Detection of Modality-Specific Properties in Unimodal and Bimodal Events

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Introduction

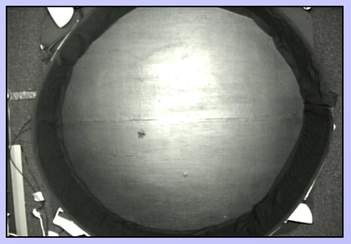
The environment provides a rich array of unimodal and multimodal stimulation. A main concern of our research has been to understand how this information and its properties are selectively attended to in early development. We have proposed an Intersensory Redundancy Hypothesis (IRH, Bahrick & Lickliter, 2002), which predicts that in early development information presented to a single sense modality will selectively recruit attention to the modality-specific properties of stimulation, such as pitch or color, and facilitate perceptual learning of those properties at the expense of amodal properties, such as tempo or rhythm. In contrast, information presented redundantly across two more sensory modalities results in the reverse scenario, with enhanced perceptual learning of amodal properties at the expense of modality-specific properties of stimulation.

In the current study, we explored these predictions of the IRH by assessing bobwhite quail embryos' prenatal detection of pitch, a modality-specific auditory property, under conditions of both unimodal and redundant bimodal stimulation. We hypothesized that prenatal unimodal auditory exposure would facilitate learning of modality-specific properties of stimulation, whereas redundant audiovisual exposure would interfere with attention to and learning of modality-specific properties of stimulation.

Method

Northern bobwhite quail (*Colinus virginianus*) embryos received exposure to an individual bobwhite maternal call for 10min/hr for 24hrs prior to hatching. In the unimodal condition, embryos received only auditory exposure to the maternal call. In the bimodal condition, a pulsed light was synchronized with the five notes of the call, providing redundant information for the amodal properties of tempo, rhythm, and duration. Following hatching, chicks' postnatal auditory preferences were assessed in individual 5-min simultaneous choice tests between the familiarized maternal call and the same maternal call with modified pitch. During these tests, the two calls were played from opposite sides of a testing arena and chicks were scored for both their latency and duration of approach to both calls. Duration and latency scores for the two calls were converted into proportion of duration (PTD) and proportion of total latency (PTL) scores (duration/latency for the familiar divided by total duration/latency for both calls).

Testing Arena

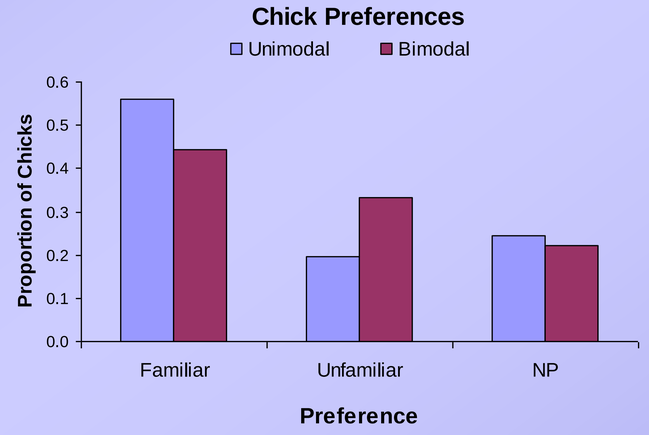


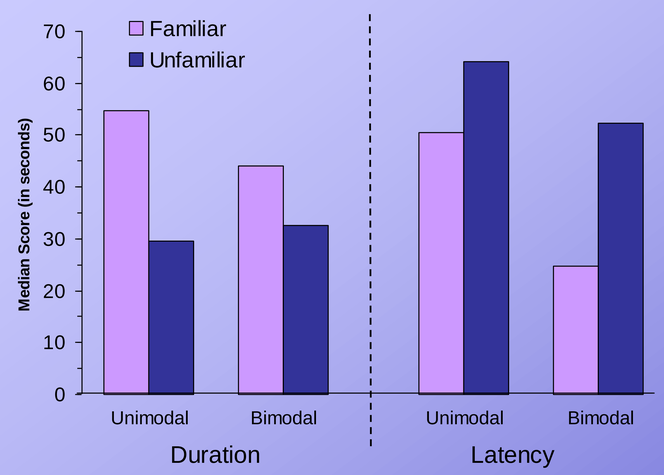
Results

• Chicks from the prenatal unimodal condition showed a significant preference for the familiarized bobwhite maternal call over the pitch-modified maternal call, $\chi 2 = 9.707$, $p = .0078$.

•Chicks from the prenatal redundant bimodal condition failed to show a significant preference for the familiar call over the pitch-modified call, $\chi 2 = 2.00$, $p = 0.368$.

•Although chicks exposed to the unimodal condition had larger PTD scores than chicks exposed to the bimodal condition, the comparison was not significant, likely because of the small sample size. (Unimodal $N = 41$, Bimodal $N = 27$)





Conclusions

•Following prenatal unimodal auditory exposure, chicks significantly preferred the familiar call over the same call with modified pitch, indicating detection of the pitch change. In contrast, chicks failed to prefer the familiar call over the modified call following prenatal redundant audiovisual exposure, indicating no detection of the pitch change.

•Confirming the predictions of the Intersensory Redundancy Hypothesis, our results show that prenatal unimodal exposure facilitates learning of the modality-specific properties of stimulation, whereas redundant bimodal stimulation interferes with attention to and learning of modality-specific properties of stimulation. Previous work has shown that redundant bimodal stimulation enhances learning of the amodal properties (i.e., tempo, rhythm, and duration) of the maternal call (Lickliter, Bahrick, & Honeycutt, 2002).

•These findings are consistent with recent findings from human infants (Bahrick, Lickliter, & Flom, 2006) and indicate that intersensory redundancy has a powerful effect on selective attention, even during the prenatal period.

•More generally, our results highlight the importance of the allocation of attention on the development of perception, learning and memory during early development.

References

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