Developmental Change in Preschoolers' Sensitivity to Pitch as a Cue to the Speaker's Emotions
Carolyn Quam, Daniel Swingley, and Jane Park

**Motivation**
We investigate children's use of intonation to infer a speaker’s emotions, as a way of better understanding how children begin to assign clearly discriminable phonetic variation to different levels of structure. Despite the demonstrated early importance of prosody in infancy (Fernald, 1993), prosodic cues to emotions appear to be exploited late in development (Friend, 2003). Using a naturalistic task without conflict between cues, we investigate when English-learning children exploit pitch as a cue to emotions (when other acoustic cues are controlled).

**Predictions**
Hypothesis I: Consistent with the early importance of pitch for other communicative functions, the pitch cue to emotions should be exploited early.
Hypothesis II: Inferring another person’s emotions is difficult, so the pitch cue to emotions may be exploited much later than pitch cues to phrase boundaries, rhythmic class, etc.

<table>
<thead>
<tr>
<th>Participants</th>
</tr>
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<tbody>
<tr>
<td>Experiment One: 38 3- to 5-year-olds</td>
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<tr>
<td>Experiment Two: 42 2- to 5-year-olds</td>
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</tbody>
</table>

**Experiment One**
Puppy searches for a toy (e.g., the Toma) on each trial. He is excited when he finds the Toma, and disappointed when he finds a different toy.

- **Trials 1-3: body-language cue**
  - Toy 1: Not Toma
    - Puppy shakes head, slumps
  - Toy 2: Toma
    - Puppy nods, dances
  - Toy 3: Not Toma
    - Puppy shakes head, slumps

- **Trials 4-7: pitch cue**
  - Toy 1: Not Toma
    - Low, flat pitch (on "Mmm")
  - Toy 2: Toma
    - High pitch, wide excursions
  - Toy 3: Not Toma
    - Low, flat pitch

(Order counterbalanced. Puppy covers Experimenter’s face in all trials.)

**Experiment Two**
Remove the word-learning component. Make the task more directly about emotions.

- **Trials 1-3: body-language cue**
  - Toy 1: Not lost toy
    - Experimenter frowns, she & Puppy slump
  - Toy 2: Lost toy
    - Experimenter smiles, she & Puppy dance

- **Trials 4-7: pitch cue**
  - Toy 1: Not lost toy
    - Low, flat pitch (on "Oh, look at that")
  - Toy 2: Lost toy
    - High pitch, wide excursions

(Order counterbalanced. Puppy covers Experimenter’s face in Condition 2.)

**Conclusions**
Children still struggle to exploit the pitch cue to emotions until age 4. We found this in a naturalistic, simple task in the absence of conflicting cues.

This suggests that pitch cues to different levels of structure are available at different points in development. Since two- and three-year-olds successfully use the body-language cue, we know they understand the underlying emotions and can succeed in the task. Instead, it is mapping the pitch contours onto those emotions that proves difficult.

**Experiment One: Pitch Accuracy by Age**
![Graph showing pitch accuracy by age in Experiment One](image)

**Experiment Two: Pitch Accuracy by Age**
![Graph showing pitch accuracy by age in Experiment Two](image)

**Proportion of Children At Least 66.7% Correct**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>Body-lang.</td>
<td>4/4 (100%)</td>
<td>8/8 (100%)</td>
<td>7/8 (88%)</td>
<td></td>
</tr>
<tr>
<td>Pitch</td>
<td>0/1 (0%)</td>
<td>4/10 (40%)</td>
<td>7/11 (64%)</td>
<td>8/10 (80%)</td>
</tr>
</tbody>
</table>

**Proportion of Children At Least 66.7% Correct**

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body-lang.</td>
<td>11/14 (79%)</td>
<td>16/16 (100%)</td>
<td>8/8 (100%)</td>
<td></td>
</tr>
<tr>
<td>Pitch</td>
<td>4/4 (29%)</td>
<td>8/16 (50%)</td>
<td>7/8 (88%)</td>
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**Related Research**

**Contact**
Carolyn Quam
cquam@psych.upenn.edu

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