

# UTD Categorization of Synchronous Infant-Directed Speech by 4- and 6-Month-Old Infants



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## Introduction

Category formation, where exemplars within a category are more likely to be treated as functionally equivalent than exemplars from another category, allows for reduced cognitive loads (Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976).

Infant-directed (ID) speech is defined as a specialized speech register used by adults and children when speaking to infants. Typically, ID speech has higher mean fundamental frequency, broader F<sub>0</sub> range, repetition of phrases and prosodic patterns, hyper-articulated vowels and simpler syntax as compared to speech directed at adults (Ferguson, 1964; Fernald, 1992; Fernald & Simon, 1984; Kuhl & Andruski, 1997).

While the properties of ID speech vary as a whole as compared to adult-directed speech, the acoustic properties within ID speech vary as a function of pragmatic context, our intent and affect (Fernald, 1992). Different prosodic patterns have been identified as occurring in specific context, such as approving, comforting, prohibiting, and attention-getting. If an infant is upset, adults tend to speak in comforting utterances, whereas when adults seek to praise or encourage behavior an infant might hear approving utterances. ID speech patterns can also be distinguished by dynamic and summary acoustic features. Dynamic acoustic features such as frequency contours, and summary features such as mean fundamental frequency, or frequency range within utterances, differentiate approvals and comforts (Katz, Cohen & Moore, 1996). Approving tones are typically higher in fundamental frequency than comforts and have more dynamic frequency contours.

The differences in how we speak to infants either as compared to adults or as a function of our intent may serve specific developmental functions for infants. Anne Fernald (1992) discusses three functions of ID speech for infants at different points in development: to modulate infant attention and affect, communicate caregiver intent and meaning and to exaggerate phonetic and linguistic structure of language, promoting learning.

Categorization of ID speech is highly relevant to Fernald's second function of ID speech. For ID speech to communicate meaning, infants must first be able to distinguish between the categories of intent. Thus infants must be able to detect similarities between utterances while disregarding irrelevant differences such as individual talker, volume, and rate of speech. If pre-verbal infants can categorize ID speech, they may be able to begin to extract meaning from speech without comprehension of words.

## Background and Aims

Previous research investigating ID speech categorization by preverbal infants has produced differential results as a function age and visual stimuli. When presented a checkerboard along with ID speech samples, 6- but not 4-month-olds categorized approving and comforting ID speech (Spence and Moore, 2003). However, 4-month-old infants show categorization effects if given a social reference point such as a female face to replace the checkerboard as a target for visual attention (Atchison and Spence, 2007; Spence, Chuang & Sokolsky, 2004). But when 6-month-old infants, who had repeatedly shown categorization in studies using the checkerboard, were shown either a static face or a moving, talking and smiling video as the visual stimuli, infants failed to categorize (Atchison, Spence & Touchstone, 2008).

While infants at both 4 and 6 months categorize ID speech, it appears they do so using different information. Six-month-old infants can categorize ID speech with just the auditory information while 4-month-old infants need the social context of a female face. However, when presented with a static or asynchronous face 6-month-old infants no longer categorize. It may be that 6-month-old infants' attention is diverted to the asynchrony between the facial and vocal speech and then do not attend to the emotional category boundaries of the samples. These differential findings based on age and visual stimuli led to the question posed in this research.

What is the role of synchrony on infants' categorization of ID speech and how is it affected by development?

## Methods

Participants:

4-month-olds:  $N = 17$ ;  $M = 118.94$  days; Range = 106 – 139 days

6-month-olds:  $N = 27$ ;  $M = 181.48$  days; Range = 168 – 201 days

Stimuli:

40 videos taken from 10 female talkers, each producing 2 comforting and 2 approving utterances

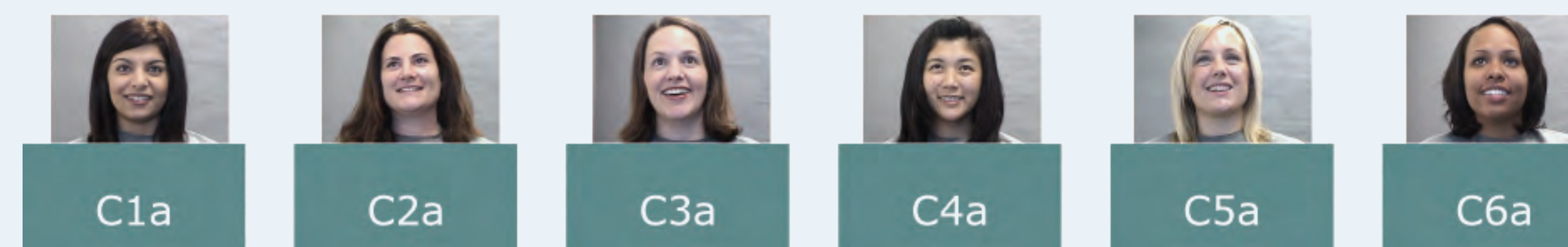
Approvals: Mean  $F_0 = 311.72$  ( $SD = 32.92$ ) Comforts: Mean  $F_0 = 265.05$  ( $SD = 40.80$ )

Procedure:

Each infant sat on parent's lap approximately 1 meter from 60" Sony HDTV



Infant-Controlled Procedure: Habituated to 6 videos of either approvals or comforts

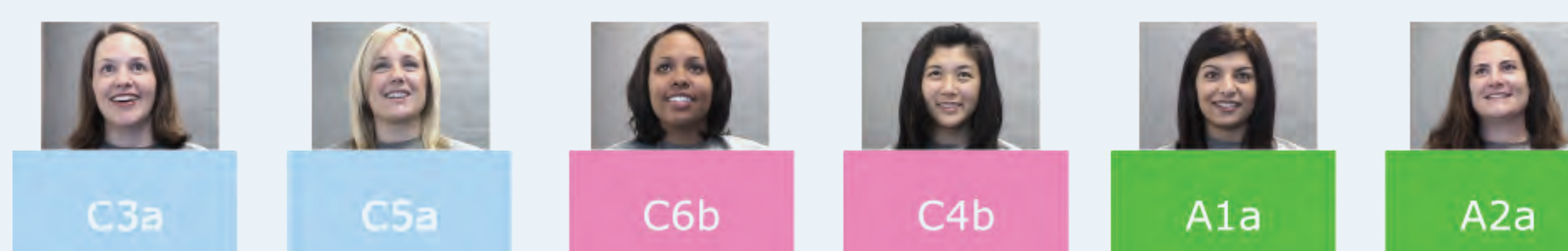


Six test trials: 2 post-habituation, 2 within-category, and 2 between-category test trials

Post-Habituation Trials: Repeated stimuli from habituation

Within-Category Test Trials: New exemplars from habituation category, spoken by previously seen talkers

Between-Category Test Trials: New exemplars from novel category, spoken by previously seen talkers



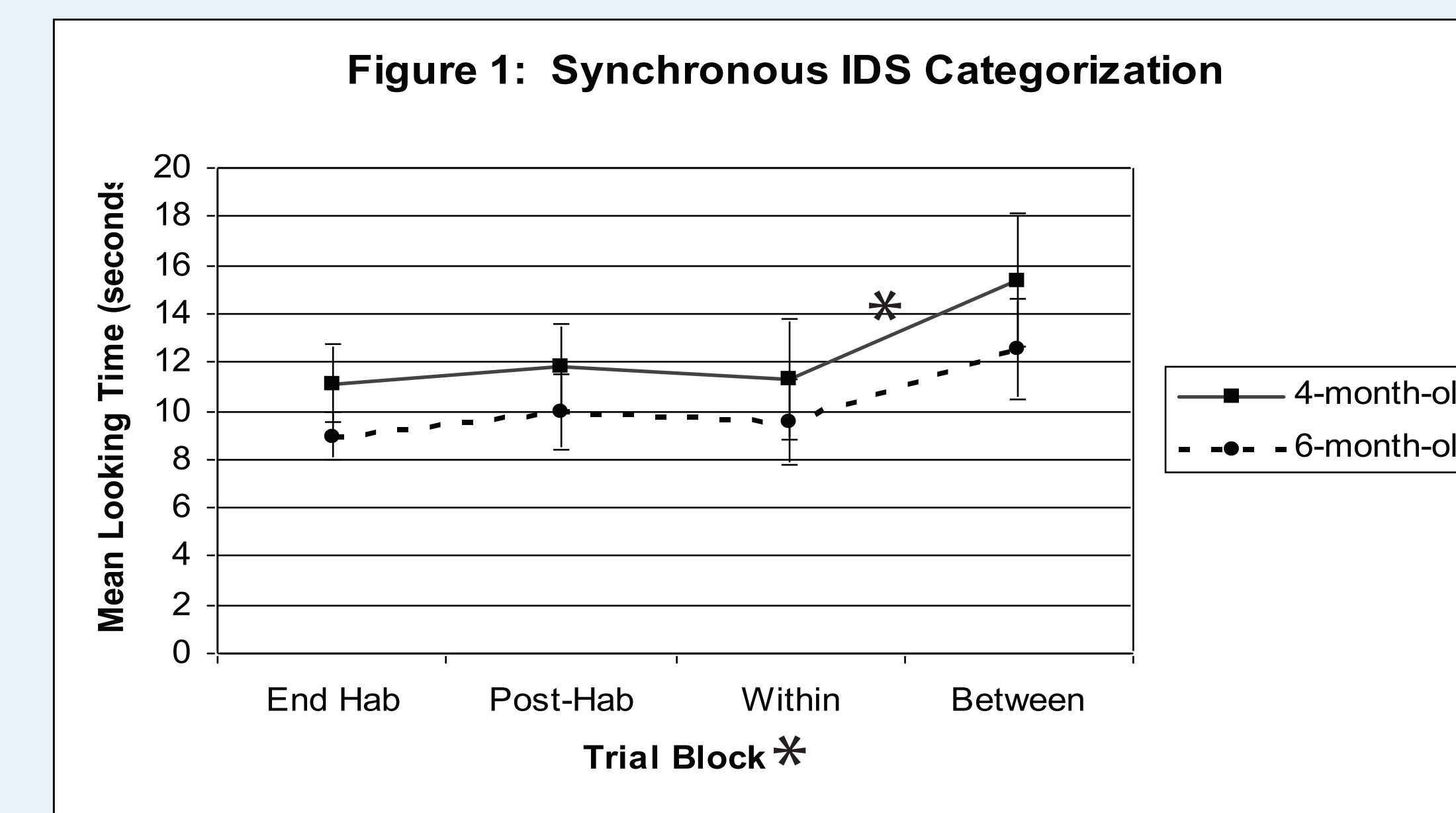
## Results

Table 1: Trial Block Mean_s (seconds)				
	End of Habituation	Post-Hab Test Trials	Within Test Trials	Between Test Trials
<b>4-month-olds:</b>				
Approval ( $n = 8$ )	8.92	12.56	9.82	13.85
Comforts ( $n = 9$ )	13.08	11.10	12.65	16.72
Total	11.13	11.79	11.32	15.37
<b>6-month-olds:</b>				
Approval ( $n = 15$ )	8.59	9.71	8.02	10.80
Comforts ( $n = 12$ )	9.39	10.24	11.35	14.77
Total	8.95	9.94	9.50	12.56

Trial block means calculated by averaging:

- Last 3 trials of habituation, in which habituation criterion was met
- 2 Post-Habituation Test Trials
- 2 Within-Category Test Trials
- 2 Between-Category Test Trials

Categorization evident with significant increases in looking from within-category to between-category test trials, as revealed by planned pairwise comparisons.



4 (trial block) X 2 (Age: 4 v. 6) X 2 (Condition: A v. C) repeated measures ANOVA

No main effect of age was found, so data was collapsed across this factor

Main Effect of Trial Block:  $F(3, 120) = 2.884^* p = .039$

Pairwise comparison (Within v. Between):  $F(1, 43) = 4.473^*, p = .046$

## Discussion

When viewing synchronous stimuli both 4- and 6-month-old infants categorized approving and comforting ID speech. Infants in both age groups looked significantly longer to new exemplars from the novel category than new exemplars from the habituation category. No main effects of age or condition were seen, though a trend may be evident for age. Four-month-olds looked longer at all stimuli compared to 6-month-olds, which is consistent with differences in information processing between ages. The results of this research provide support for the hypothesis that infants at both ages will categorize approving and comforting ID speech when the stimuli are presented synchronously.

## Conclusions

Previous research reported divergent outcomes between 4- and 6-month-old infants' ID speech categorization dependent on the asynchrony of audio and visual components of approving and comforting ID speech. A female static face and a silent asynchronous video of a face seem to disrupt 6-month-old infants' categorization of approving and comforting ID speech, whereas 4-month-old infants categorize ID speech in the presence of a female static face. However, 6- but not 4-month-old infants categorize ID speech when no face is present. These results suggest that 4-month-old infants' categorization is facilitated by the social context provided by a female face, but 6-month-old infants are disrupted by the mis-match between visual and auditory stimuli (Atchison, Spence & Touchstone, 2008; Atchison & Spence, 2007). If infants become more proficient at matching faces and voices between 4 and 6 months of age, then asynchronous facial and vocal stimuli may interrupt 6-month-olds' attention to the category boundaries of ID speech.

The current research began to investigate the role of synchrony in the development of the categorization of ID speech. We found evidence to support infant categorization of approvals and comforts at both 4 and 6 months of age. Synchronous speech allows emotion to be presented redundantly across both visual and auditory modes. Using synchronous speech provides infants with stimuli that are more similar to those experienced in the real world and thus should provide more ecological findings (Walker-Andrews & Bahrick, 2001).

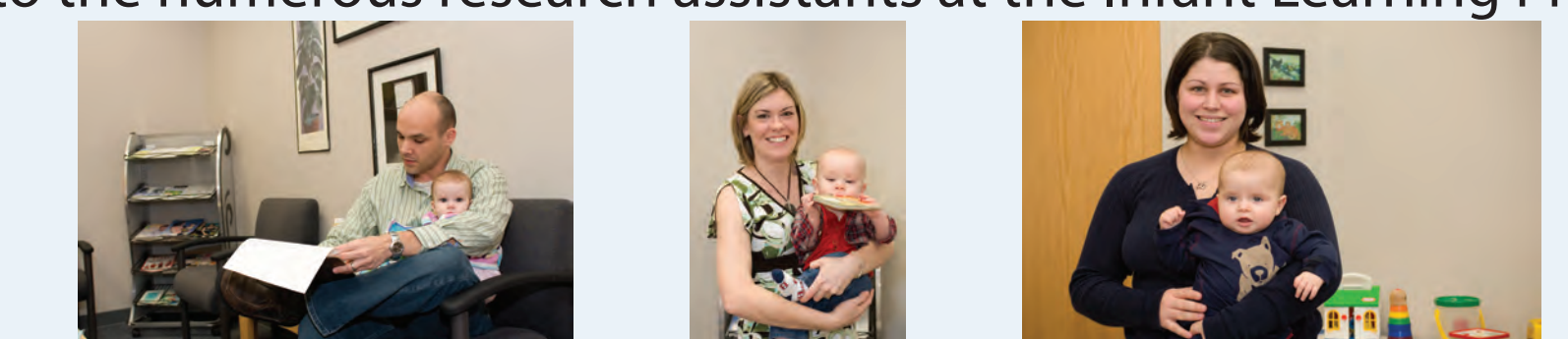
One function of ID speech is communication of caregiver affect; adults' use of different ID speech patterns in differing contexts may provide opportunities for infants to learn patterns of communicative intent. Yet, in order for infants to comprehend ID speech as meaningful signals, they must detect similarities in acoustically different stimuli from the same context and discriminate different ID speech patterns. Development of ID speech categorization may be prerequisite for this communicative function of ID speech and has implications for infants' developing social-communicative and linguistic competence.

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