INTRODUCTION

- Gesture and speech are complementary components of an integrated system (McNeill, 1992).
- Children’s early gestures complement and preview information that will later occur in speech (Buissie & Goldin-Meadow, 2000; Iverson & Goldin-Meadow, 2005; Özçaliskan & Goldin-Meadow, 2005, 2009).
- Previous research suggests that children also produce gestures to demonstrate their knowledge about a cognitive task (e.g., Piagetian conservation, math problems, counting, and the Tower of Hanoi problem; Alibali & Goldin-Meadow, 1993; Ehlrich, Levine, & Goldin-Meadow, 2006).

Our study:

- Although preschoolers’ causal understanding has been the target of many studies (e.g., Bullock & Gelman, 1979; Bullock, 1985; das Gupta & Bryant, 1989; Gopnik & Shulz, 2007; Gopnik & Sobel, 2000), children’s causal descriptions have not been assessed in speech and gesture modalities (for causal descriptions in motion events see Furman, Özyürek, & Allen, 2006).
- This study explores the relationship between speech and gesture in children’s expression of a direct causal event they have just witnessed.

RESEARCH QUESTIONS

- How do preschoolers express cause in gesture and speech?

Hypothesis: Younger children will use more gestures than older children.

Hypothesis: Younger children will use more gestures than older children to complement/supplement their speech.

Hypothesis: Which components of causal events children describe in speech and/or gesture?

METHOD

Participants

- 64 monolingual English-speaking children balanced for gender separated evenly into four age groups:
  - 2.5-year-olds (M= 32.91 mo., SD= 1.71 mo.)
  - 3-year-olds (M= 39.91 mo., SD= 2.40 mo.)
  - 4-year-olds (M= 52.76 mo., SD= 4.36 mo.)
  - 5-year-olds (M= 65.16 mo., SD= 4.19 mo.)

Materials and Procedure

- The experimenter used a stick to push an object (either a ball or a ring) across a pool of water (see Figure 1).
- Children were asked to describe the causal event.

Figure 1. Experimental procedure and the directions used in test trials.

Coding

Speech

- Causal verbs (e.g., make, push, hit) and non-causal verbs (e.g., go, float) were coded.
- Speech-only expressions were divided into components: agent (i.e., you), patient (the ball or the ring), instrument (i.e., the stick), nonobligatory components: the location (i.e., there, here, other side) and direction (i.e., this way, across here).

Gesture

Type of gesture:

- Pointing: showing an object or location
- Representational: indicating attributes or actions of an object’s direction (e.g., moving the hand away from self in a diagonal direction).
- Gesture categories (Özçaliskan & Goldin-Meadow, 2005, 2009):
  - Complementary gestures: gesture and speech conveyed same information (e.g., pointing at the ball while saying “ball”)
  - Supplementary gestures: gesture added information to speech (e.g., holding a stick gesture while saying “when you pushed it”)
- Gesture only expressions: gestures produced without speech
- For each category, gesture referents were coded: agent (i.e., you), patient (i.e., the ball or the ring), instrument (i.e., stick), location (i.e., endpoint), or direction (i.e., the vector of the movement).

RESULTS

How do children describe a causal event in speech?

![Graph showing the number of children who used causal and non-causal sentences in their descriptions.]

Table 1. The number of children who used causal and non-causal sentences in their descriptions.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Causal</th>
<th>Non-Causal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>Older</td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

Do children’s gestures complement and/or supplement speech in describing causal events?

![Graph showing the number of children who used causal and non-causal gestures in their descriptions.]

- In causal sentences: Regardless of age children used more complementary gestures compared to supplementary gestures and gesture only expressions (p<.024).
- Contrary to the hypothesis, younger and older children produced equal amounts of gestures.
- In general, children used more pointing gestures compared to representational gestures (p<.05). Only the instrument and direction were produced as representational gestures.

DISCUSSION

- This study examined children’s verbal and gestural expressions for causal events. Results indicated that only older preschoolers frequently produced causal sentences to describe a causal event.
- Children’s gestures facilitate their causal descriptions: in half of their expressions, children use at least one form of gestures (complementary, supplementary or gesture-only). The instrument and spatial components (location and direction) appear mostly in gestural modality.
- By forming a coherent system with language (McNeill, 1992), this study suggests that children’s gestures might signal upcoming changes in speech for causal descriptions.

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