



FIU The Development of Infant Voice Discrimination: From Unimodal Auditory to Bimodal Audiovisual Stimulation

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Abstract

Bahrick & Lickliter (2000, 2002) proposed an “intersensory redundancy hypothesis” (IRH) which holds that in early development, experiencing an event redundantly across two senses facilitates perception of amodal properties (e.g. synchrony, tempo, rhythm) whereas experiencing an event in one sense modality alone facilitates perception of modality specific aspects of stimulation (e.g. pitch, timbre, color, pattern). A prior study in our lab supported this prediction, demonstrating that at 3-months of age, discrimination of individual voices (modality specific information) was enhanced when the voices were presented unimodally, in the absence of intersensory redundancy, and attenuated when they were presented bimodally, in the presence of intersensory redundancy. Across development, however, attention becomes more flexible and perception of modality specific properties extends from unimodal to bimodal redundant stimulation. The present study tested this developmental prediction of the IRH. Four-month-old infants were habituated to the voice of a woman speaking in the context of intersensory redundancy or no redundancy in a procedure like that used for the 3-month-olds. Test trials played the voice of a novel woman speaking. Results supported our prediction and demonstrated significant visual recovery to the novel voice in both the redundant and nonredundant conditions. Together with results of our prior study, these findings demonstrate a developmental pattern. In early development, infants attend to modality specific properties primarily in unimodal, nonredundant stimulation. With experience attention becomes more flexible, allowing infants to detect modality specific properties in unimodal, nonredundant as well as in bimodal, redundant stimulation.

Introduction

Research demonstrates that young infants are excellent perceivers of human voices. However, little is known about their perception of voices in the context of naturalistic, dynamic, multimodal events such as audiovisual speech. Bahrick and Lickliter (2000, 2002) proposed an “intersensory redundancy hypothesis” (IRH) which states that in early development, experiencing an event redundantly across two senses (bimodally) facilitates perception of amodal properties such as synchrony, tempo, and rhythm. In contrast, experiencing an event in one sense alone (unimodally) facilitates perception of modality specific information such as pattern, pitch, and timbre. Further, according to the developmental prediction of the IRH, with experience, attention becomes more flexible allowing infants to extend their perception of modality specific properties from unimodal, nonredundant to bimodal, redundant stimulation.

A prior study (Bahrick, Lickliter, Shuman, Batista, & Grandez, 2003) demonstrated unimodal facilitation of voice perception in 3-month-old infants. Discrimination of voices was enhanced in unimodal, nonredundant stimulation (voice accompanied by static face) and attenuated in bimodal, redundant stimulation (voice accompanied by synchronously moving face). The present study tested the developmental prediction of the IRH, by assessing if older infants would discriminate the voices under bimodal, redundant as well as unimodal, nonredundant conditions in methods identical to those of our prior study.

Method

Thirty-two 4-month-old infants were habituated in an infant control procedure to videos of one of two women (see Figure 1) speaking a nursery rhyme under bimodal (audiovisual speech with synchronously moving face) or unimodal (auditory speech accompanied by a static face) conditions ($N=16$ each group). Following habituation, infants received two test trials depicting the voice of a novel woman speaking the same nursery rhyme, under their respective conditions (with no change in the familiar face). Visual recovery to the change in voice served as the measure of discrimination. It was expected that infants would demonstrate visual recovery to the change in voice in both the bimodal, redundant, audiovisual speech and unimodal, nonredundant, auditory speech conditions if experience promoted more flexible attention across development.

Figure 1

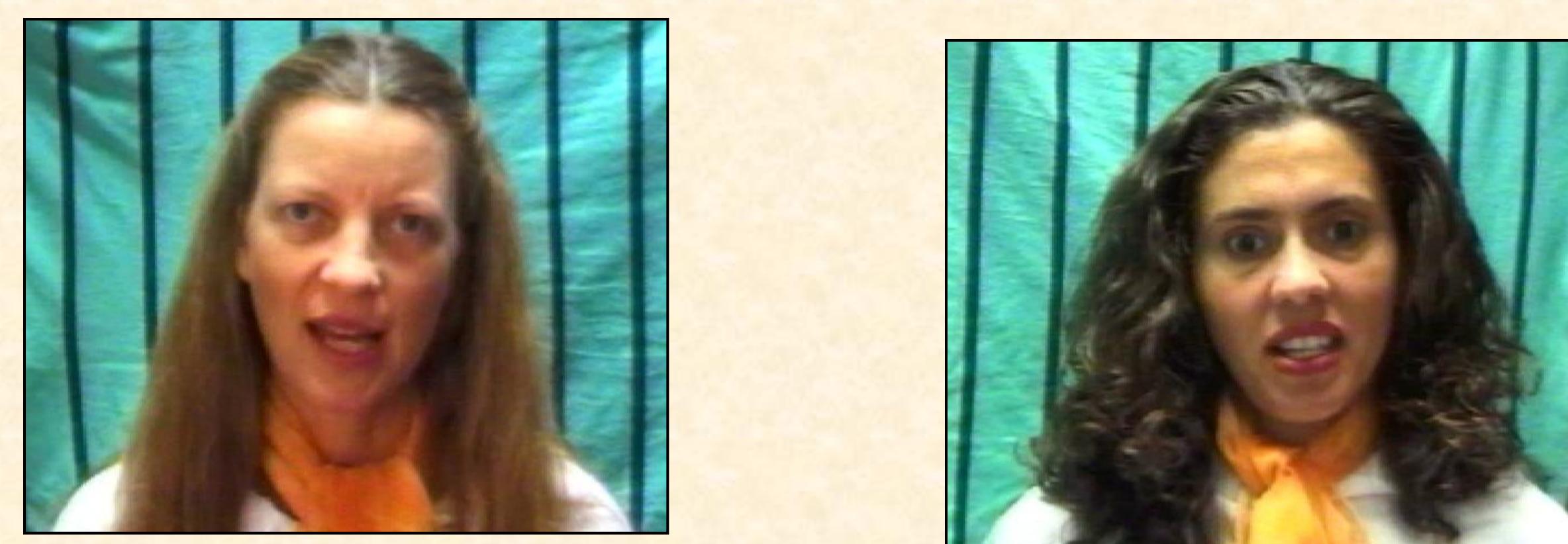
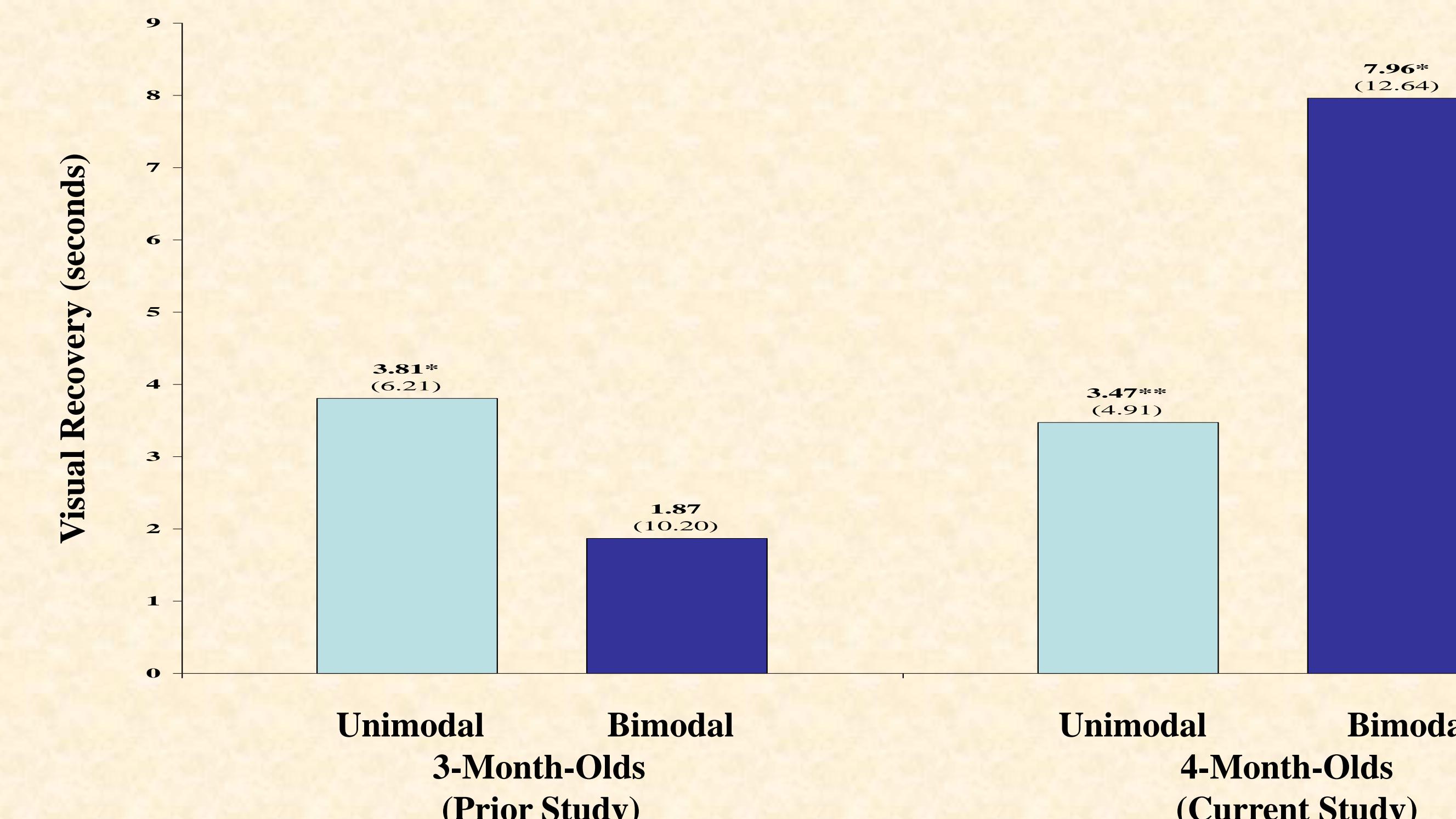


Figure 2

Mean visual recovery (and SD) to a change in voice



** $p \leq .01$
* $p < .05$

Results

Results (depicted in Figure 2 along with those of our prior study) support the developmental prediction of the IRH and demonstrate that 4-month-old infants showed significant visual recovery to the novel voice in both bimodal, audiovisual speech ($t(15) = 2.52$, $p <.05$) and unimodal, auditory speech ($t(15) = 2.83$, $p <.05$). These findings contrast with those of the 3-month-olds of our prior study who showed significant visual recovery to the novel voice in only the unimodal, auditory speech condition ($t(15) = 2.45$, $p <.05$).

Conclusions

These findings demonstrate that 4-month-old infants are able to discriminate between the voices of two women speaking in bimodal, audiovisual speech as well as unimodal, auditory speech. Apparently infants extend their detection of unfamiliar voices from unimodal, auditory speech at 3-months, to bimodal, audiovisual speech by the age of 4-months, on the basis of just one month additional experience with naturalistic multimodal stimulation. Together these findings support predictions of the IRH and suggest that across development, as infants gain experience and attentional flexibility, their detection of modality specific information such as that distinguishing among voices of individuals, extends from unimodal to multimodal stimulation. Future research will explore the physiological bases for these attentional shifts across early development.

References

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