Towards a Computational Model of Child Gesture-Speech Production. How information is spread across modalities in pre-school children

Olga Abramov, Stefan Kopp, Anne Németh, Friederike Kern, Ulrich Mertens and Katharina Rohlfing

Abstract: Previous work by [1] studied gesture-speech interaction in adults. [1] focused on temporal and semantic coordination of gesture and speech and found that while adult speech is mostly coordinated (or redundant) with gestures, semantic coordination increases the temporal synchrony. These observations do not necessarily hold for children (in particular with respect to iconic gestures, see [2]), where the speech and gesture systems are still under development. We studied the semantic and temporal coordination of speech and gesture in 4-year old children using a corpus of 40 children producing action descriptions in task oriented dialogues. In particular, we examined what kinds of information are transmitted verbally vs. non-verbally and how they are related. To account for this, we extended the semantic features (SFs) developed in [3] for object descriptions in order to include the semantics of actions. We coded the SFs on the children’s speech and gestures separately using video data. In our presentation, we will focus on the quantitative distribution of SFs across gesture and speech. Our results indicate that speech and gestures of 4-year olds are less integrated than those of the adults, although there is a large variability among the children. We will discuss the results with respect to the cognitive processes (e.g., visual memory, language) underlying children’s abilities at this stage of development. Our work paves the way for the cognitive architecture of speech-gesture interaction in preschoolers which to our knowledge is missing so far.

Motivation

- How is the meaning transmitted through the two modalities – speech and gesture in preschoolers? Defining a means to measuring speech-gesture redundancy.
- Statistical evidence: which types of gestures occur more frequently in one context than in others?
- Modelling the cognitive capabilities of children (age 4-5).

Related Work

Alibali et al. (2009) • narrative data 27 children (5-10 years)
- 20 adults, children produced more non-redundant combinations than adults

Jonge-Hokstra et al. (2016) • 12 Dutch children, ~30.1 months old
- Natural teaching-learning interaction
- Increasing age: speech and gesture more synchronized

Bergmann & Kopp (2008) • 20 adults in a direction giving experiment
- Semantic features of gestures based on their lexical affiliate

Data

- 40 children were recorded at the age of 4 in different experimental situations
- Context 5: retelling the mother how the dog-puppet did everything wrongly
- Children: Intonation phrases: 1299, iconic gestures (hand and body): 255

Example Gestures

- The overall distribution of semantic features is similar to the distribution of the adults
- The overall rate of overlap (Jaccard index) is ~44% (~12%)
- However, individual child profiles reveal substantial differences among the children
- Gesture speech integration seems to compensate problems in speech development
- This study paves the way for the cognitively plausible model of a 4-year old where different parameters observed empirically will be varied

References


