

Tempo Discrimination in Infants: The Roles of Intersensory Redundancy, Task Difficulty, and Expertise

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Abstract

The present study tested a new prediction of the Intersensory Redundancy Hypothesis (IRH): Effects of intersensory redundancy on selective attention and perceptual processing of amodal properties of events persist across development and are most apparent in tasks of relatively high difficulty. As an initial test of this prediction, we assessed discrimination of tempo contrasts of differing difficulty in redundant, bimodal vs. nonredundant, unimodal stimulation in 5-month-old infants. It was predicted that infants would discriminate tempo contrasts in bimodal, redundant stimulation, but not in unimodal, nonredundant stimulation for difficult tasks, whereas they would show discrimination under all conditions for easy tasks. Results supported our predictions.

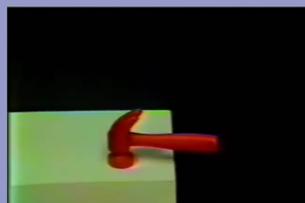
Introduction

Prior research has provided support for the Intersensory Redundancy Hypothesis (IRH, Bahrick & Lickliter, 2000, 2002, 2004), which proposes that in early development information presented redundantly and synchronously across two or more sense modalities is highly salient and facilitates perceptual learning of amodal properties (e.g., tempo, rhythm, intensity) to a greater extent than the same information presented to one sense modality. Further, later in development with increased experience, infants discriminate amodal properties in both redundant, multimodal and nonredundant, unimodal stimulation. The present study tested a new prediction of the IRH: Effects of intersensory redundancy on selective attention and perceptual processing persist across development and are most apparent in tasks of relatively high difficulty in relation to the capabilities of the perceiver. As an initial test of this prediction, we assessed discrimination of tempo contrasts of differing difficulty in redundant, bimodal vs. nonredundant, unimodal stimulation in 5-month-old infants. In our prior studies, younger (3-month-old) infants showed intersensory facilitation for discrimination of tempo contrasts of 110 vs 240 bpm, but older (5-month-old) infants showed no intersensory facilitation. They discriminated these tempo contrasts in both redundant and nonredundant conditions (Bahrick & Lickliter, 2004). We predicted that intersensory facilitation would be reinstated in 5-month-old infants in tasks of higher difficulty, but not in tasks of low difficulty.

Methods

Stimuli and data from our prior study of tempo discrimination in 5-month-olds (Bahrick & Lickliter, 2004) served as the low difficulty condition (110 vs. 240 bpm), and tempo contrasts of moderate (110 vs. 138 bpm) and high difficulty (110 vs. 129 bpm) were created for the present study. Infants were randomly assigned to modality (bimodal audiovisual vs. unimodal visual) and difficulty level conditions (moderate vs. high). As in our prior study, infants were habituated with a video of a toy hammer (see Figure 1) tapping a four-beat rhythm at one of two tempos (faster vs slower, counterbalanced). Following habituation they received two test trials depicting the hammer tapping at a novel tempo. Visual recovery to the novel tempo served as an index of discrimination.

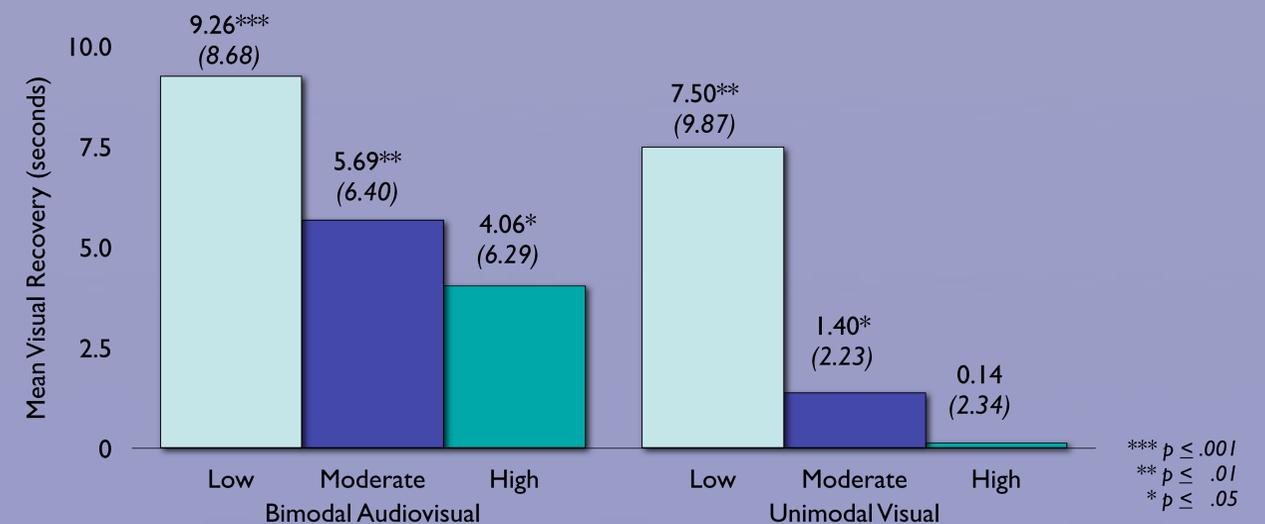
Figure 1:



Results

Results are depicted in Figure 2 along with those of the low difficulty condition from our prior study. Five-month-old infants discriminated the low and moderate difficulty tempo contrasts in the bimodal audiovisual ($t(15) = 4.27, p = .001$; $t(11) = 3.08, p = .01$, respectively) and in the unimodal visual ($t(15) = 3.04, p = .008$; $t(11) = 2.17, p = .05$, respectively) conditions. However, they discriminated the high difficulty tempo contrasts only in the bimodal audiovisual condition ($t(11) = 2.24, p = .05$). Main effects of condition ($F(1, 74) = 4.47, p = .04$) and difficulty level ($F(2, 74) = 6.37, p = .003$) were also significant and discrimination was a linear function of task difficulty ($F(1, 78) = 12.36, p = .001$).

Figure 2: Mean visual recovery (and SDs) to a change in tempo as a function of condition (bimodal audiovisual vs. unimodal visual) and difficulty level (low vs. moderate vs. high).



Conclusions

These findings demonstrate intersensory facilitation for the amodal property of tempo in older (5-month-old) infants. As task difficulty increases, discrimination of tempo is facilitated in bimodal, redundant stimulation as compared with unimodal, nonredundant stimulation. In more difficult tasks, older infants revert to patterns of facilitation characteristic of younger infants. These findings provide initial support for a new prediction of the IRH: that facilitating effects of intersensory redundancy on perceptual processing of amodal properties persist across development and are most apparent for tasks of high difficulty in relation to the expertise of the perceiver. Taken together, these findings suggest that intersensory facilitation may be evident across the lifespan for tasks of relatively high difficulty.

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. & Lickliter, R. (2004). Infants' perception of rhythm and tempo in unimodal and multimodal stimulation: A developmental test of the intersensory redundancy hypothesis. *Cognitive, Affective and Behavioral Neuroscience, 4*, 137-147.