The Development of Infants' Sensitivity to the Orientation of Object Motion: Predictions of the Intersensory Redundancy Hypothesis

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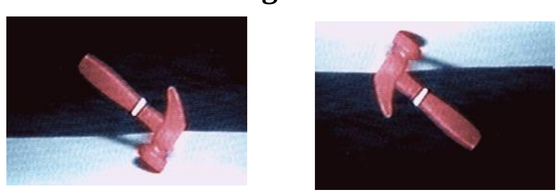
Abstract

Bahrick and Lickliter (2000, 2002) proposed an intersensory redundancy hypothesis (IRH) which holds that in early development, perception of modality specific properties of events (e.g., orientation, color, pattern, pitch, timbre) is facilitated in unimodal stimulation to a greater extent than in bimodal stimulation (where intersensory redundancy attracts attention to redundantly specified amodal properties). Further, with experience, attention becomes more flexible and infants can detect modality specific properties in both unimodal and bimodal, redundant stimulation. Infants of 3- and 5-months were tested in an infant control habituation procedure to determine if they could discriminate the orientation of an object's motion (a property that can be seen but not heard). A toy hammer was presented tapping out a rhythm in one of two orientations (upward vs downward) under either a unimodal visual or a bimodal audiovisual condition. Results indicated that infants discriminated a change in the orientation of the movement under the unimodal visual but not the bimodal audiovisual conditions at both 3- and 5-months of age, supporting the prediction of the IRH. A further study revealed that by the age of 8-months infants were also able to discriminate between the two orientations in the bimodal audiovisual condition, supporting the developmental prediction of the IRH. Together these findings suggest that discrimination of modality specific properties of events emerges first in the context of unimodal stimulation and is later extended to bimodal stimulation.

Introduction

Young infants detect both amodal (e.g., synchrony, tempo, rhythm, intensity) and modality specific (e.g., orientation, color, pattern, pitch, timbre) properties of naturalistic events. Bahrick and Lickliter (2000, 2002) proposed an intersensory redundancy hypothesis (IRH) to describe what guides attentional selectivity to different properties of stimulation across early development. The IRH holds that in early infancy, perception of modality specific properties of events is facilitated in unimodal (audiory or visual) stimulation to a greater extent than in bimodal (audiovisual) stimulation. In contrast, in bimodal stimulation, intersensory redundancy attracts attention to redundantly specified amodal properties of stimulation to a greater extent than in unimodal stimulation. Further, with experience, attention becomes more flexible and infants can detect modality specific properties in both unimodal and bimodal, redundant stimulation (Bahrick & Lickliter, in press). The present study assessed the development of infants' detection of orientation, a property specified visually but not acoustically, under unimodal and bimodal presentations. It was expected that detection of changes in orientation would be demonstrated in unimodal visual stimulation in early development, and in later development changes in orientation would be detected in both unimodal and bimodal stimulation.

Figure 1



Method: Experiment 1

Infants of 3- and 5- months (N=32 each age) were habituated in an infant-control procedure, to films of a hammer tapping out a rhythm. The movements of the hammer depicted one of two orientations of motion. Either the hammer hit downward against a wooden floor, or it hit upward against a wooden ceiling (see Figure 1). Infants of each age were randomly assigned to the unimodal visual (silently moving hammer) or the bimodal audiovisual (synchronous audible and visual impacts) condition, with half the infants in each condition receiving the upward and half the downward motion. Following habituation and two no-change posthabituation trials, infants received two test trials depicting a change in orientation under their respective conditions. Visual recovery (the difference between looking time during the test trials and the no-change posthabituation trials) served as the measure of discrimination.

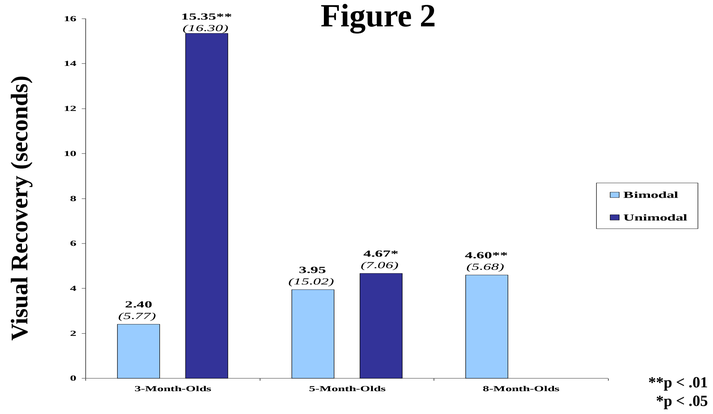
Results: Experiment 1

Results are depicted in Figure 2. Infants of both ages showed significant visual recovery to the change in orientation in the unimodal visual condition, ($t(15)= 3.76$, $p=.002$, at 3-months; $t(15)= 2.64$, $p=.02$, at 5-months) but not in the bimodal audiovisual condition. Thus, infants discriminated the change in orientation following unimodal but not bimodal exposure to the events at 3- and 5-months of age.

Experiment 2

In order to test the developmental prediction of the IRH, we habituated older infants under the bimodal audiovisual condition, to determine whether they would detect a change of orientation in the bimodal events, in procedures identical to those above. Results (Figure 2) demonstrated significant visual recovery to the change in orientation of the bimodal events at 8 months of age ($t(19)=2.75$, $p=.02$).

Figure 2



Conclusions

These finding demonstrate that 3- and 5-month-old infants are able to perceive a change in the modality specific property of orientation when events are experienced unimodally, whereas when they are experienced bimodally, they show no evidence of sensitivity to orientation. Apparently the addition of the soundtrack created intersensory redundancy and selectively recruited attention to redundantly specified properties (such as rhythm, and tempo; see Bahrick & Lickliter, 2000; Bahrick, Flom & Lickliter, 2002) at the expense of modality specific properties, such as orientation. Further, by the age of 8-months, infants are more experienced perceivers and they are able to detect a change of orientation in bimodal, redundant stimulation. These findings support the developmental prediction of the IRH. They demonstrate that attentional biases effect selectivity in early infancy, but later in development, as infants gain experience, attention becomes more flexible and they can detect amodal and modality specific properties in both bimodal and unimodal stimulation. These findings converge with those of animal infants (Lickliter, Bahrick, & Honeycutt, 2002, in press) and demonstrate the salience of intersensory redundancy in guiding and constraining early perceptual development.

References

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