



# TESTING THE INTERSENSORY REDUNDANCY HYPOTHESIS DURING EARLY POSTNATAL DEVELOPMENT

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## Introduction

The Intersensory Redundancy Hypothesis (IRH, Bahrack & Lickliter, 2002) predicts that early in development information presented redundantly across two or more sensory modalities results in enhanced perceptual learning of amodal properties, such as tempo or duration, at the expense of modality-specific properties of stimulation, such as pitch or orientation. In contrast, the IRH predicts that information presented to a single sense modality selectively recruits attention to the modality-specific properties of stimulation and facilitates perceptual learning of those properties at the expense of amodal properties. The IRH also predicts that as development proceeds and processing efficiency and attentional flexibility increase, amodal and modality-specific information should be detected and processed in the context of both unimodal and bimodal stimulation.

We previously showed that when bobwhite quail chicks were *prenatally* exposed to a maternal call unimodally (auditory only), but not bimodally (synchronous audio-visual presentations), they preferred the familiarized call over the same maternal call with altered pitch in a postnatal simultaneous choice test (Vaillant, Bahrack, & Lickliter, 2009). This finding supported the prediction of the IRH that unimodal presentation facilitates learning of modality-specific properties of stimulation in early development.

In the current study, we tested the developmental prediction of the IRH that later in development, modality-specific information should be detected under conditions of unimodal *and* bimodal stimulation. We assessed bobwhite quail chicks' *postnatal* detection of pitch in both unimodal auditory and redundant audiovisual stimulation. In the unimodal condition, chicks received only auditory exposure to an individual maternal call following hatching. In the bimodal condition, a pulsed light was synchronized with the notes of the call, providing redundant information for amodal stimulus properties (e.g., tempo, rhythm, duration). Chicks' auditory preferences were assessed 24 hr after stimulation offset in a simultaneous choice test between the familiarized call and the same call with an altered pitch.

## Methods

Northern bobwhite quail (*Colinus virginianus*) chicks received exposure to an individual bobwhite maternal call in one of two conditions at 24 hr following hatching. In the Unimodal Condition, chicks received auditory exposure to a maternal call for 10min/hr for 24 hours. In the Bimodal Condition, the same maternal call was paired with a light synchronized with the notes of the call for 10min/hr for 24 hours.

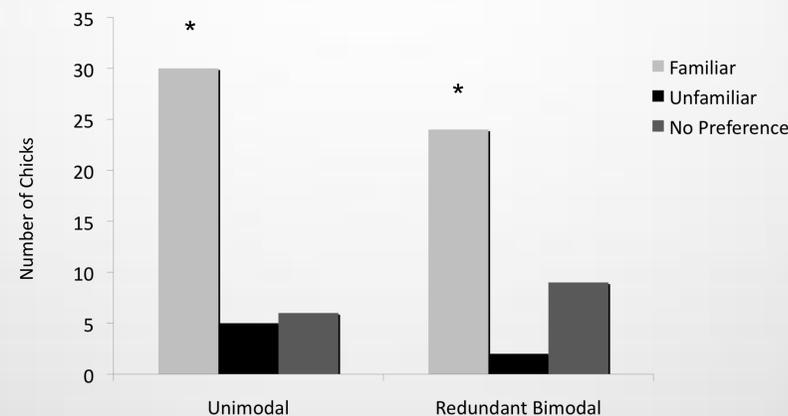
All chicks were tested at approximately 72 hrs of age (24 hr after stimulus offset) in a simultaneous choice test between the familiarized maternal call and the same call with altered pitch. During these tests, the two calls were played from opposite sides of a circular testing arena and chicks were scored for their latency to approach and duration of proximity to both calls. Duration scores for the two calls were converted into proportion of total duration (PTD) scores.

## Results

Chicks provided with unimodal auditory exposure to the maternal call did prefer the familiarized call over an unfamiliar variant of the maternal call ( $\chi^2 = 29.317, p < .000$ ) in postnatal testing.

Chicks provided with redundant audio-visual exposure also significantly preferred the familiarized call over the unfamiliar call ( $\chi^2 = 25.657, p < .000$ ) in postnatal testing.

Figure 1: Chick Preferences

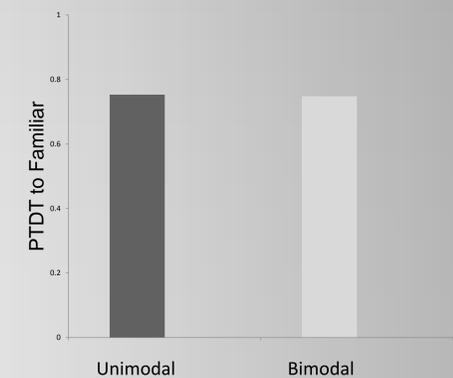


Wilcoxon signed-ranks test revealed that the unimodal group showed significantly longer duration ( $z = -4.024, p < .05$ ) and shorter latency ( $z = -3.959, p < .05$ ) to the familiarized call.

Wilcoxon signed-ranks test revealed that the bimodal group also showed significantly longer duration ( $z = -4.259, p < .05$ ) and shorter latency ( $z = -3.734, p < .05$ ) to the familiarized call.

A one-way ANOVA indicated that the unimodal group did not have significantly different PTD ( $F(1, 74) = .008, p = .931$ ) from the bimodal group.

Figure 2: Proportion of Total Duration Time for the Familiar Call



## Conclusions

Following unimodal auditory *and* redundant audio-visual exposure, quail chicks preferred a familiarized maternal call over the same maternal call with altered pitch, indicating perceptual learning of the modality-specific property of pitch. Our results and those of our previous study (Vaillant, Bahrack, & Lickliter, 2009) indicate that detection of modality specific properties is first detected in unimodal stimulation and later in postnatal development detection is extended to bimodal, redundant stimulation. These results indicate a developmental shift in the deployment of selective attention and subsequent perceptual learning during the perinatal period and support the predictions of the Intersensory Redundancy Hypothesis.

### References

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Vaillant, J., Bahrack, L. E., & Lickliter, R. (2009, April). *Detection of modality specific stimulus properties are enhanced by unimodal exposure during prenatal development*. Poster presented at the Society for Research in Child Development meeting, Denver, CO.

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