Intersensory Redundancy Educates Infants' Attention to Amodal Information in Unimodal Stimulation

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Abstract

Consistent with the intersensory redundancy hypothesis (IRH), research has shown that in early development information presented redundantly and in synchrony across two senses is highly salient and facilitates perceptual learning of amodal properties such as tempo, to a greater extent than in unimodal stimulation (Bahrick & Lickliter, 2000, 2002). If redundancy highlights amodal properties, how do infants learn to detect amodal properties in unimodal stimulation? We (Lickliter, Bahrick, & Markham, 2006) postulated that detection of amodal properties in redundant bimodal stimulation could educate attention, highlighting those same properties in subsequent unimodal stimulation. Accordingly, quail chicks showed auditory learning for a maternal call only when auditory training was preceded by redundant audiovisual, but not unimodal auditory familiarization to the call. The present study investigated whether, in 2-month-old human infants, attention could be educated to the tempo of an event (toy hammer tapping) during a unimodal visual habituation session, by presenting bimodal, redundant as compared with unimodal visual familiarization trials prior to habituation. Results demonstrated that only infants who received bimodal familiarization detected the tempo, supporting the hypothesis that detection of amodal properties such as tempo in bimodal stimulation scaffolds attention to the same stimulus properties in subsequent unimodal stimulation. Our results suggest that during early development, sensitivity to amodal properties emerges in the context of redundant bimodal stimulation and is later extended to non-redundant unimodal stimulation.

Introduction

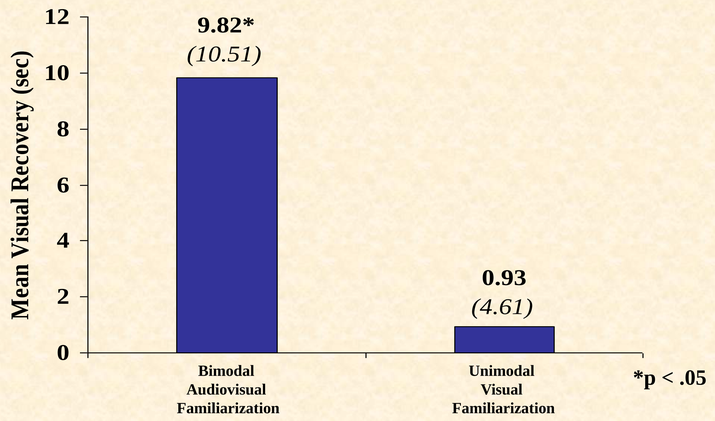
Research has shown that early in development, information presented redundantly and in synchrony across two senses is highly salient and facilitates perceptual learning of amodal properties such as tempo and rhythm, to a greater extent than information presented non-redundantly in unimodal stimulation (Bahrick, Flom, & Lickliter, 2002). How then, do infants learn to detect amodal properties in unimodal stimulation? Lickliter, Bahrick, and Markham (2006) found that detection of amodal properties in redundant bimodal stimulation could educate attention to those same properties in subsequent unimodal stimulation. Bobwhite quail embryos showed auditory learning of a maternal call only when auditory training was preceded by redundant audiovisual, but not unimodal auditory or asynchronous audiovisual familiarization to the call. The present study extends these findings by investigating whether 2-month-old human infants' attention could likewise be educated to the tempo of an event during a unimodal visual habituation session, by presenting redundant versus non-redundant familiarization trials prior to habituation. We predicted that infants would discriminate a change in the tempo of the event during the unimodal habituation session only if they had received bimodal audiovisual familiarization and not if they received unimodal visual familiarization prior to habituation.

Method

Twenty-four 2-month-old human infants participated in a familiarization phase in which half the infants were presented with 4 15-sec trials of bimodal audiovisual stimulation and half were presented with unimodal visual stimulation of films depicting a toy hammer (Figure 1) tapping at one of two tempos (159 vs 240 bpm). Infants in the bimodal audiovisual familiarization condition received redundant (synchronous) audiovisual stimulation, while infants in the unimodal visual familiarization condition received silent visual stimulation of a toy hammer tapping at one of two tempos. Following the familiarization phase, all infants participated in a unimodal visual infant-controlled habituation phase where they viewed a toy hammer tapping silently at the same tempo they received during familiarization. Once infants were habituated, they received two test trials depicting the hammer tapping silently at a novel tempo.

Figure 1

Figure 2: Infants' Mean Visual Recovery (and SD) to a Novel Tempo



Results

Infants' mean visual recovery (the difference between looking during test versus posthabituation trials) to a novel tempo served as the dependent variable. Results (Figure 2) indicate that 2-month-old infants were able to discriminate a change in tempo when they received bimodal audiovisual familiarization followed by a unimodal visual habituation session ($t(10) = 3.099$, $p = .011$). In contrast, infants were unable to discriminate a change in tempo when they received unimodal visual familiarization followed by a unimodal visual habituation session ($t(11) = 0.93$, $p = .500$). Further, visual recovery to the change in tempo was significantly greater for infants who received audiovisual familiarization than those who received unimodal visual familiarization ($t(21) = 2.586$, $p = .022$).

Conclusions

These results support the hypothesis that detection of amodal properties such as tempo in redundant bimodal audiovisual stimulation can scaffold or "educate" selective attention to the same stimulus properties in subsequent non-redundant unimodal stimulation. In addition, these results converge with our animal based findings (Lickliter et al., 2006), where quail embryos were able to learn the temporal properties of a maternal quail call following redundant bimodal audiovisual familiarization but not following non-redundant unimodal auditory familiarization. Taken together, our findings suggest that during early development, sensitivity to amodal properties emerges in the context of redundant bimodal stimulation and is later extended to non-redundant unimodal stimulation. One avenue for this developmental progression is education of attention from bimodal, redundant to unimodal, non-redundant stimulation. These comparative findings are the first to demonstrate how detection of intersensory redundancy can facilitate infants' perceptual learning of amodal properties in unimodal contexts. Moreover, these results enhance our understanding of the role of intersensory redundancy in guiding selective attention and learning of perceptual properties of events in early development.

References

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

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* (pp153-187). New York: Academic Press.

Lickliter, R., Bahrick, L. E., & Markham, R. (2006). Intersensory redundancy educates selective attention in bobwhite quail embryos. *Developmental Science, 9*, 605-616.

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