Intersensory Redundancy Facilitates Discrimination of the Tempo of Speech in Difficult Tasks for Preschool-Aged Children

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Abstract

According to the Intersensory Redundancy Hypothesis (IRH), perceptual processing of amodal properties (e.g., tempo, rhythm) is facilitated in redundant (synchronous) audiovisual stimulation and attenuated in nonredundant (unimodal visual and audiovisual asynchronous) stimulation. The IRH also proposes that intersensory facilitation is not limited to early development; rather, it extends across the lifespan and is most evident in tasks of high difficulty (Bahrick & Lickliter, 2012). The present study extended evidence of intersensory facilitation in tempo discrimination tasks of high difficulty to preschool-aged children.

Introduction

Consistent with predictions of the Intersensory Redundancy Hypothesis (IRH), infant studies have demonstrated that perceptual processing of amodal properties (e.g., tempo, rhythm, affect, prosody) is facilitated in redundant (synchronous) audiovisual stimulation and attenuated in nonredundant, unimodal stimulation (Bahrick & Lickliter, 2000, 2004, 2012; Bahrick, Flom, & Lickliter, 2002). This is referred to as intersensory facilitation. The IRH also proposes that intersensory facilitation is not limited to early development. Rather, it extends across the life span for tasks of high difficulty relative to the skills of the perceiver. For example, older infants show intersensory facilitation for difficult, but not easy tasks (Bahrick, Lickliter, Castellanos, Vaillant-Molina, 2010).

A recent study tested this hypothesis in preschool-aged children by examining intersensory facilitation for detecting changes in the tempo of speech (Bahrick, Krogh-Jespersen, Naclerio, & Lau, 2011). Consistent with the IRH, children showed enhanced discrimination of changes in synchronous audiovisual speech as compared with unimodal visual speech for difficult but not easy tempo contrasts.

The present study was designed to rule out alternative hypotheses and test whether detection of intersensory redundancy was the basis for the above findings. Children may have shown enhanced detection of tempo changes in synchronous audiovisual speech because it provides more stimulation (audio plus visual) or different types of stimulation (auditory and visual) than unimodal visual speech. In the present study, children received asynchronous audiovisual speech, which eliminated intersensory redundancy while equating the amount and type of stimulation with synchronous audiovisual speech. We predicted impaired detection of tempo changes in asynchronous as compared with synchronous speech for difficult tasks if sensitivity to intersensory redundancy was in fact the basis for enhanced tempo discrimination.

Method

Sixteen 3.5- to 4-year-old children (*M* = 45.36 months; *SD* = 1.49) participated in the asynchronous audiovisual control condition using methods identical to those of the prior study. All children received videos of the same woman speaking, sequentially, on different sides of the screen. The woman spoke at a standard tempo of 130 or 160 syllables per minute (spm, see Figure 1) on one side of the screen, and on the other side (counterbalanced), she spoke at a different rate (±45 spm: easy tempo contrast; ±30 spm: difficult tempo contrast). Then, two static images of the woman appeared side-by-side and children were asked to point to the woman who spoke faster. Four trials were presented per block, and children received one block of easy contrasts and one block of difficult contrasts (order counterbalanced across participants).

Figure 1a. Children viewed 2 dynamic videos of the same woman speaking, presented sequentially, each on a different side of the screen.

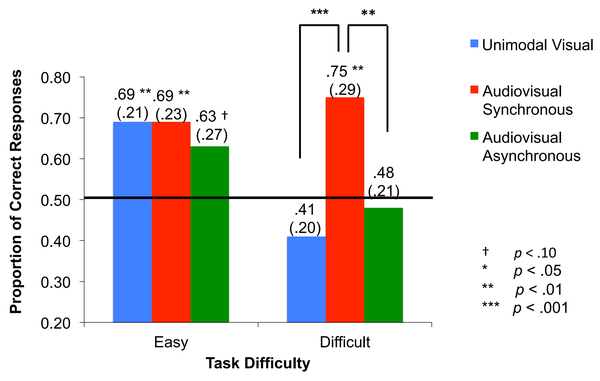
“Look at the mommy.”

“Look at the mommy.”

Figure 1b. Children viewed two static images of the woman, one on each side of the screen. They were asked to point to which mommy spoke faster.

“Which mommy spoke faster?”

Figure 2. Mean proportion of correct responses during test trials to a change in tempo of speech as a function of redundancy condition and task difficulty *(N* = 16 per condition).



Results

An ANOVA was conducted on the proportion of correct responses to assess performance across conditions (synchronous, asynchronous, and unimodal visual) as a function of task difficulty. Results revealed significant main effects of stimulus condition, $F(2, 45) = 5.25$, $p = .01$, and task difficulty, $F(1, 45) = 6.00$, $p = .02$, as well as an interaction, $F(2, 45) = 4.16$, $p = .02$. For difficult contrasts, performance in the synchronous condition was significantly greater than in the unimodal visual and asynchronous conditions (ps < .003); no difference in performance was found across conditions for the easy contrasts (ps > .47; see Figure 2). Further, for the difficult task, single-sample *t*-tests against chance (50%) revealed significant detection of tempo changes in the synchronous audiovisual ($p < .003$), but not in the asynchronous audiovisual or unimodal visual conditions.

Discussion

Preschool-aged children showed no evidence of discriminating difficult tempo contrasts in asynchronous audiovisual speech and showed reduced discrimination as compared with synchronous speech. Synchronous and asynchronous audiovisual speech provide the same type and amount of stimulation, differing only in intersensory redundancy. Consistent with predictions of the IRH, these findings highlight the facilitating role of intersensory redundancy in tempo discrimination and provide the first demonstration that intersensory facilitation extends to preschool-aged children for difficult tasks.

References

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