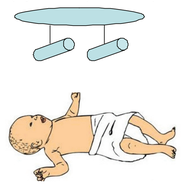
Procedure/Design

Experimental Group
Visual(cylinders) Tactile(cylinder)



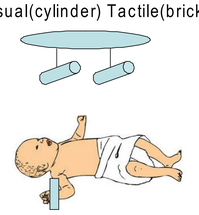
Learn to kick to make cylinders move while holding a cylinder. Amodal dimension of shape is processed both visually and haptically and is congruent across modalities.

Control Group 1
Visual(cylinders) Tactile(none)



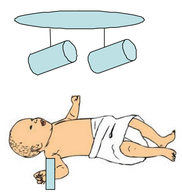
Learn to kick to make cylinders move while not holding an object. Amodal dimension of shape is not available.

Control Group 2
Visual(cylinder) Tactile(brick)



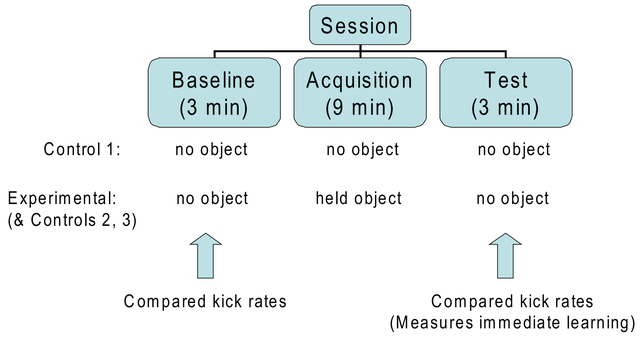
Learn to kick to make cylinders move while holding a brick. Amodal dimension of shape is processed visually and haptically but is not congruent across modalities.

Control Group 3
Visual(large cylinders) Tactile(brick)



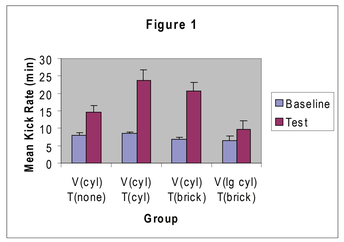
Learn to kick to make larger cylinders move while holding a brick. Serves as a control group to ensure that infants can visually process the global features of the mobile's cylinders.

Learning session

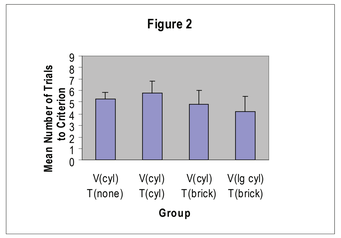


Results

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.



A one-way ANOVA on the mean number of trials to criterion revealed no significant main effect of group, $F(3,32) = .42$, $p = .73$. See Figure 2. All groups reached the criterion in the same number of trials (overall $M = 5.1$ trials, $SE = .47$). Learning criterion: Infants must kick 1.5 times above their baseline rate for at least 2 out of 3 consecutive minutes during acquisition.



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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