Age Differences in Infants' Eye-Tracking of Synchronous & Desynchronous Infant-Directed Speech

Mariah L. Fowler, Priscilla Jacob, & Melanie J. Spence

School of Behavioral & Brain Sciences, The University of Texas at Dallas

INTRODUCTION

Six- and ten-month-old infants' eye-tracking patterns for audiovisual (AV) infant-directed speech (IDS) were examined. Speech samples varied by communicative intent and facial-vocal synchrony.

Communicative intent refers to the intended meaning and function of the speaker's message and is particularly salient in IDS.[5, 6]

- Approving and comforting IDS are distinct intent categories with differing acoustic and visible properties displayed in the voice and on the face of the speaker.[5, 6, 7, 8]

IDS INTENT	*VOCAL FEATURES*	*FACIAL FEATURES*
Approval	Higher F_0, Wider F_0 Range	Wide Eyes, Smiling Mouth
Comfort	Lower F_0, Narrow F_0 Range	Furrowed Brow, Frowning Mouth

Natural AV speech is characterized by synchrony between the audible speech stream and visible facial movements of the talker.

- Synchronous IDS: Normal AV infant-directed speech, audio and video match.
- Desynchronous IDS: Visual and auditory streams mismatched to communicate different utterances from within the same intent category (either approving or comforting).[1, 2] Speech onset and offset times misaligned by 1 s.[3, 4]

The perception of synchronous, redundant information directs sensory exploration in the first postnatal months.[3, 4, 9, 10]

- AV speech is sensory redundant by providing the availability of identical information across multiple sensory systems.[9, 10, 11]

Prior work examined the impact of facial-vocal synchrony on infants' categorization of approving and comforting IDS intents.

- 6-month-olds categorized approving and comforting synchronous IDS across multiple talkers producing distinct utterances but did not categorize desynchronous IDS.[1, 2]

RESEARCH QUESTION

Do 6- and 10-month-old infants scan audiovisual faces differently as a function of communicative intent and/or facial-vocal synchrony?

METHOD

Participants: 102 typically developing 6- and 10-month-old infants

AGE GROUP	*TOTAL N*	*GENDER*	*MEAN AGE*	*SD AGE*
6 months	46	26 m, 20 f	179 days	12 days
10 months	56	31 m, 25 f	294 days	9 days

METHOD

Measures & Procedure: Infants' looking time and gaze location measured using Tobii T60 XL eye-tracker while seated on parents' lap.

Five-point calibration procedure → *Pre-test trial: animated drum → **Stimulus Presentation** → *Post-test trial: animated drum

**Pre- and post-test trials were not analyzed. Included as measures of attention (pre-test) and fatigue (post-test)*

Stimulus: AV video of a female speaker producing a 2-second utterance in English IDS; utterance looped for 10-seconds. Intent & Type counterbalanced across infants.

Each infant randomly assigned to one of four experimental conditions indicating:

- Communicative Intent (Approving OR Comforting)
- Stimulus Type (Synchronous OR Desynchronous)

Synchronous Approval | Synchronous Comfort | Desynchronous Approval | Desynchronous Comfort

ANALYSES

Mixed, Repeated Measures ANOVA

Analyzed proportion of total looking time (PTLT) during first 2.5 seconds to predefined areas of interest (AOIs) on the speaker's face [5, 12, 13, 15, 16]

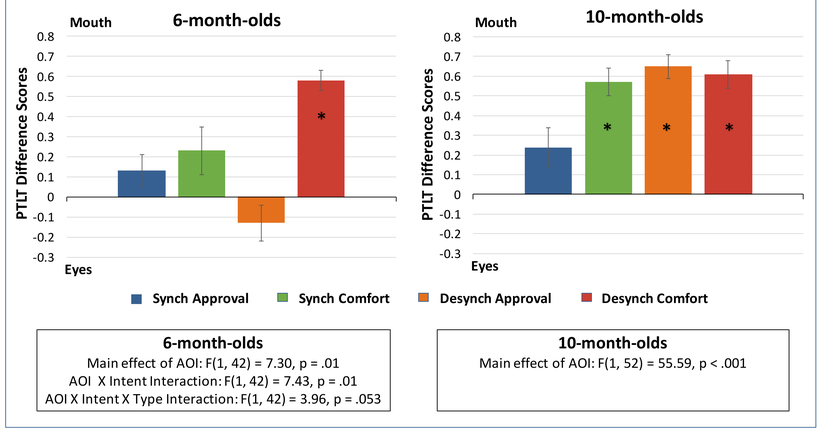
AOI	x	*INTENT*	x	*TYPE*	x	*AGE*
(Eyes, Mouth)		(Approval, Comfort)		(Synch, Desynch)		(6-mos, 10-mos)

RESULTS

Main Effect of Age
$F(1,94) = 6.07$, $p = .02$
Main Effect of AOI
$F(1, 94) = 50.06$, $p < .001$
AOI x Intent Interaction
$F(1, 94) = 7.01$, $p = .01$
AOI x Age Interaction
$F(1, 94) = 10.35$, $p = .002$
AOI x Intent x Type x Age Interaction
$F(1, 94) = 5.41$, $p = .02$

PTLT Means by Age & AOI

	6 months		10 months	
	Eyes	*Mouth*	*Eyes*	*Mouth*
Synch Approval	.28 (.08 SE)	.41 (.08 SE)	.30 (.10 SE)	.54 (.10 SE)
Synch Comfort	.23 (.09 SE)	.47 (.09 SE)	**.12** (.04 SE)	**.69** (.07 SE)
Desynch Approval	.42 (.13 SE)	.29 (.11 SE)	**.10** (.05 SE)	**.75** (.09 SE)
Desynch Comfort	**.05** (.02 SE)	**.62** (.09 SE)	**.12** (.05 SE)	**.73** (.08 SE)



6-month-olds
Main effect of AOI: $F(1, 42) = 7.30$, $p = .01$
AOI X Intent Interaction: $F(1, 42) = 7.43$, $p = .01$
AOI X Intent X Type Interaction: $F(1, 42) = 3.96$, $p = .053$

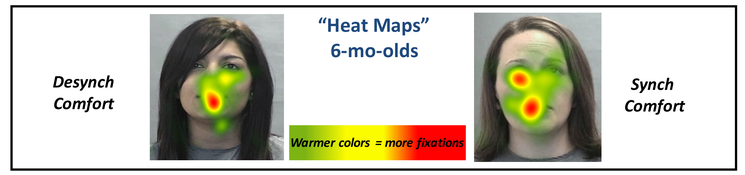
10-month-olds
Main effect of AOI: $F(1, 52) = 55.59$, $p < .001$

DISCUSSION

- The data revealed no consistent fixation patterns for synchronous vs. desynchronous AV faces OR for comforting vs. approving IDS intent.
- Instead, different fixation patterns emerged at each age for the two types of stimuli.

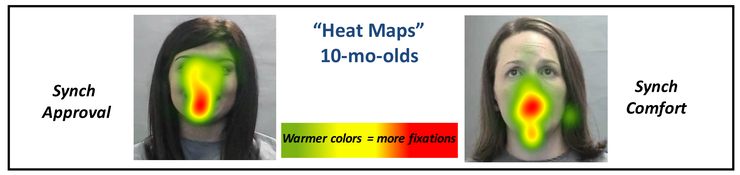
6-month-olds

- Attended eyes and mouths of synchronous faces, both approving and comforting, for similar amounts of time, consistent with previous findings. [5, 14, 15, 16]
- But they scanned *desynchronous comforting* faces differently than other types of AV faces, with more attention to mouths.
  - Because features of comforting expressions are diminished in intensity, infants' attention may be drawn to the most salient moving feature – the mouth, when the message intent is unclear.



10-month-olds

- Looked longer at mouths than eyes of desynchronous faces and synchronous comforting faces.
- Looked equally at eyes and mouth only for synchronous approval, which may provide the most salient visual and auditory cues for communicative intent.
- Results are consistent with previous findings that infants look more at mouths of speaking faces at end of first year.[12, 14, 15]
- 10-month-olds spent more time looking at the face overall than 6-month-olds.



Conclusions

- Prior work shows that approving and comforting IDS category boundaries are clear to infants as young as 6 months of age when they hear IDS audio only[7,8] and when they experience AV synchronous IDS, but that desynchrony between audio and visual streams disrupts IDS categorization.[1,2]
  - Desynchronized audio and visual streams may likely be perceived as separate unimodal events, disrupting infants' categorization of desynchronous IDS.
- Different eye-tracking patterns for desynchronous and synchronous IDS provides some converging evidence for prior findings of disruption of IDS categorization for desynchronized IDS.
- More work is needed to explore attentional differences to faces as a function of synchrony and IDS intent.

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Acknowledgements

- We would like to extend our deepest gratitude to the families of the infant participants for their time and interest.
- Thank you to the research assistants at the Infant Learning Project for all of their hard work!
- We thank Dr. Kristin Atchison for the face stimuli and Dr. Susan Jerger for the animated drum stimulus used in this study.
- Participant recruitment supported by the Texas Department of State Health Services.
- Support for this research provided by the Timberlawn Psychiatric Research Foundation to Dr. Melanie J. Spence.

Email Contact: mariah.fowler@utdallas.edu

Poster presented at the XX Biennial International Conference on Infant Studies – May 26, 2016 – New Orleans, LA