

4<sup>th</sup> Conference of the International Society for Gesture Studies (ISGS)  
European University Viadrina Frankfurt/Oder, 25-30 July 2010

# **Gesture in Everyday Scientific Reasoning and Explanation**

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# Motivation



*Explaining the phases of the moon*

# Question

**How does gesture function in  
everyday scientific reasoning  
and explanation?**

# Explanation vs. Reasoning

(Crowder & Newman 1993; also Roth & Welzel 2001; Singer et al. 2008; etc.)

## Describing Models

- Synchronized with speech
- Redundant iconics & simple points
  - illustrate / highlight
- Outside perspective
  - gesture in front of body
  - look at addressee

*Presentational*

## Building & Running Models

- Often precede speech
- Enhancing iconics & elaborated points
  - add / explore meanings
- Inside perspective
  - inhabit gesture space
  - watch gestures

*Exploratory*

# Method

- Posed questions to small groups of college students (3 - 5 students, diverse majors)
  - *What causes the seasons? / Why is hot in the summer and cold in the winter?*
  - *What causes the phases of the moon?*
  - *What causes the tides? / Why is the tide highest at the full moon?*
- Instructed to:
  1. Discuss until they agree
  2. Explain their answer

# Choice of Topics

- (Mis)conceptions
  - **Seasons:** tilt of earth vs. distance from sun
  - **Phases:** angle of viewing vs. earth's shadow
  - **Tides:** moon's & sun's gravity vs. moon's gravity (alone)
- Representational challenges
  - Complex spatial relations (2 or 3 objects, 3D)
  - Multiplicity of motions
  - Force dynamics (gravity)
  - Non-human scale (cosmic)

# Analysis

- Macro-level
  - Patterns: group reasoning vs. explaining answers
- Micro-level (*reasoning*)
  - Collaborative building & running of models
    - Conceptual inputs, mappings, and blends
    - Anchoring in the physical environment
    - Enactment of dynamics to generate inferences
  - Functions of gesture
    - Representational gestures & deictic points/traces

# Explaining Answers



*seasons – phases – tides*

# Group Reasoning

- Separation of gesture & speech (lack of words)



# Group Reasoning

- Mirroring of gestures



# Group Reasoning

- Co-inhabiting gesture space



# Group Reasoning



- Collaborative gesturing

# Collaborative Model-Building

## Using facets

- Introducing facets with speech and gesture
- Fitting facets together
- Testing emergent models



## What causes the seasons?

*rotation of earth*

*angle of **axis***

*moon / sun /  
**planetary bodies***

*magnetic fields*

*hours of sunlight*

***orbit** around sun /  
position & distance*

*earthquakes /  
**geological phenomena***

# Next Steps

- Documentation of macro-level patterns
- Micro-analysis of episodes
  - Conceptual level:
    - introducing conceptual content
    - anchoring conceptual entities
    - coordinating, mapping, blending
    - enacting dynamics (*etc.*)
  - Discourse level:
    - establishing common ground
    - building models
    - generating inferences (*etc.*)



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