Gesture in Learning and Teaching

Martha W. Alibali
University of Wisconsin
Basics

• What are gestures?
  – Definition
  – Classification

• Why do speakers produce gestures?
  – Self-oriented functions
  – Other-oriented functions
What are gestures?

- Spontaneous body movements produced when speaking (or in place of speech)
- Most produced with hands or arms

- Not functional actions, self-adaptors, fidgeting
Kendon’s Continuum

Gesticulation ↔ Pantomime ↔ Emblem ↔ Sign Language

• Moving left to right,
  – Speech becomes less obligatory
  – Gesture becomes more systematized
  – Gesture becomes more conventionalized
Kendon’s Continuum

Gesticulation ↔ Pantomime ↔ Emblem ↔ Sign Language

- Moving left to right,
  - Speech becomes less obligatory
  - Gesture becomes more systematized
  - Gesture becomes more conventionalized

- My focus today: gesticulation
Non-conventional Gestures

- Not socially regulated – therefore, nonconventional and idiosyncratic
- Spontaneously created at the moment of speaking
- Do not have standards of form
- Used to indicate, convey information, emphasize, and regulate interaction
Why study gestures?

• A window on the mind
• Insights into language and communication
• Insights into thinking, learning, teaching
• Insights into development
Classification Schemes

• There are many!

• Categories vs. dimensions

• Key features
  – Indexicality
  – Iconicity
  – Rhythmicity
Basic Scheme
Based on McNeill (1992)

• Points
• Representational gestures
  – Iconics
  – Metaphorics
• Beats
• Interactive gestures (Bavelas, 1992)
Pointing (Deictic) Gestures

- Indicating gestures that refer to objects or locations
- Can be used literally or metaphorically
Representational Gestures

• Depict semantic content of speech via handshape or motion trajectory
• Related to speech content iconically or metaphorically
Beats

- Motorically simple gestures
- Linked to rhythm or prosody of speech, or used to mark discourse structure
Interactive Gestures

• Used to regulate social interaction
  – Manage turn-taking, acknowledge previous contributions, involve listener
When do people gesture?

- Whenever they talk!
- Commonly studied situations:
  - Conversation
  - Problem explanation
  - Narrative monologue
  - Instructional settings (tutorials, classrooms)

- Varying methodological approaches: experimental, ethnographic, mixed
Why do people gesture? *Function*

- For the speaker
- For the listener

- Speaking
- Thinking
- Communicating
Gesture Function: Thinking

- Activates mental images (e.g., de Ruiter, 1998)
- Helps to manage cognitive load of speaking (e.g., Goldin-Meadow, Nusbaum, Kelly & Wagner, 2001)
- Promotes focus on perceptual-motor information (e.g., Alibali & Kita, 2010)
Gesture Function: Speaking

- Facilitates access to lexical items (e.g., Krauss, 1998)
- Helps speakers package information into verbalizable syntactic units (e.g., Kita, 2000)
Gesture Function: Communicating

• Supports comprehension of accompanying speech
  – Especially true for complex speech, degraded speech, noisy environments, younger listeners

• Expresses additional information

• Helps to foster shared understanding or “common ground”
Why do gestures communicate?

- Pointing gestures *ground speech* in environment
- Representational gestures *guide mental simulations* in listeners
- Some representational gestures reveal body-based metaphors
Learners’ gestures...

- Increase activation on perceptual, motoric, spatial knowledge
- Help learners “redescribe” such knowledge into more explicit, verbal form
- Highlight inconsistencies in knowledge
- Provide interaction partners with information about the “leading edge” of children’s knowledge
  - Contents of the ZPD
Learners
For discussion

• What sorts of information are best expressed or most effectively communicated in gestures?
• Can the same gestures simultaneously serve self-directed and other-directed functions?
• Do all learners rely equally on gesture in expression and communication?
• How are gestures integrated with other systems for making meaning?
Teachers’ gestures...

- Guide learners’ attention to crucial elements of complex visual displays
- Link related representations
- Resolve “trouble spots” in classroom communication, forge common ground
Learning to See

• Acquiring “professional vision” (Goodwin, 1994)
  – Archaeologists learn to recognize traces of ancient civilizations in color patterns in dirt
  – Math learners learn to recognize key elements of mathematical problems, inscriptions

• Disciplined perception
  (Stevens & Hall, 1998)
Highlighting

- Making specific phenomena in a complex perceptual field salient by *marking* them
  - “Through these practices structures of relevance in the material environment can be made prominent”, both for self and others (Goodwin, 1994)

- Talk, pointing, other gestures, structure of artifacts and inscriptions
  - *Focusing* phenomena (Lobato, Ellis, & Muñoz, 2003)
Guide learners’ attention

- Instructional gestures guide learners’ attention, highlight relevant information (Alibali, Nathan, & Fujimori, 2012)
Learning to “See” in the Classroom

- Example
  - High school geometry
  - Going over homework
  - PB tangent to circles Q and R
  - Prove $PA \cong PB \cong PC$
Watch for

- Highlighting with deictic gestures
- “Anti-highlighting” by covering up what *not* to look at
Highlighting
Gestures link related representations

- Highlight corresponding elements
  - Sequentially or simultaneously
- Express similarity, cohesion

Alibali, et al., *Cognition & Instruction*, 2014
Example Link

- Linked representations
  - Standard notation of a number 206,895
  - Corresponding expanded notation
    \[2 \times 10^5 + 6 \times 10^3 + 8 \times 10^2 + 9 \times 10^1 + 5 \times 10^0\]
- *Element by element* linking
  - Note: 0 place holder for $10^4$
- Initially sequential, then simultaneous pointing
Example Link

• Linked representations
  – Standard notation of a number  206,895
  – Corresponding expanded notation
    \[ 2 \times 10^5 + 6 \times 10^3 + 8 \times 10^2 + 9 \times 10^1 + 5 \times 10^0 \]

• *Element by element* linking
  – Note: 0 place holder for \(10^4\)

• Initially sequential, then simultaneous pointing
Gestures link related representations
Gestures link related representations

- T’s gestures ground complex mathematical language in two inscriptions simultaneously
  - E.g., term “ten to the fifth” is connected both to its explicit written form in expanded notation \((10^5)\) and to the hundred thousands place in standard notation

\[2 \times 10^5 + 6 \times 10^3 + 8 \times 10^2 + 9 \times 10^1 + 5 \times 10^0 = 206,895\]
Forging “common ground”

- When classroom communication breaks down, do teachers adjust their use of gesture?
- Quantitative data suggests “yes”

Alibali, et al., *ZDM*, 2013
# Side Length and Numbers of Cubes

How many cubes total? 3 faces showing? 2 faces showing? 1 face showing? No faces showing?

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2)</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3)</td>
<td>27</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>4)</td>
<td>64</td>
<td>8</td>
<td>24</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>5)</td>
<td>125</td>
<td>8</td>
<td>36</td>
<td>??</td>
<td>27</td>
</tr>
<tr>
<td>6)</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>64</td>
</tr>
</tbody>
</table>
Trouble spot

• T holding 4x4 cube
• Q: If we have a 5x5 cube, how many blocks would there be in the middle of the face?
  – Gesture to middle blocks of (hypothetical) 5x5

• Student answers for 4x4 cube: 4? (trouble spot)

• Watch for T’s elaborated gesture of 5x5 cube, middle blocks
Trouble spot and Response
For discussion. . .

• How can we tell whether gestures help students attend to key information, make links among representations?
• How do gestures foster shared understanding?
• How are gestures integrated with other systems for making meaning?
Thanks to . . .

- Mitchell Nathan
- Breckie Church
- Susan Goldin-Meadow
- Sotaro Kita
- Autumn Hostetter
- Rogers Hall
- Ricardo Nemirovsky
- Matthew Wolfgram
- Eric Knuth
- Maia Ledesma

Institute of Education Sciences
Cognition and Student Learning Program

National Science Foundation,
Research & Evaluation on Education in Science & Engineering Program