

# Developing an understanding of communication

Alia Martin  
Harvard University

CBMM Summer School  
August 25, 2015

What is communication?

transfer or exchange of information



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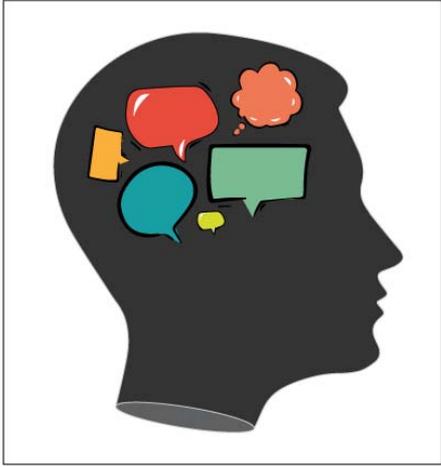


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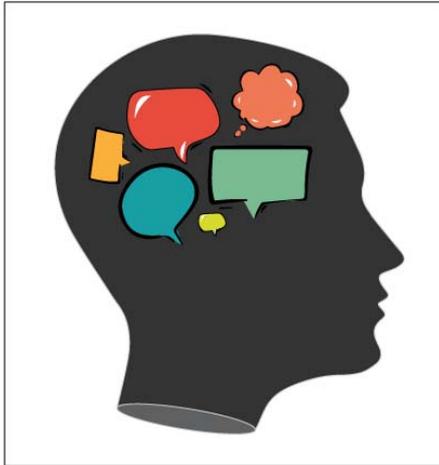


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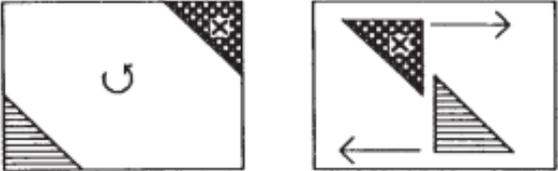


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Human communication requires:  
reasoning about *cognitive states*  
reasoning about *social interaction*  
(often) reasoning about *language*

# Core Knowledge

## Geometry/Space



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## Agents



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## Number



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## Objects



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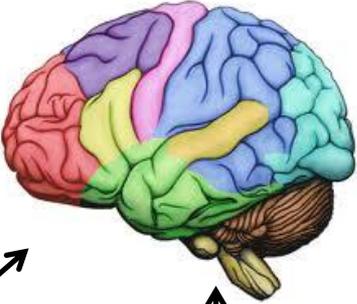
## Social Beings



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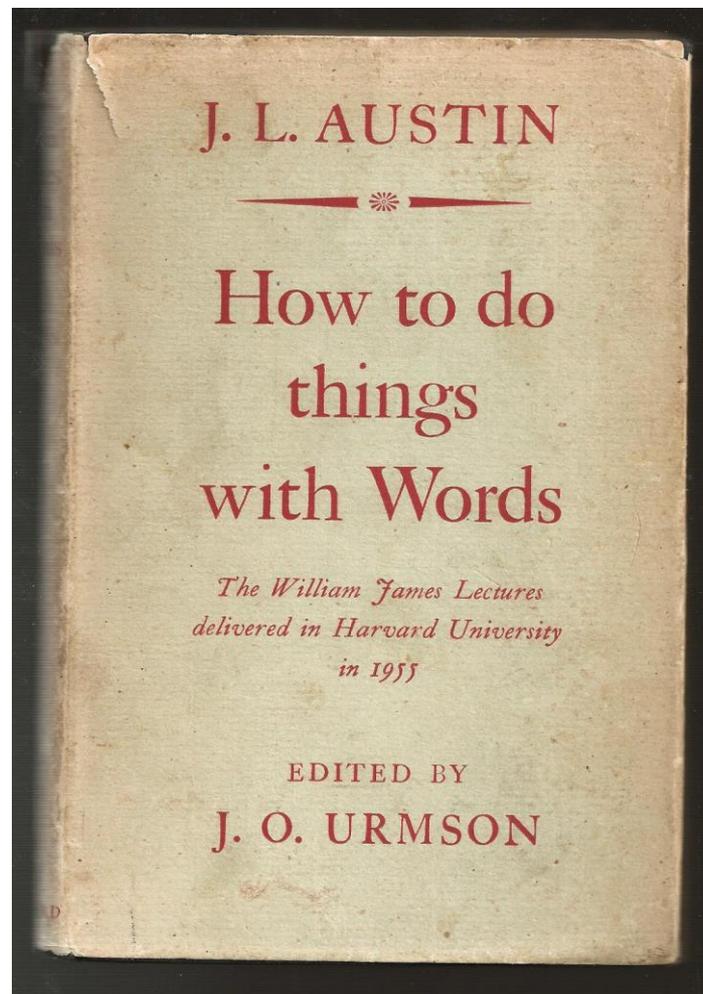


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# 1. Language is an *action*



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*Locutionary act: interrogative about presence of salt*

*Illocutionary act: requesting salt*

*Perlocutionary act: causing addressee to provide salt*

*Austin, 1955*



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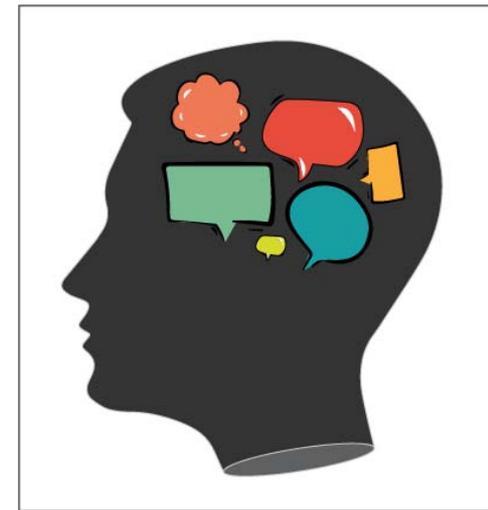
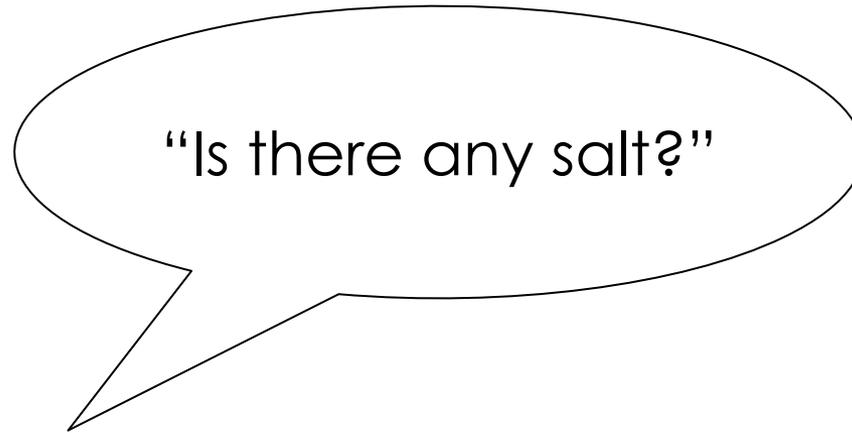


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1. Developing an ability to identify a communication action or situation

# Identifying communicative contexts

- Newborns prefer speech to other sounds  
*(Vouloumanos & Werker, 2004; 2007; Shultz & Vouloumanos, 2010)*



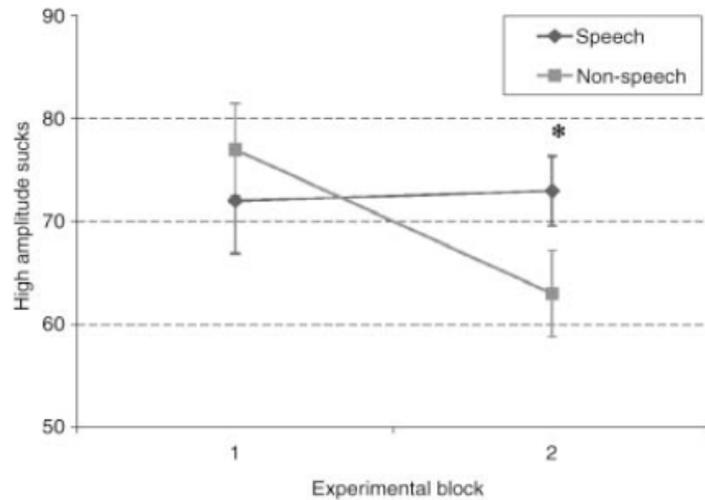
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Source: Vouloumanos, Athena, and Janet F. Werker. "Listening to language at birth: Evidence for a bias for speech in neonates." *Developmental science* 10, no. 2 (2007): 159-164.

*1 to 4 days old*

*Vouloumanos & Werker, 2007*



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 Source: Vouloumanos, Athena, and Janet F. Werker. "Listening to language at birth: Evidence for a bias for speech in neonates." *Developmental science* 10, no. 2 (2007): 159-164.



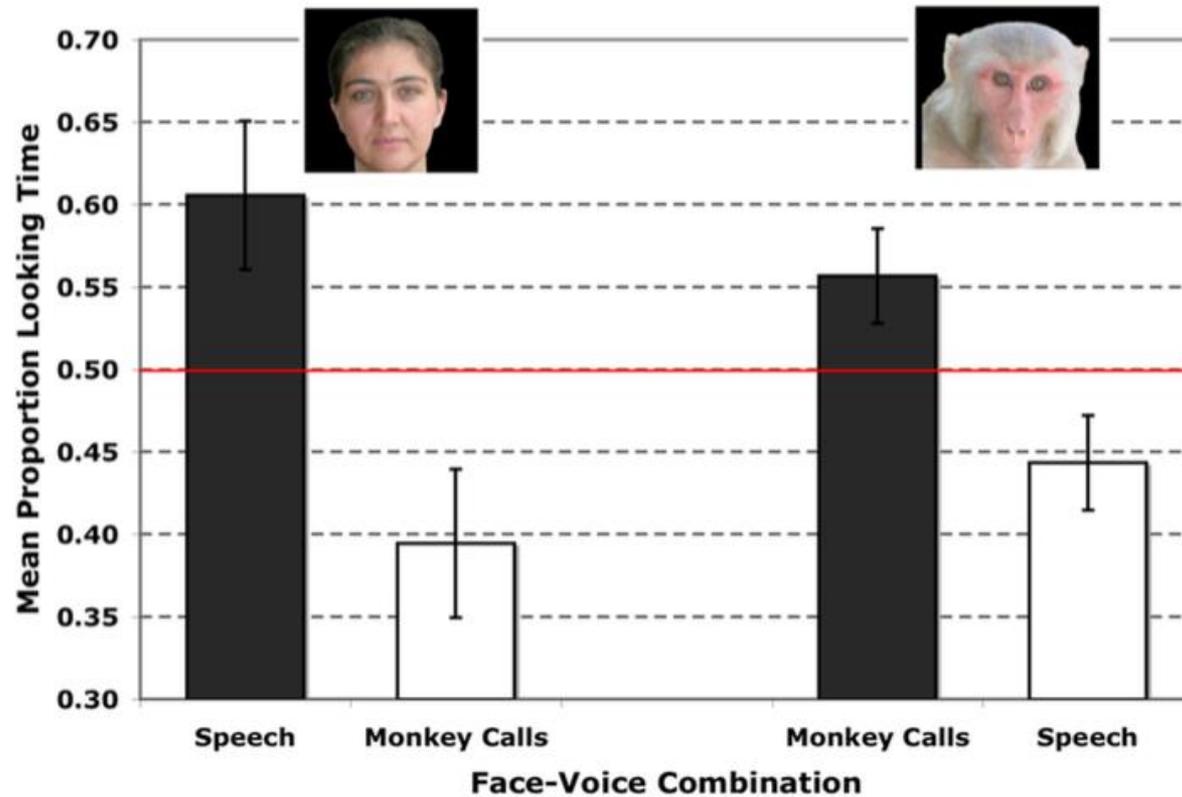
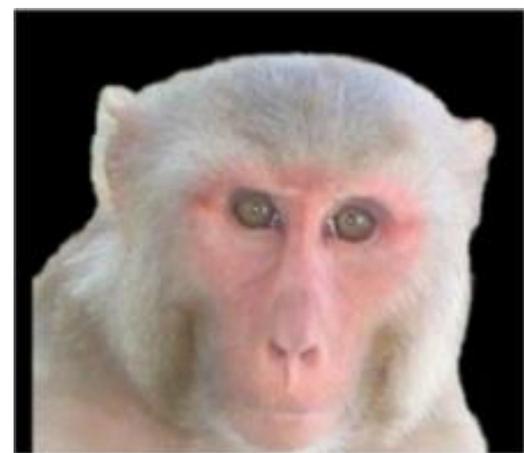
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# Identifying communicative contexts

- Newborns prefer speech to other sounds  
*(Vouloumanos & Werker, 2004; 2007; Shultz & Vouloumanos, 2010)*
- 6-month-olds recognize speech is human-produced *(Vouloumanos et al., 2009)* and human-directed *(Legerstee et al., 2000; Molina et al., 2004)*



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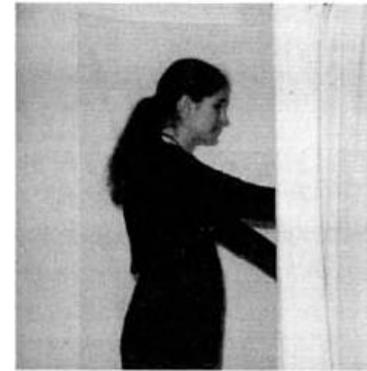


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# Habituation



Talking



Acting

## Test



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Source: Legerstee, Maria, Joanne Barna, and Carolyn DiAdamo. "Precursors to the development of intention at 6 months: Understanding people and their actions." *Developmental Psychology* 36, no. 5 (2000): 627.

6-month-olds

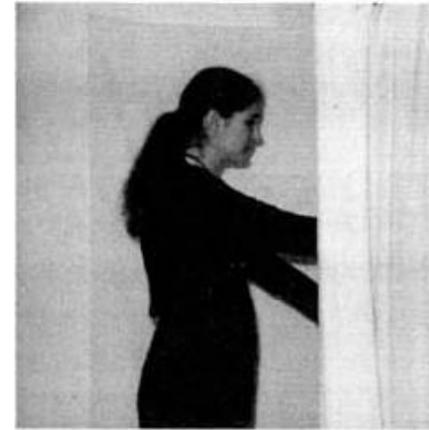
Occluder reveals person

*Legerstee et al., 2000*

# Habituation



Talking



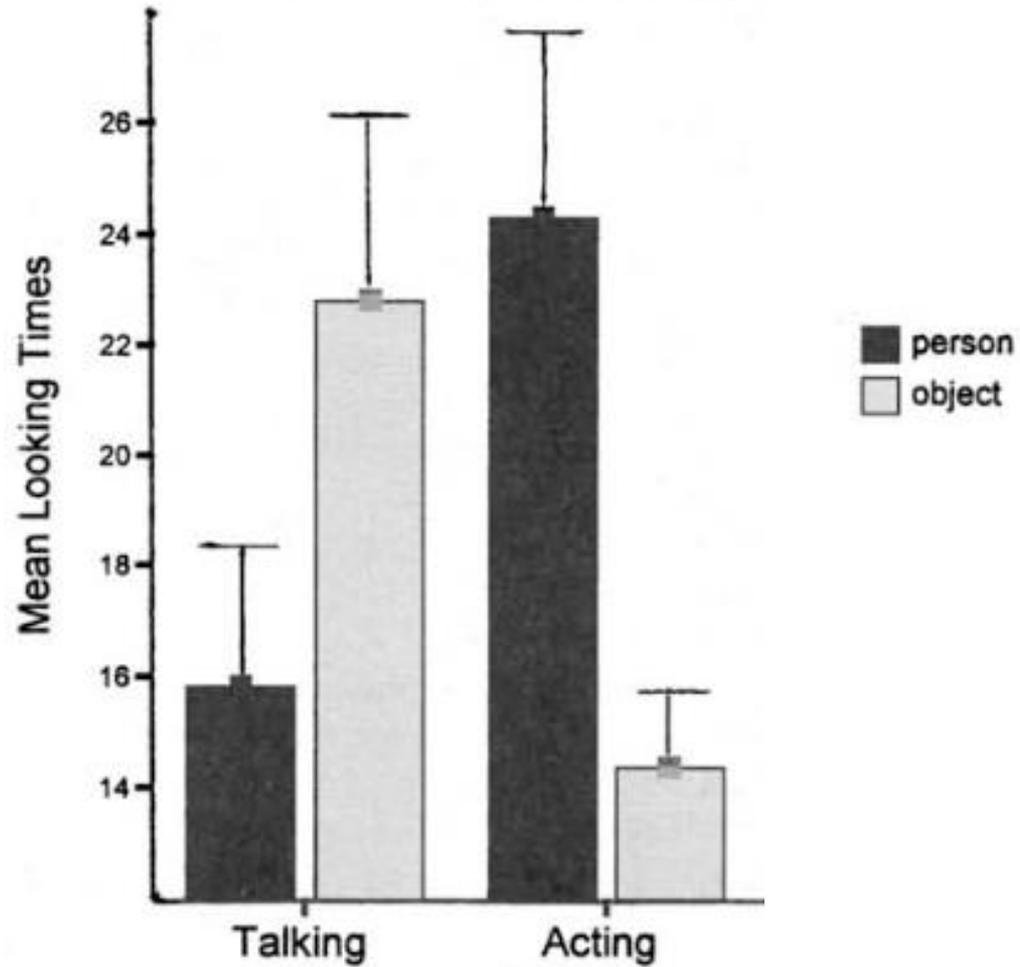
Acting

## Test



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Source: Legerstee, Maria, Joanne Barna, and Carolyn DiAdamo. "Precursors to the development of intention at 6 months: Understanding people and their actions." *Developmental Psychology* 36, no. 5 (2000): 627.

Occluder reveals object



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Source: Legerstee, Maria, Joanne Barna, and Carolyn DiAdamo. "Precursors to the development of intention at 6 months: Understanding people and their actions." *Developmental Psychology* 36, no. 5 (2000): 627.

# Identifying communicative contexts

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- 10-month-olds expect mutual gaze between speakers *(Beier & Spelke, 2011)*

Hey there!

Oh hi!



Hey there!

Oh hi!



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Source: Beier, Jonathan S., and Elizabeth S. Spelke. "Infants' developing understanding of social gaze." *Child development* 83, no. 2 (2012): 486-496.

Hey there!

Oh hi!



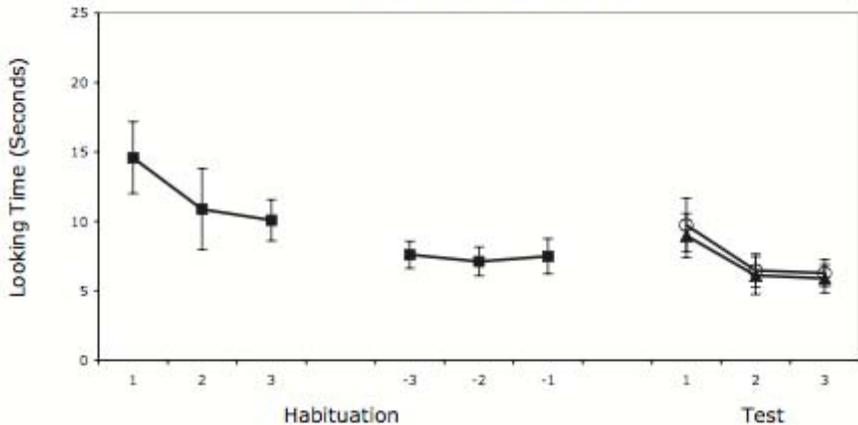
Hey there!

Oh hi!

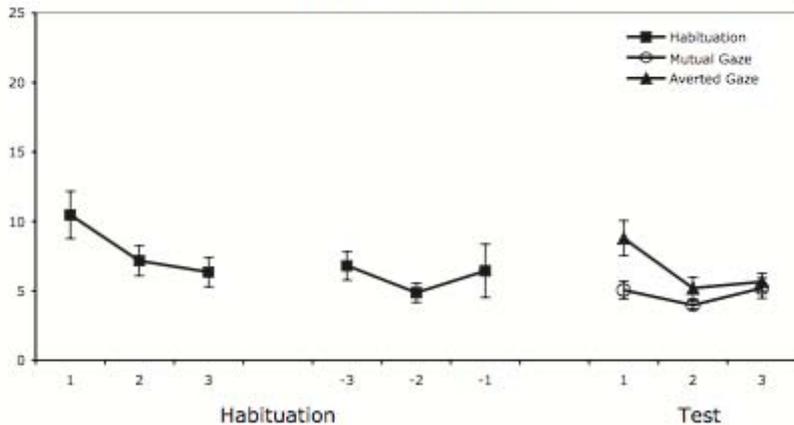


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Source: Beier, Jonathan S., and Elizabeth S. Spelke. "Infants' developing understanding of social gaze." *Child development* 83, no. 2 (2012): 486-496.

**Nine-Month-Old Infants**



**Ten-Month-Old Infants**



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- 10-month-olds expect mutual gaze between speakers *(Beier & Spelke, 2011)*

Do infants understand that  
speech transfers information  
between people?



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Communicator



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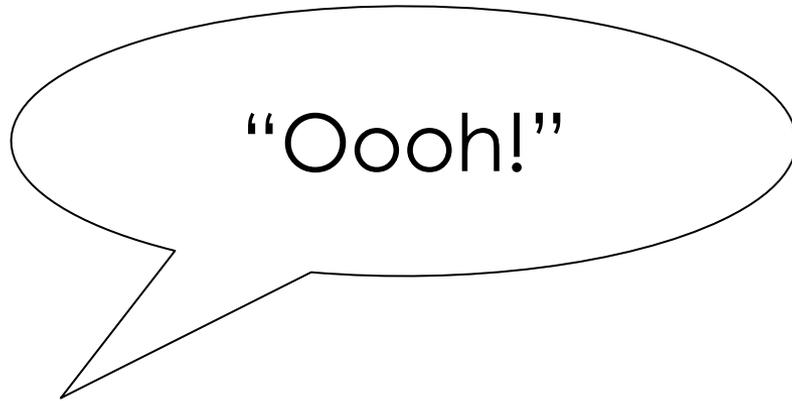


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La taza!  
 Bēizi! “The cup!” katora!  
 La tasse! Der becher!



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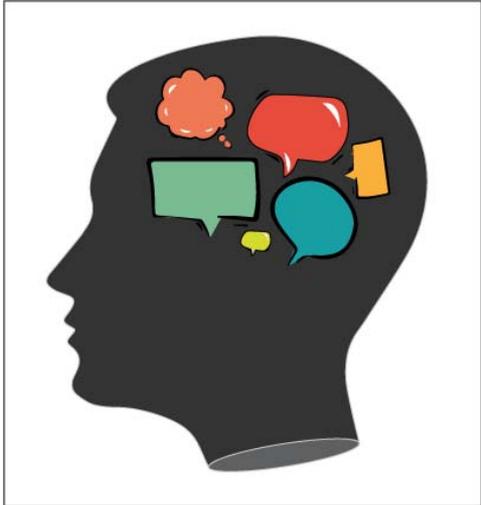


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# Communicator



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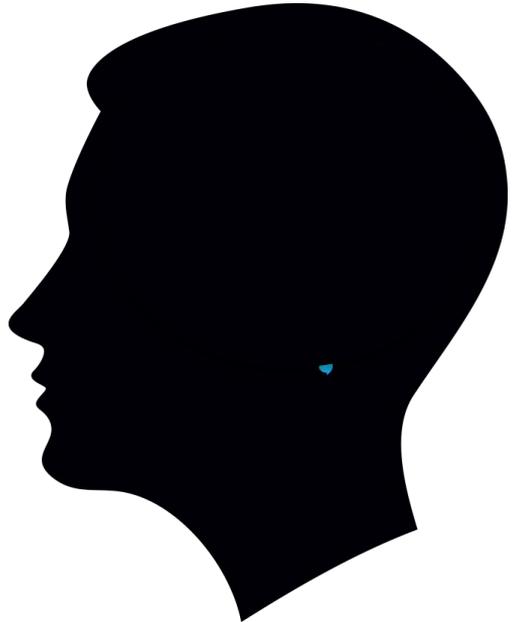
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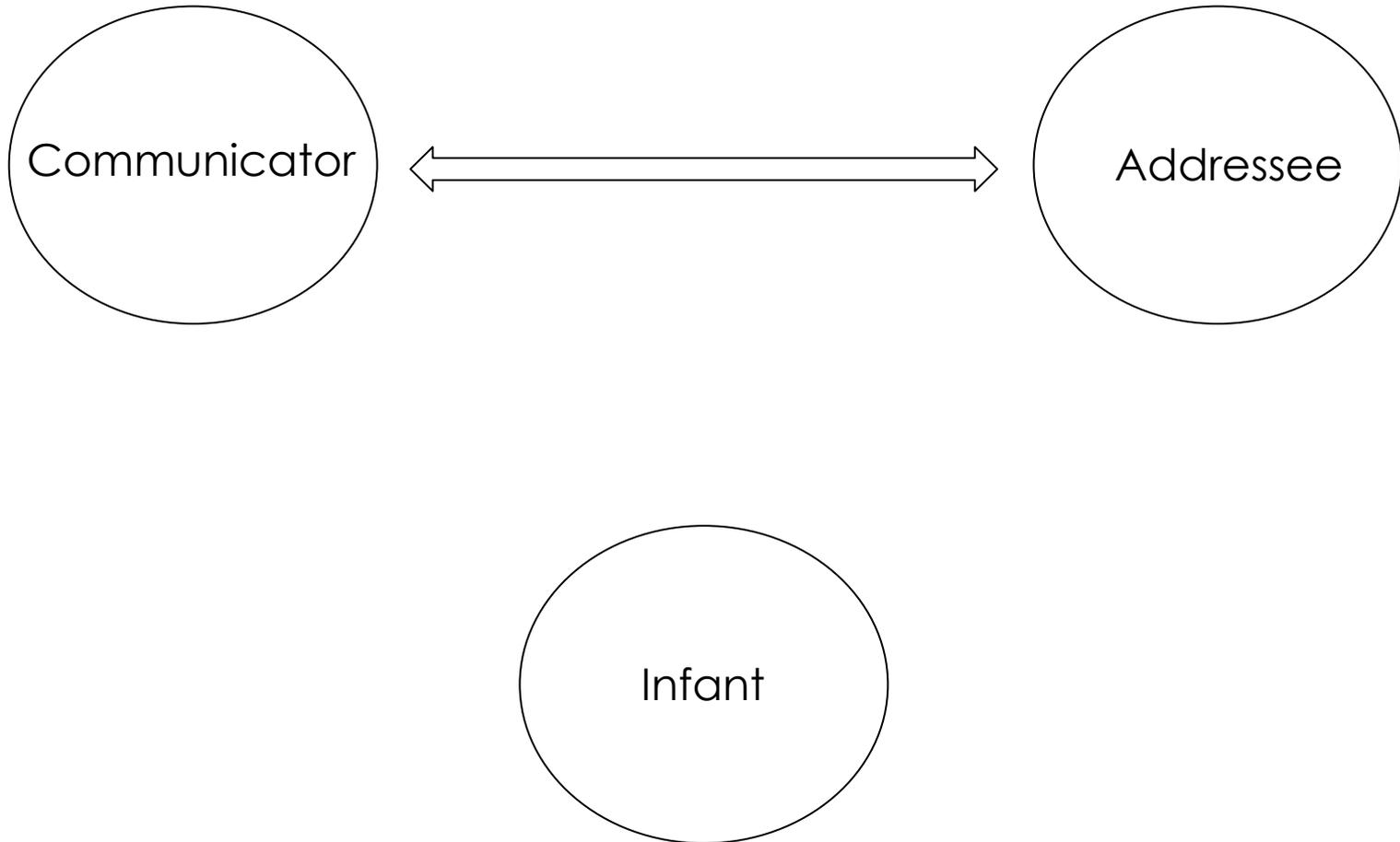


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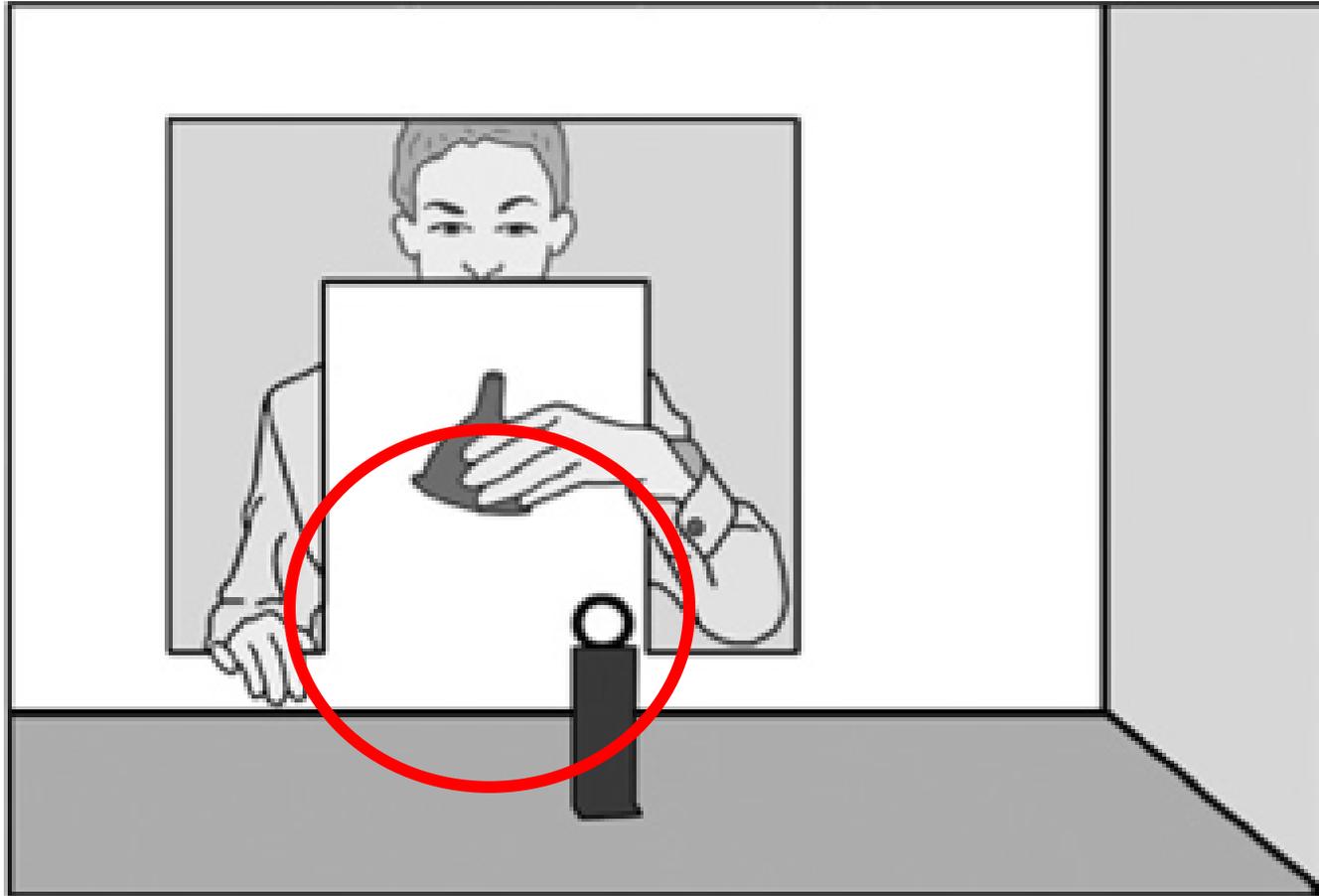
Do infants recognize that  
speech is communicative?

# Procedure

# Procedure



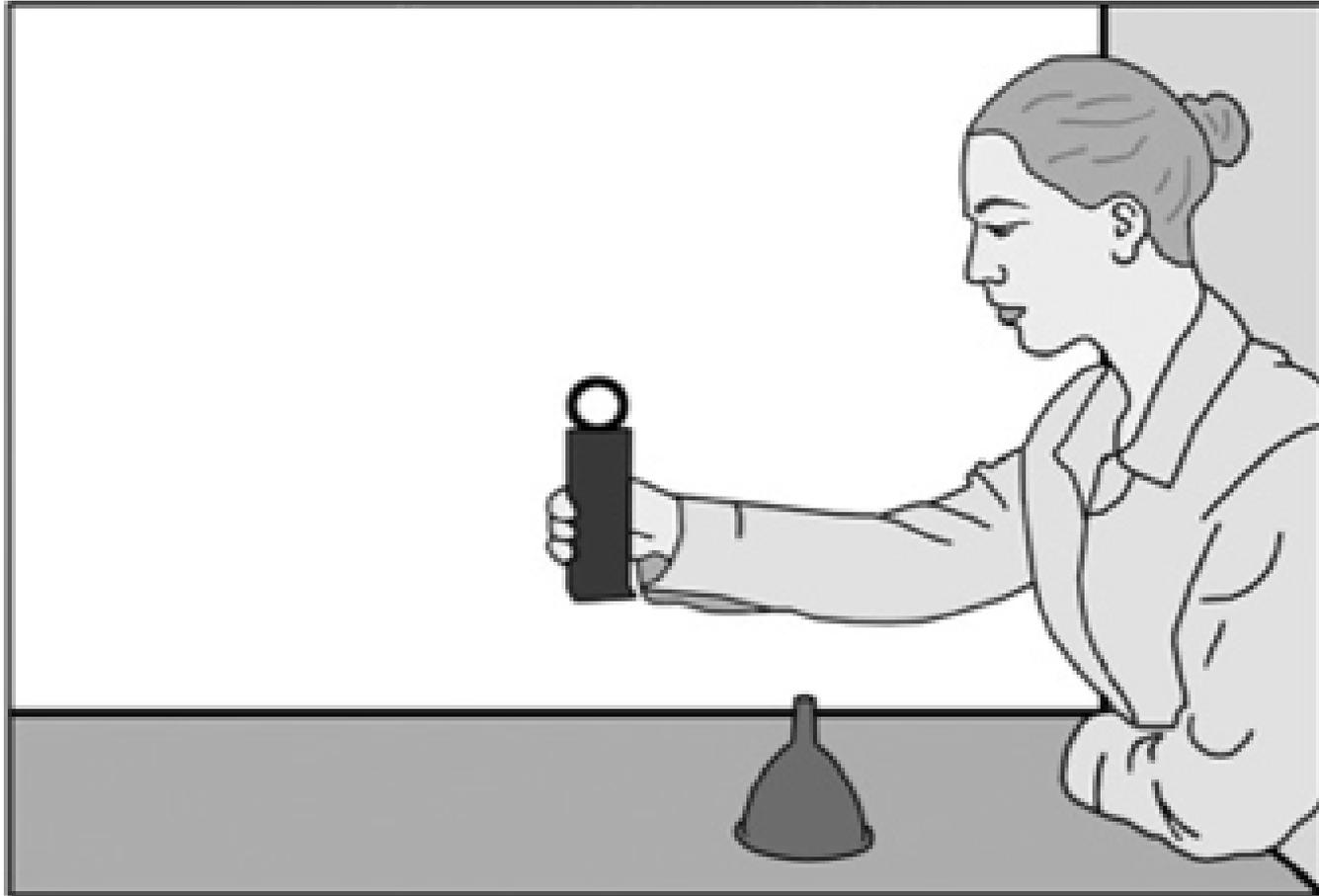
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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003.

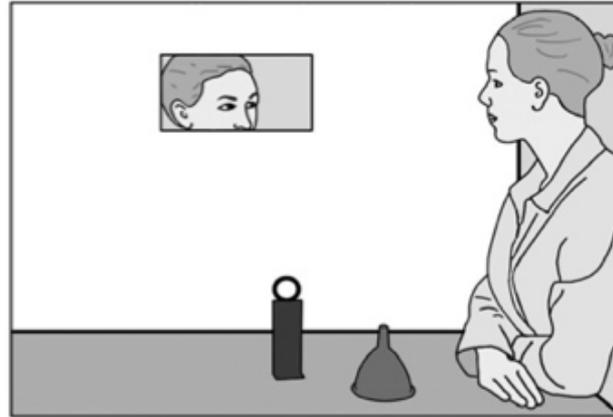
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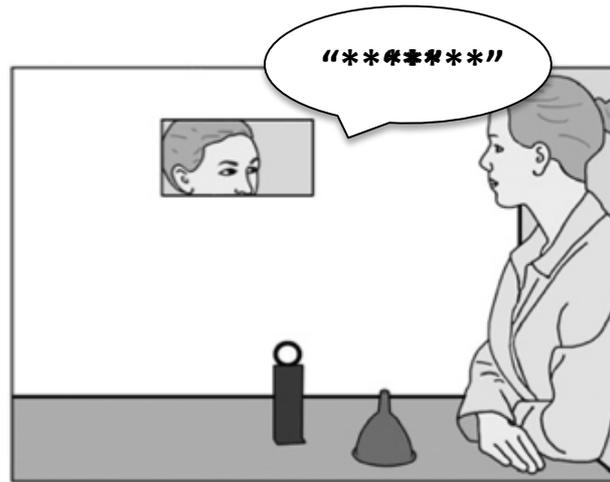
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# Test



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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003.

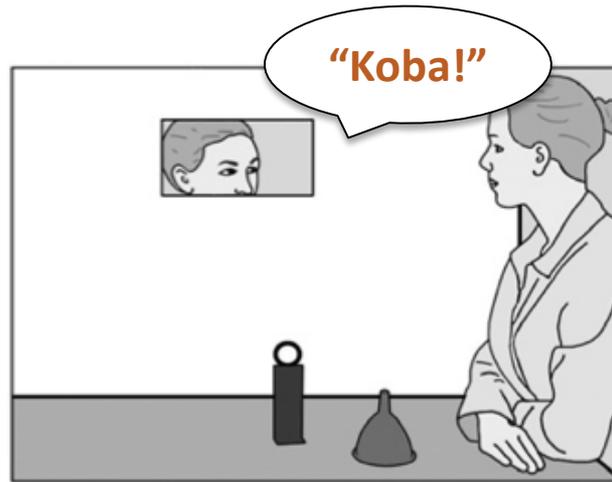
# Test



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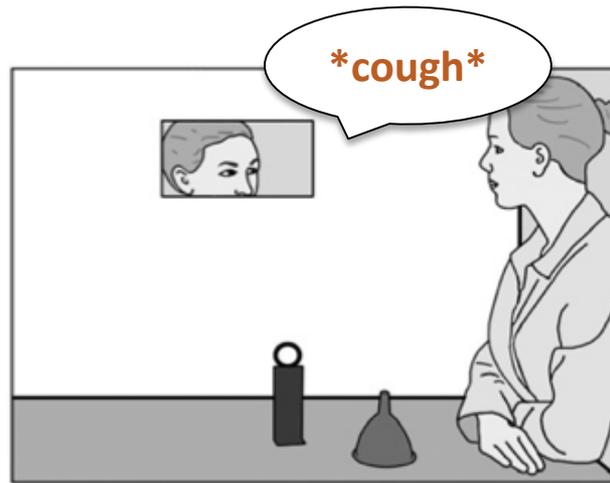
# Test - Speech



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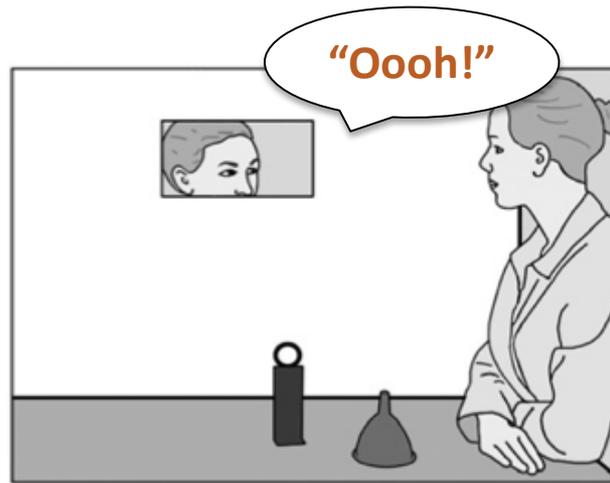
# Test - Cough



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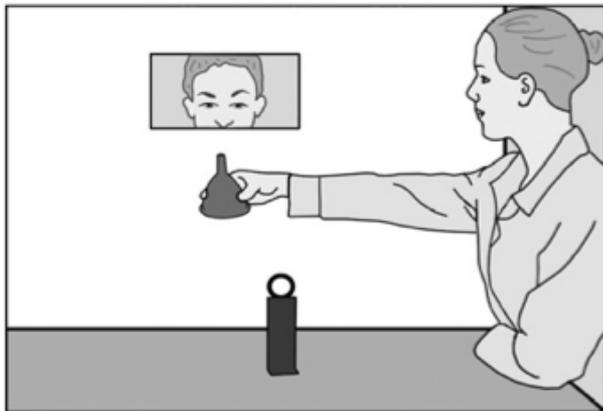
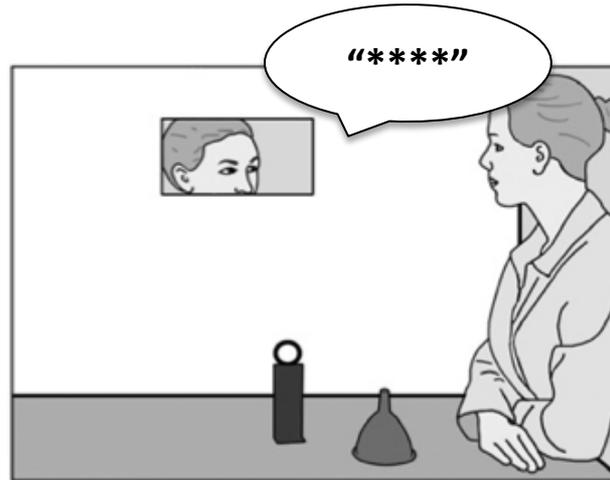
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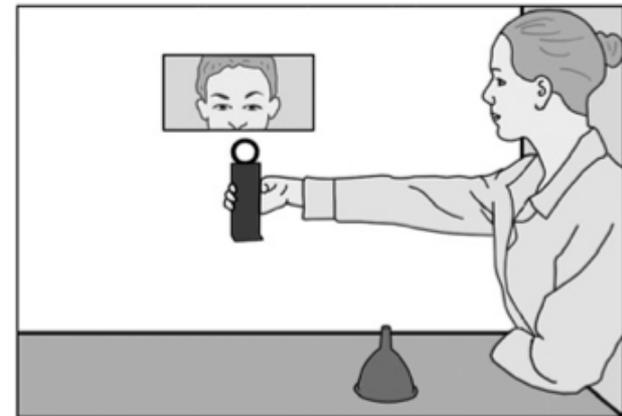
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# Test



Target

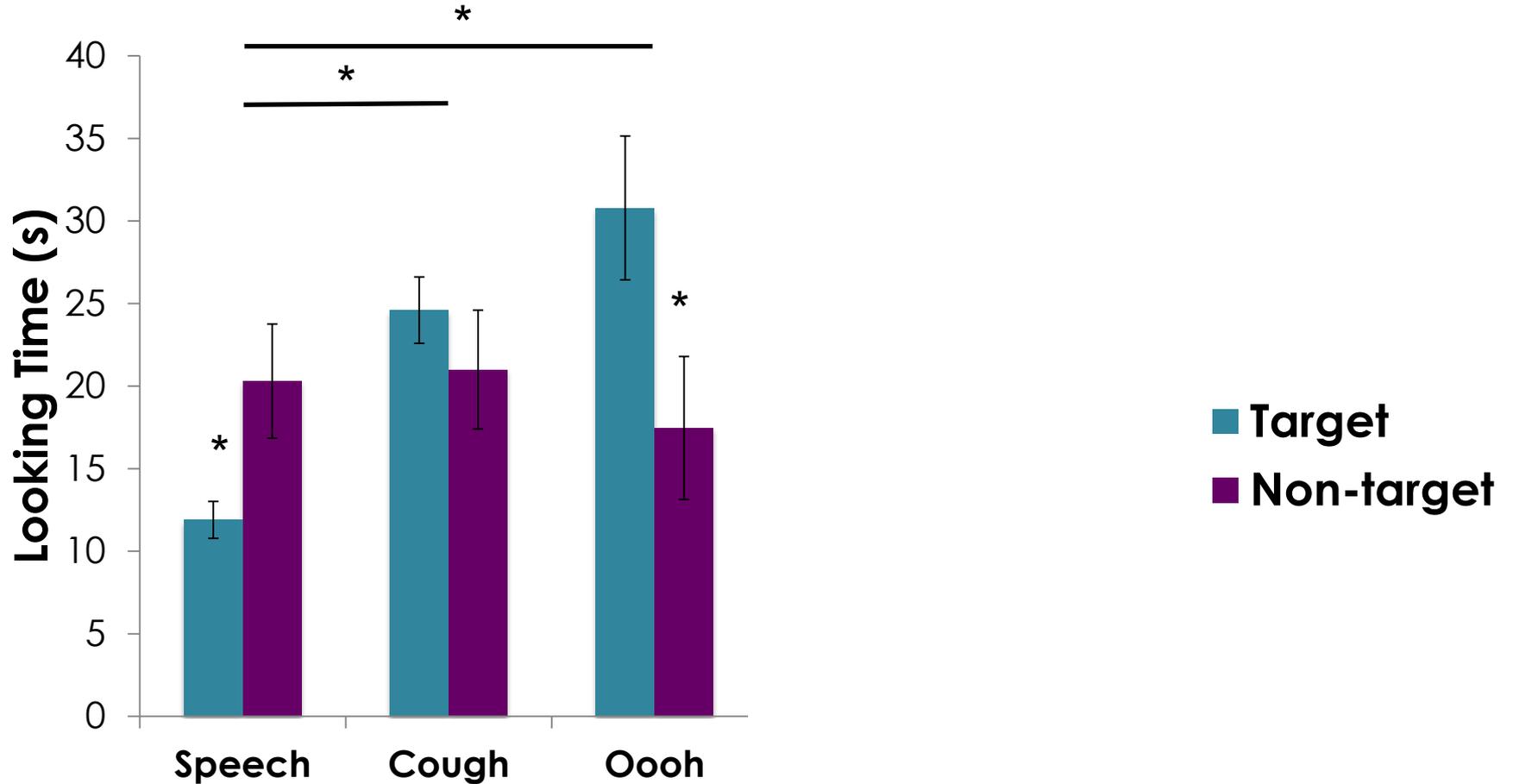


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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003.

# Results



# Discussion

- 12-month-olds recognize that speech can transfer information about an object, but emotional expressions and coughing cannot
- Reasoning about information access?



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# Communicator



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# Addressee



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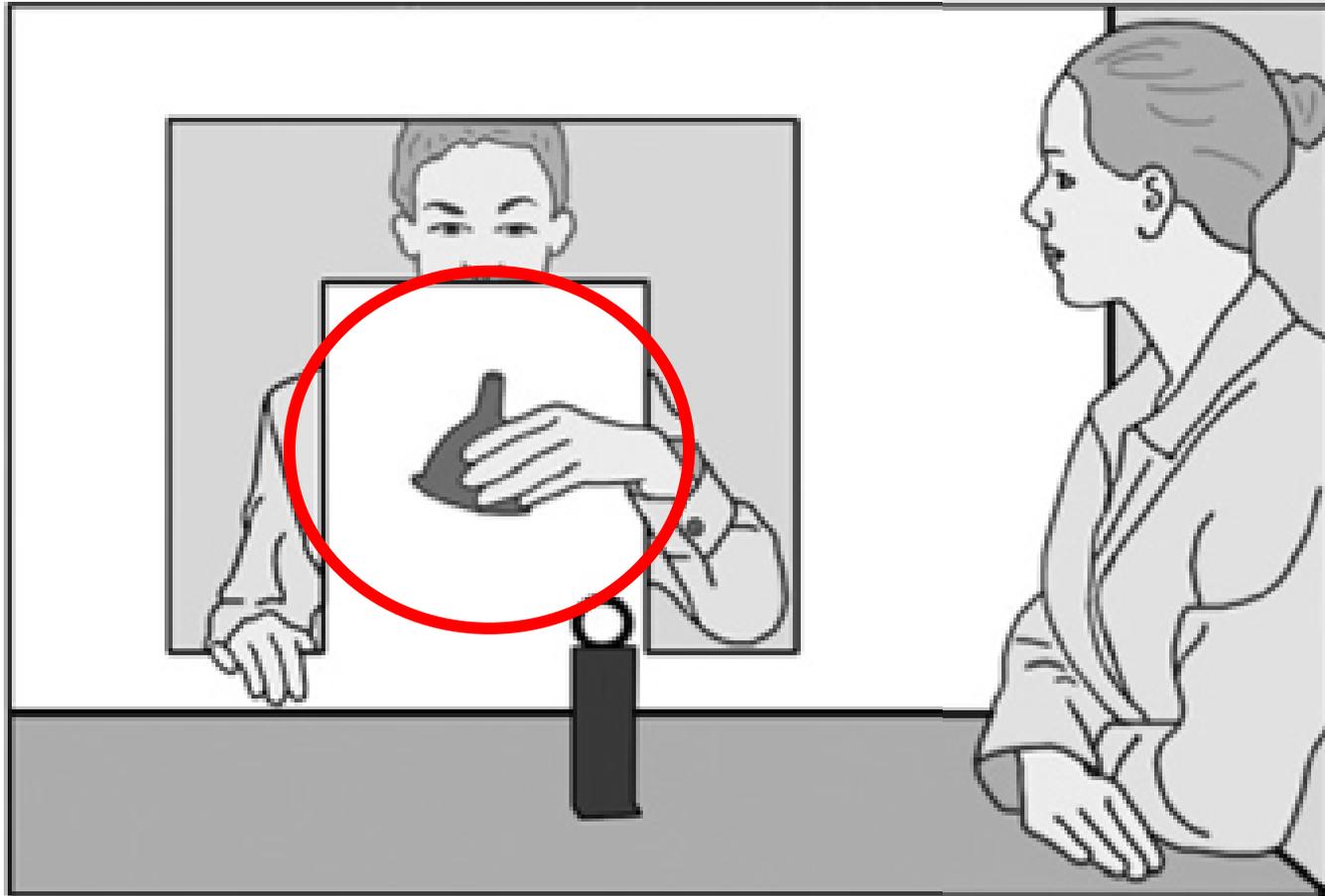
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# Communicator Familiarization

## Addressee Visual Access



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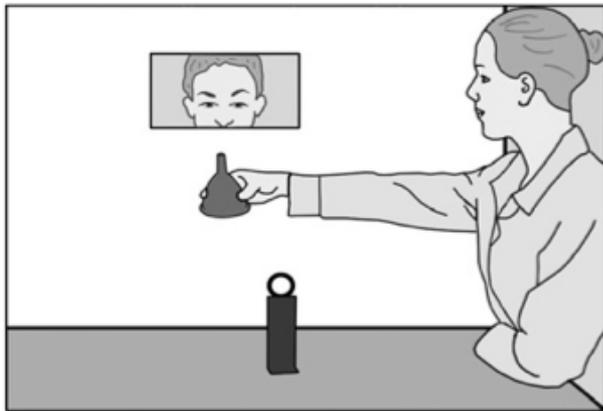
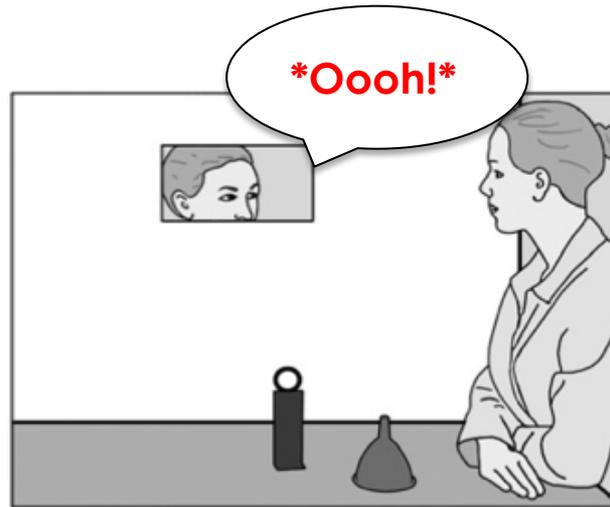
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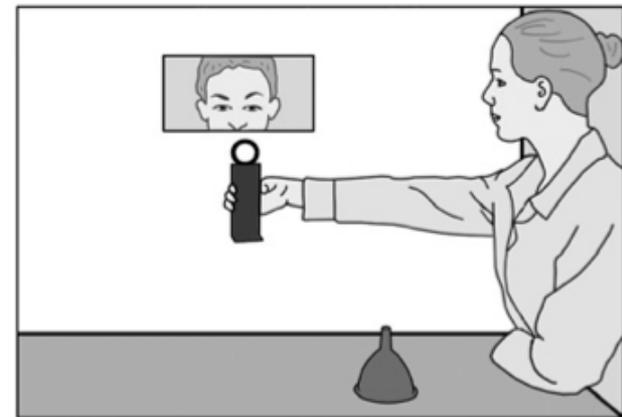
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# Test



Target

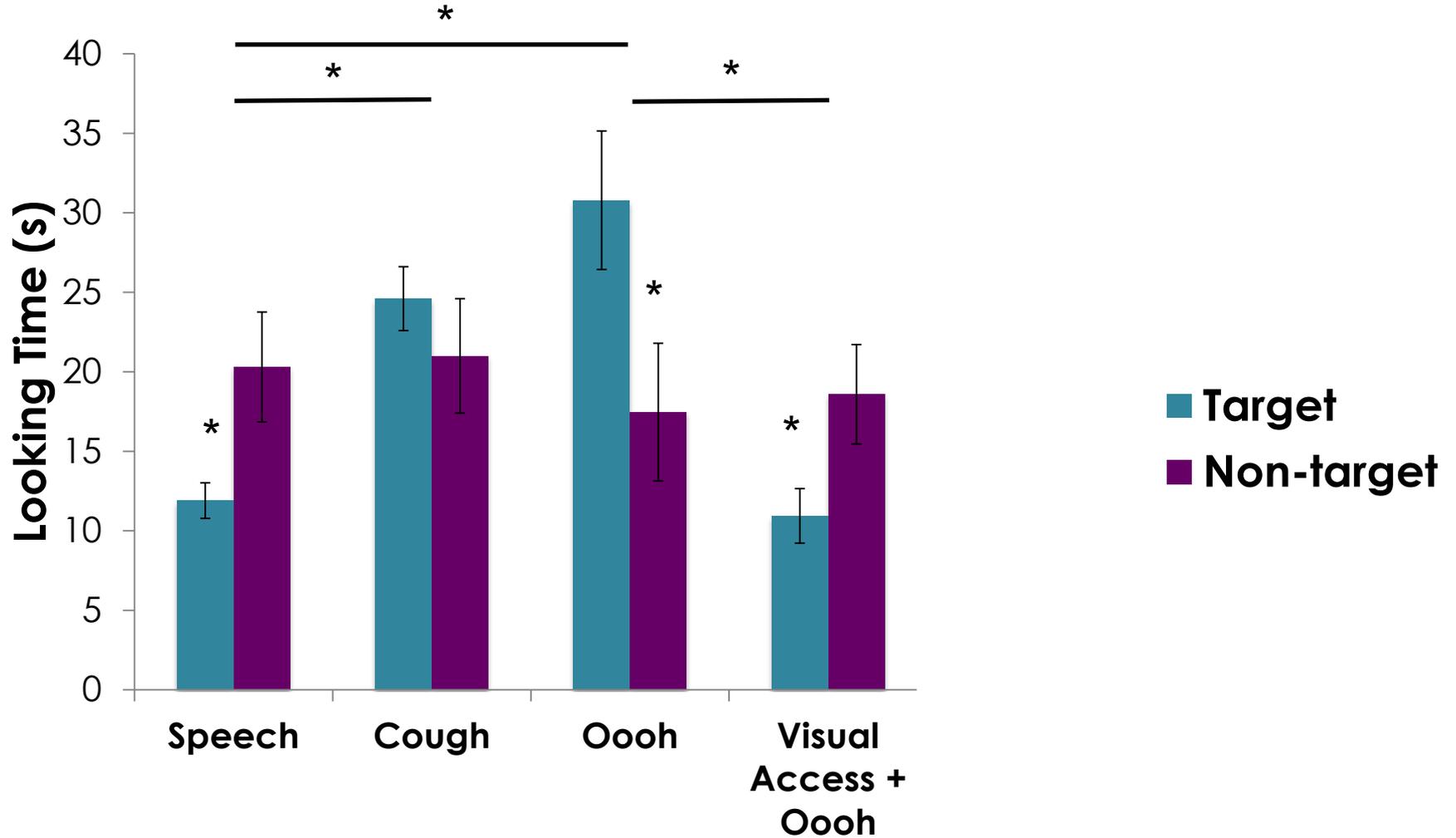


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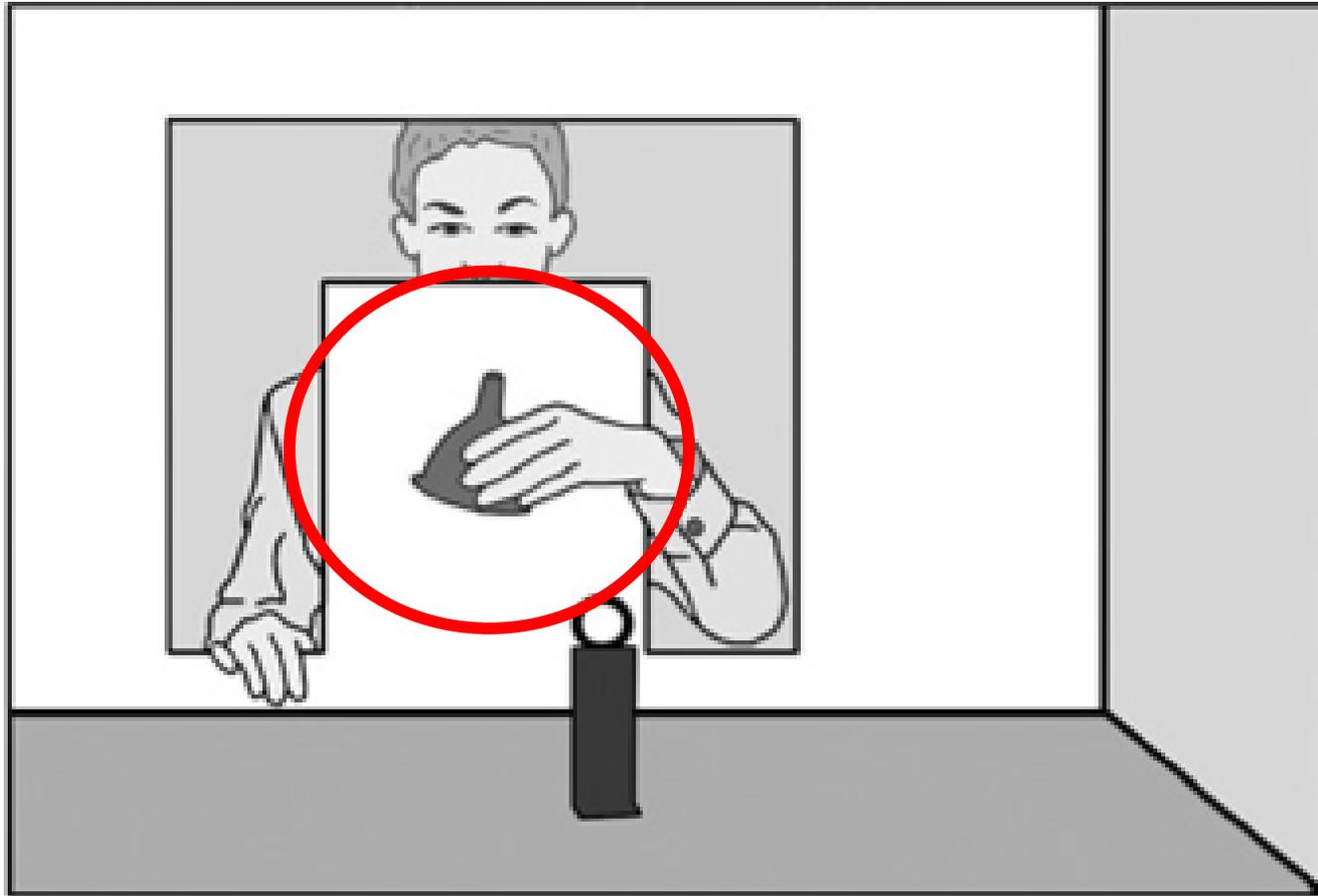
# Results



# Discussion

- 12-month-olds recognize that speech can transfer information about an object, but emotional expressions and coughing cannot
- Reasoning about information access?  
Yes!
- Reasoning about information sources?

# Communicator Familiarization



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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003

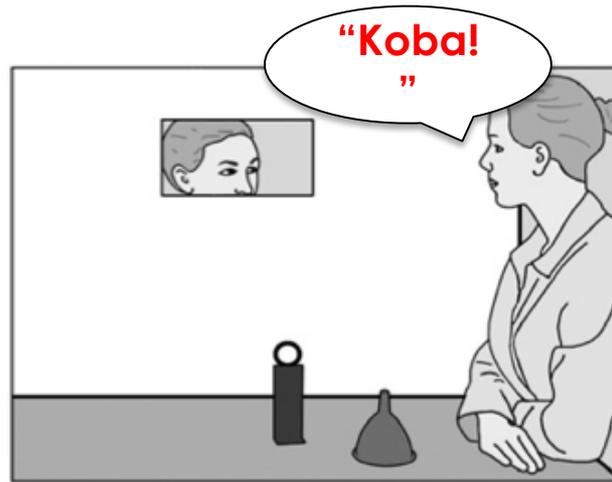
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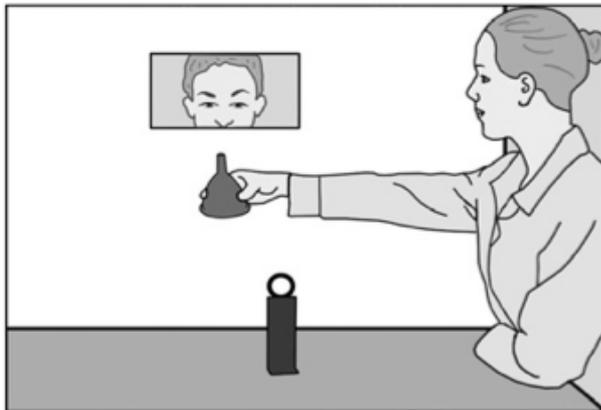
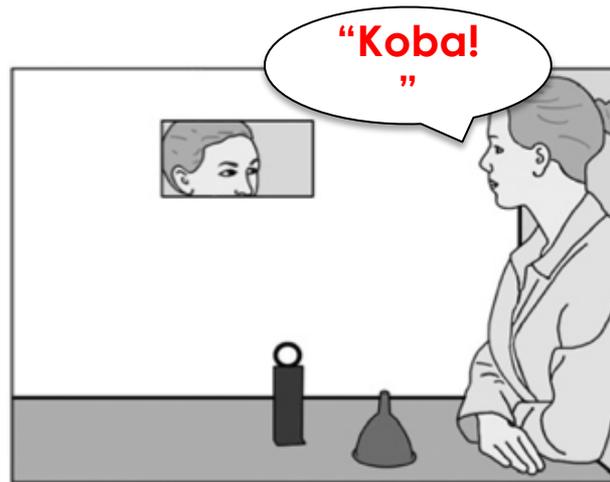
# Test – Addressee Speech



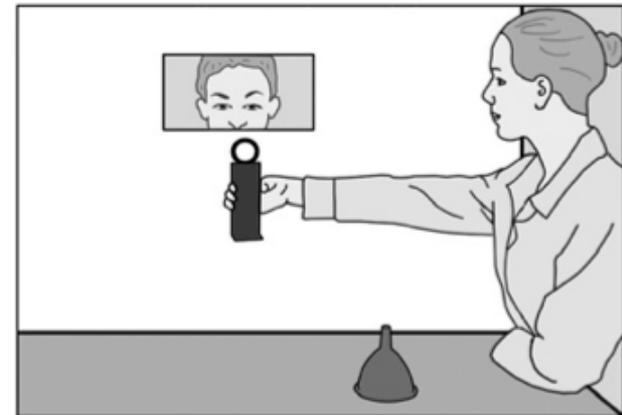
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# Test



Target

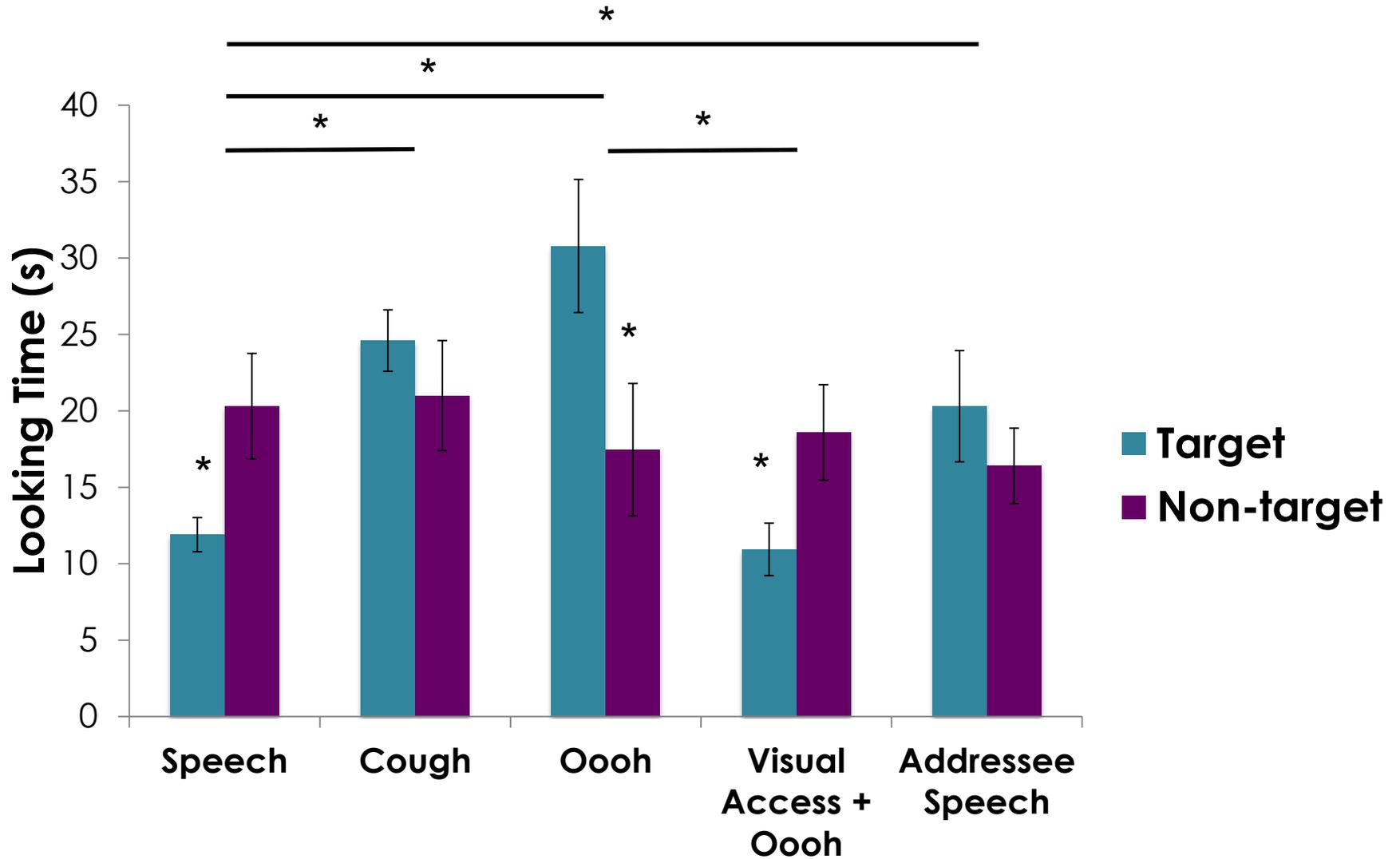


Non-target

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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003.

# Results



# Discussion

- 12-month-olds recognize that speech can transfer information about an object, but emotional expressions and coughing cannot
- Reasoning about information access?  
Yes!
- Reasoning about information sources?  
Yes!

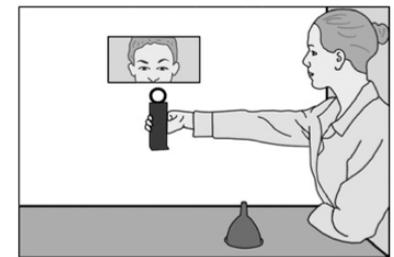
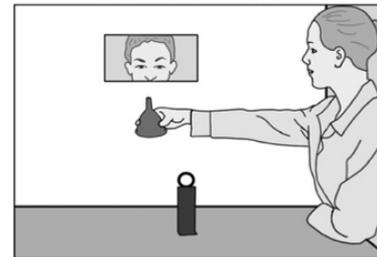
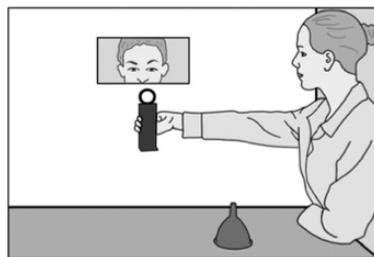
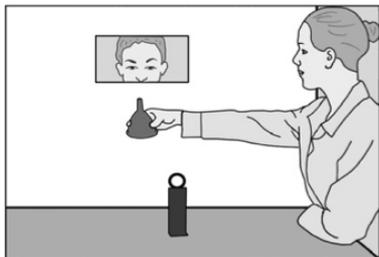
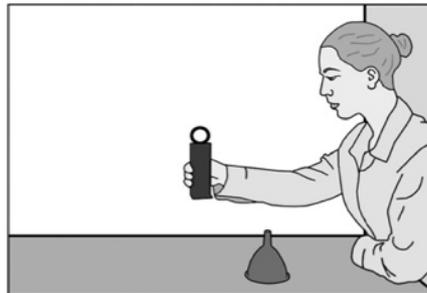
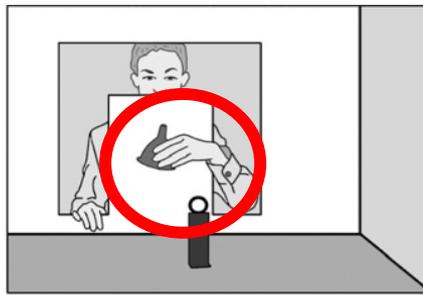
Do infants recognize that  
speech is communicative?

12-month-olds

6-month-olds?

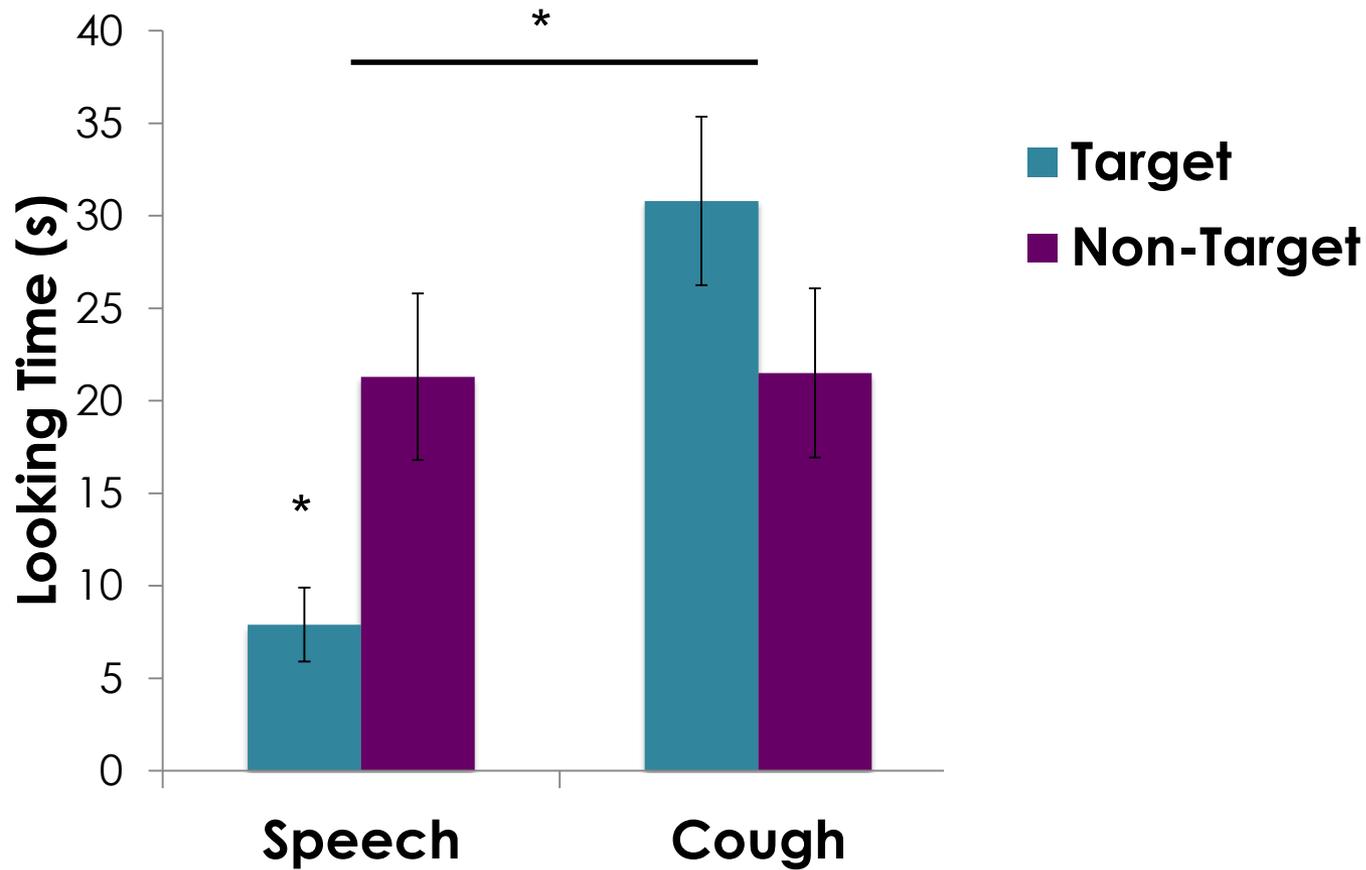
# 6-month-olds...

- understand some common words used in their environment *(Bergelson & Swingley, 2012; Tincoff & Jusczyk, 1999; 2012)*
- no evidence for learning a word in a single trial



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Source: Martin, Alia, Kristine H. Onishi, and Athena Vouloumanos. "Understanding the abstract role of speech in communication at 12months." *Cognition* 123, no. 1 (2012): 50-60. doi:10.1016/j.cognition.2011.12.003.

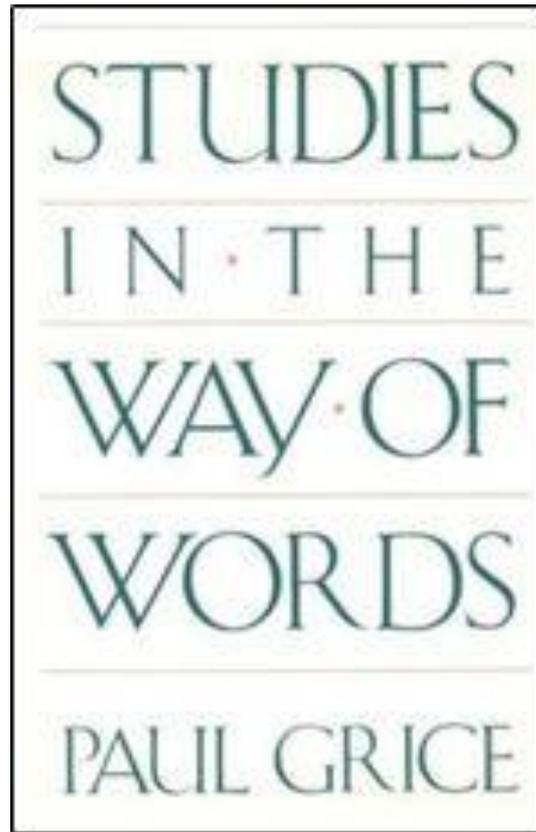
# Results: 6-month-olds



# Speech is communicative for infants

- 6- and 12-month-old infants recognize that speech is communicative
  - transfers information from one person to another
- May provide a mechanism for language and knowledge acquisition

1. Developing an ability to identify a communication action or situation



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## 2. Communication requires a focus on *intentions*

# Communicative Intentions



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“Is there any salt?”



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*Locutionary act: interrogative about presence of salt*

*Illocutionary act: requesting salt*

*Perlocutionary act: causing addressee to provide salt*

# Grice (1957): Speaker meaning

- 1) The communicator (C) intends the addressee (A) to respond in a particular way (R)
- 2) C intends A to recognize that C intends for A to respond R
- 3) C intends A to fulfill (1) on the basis of (2)

# Infant attention to communicative intentions



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17 months

*Southgate et al., 2010*

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# Actor does NOT see switch

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# Grice (1957): Speaker meaning

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# Speaker meaning in children?



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You asked for the **truck**? I'm going to give you the **truck**.



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You asked for the **truck**? I'm going to give you the **sock**.



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# Speaker meaning in children?

- By 18-24 months, children care about the impact of their communicative signals on the understanding (not just the response!) of their addressee



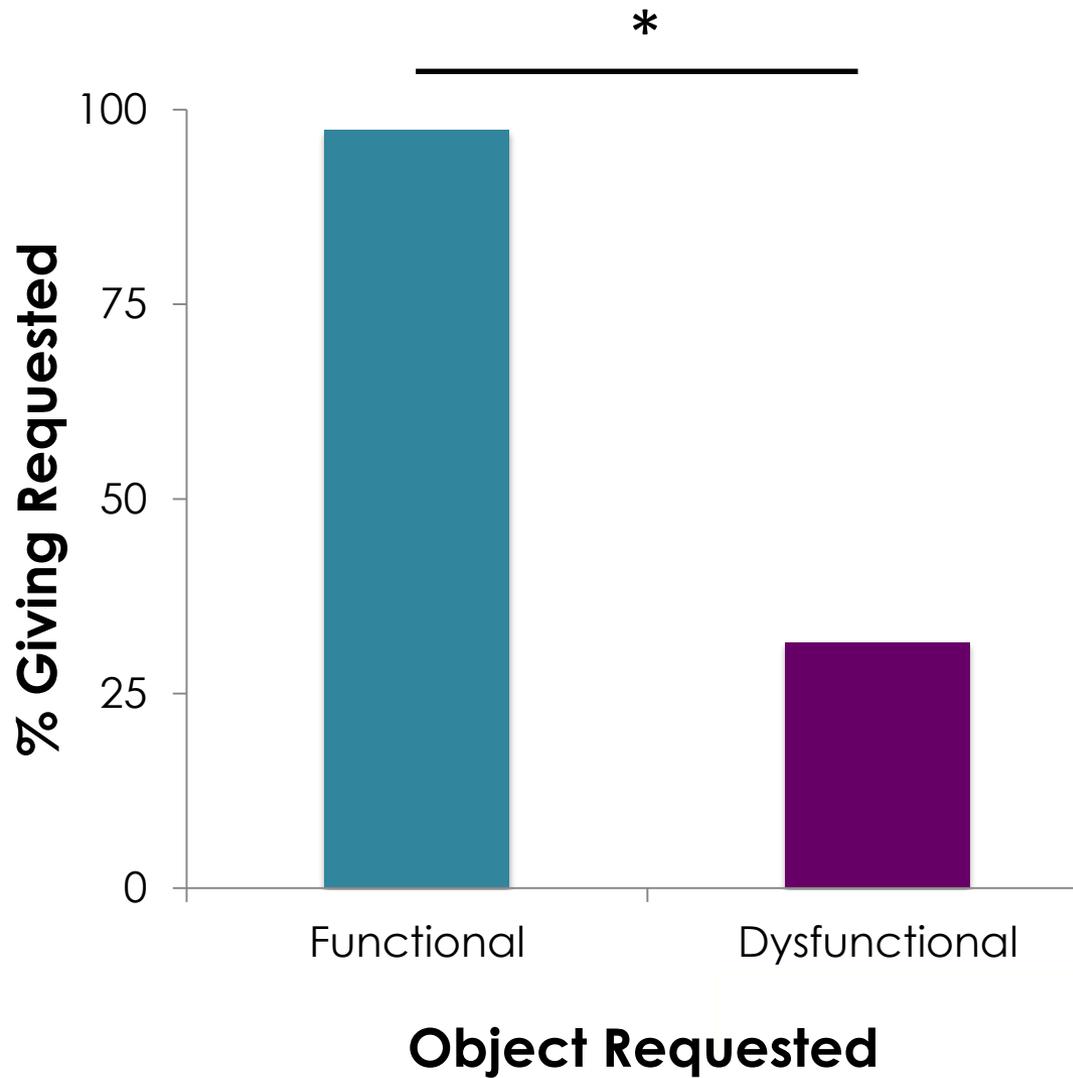
“Can you give me that cup so I can pour a cup of water?”



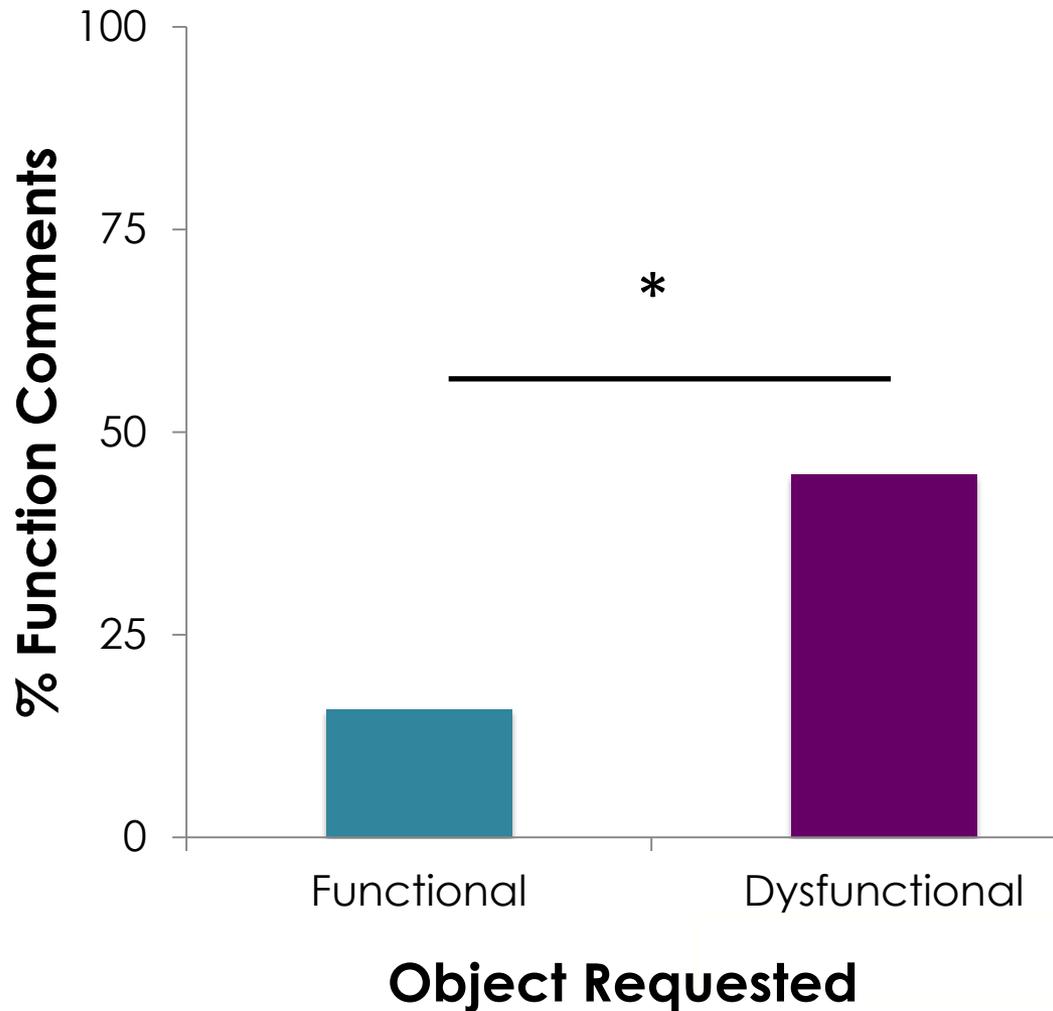
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# Results

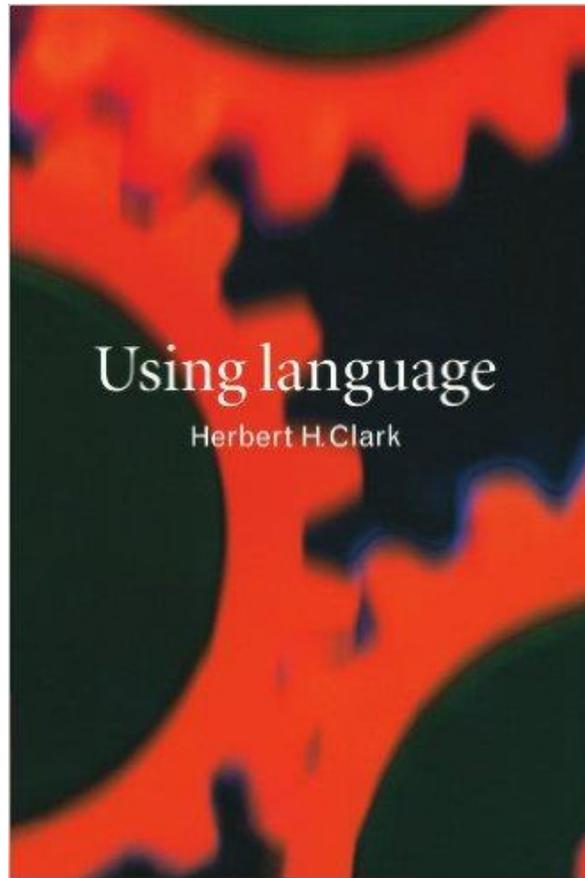


# Results



# Speaker meaning in children?

- By 18-24 months, children care about the impact of their communicative signals on the understanding (not just the response!) of their addressee
- By 3 years, children acknowledge what the speaker meant to ask for, even if they give her something else



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3. Communication is a joint action, of accumulating common ground

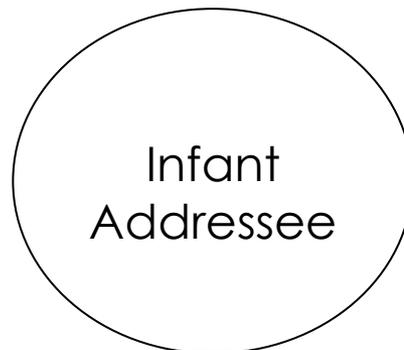
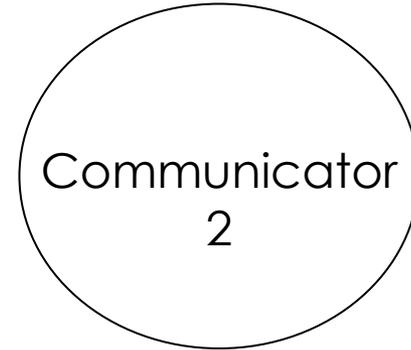
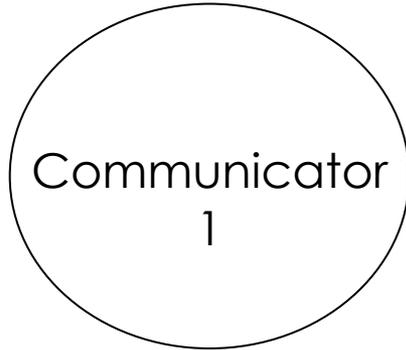


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~9months – joint attention

*Tomasello, 1995; Tomasello & Carpenter, 2007*

~12months – use shared experience  
to interpret communication



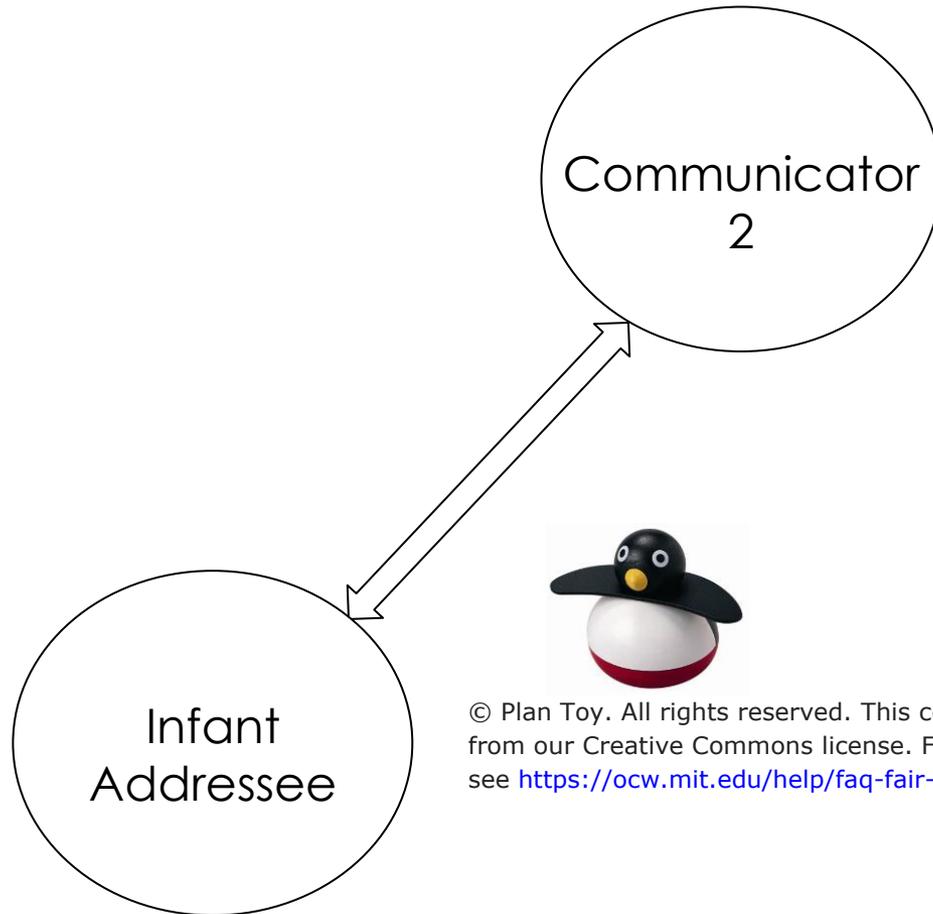
*e.g., Ganea & Saylor, 2007; Liebal et al., 2009; Moll et al., 2006; 2007; Saylor & Ganea, 2007*

Communicator  
1



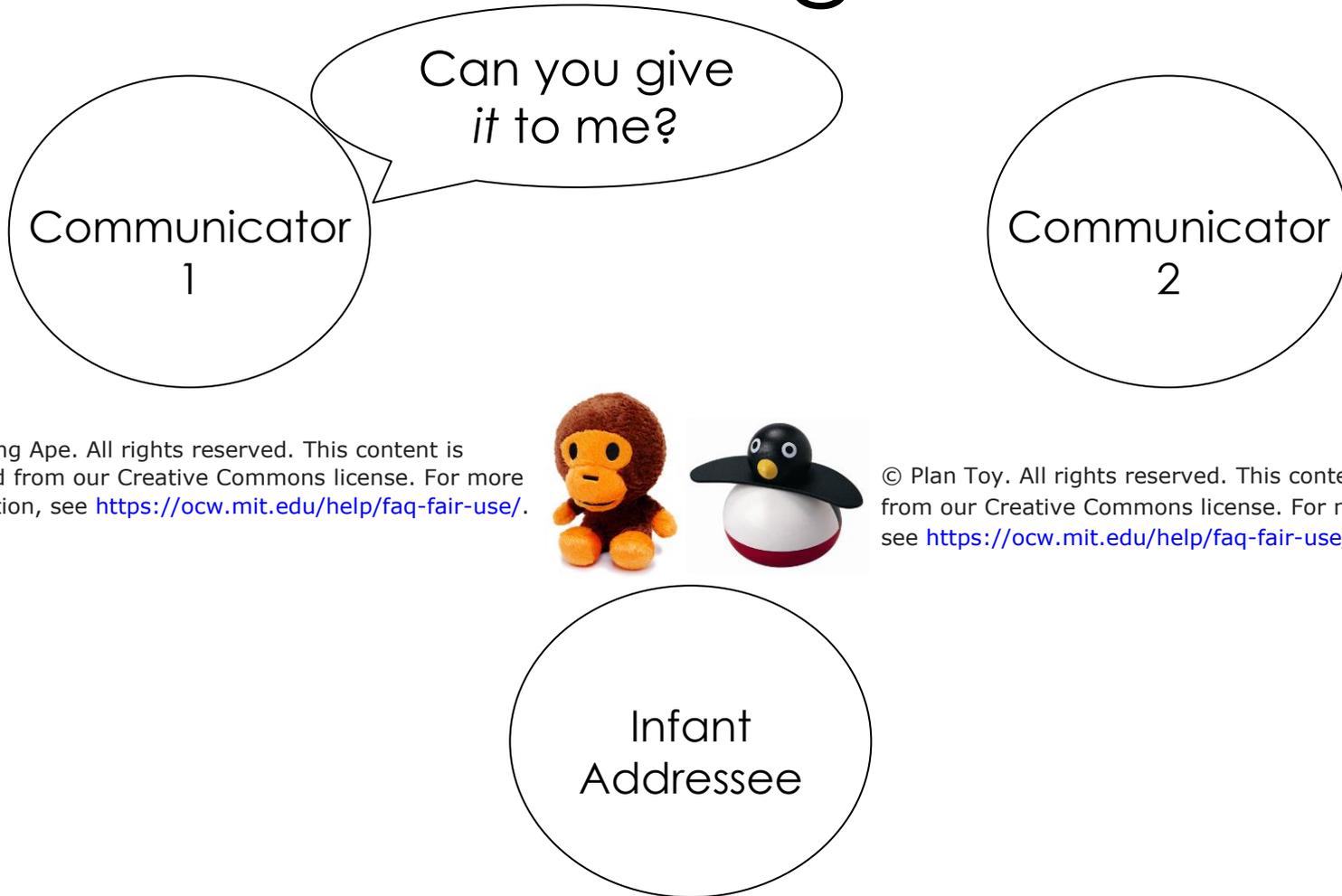
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Infant  
Addressee



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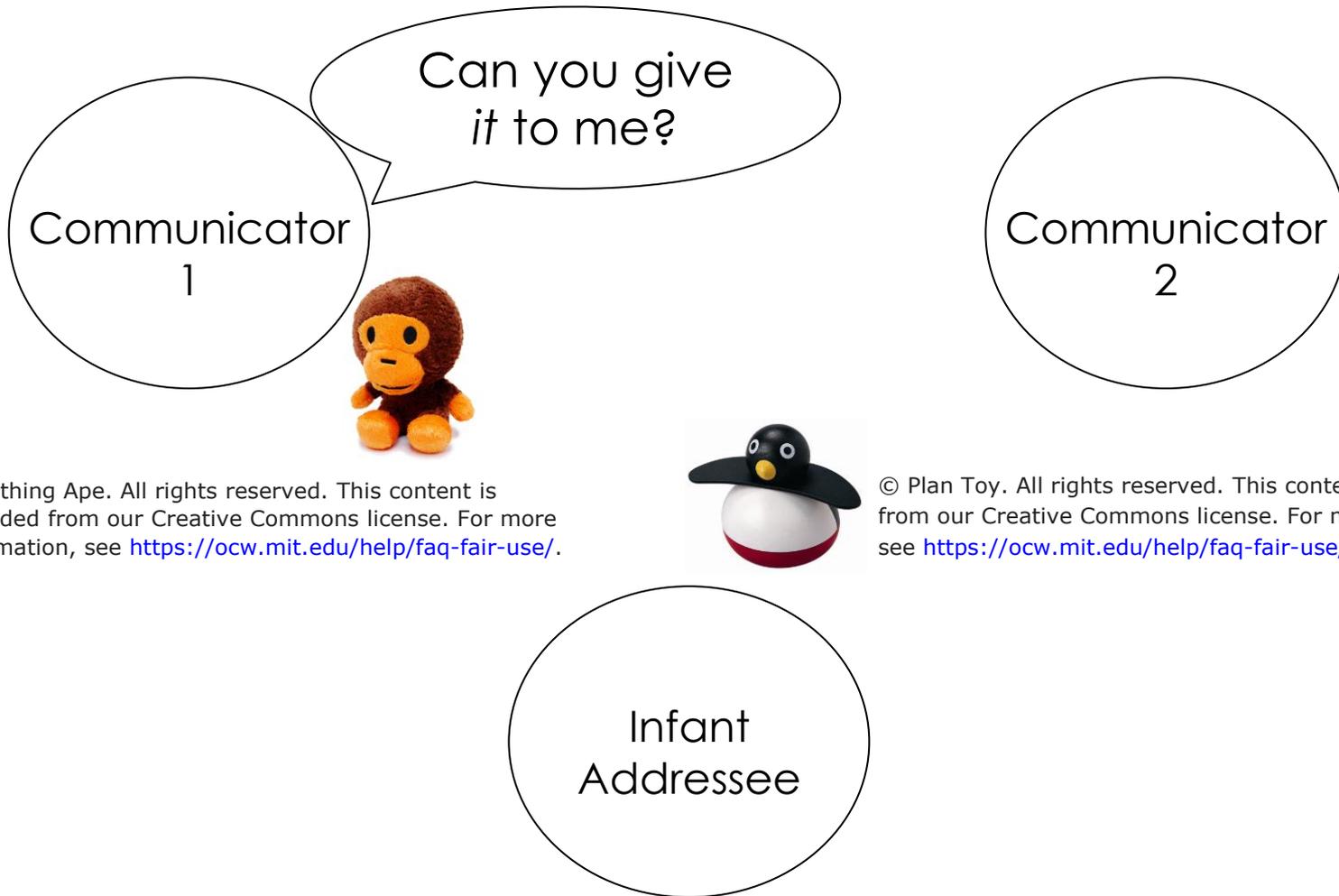
# Common ground



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Communicator  
1

Can you give  
*it* to me?

Communicator  
2

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Infant  
Addressee

Communicator  
1

Can you give  
*it* to me?

Communicator  
2



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Infant  
Addressee

# Remaining questions:

## How rich are infants' representations of common ground?



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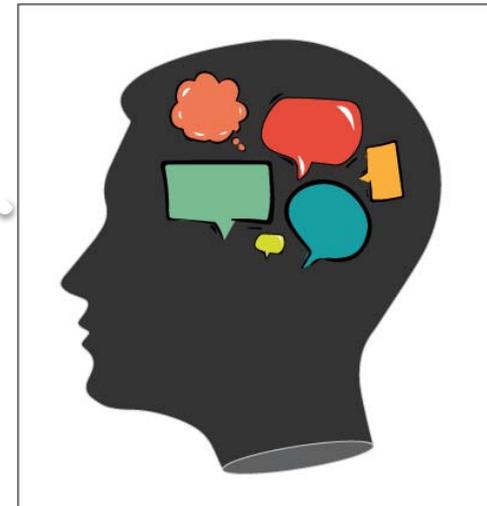
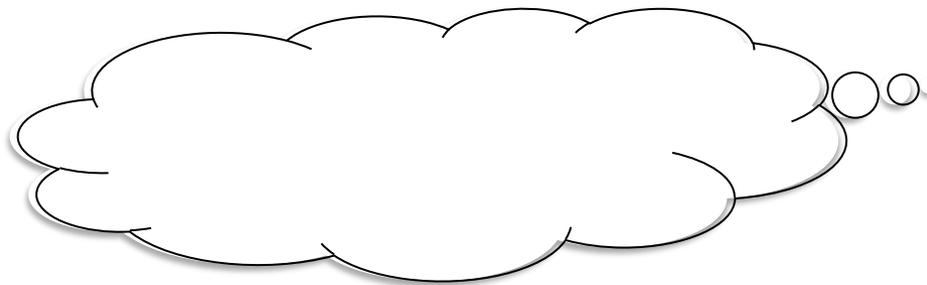


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## community membership?

# Remaining questions:

## How rich are infants' representations of common ground?



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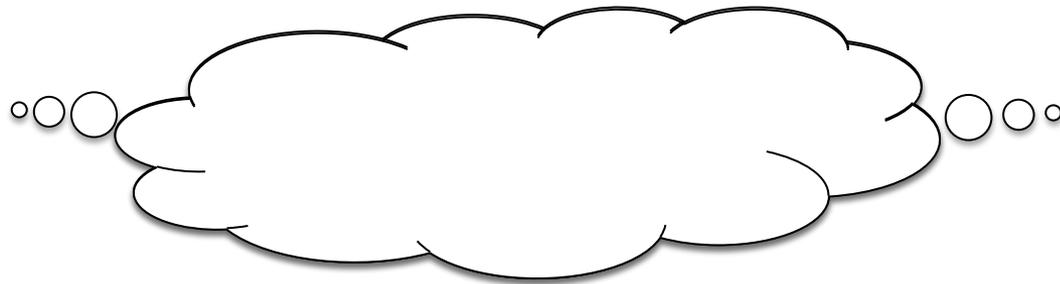


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## community membership?

## Remaining questions:

How rich are infants' representations of common ground?

How do children build an understanding of common ground based on non-episodic cues like community membership?



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# Animal communication



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# Animal communication

- Sensitivity to presence of audience
  - e.g., alarm-calling species rarely alarm call if no members of their species are present
- Sensitivity to identity of audience
  - e.g., ground squirrels, vervet monkeys alarm call much more in presence of kin
- Sensitivity to knowledge state of audience
  - e.g., Wild chimpanzees alarm-call more when unaware chimpanzees are around

# Animal communication

- Eliciting stimuli for communicative signals, and signals themselves, tend to be fixed/inflexible
- Receivers acquire information from vocal signals, but no evidence of information about mental states
- Communicators' signals can cause a beneficial response in receivers, but no evidence for intention of changing receiver's mental state

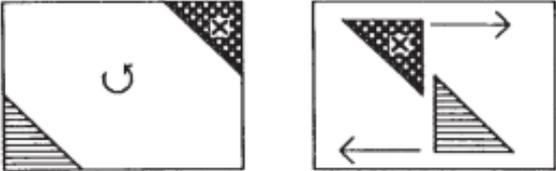
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The inability of most animals to recognize the mental states of others distinguishes animal communication most clearly from human language. Whereas signalers may vocalize to change a listener's behavior, they do not call to inform others. Listeners acquire information from signalers who do not, in the human sense, intend to provide it.

# Core Knowledge

## Geometry/Space



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## Number



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## Agents

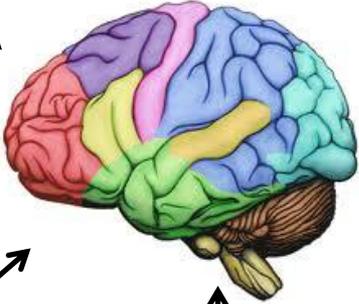


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## Social Beings



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## Objects



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Communication requires:

reasoning about *cognitive states*

reasoning about *social interaction*

(often) reasoning about *language*

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## Resource: Brains, Minds and Machines Summer Course

Tomaso Poggio and Gabriel Kreiman

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