Hand–Mouth Coordination in a Pointing Task Requiring Manual Precision

Aleksandra Ćwiek[1,2] & Susanne Fuchs[1]
[1]Leibniz-Centre General Linguistics, [2]Humboldt-Universität zu Berlin

SUMMARY

We investigated the coordination of articulatory and hand movements in a task requiring manual precision.

We found that: (1) **the onset of the lip closing gesture for initial /p/ occurs after hand gesture onset** in all speakers and mostly before reaching hand gesture nucleus – some speakers anticipate speech (2, 3, 9), while others start later (1, 6, 8, 10); (2) **the lip closing onset for initial /p/ occurs before hand gesture nucleus** in 4 out of 7 speakers; (3) in general, interval 7 < interval 8, i.e., lip closing onset is closer to hand gesture onset than to nucleus onset

Our research shows the **flexibility in coordination** between hand and mouth when the articulatory movement is not audible (/p/).

BACKGROUND

On hand-mouth coordination

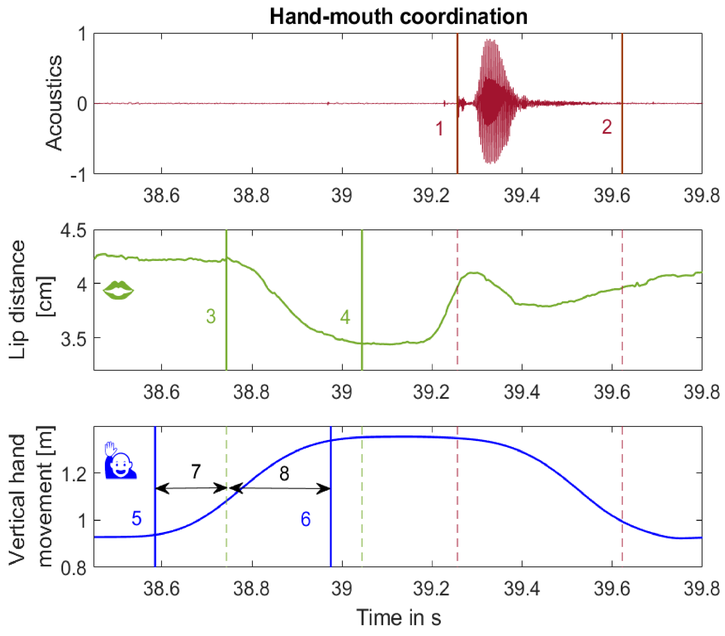
- Hand-mouth coordination **= important step in speech acquisition** (see Iverson and Thelen, 1999 for a review)
- Most authors describe **a tight coordination** between speech and pointing gestures.
- **Coordination depends on a number of factors**, e.g., the location of prominent syllable (Rochet-Capellan et al., 2008), the production of emphatic stress (Parrell et al., 2014), the presence of prosodic boundaries (Krivokapic et al., 2017).
- **If coordination of the hand or mouth is perturbed**, the **other system is also affected** (Pouw and Dixon, 2019; Chu and Hagoort, 2014) = functional link between the two.

Specificities

- Two motor systems with **different dynamical properties**
  - Hand: slow, heavy in mass
  - Mouth: fast, light in mass
- **Consequences for coordination**
  - slow system starts earlier
  - fast system is more flexible to adjust

PREDICTIONS

- **Anticipation**: hand gesture onset occurs earlier than lip gesture onset.
- **Coordination can be speaker specific**: lip closing onset can occur close to hand gesture onset or nucleus (flexibility).

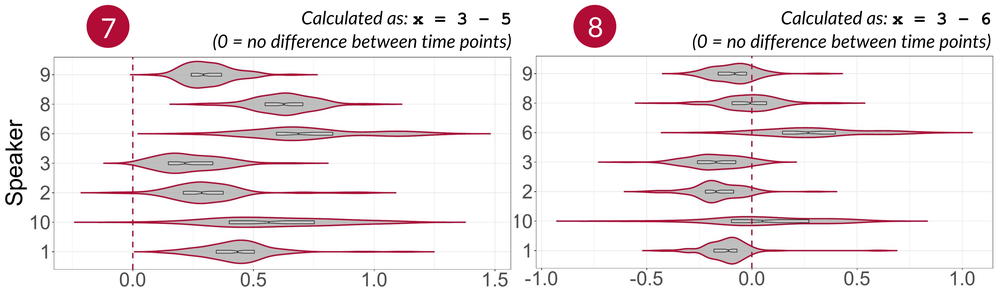


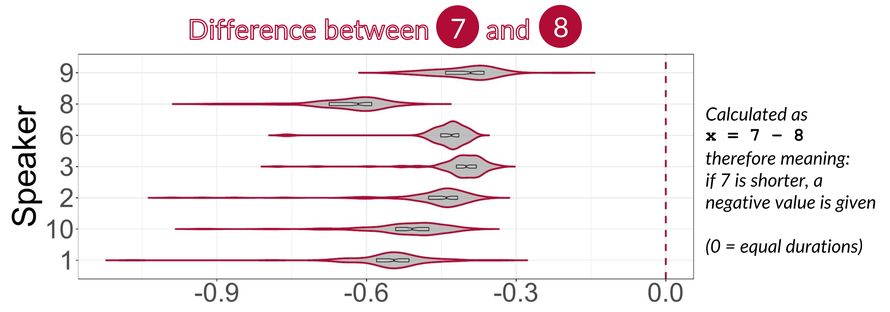
RESULTS

7: Hand gesture onset (M = 69.17) to lip closing onset (M = 69.85): $p < .001$, $r = 0.86$.

8: Lip closing onset (M = 69.85) to hand gesture nucleus (M = 69.92): $p < .001$, $r = 0.41$.

Duration difference between **7** (M = 0.40) and **8** (M = -0.09): $p < .001$, $r = 0.87$.





METHODS

- Participants were asked to shoot a can projected onto a wall in front of them using a laser pointer and to say the word on the can (*piff* or *paff*).
- Acoustics and movements of 31 female participants (here subset *N* = 7) were recorded (motion capture system *Optitrack*).
- **Annotations** (cf. Figure above, left): **1.** speech onset, **2.** speech offset, **3.** lip closing onset, **4.** lip closing offset, **5.** hand gesture onset, **6.** hand gesture nucleus,
- **Analyses** (cf. Figure above, left): **7.** hand gesture onset to lip closing onset, **8.** lip closing onset to hand gesture nucleus, plus duration difference between **7** and **8**.
- Paired Wilcoxon signed rank tests to analyze the above.

Follow our project on ResearchGate for future updates!

XPRAG.de
DFG