The Emerging Power of Attention to Facilitate and Guide Early Language Learning in Human Infancy

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The Non-Social Nature of Infant Language Learning Research

- Studies on infants’ perception of speech
  - Non nutritive sucking
  - Head turning
  - Visual fixations

- What have we learned?
  - Sensitivity to rhythm/stress
  - Phonetic/phonemic attunement
  - Parsing/segmentation
  - Word recognition; word/object associations

- Body of results collected in quiet (often soundproof), dim experimental chambers, as infants look at (often) arbitrary visual events (flashing lights, checkerboards) and listen to speech (often synthetic, male-generated)
“Traditionally, variability in behavioural data is a researcher’s nightmare. Too much within- or between-subject variability swamps any experimental effects. Thus, researchers deliberately choose tasks to make people look alike. But real behavior in real children is not like that. Their performance is notably fragile and context dependent. Dynamic systems theory turns variability from a scourge into a blessing.”

Ester Thelen
Respecting Communion

- Language learning occurs
  - in a rich, multimodal context
  - under perceptual challenge
  - in interaction with others

- Language learning involves *contingency and communion*: a continuous state or feeling of connectedness owing to the existence of a communications link that is maintained by frequent signaling (Locke, 2007)

- Language learning may be “gated” by a social brain (Kuhl, 2007)
Relationships Between General Attention Patterns and Language

• Shorter duration of looking on habituation tasks in infancy (thought to reflect memory and speed of processing) is associated with larger vocabulary (Bornstein & Sigman, 1986; Colombo, Shaddy, Richman, Maikranz & Blaga, 2004; Colombo et al., 2008)

• Longer duration of attention (thought to reflect sustained attention and persistence) has been associated with better language abilities (Kannass & Oakes, 2008; Kopp & Vaughn, 1982)

• Lower distractibility when viewing dynamic, complex events is related to gains in cognitive development (Courage, Reynolds & Richards, 2006; Lansink & Richards, 1997; Oakes & Tellinghuisen, 1994)

So infants’ flexibility in attention strategies should be highly advantageous with respect to language learning
Heart rate (HR) as a measure of focused (sustained) attention
With increasing age, infants show more sustained attention (both in looking and sustained HR) to dynamic events (including face+voice).

- **3 mos; n = 15**
- **6 mos; n = 15**
- **9 mos; n = 15**

### Mean Looking Time (sec)

- **Static Object**
- **Static Face**
- **Dynamic Object**
- **Dynamic Face**

*Significant differences indicated by *.*
Attention to Dynamic vs. Static Speakers

(n=22; 10-mo-olds)

Generally: Mouth > Eyes or Mouth = Eyes but rarely Eyes > Mouth
Attention to Dynamic Speakers
\(n=22;\) 8 to 12-mo-olds

<table>
<thead>
<tr>
<th>Duration (s)</th>
<th>Condition</th>
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<tbody>
<tr>
<td></td>
<td>EyeR</td>
</tr>
<tr>
<td></td>
<td>MouthR</td>
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<tr>
<td></td>
<td>Not AOI</td>
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</tbody>
</table>

Generally:
Mouth > Eyes or
Mouth = Eyes, but
never Eyes > Mouth
Attention to Visual Articulation

11-mo-old English learning infants (n = 24) Habituated to either dental or retroflex, and tested with the novel contrast

dental /də/

retroflex /ɖə/

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First 2 Trials | Fam Trials | Novel Trials

* p < .05
Is Emerging Attention to Areas of the Face Related to Infants’ Language Skills?

- So, we generally do not find a bias toward fixation on eyes of a dynamic speaker; if any bias, it is more fixation on the mouth.

- We began a variety of studies examining infants’ scanning of faces under various conditions and correlations with emergent language skills.

  - MacArthur-Bates Communicative Development Inventory (MBCDI) (short form): parent report on 89-word vocabulary checklist (comprehension and production).
  - Vineland Adaptive Behavior Scales-Communication (VABS): parent report; expressive and receptive language; skills rated as always present, sometimes present, seldom or never present.
  - Ages and Stages Questionnaire-Communication (ASQ): parent report; developmental screening measure describing behaviors that are either observed or easily elicited by parents in the home (e.g., Does your baby make two similar sounds like “ba-ba”? If you call your baby when you are out of sight, does she look in the direction of your voice?).
Focused Attention on Social Displays and Vocabulary
(11-mo-olds; $n = 53$)

- Measured distractibility at 11 months and vocabulary at 18 months

- Infants’ latency to look away from a dynamic speaker significantly predicted MBCDI (productive) $\beta = 0.49$

Focused Attention on Social and Non-Social Displays
(16-mo-olds; \(n=20\))

Familiar Social

- Longest %fixation to upright face+voice
- Eye Region = Mouth Region
- %Fixation significantly correlated with VABS-Comm \(+.29\)

Novel Social

- Eye Region = Mouth Region
- Latency to distracter significantly correlated with ASQ-Comm \(+.46\)

Abstract

- “Mouth Region” > “Eye Region”
- Latency to distracter negatively correlated with MBCDI \(-.49\)
Attention to Dynamic Female Speakers in the Context of Object-Word Relations: Effects of Emotion

- Sentences with Target Words in Reference to Objects (12-mo-olds; n=20): Happy and Neutral Conditions

**FAMILIARIZATION**
- %Fixation on Mouth significantly correlated with MBCDI-productive vocabulary +.86
- %Fixation on Objects significantly correlated with ASQ-Comm +.86

**TEST**
- More attention to novel object in Happy Condition only
- %Fixation on Objects significantly correlated with ASQ-Comm +.64
Attention to Dynamic Female Speakers in the Context of Object-Word Relations: Effects of Cognitive Load

- **Target words in Reference to Objects with Minimal Pair Labels**
  (14-mo-olds; \( n=20 \)):

  **TEST**
  - More attention on mouth during switch trial compared to familiar trial
  - \%Fixation on Control Object during familiar tests significantly correlated with MBCDI-expressive vocabulary (\(+.60\))
Summary of Observations

- Generally, infants (from at least 8 to 16 months of age) distribute their foveal attention across eyes and mouth of dynamic speakers, but fixate longer on the mouth region unless mouth is static.

- Infants increase their foveal attention on the mouth region in the context of object regard even though attention gets distributed across the speaker and the objects being named.

- Relationship between attention to mouth region and emerging language skills is not easily observed; may depend on aspects of the task itself and kinds of measures being collected (e.g., MBCDI vs. ASQ-Comm).

- Is emerging attention to dynamic visual speech in and of itself an essential experience for language learning?
Emerging Attention to Dynamic Social Information and Language

- quick, frequent attention
  - ostensive value

- IDS – slower, sustained attention
  - ostensive value

- multisensory integration
  - increases sustained attention
  - general lexical value

- AV pattern perception
  - specific lexical value
It takes a village to test a baby

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