Expectancy Learning and Later Vocabulary

Erica M. Ellis and Gedeon O. Deák
San Diego State University and University of California, San Diego
Joint Doctoral Program in Language and Communicative Disorders

ABSTRACT
We investigated the relation between expectancy learning and later vocabulary in infants. Very young infants can learn statistical regularities in sequences of events. To learn words, however, infants must find regularities, or contingencies, between heard speech and possible referents. Little is known about how infants’ contingency learning supports their language acquisition. We used the visual expectancy paradigm (VExP) to test infants’ ability to learn novel predictable sequences of events. Speed of learning was measured in terms of infants’ saccades to the location of the next event. Results suggest that the ability to learn to predict predictable sequences of events might contribute to later vocabulary (12-22 months). This indicates that infant’s sequence-learning ability might contribute to later word learning.

BACKGROUND
Learning Contingencies From a young age infants learn contingencies and expect sequences of information in “noisy” social settings (Kaye, 1982).
• Relationship to IQ Infants’ ability to learn simple event sequences predicts later IQ (Dougherty & Haith, 1997). However, it is not known how contingency learning contributes to later language learning.
• Relationship to Word Learning Infants learn contingencies between patterns of sounds and events in the social environment, utilizing temporal event synchrony for word learning (Gogate et al., 2000).
• The Task Habib (1993) tested contingency learning using a Visual Expectancy Paradigm to show the development of forming expectations in young infants.

METHOD
Participants
<table>
<thead>
<tr>
<th>Session</th>
<th>N</th>
<th>Male</th>
<th>Female</th>
<th>Age in Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mths</td>
<td>32</td>
<td>17</td>
<td>15</td>
<td>188</td>
</tr>
<tr>
<td>7 mths</td>
<td>29</td>
<td>14</td>
<td>15</td>
<td>218</td>
</tr>
</tbody>
</table>

Demographics
• Healthy typically developing infants with no reported perceptual or medical difficulties.
• Participants were from primarily English speaking middle-SES homes in the San Diego area.
• Average Bayley Cognitive score was 109 (12.5).

Procedure: Visual Expectancy Paradigm
• Infants sat on mother’s laps facing a projection screen (Figure 1). Mother could not see or hear the events.

Each Trial (Figure 2)
• Center Cues: two novel shapes A or B (700 ms)
• Rewards: two distinct moving shapes, A (left) or B (right), paired with unique sounds (1 sec).
• ISI: 1 sec central orientation stimulus

Predictable Block
• Cue A always preceded Reward A. Cue B always preceded Reward B. (Cues were in random order.)

Learning the Contingency
• Infants must learn that each center cue predicts a different visual reward on the left or right.
• Infants who learn the cue/reward associations will shift to the correct location, gradually faster, and sometimes even before the reward begins (anticipatory).
• Infants complete a random block to assess baseline responses to the reward videos onset.

VOCABULARY/COGNITIVE MEASURES

Table 1. Mean for infants at 6 and 7 months for Percent of Correct Anticipatory Looks and mean RT.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>6 mth session</th>
<th>7 mth session</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Anticipatory Looks</td>
<td>23.4% (12%)</td>
<td>25.7% (16%)</td>
</tr>
<tr>
<td>RT Anticipatory Looks</td>
<td>1.44 (1.22)</td>
<td>1.28 (1.11)</td>
</tr>
</tbody>
</table>

Table 2. Means and SDs: BSID-III Cognitive; MBCDI at 12, 16 (n=21), and 22 mths (n=19).

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSID (Bayley) 12 mth Cognitive</td>
<td>110.3 (12.9)</td>
</tr>
<tr>
<td>12 mth MBDI: Comprehension</td>
<td>23.9 (17.7)</td>
</tr>
<tr>
<td>12 mth MBDI: Production</td>
<td>3.77 (4.5)</td>
</tr>
<tr>
<td>16 mth MBDI: Production</td>
<td>13.6 (16.2)</td>
</tr>
<tr>
<td>22 mth MBDI: Production</td>
<td>40.2 (19.3)</td>
</tr>
</tbody>
</table>

VEP MEASURES
Infant looking was coded offline frame by frame (30 fps) using Mangold Interact 8.0.
Infant looking codes for location and saccade times were synched to the online event log times.

Infant Looking Behavior
• Anticipatory look: Correct saccade to reward location after the center cue but before the reward onset
• Reactive look: Correct saccade to reward location after the reward onset

Dependent Measures:
• Percent of Anticipatory Looks out of all valid trials
• Average RT: Time from cue onset to the initiation of a reward-directed saccade
• Learning Speed: RT change from early to late trials

RESULTS: CONTINGENCY LEARNING

Stability across months: RT on correct anticipatory trials is correlated at 6 mths and 7 mths (r = .58, p = .015).
Contingency Learning and Vocabulary: Overall RT (6 and 7 mths) predicts 12 mth MBCDI comprehension, r (27) = .42, p = .03.

SUMMARY
1. Early infancy measures of learning may reveal new relations to later language development
   • Predictive validity was highest at 12 months
2. Ability to learn and anticipate event sequences might be a critical factor in word learning
   • Visual contingency learning shows moderate individual stability from 6 to 9 months (Canfield et al., 1997).
3. Infant learning speed (i.e., RT decline over trials) might be another useful (and previously unexplored) measure of infants’ contingency-learning ability.

Support: This project was funded by a grant from the National Science Foundation (HSD-0527758) to G. Deák; NSF Temporal Dynamics Learning Center; NIDCD-T32DC007361 to Lew Shapiro.

Acknowledgements: We are also grateful to children and families who participated, and to Marybel Robles, Jordan Darby, Kelly Ruebsema, Kathy Brecht, Melissa Galinato, and other members of the Cognitive Development Lab.