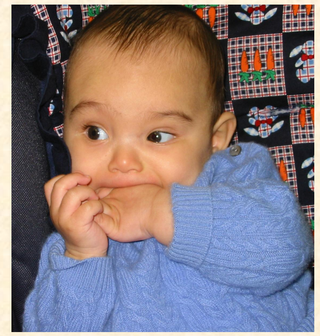
The Development of Infants' Discrimination of Tempo in Unimodal and Bimodal Stimulation

Lorraine E. Bahrick, Robert Lickliter, Laura Batista, and Mariana Vaillant
Florida International University, Miami, FL



Abstract

Bahrick and Lickliter (2000) proposed an intersensory redundancy hypothesis (IRH) which states that in early development information presented redundantly and in temporal synchrony across two sensory modalities (bimodally) is highly salient and facilitates perceptual learning of amodal properties (e.g. tempo, rhythm, intensity) to a greater extent than when information is presented to one sense modality alone (unimodally). A previous study supported this prediction and demonstrated that 3-month-old infants discriminated between two tempos when they were presented bimodally, but not unimodally. The IRH also makes a developmental prediction, that perceptual processing becomes faster and more flexible with experience, allowing older infants to discriminate amodal properties in unimodal as well as bimodal stimulation. The present study tested this developmental prediction. Older infants were tested using the same infant control habituation procedures as the prior study. Results demonstrated that by the age of 5-months, infants could discriminate between the two tempos under both the bimodal audiovisual and the unimodal visual conditions. These results support predictions of the IRH and demonstrate that perceptual processing becomes more flexible with experience. Taken together, our results suggest that in early development, sensitivity to amodal properties of stimulation emerges in the context of bimodal, redundant stimulation and is later extended to unimodal stimulation.

Introduction

Infants perceive coherent, unified events through stimulation to different senses, even in the first months of life. Bahrick & Lickliter (2000, 2002) proposed an intersensory redundancy hypothesis (IHR) as an explanation for how this process could be initiated and guided during early infancy. According to this view, when information is presented redundantly and in synchrony across more than one sense modality, it selectively recruits attention, causing amodal properties of events (such as synchrony, tempo, rhythm, duration, intensity) to become "foreground" and other properties to become "background". This leads to earlier perceptual processing of properties that are specified in more than one sense modality. Bahrick, Flom, & Lickliter (2002) provided support for this hypothesis by demonstrating that 3-month-old infants detected a change in the tempo of an event when it was presented bimodally (audiovisually), but not when it was presented unimodally (visually). However, according to this hypothesis, the advantage of intersensory redundancy for detecting amodal properties is most pronounced during early development. Later, with experience, processing becomes faster and attention becomes more flexible, and infants extend detection of amodal properties from bimodal, redundant to unimodal, nonredundant stimulation. The present study tested this developmental prediction by investigating sensitivity to the tempo of an event in bimodal versus unimodal stimulation in older infants using the same methods as in our prior study.

Method

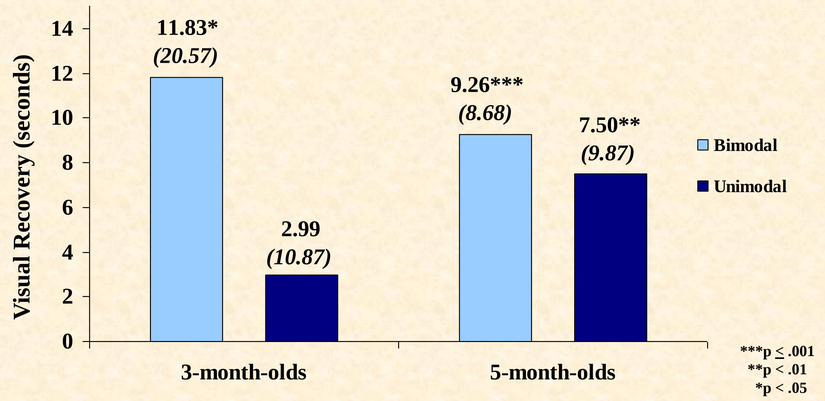
Thirty-two 5-month-old infants were habituated, in an infant control procedure, to films of a hammer (see Figure 1) tapping a rhythm at one of two tempos (55 vs 120 bpm), under a bimodal, synchronous, audiovisual condition (N=16) or a unimodal, visual (N=16) condition. Following two no change post habituation trials, infants received two test trials depicting a change in tempo under their respective conditions. The tempo used for habituation versus test was counterbalanced across infants within each group.

Figure 1

Results

Visual recovery (the difference between seconds looking during test versus posthabituation trials) to the change in tempo served as the dependent variable. Results (see Figure 2) indicate that 5-month-old infants were able to discriminate a change in tempo under both the bimodal and the unimodal conditions ($t(15) = 4.27$, $p=.001$, $t(15)= 3.04$, $p=.008$, respectively). These findings contrast with those of the 3-month-olds where discrimination was evident in only the bimodal and not the unimodal condition ($t(15) = 2.30$, $p=.036$, $t(15)= 1.10$, $p=.289$, respectively).

Figure 2



Conclusions

These finding demonstrate that by 5-months of age, infants no longer require intersensory redundancy for discriminating two tempos from one another. In contrast with younger infants, 5-month-olds can discriminate tempos in unimodal and bimodal presentations. Together these findings support the intersensory redundancy hypothesis and the developmental prediction that with experience infant attention becomes more flexible, allowing them to extend their detection of amodal properties of events from bimodal, redundant stimulation to unimodal stimulation. The facilitating effects of intersensory redundancy are apparently most pronounced in early development when infant attention is most limited and least flexible. This initial salience of redundancy has important consequences for the development of perception and cognition. It creates a developmental precedence for detection of properties that are amodal and redundantly specified and this can guide early attention, perception, and learning in naive perceivers.

References

Bahrick, L.E. & Lickliter, R. (2000). Intersensory redundancy guides attentional selectivity and perceptual learning in infancy. *Developmental Psychology, 36*, 190-201.

Bahrick, L.E. & Lickliter, R. (2002). Intersensory redundancy guides early perceptual and cognitive development. In R. Kail (Ed.), *Advances in Child Development and Behavior, 30* (pp. 153-187). New York: Academic Press.

Bahrick, L.E., Flom, R., & Lickliter, R. (2002). Intersensory redundancy facilitates discrimination of tempo in 3-month-old infants. *Developmental Psychobiology, 41*, 352-363.

Presented at the International Society of Developmental Psychobiology, June, 2004, Aix en Provence, France. This research was supported by NIMH grants RO1 MH 62226 and RO1 MH 62225 to the first and second author, respectively. Requests for reprints should be sent to the first author at bahrick@fiu.edu.