Infants’ early pragmatic understanding of pointing gestures: the role of prosody and gesture shape

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Introduction

- Human communication is **multimodal** because we express our intentions and emotions through oral and visual cues.

- Infants have to pay attention to both strategies to **understand** the adult’s intentions and emotions.

Can they do that? If so, when?
Introduction

Aim

Methodology

Results

Conclusion

3-month-old infants show different neural responses when somebody has a fearful facial expression accompanied by eye-gaze, than when it is only a fearful facial expression (Hoehl, Wiese & Striano, 2008)

14-month-old infants rely on lexical and prosodic cues to know when an action is intentional or accidental (Csibra & Gergely, 2009; Martin et al., 2012; Sakkalou & Gattis, 2012)

12-month-old infants understand that a pointing gesture has an imperative, expressive, or informative intention if the social-contextual information helps them. (Aureli et al. 2009; Behne et al., 2005; Behne et al., 2012; Camaioni et al., 2009)
• Human communication is **multimodal** because we express our intentions and emotions through oral and visual cues.

• Infants have to pay attention to both strategies to **understand** the adult’s intentions and emotions.

Can they do that? If so, when?

• When **common ground provides enough relevant information**, infants are able to identify the specific adult’s intention from gesture or speech.

• When **no common ground is available**, infants rely on gesture or speech cues to decide whether an act is intentional or not.
So... What we do not know?

When no common ground is available, whether infants can identify the specific adult’s intention by relying on both gesture and speech cues.

In our study,

1. No common ground is available for infants

1. Infants will have to identify an imperative, expressive, or informative intention behind a pointing gesture accompanied by speech.
(1) Can 12-mo infants infer the specific imperative, expressive, or informative intent of an act when no common ground is available and they can only rely on the adult’s use of gesture and speech cues?

H1: they can

(2) Which are the specific gesture and speech strategies that adults use to convey these communicative intentions, specifically in terms of gesture shape and prosodic cues?

(3) Do infants rely on these gesture shape and prosodic cues to determine the imperative, expressive, or informative intentionality of the adult’s act?

H2: gesture shape and prosodic cues are crucial
(1) Can 12-mo infants infer the specific the imperative, expressive, or informative intent of an act when no common ground is available and they can only rely on the adult’s use of gesture and speech cues?
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H2: gesture shape and prosodic cues are crucial
Participants

Eighteen Dutch caregiver-infant dyads (9 girls; \( M \) infants’ age = 12;17; range = 12;07–12;28).

Recruited from a Dutch database of parents from a middle-size city in The Netherlands who expressed interest in participating in research with their child.

Methodology

The experiment had three conditions (expressive, informative, and imperative), and some dyads were assigned to the expressive condition \((N=6)\), some to the informative condition \((N=6)\), and some to the imperative condition \((N=6)\).
Same set-up, materials and procedure across conditions. The only difference was that we told parents to have different intents across conditions.

**Imperative condition**
“Ask your son/daughter to give you the cup. Feel free to use the words or gestures you feel like using but please, don’t touch the cup before the child reacts”

**Expressive condition**
“Share your interest about the cup with your son/daughter. Feel free to use the words or gestures you feel like using but please, don’t touch the cup before the child reacts”

**Informative condition**
“Inform your son/daughter that there is something under the cup. Feel free to use the words or gestures you feel like using but please, don’t touch the cup before the child reacts”
Infant’s behavior

Caregiver’s use of speech & gesture
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Infant’s behavior

Chi-square test:  $\chi^2 (4, N=125) = 60.2, p < .001, \phi = 0.694$
Infant’s behavior

ANOVA: $F(2,124) = 14.430, \ p < .001, \ \eta^2 = .191$
Results

ANOVA: $F(2,124)=19.925$, $p < .001$, $\eta^2 = .246$
Infant’s behavior

ANOVA: \( F(2,124)=21.243, p < .001, \eta^2 = .258 \)
Infant’s behavior

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- **Aim**
- **Methodology**
- **Results**
- **Conclusion**

### Infant’s behavior

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>expressive</td>
<td></td>
</tr>
<tr>
<td>imperative</td>
<td></td>
</tr>
<tr>
<td>informative</td>
<td></td>
</tr>
</tbody>
</table>

- **attending cup**
- **offering cup**
- **attending stick(er)**
Caregiver’s use of speech and gesture

**Introduction**

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**Intonation contour**

- Mean = 170.7 ms
- SD = 56.3 ms

**Syllable duration**

- Mean = 196.9 Hz
- SD = 102.1 Hz

**Pitch range**

- Mean = 223.3 Hz
- SD = 127.8 Hz

**Hand shape**

- Mean = 151.6 Hz
- SD = 117.5 Hz
## Caregiver’s use of speech and gesture

### Aim

#### Imperative

<table>
<thead>
<tr>
<th>Intonation contour</th>
<th>Syllable duration</th>
<th>Pitch range</th>
<th>Hand shape</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Mean = 196.9 Hz</td>
<td>SD = 56.3 ms</td>
<td>SD = 102.1 Hz</td>
</tr>
</tbody>
</table>

### Methodology

#### Expressive

| Mean = 261.9 ms    | Mean = 223.3 Hz  | Mean = 151.6 Hz |
| SD = 85.1 ms       | SD = 127.8 Hz    | SD = 117.5 Hz   |

### Results

#### Informative

| Mean = 178.8 ms    | Mean = 151.6 Hz  |
| SD = 33.8 ms       | SD = 117.5 Hz    |
Experiment 1

(1) Can 12-mo infants infer the specific the imperative, expressive, or informative intent of an act when no common ground is available and they can only rely on the adult’s use of gesture and speech cues?
   Yes, they can because behaved in a different way in each pragmatic situation.

(2) Which are the specific gesture and speech strategies that adults use to convey these communicative intentions, specifically in terms of gesture shape and prosodic cues?
   In an imperative condition: falling contour, short syllables, high pitch range, and open-hand gesture.

   In an expressive condition: falling contour, long syllables, high pitch range, and index-finger pointing gesture.

   In an informative condition: falling contour, short syllables, narrow pitch range, and index-finger pointing gesture.
(1) Can 12-mo infants infer the specific the imperative, expressive, or informative intent of an act when no common ground is available and they can only rely on the adult’s use of gesture and speech cues?
   H1: they can

(2) Which are the specific gesture and speech strategies that adults use to convey these communicative intentions, specifically in terms of gesture shape and prosodic cues?

(3) Do infants rely on these gesture shape and prosodic cues to determine the imperative, expressive, or informative intentionality of the adult’s act?
   H2: gesture shape and prosodic cues are crucial
Thirty Dutch infants (9 girls; $M$ infants’ age = 12;12; range = 12;03–12;26).

Recruited from a Dutch database of parents from a middle-size city in The Netherlands who expressed interest in participating in research with their child.

There were three conditions in the experiment (expressive, informative, and imperative), and some dyads were assigned to the expressive condition ($N=10$), some to the informative condition ($N=10$), and some to the imperative condition ($N=10$).
### Methodology

<table>
<thead>
<tr>
<th>Participants</th>
<th>Set-up and materials</th>
<th>Procedure</th>
<th>Data coding</th>
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</table>

Setting as in Exp. 1, but now it is an experimenter that drives the infants’ attention.

The experimenter uses three different strategies to drive the infant’s attention (based on exp. 1 results):

![Image of experiment setting]

### Results

- **Imperative**
**Set-up and materials**

**Setting** as in Exp. 1, but now it is an experimenter that drives the infants’ attention.

The experimenter uses three different strategies to drive the infant’s attention:
**Setting** as in Exp. 1, but now it is an experimenter that drives the infants’ attention.

The experimenter uses three different strategies to drive the infant’s attention:
Setting as in Exp. 1, but now it is an experimenter that drives the infants’ attention.

The experimenter uses three different strategies to drive the infant’s attention:

Crucial!
The lexical information is controlled.
Infant’s behavior

a. Offering cup
(expected behavior in the imperative cond.)

b. Attending cup
(expected behavior in the expressive cond.)

c. Attending stick(er)
(expected behavior in the informative cond.)

d. No reaction
Infant’s behavior

Chi-square test: $\chi^2 (4, N=219) = 41.5, p < .001, \phi = 0.436$
Infant’s behavior

ANOVA: $F(2,218) = 14.192, \ p < .001, \ \eta^2 = .135$
Infant’s behavior

ANOVA: $F(2,218)=8.306$, $p < .001$, $\eta^2 = .067$
Infant’s behavior

ANOVA: $F(2, 218)=13.860, p < .001, \eta^2 = .083$
Experiment 2

(3) Do infants rely on these gesture shape and prosodic cues to determine the imperative, expressive, or informative intentionality of the adult’s act?

Yes, because they behave in a different way when they are addressed with an expressive, imperative or informative motive, even if the only differences across motives are the adults’ use of phonetic cues of prosody and their hand shape.
12-month-old infants understand the intentionality of multimodal acts relying on gesture and speech cues

- The gesture shape and the prosodic cues play a crucial role in this early ability.
- They can do it in absence of contextual information (experiment 1)
- They can even do it in absence of lexical information (experiment 2)
Follow-up questions

- Infants rely on prosody and gesture shape, but what would happen if we only have either prosody or gesture shape as a cue?

  Would infants rely on prosody more than gesture? Would they rely more on gesture cues? Or do they need both cues together?

- And, what would happen if the information carried by the gesture or the one is speech is not congruent?
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