

The Effectiveness of Intersensory vs. Intrasensory Redundancy in Facilitating Discrimination of Tempo in 2-Month-Old Infants

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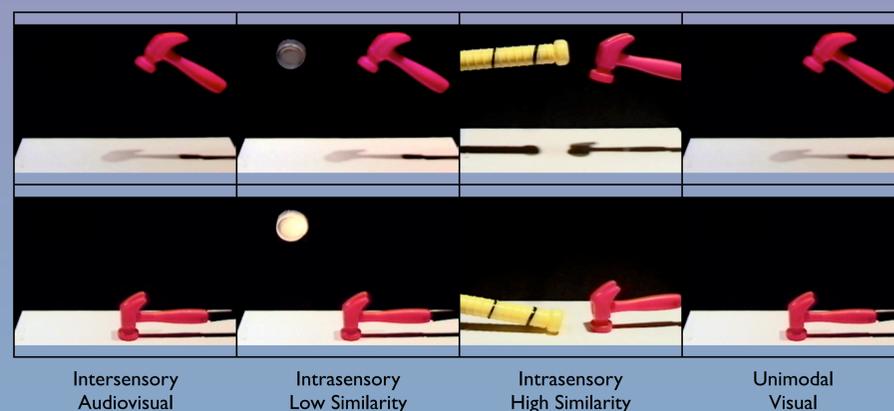
Introduction

Research across human and animal studies has provided support for the Intersensory Redundancy Hypothesis (IRH, Bahrick & Lickliter, 2000, 2002, 2012), 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 alone (intersensory facilitation). However, it is not known if redundancy within a single sense modality might also facilitate attention and perceptual processing of redundantly specified properties (intrasensory facilitation) and, if so, whether it is as effective as redundancy across the senses. Consistent with Gibson's (1969) invariant detection view, we hypothesized that greater differences across two patterns of redundant stimulation (e.g., in number of dimensions or type of stimulation) might lead to better detection of the amodal properties that were invariant across the two patterns of stimulation. The present study addressed these questions by examining the effects of intersensory redundancy and intrasensory redundancy of two similarity levels on infants' perception of tempo, an amodal property. It was predicted that infants would show both intersensory and intrasensory facilitation by enhanced discrimination of a change in tempo in audiovisual and visual-visual stimulation (respectively) as compared with unimodal (baseline) discrimination, and that performance might vary as a function of similarity condition.

Method

Videos consisted of a red toy hammer tapping a distinctive rhythm at one of two tempos (slow, fast) under four redundancy conditions (see Figure 1): 1) Intersensory audiovisual redundancy (hammer/sound) - depicting synchrony between the continuous movements of the red hammer tapping and the discrete sounds of impact, 2) intrasensory low similarity visual redundancy (hammer/light) - depicting synchrony between the continuous movements of the red hammer and the discrete flashing of a light, 3) intrasensory high similarity visual redundancy (hammer/bat) - depicting synchrony between the continuous movements of the red hammer and the continuous movements of a yellow bat, 4) unimodal visual baseline control (hammer alone) - depicting silent continuous movements of the red hammer. Thus, stimulus event conditions could be ordered in terms of the degree of similarity between the two streams of stimulation with respect to modality (auditory vs. visual) and movement type (continuous vs. discrete), with the intersensory condition depicting no similarity (different modality, different movement type), the hammer/light condition depicting low similarity (same modality, different movement), and the hammer/bat condition depicting high similarity (same modality, same movement).

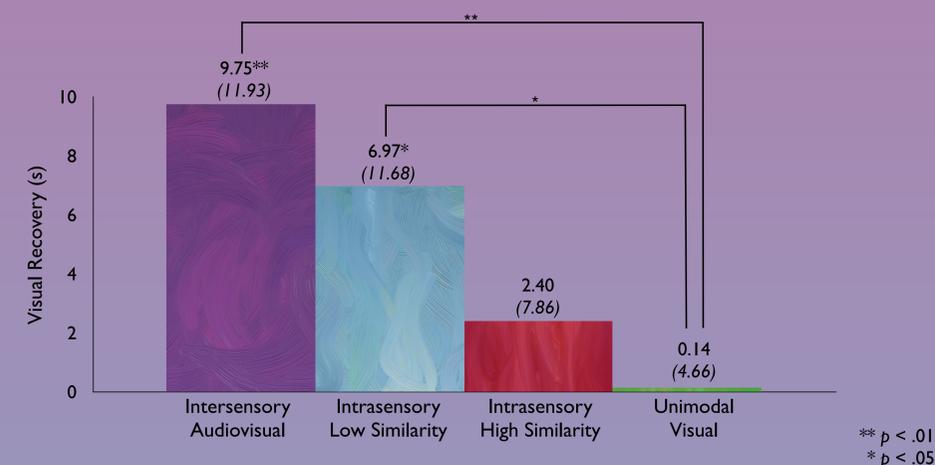
Figure 1: Images of the stimulus events.



Results

Results indicate that infants in the intersensory audiovisual and intrasensory low similarity conditions demonstrated significant visual recovery to the change in tempo ($t(15) = 3.27, p = .005$; $t(15) = 2.39, p = .03$, respectively), indicating tempo discrimination. In contrast, in the intrasensory high similarity condition, where redundancy was available through two objects, both moving continuously, infants failed to show significant visual recovery to the change in tempo ($t(15) = 1.22, p = .24$). Similarly, in the unimodal visual baseline condition, where redundancy was not available, infants also failed to show visual recovery to the change in tempo ($t(15) = 0.12, p = .90$). An ANOVA on visual recovery with condition as the between-subjects factor revealed a main effect of condition ($F(3, 60) = 3.34, p = .03$). Planned pairwise comparisons indicated that infants in the intersensory audiovisual and intrasensory low similarity conditions demonstrated significantly greater visual recovery to the change in tempo than infants in the unimodal visual baseline condition ($p = .006, p = .03$, respectively). This provides evidence for intersensory and intrasensory facilitation. Furthermore, results indicated a significant linear decrease across condition ($p = .003$) with visual recovery scores decreasing monotonically as a function of degree of similarity.

Figure 2: Mean visual recovery (and SD) to a change in tempo as a function of condition (intersensory audiovisual, intrasensory low similarity, intrasensory high similarity, unimodal visual baseline).



Conclusion

Two-month-old infants who received intrasensory redundancy between the continuous movements of a toy hammer tapping and the discrete flashing of a synchronous light showed significantly greater detection of a change in the tempo of the toy hammer tapping than infants who received unimodal visual stimulation. This provides the first evidence of intrasensory facilitation of an amodal property of stimulation in infants. Results also revealed no evidence of intrasensory facilitation for two visual events of high similarity (the hammer and a bat both undergoing synchronous, continuous movements). These findings expand the conceptual frame of the IRH and suggest that redundancy within a sense modality is also effective in recruiting infants' selective attention and promoting perceptual processing of amodal properties of stimulation, particularly when the two patterns of stimulation are relatively dissimilar.

References

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