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### ► To cite this version:

Hélène Serré, Susanne Fuchs, Marion Dohen, Amélie Rochet-Capellan. Speaking while moving: Does the head compensate for the hands not being able to move?. ISSP 2020 - 12th International Seminar on Speech Production, Dec 2020, Providence (virtual), United States. hal-03094445

**HAL Id: hal-03094445**

**<https://hal.science/hal-03094445v1>**

Submitted on 4 Jan 2021

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# Speaking while moving: Does the head compensate for the hands not being able to move?

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## Background

- Not being able to move the hands can reduce vocabulary diversity and precision (Rimé, 1984; Hostetter, Kita & Alibali, 2007) and increase disfluency (Finlayson et al., 2003; Hostetter, Kita & Alibali, 2007). However, for contradictory results see Hoetjes et al., 2014.
- While speaking, people also move their head and eyebrows (e.g. Kendon, 2004) potentially in synchrony with prosodic parameters (Graf et al., 2002; Hadar, 1983).
- Eyebrow, eye and finger movements would increase when speakers cannot gesture with their hands (Rimé et al., 1984).
- Participants could compensate for not being able to move their hands by moving other parts of their body (Finlayson et al., 2003). This compensation might remove the effects of the constraint.

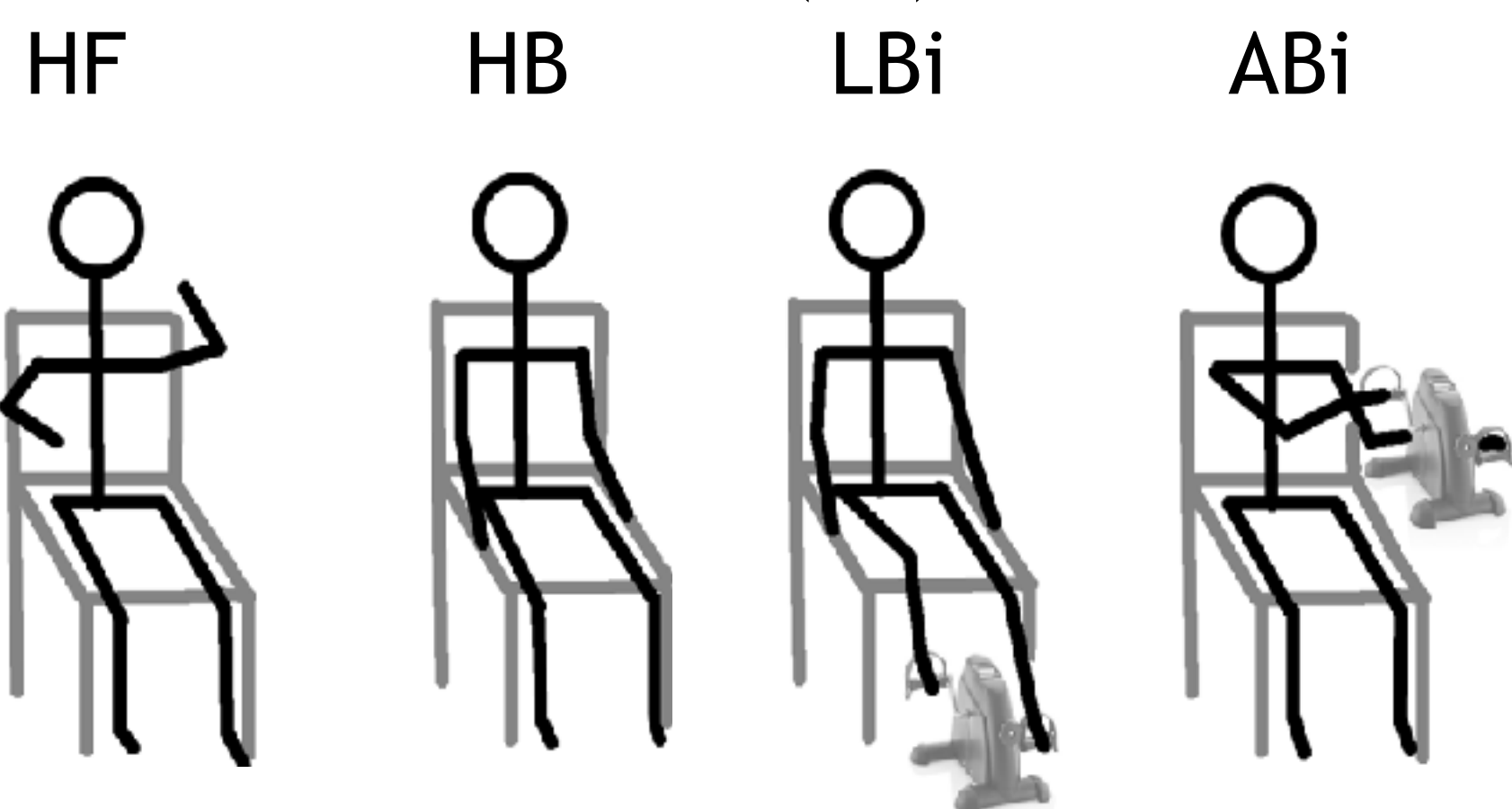
## Question

- Do head movements compensate for the hands not being able to move?
- In this preliminary study, we analyzed the kinematics of head movements using data from a motion capture experiment investigating speech-limb-breathing interaction. People were asked to recall stories in different limb movement conditions-
- Automatic analysis of motion using motion capture could be helpful for analysing larger data sets and provide complementary evidences to qualitative approaches (Zhao et al, 2012).

## Procedure

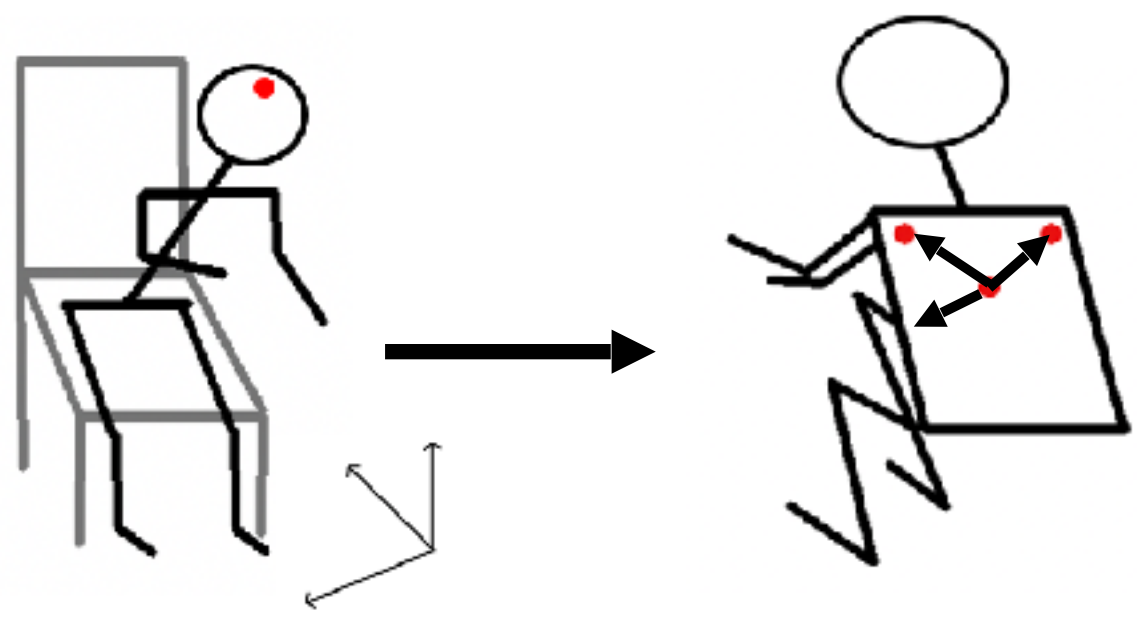
25 German speakers (19 women and 6 men) between 20 and 29 years old (mean=23.3 years, standard deviation=2.5 years)

Main task : recall 4 stories freely, in one of the following conditions: hands free (HF), hands blocked (HB), biking with the legs (LBi), biking with the arms (ABi)

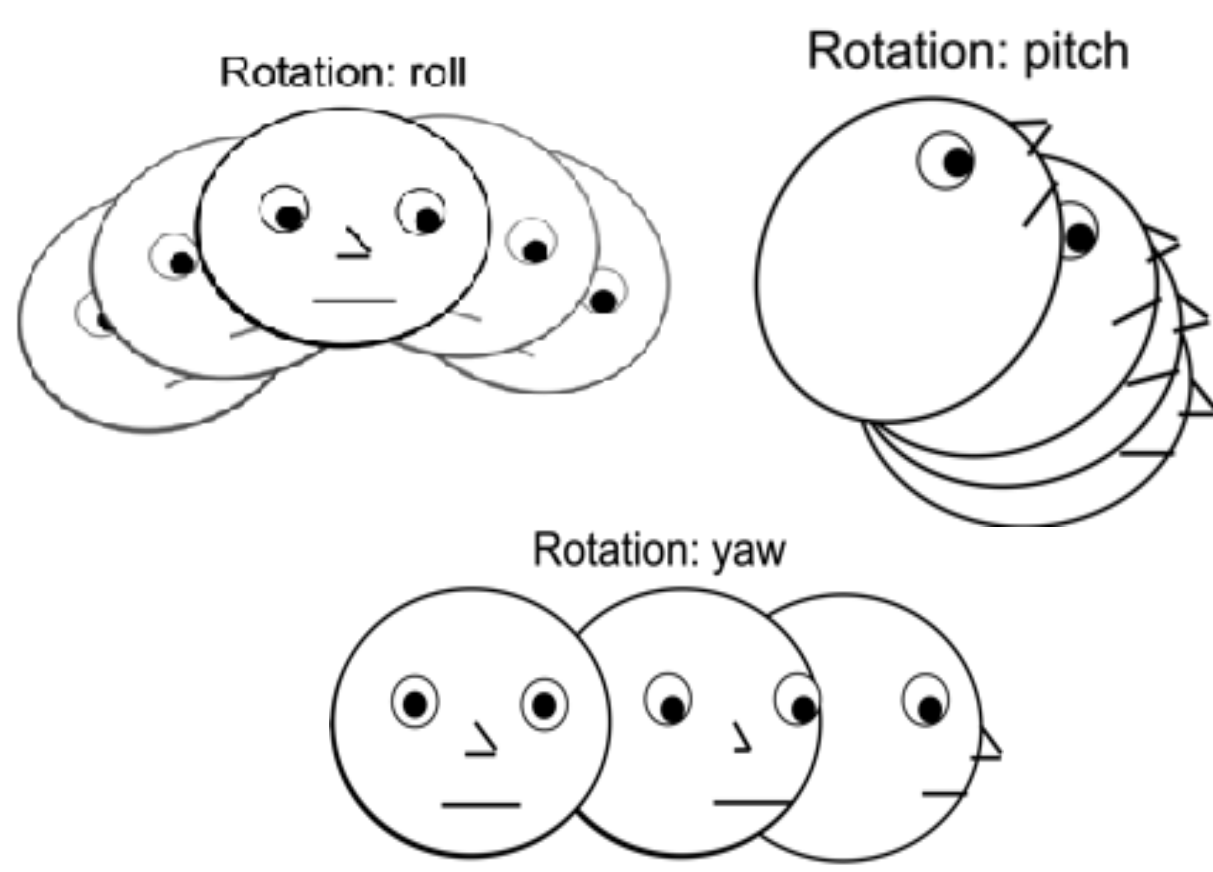


## Analysis

1 Switch from fixed to moving coordinate referential

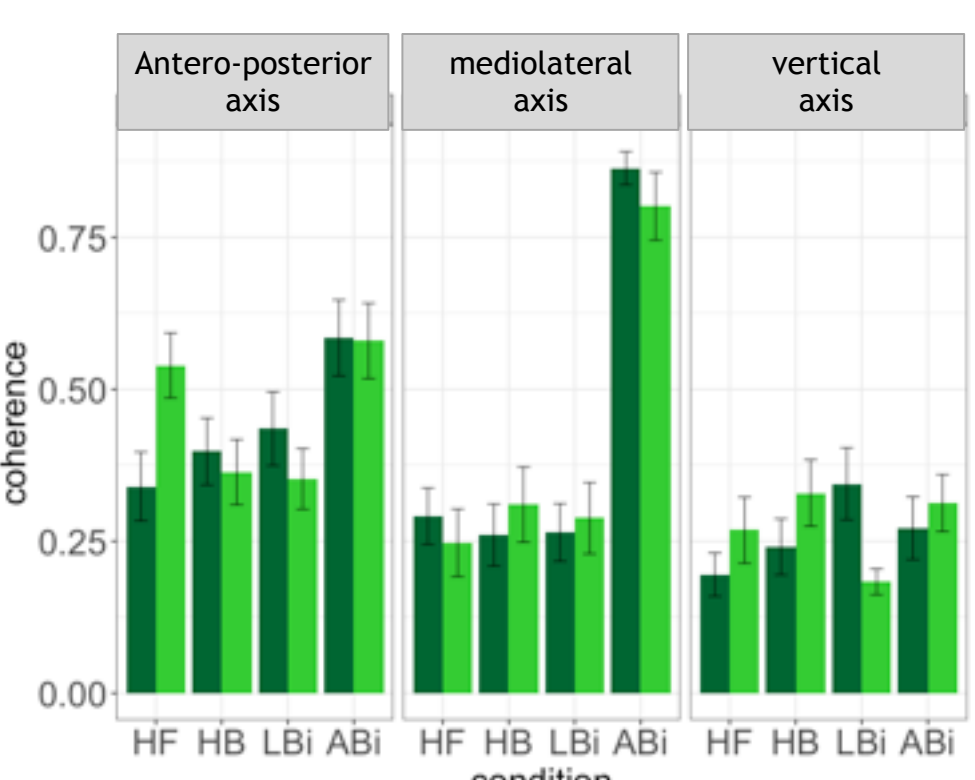


3 3D displacement and rotation movements

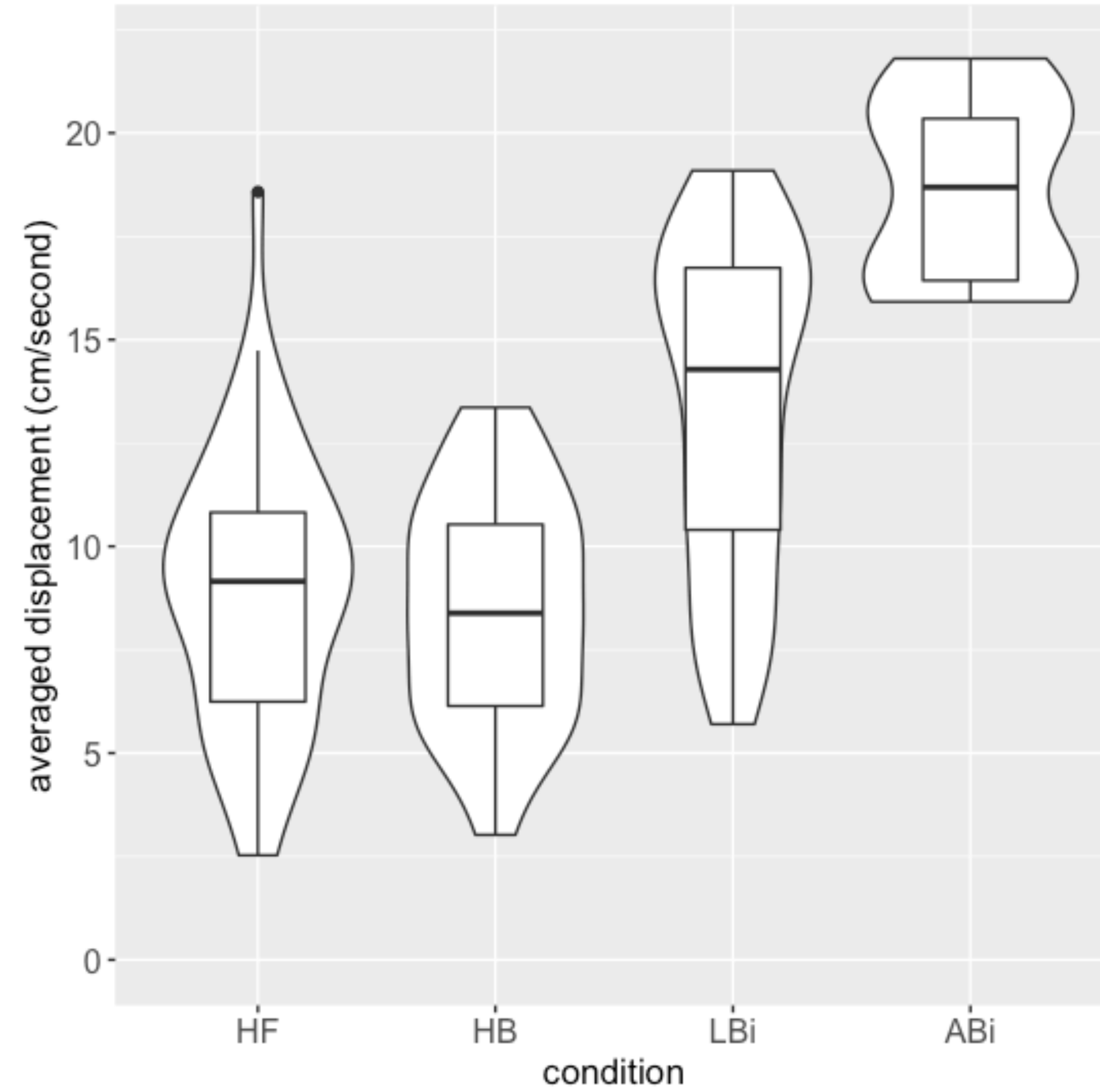
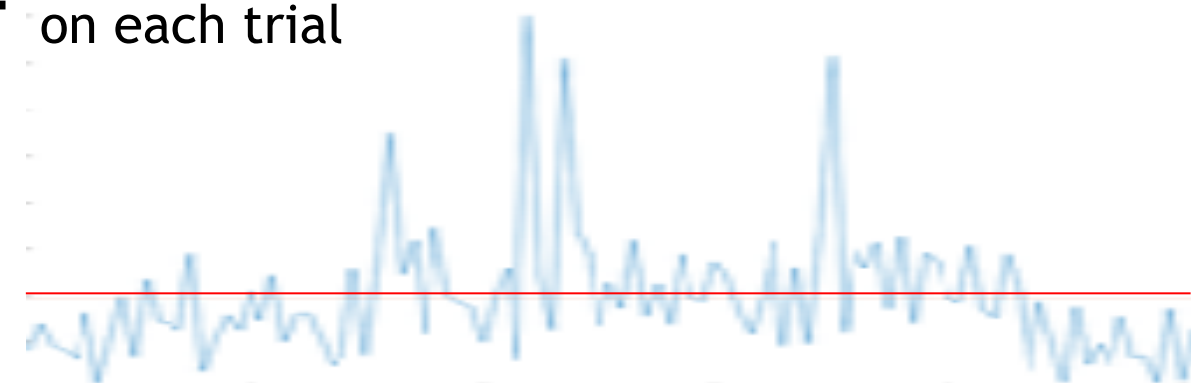


Wagner et al, 2014

2 measure of synchronisation between back and head movements on each axis: coherence



4 Averaged displacement and rotation of the head on each trial

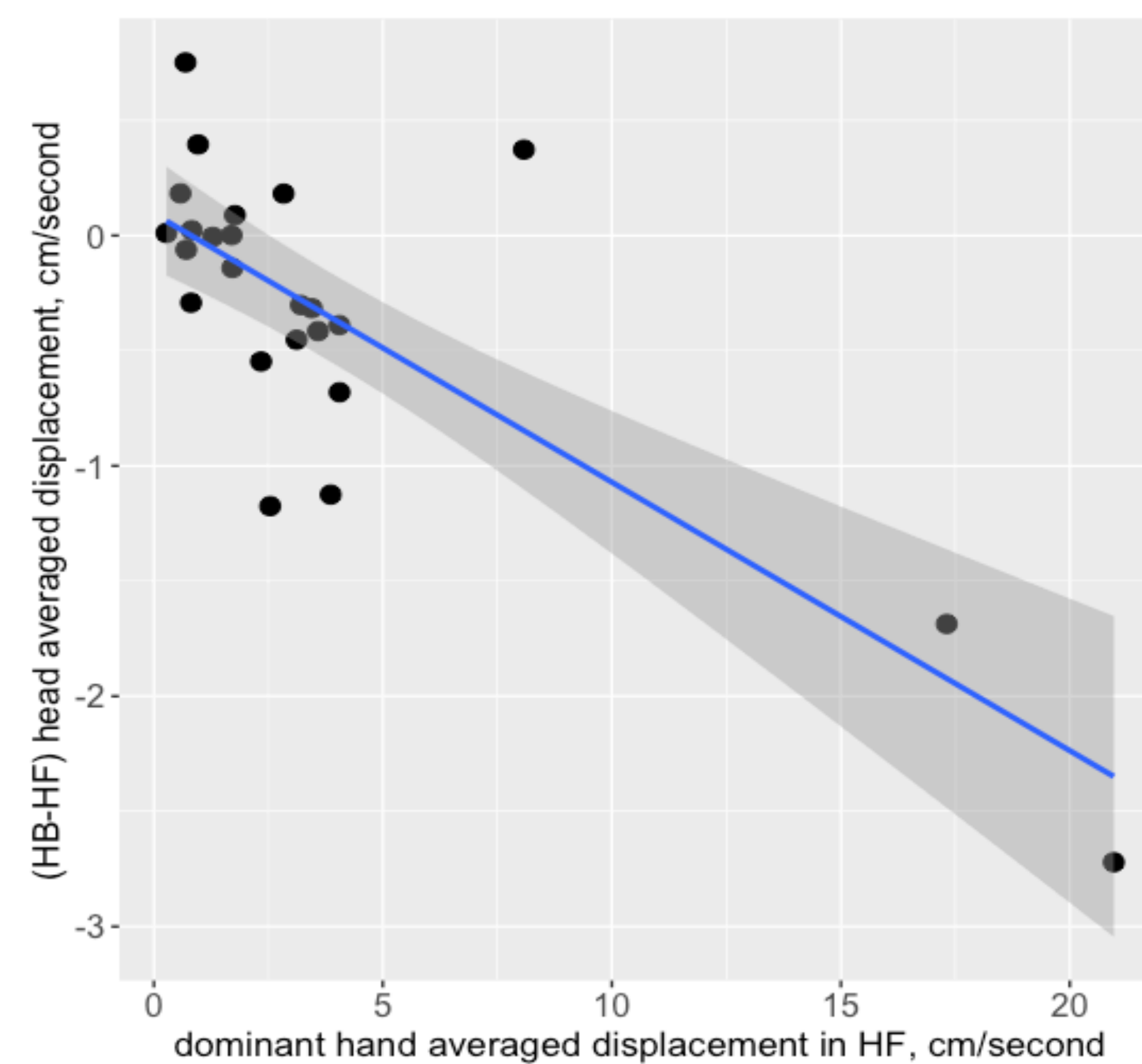


Violin plots of average displacement of the head (y-axis) as a function of movement conditions (x-axis).

- No difference between HF and HB
- As predicted by the coherence, More head movement for ABi

## Results

But if participants don't hand gesture when they are free to do so, they do not need to compensate with the head when they are constrained. What about the relationship between hands movement quantity and difference in head movement quantity from free to blocked condition?



Scatterplot with difference of displacement of the head between HB and HF (y-axis) as a function of the averaged hand displacement in HF (Pearson correlation is -0.8,  $t = -6.21$ ,  $df = 22$ ,  $p$ -value =  $2.8e-06$ ).

In the HF condition, the more the participants gesture with the hands, the more they move the head, but it is not correlated with head movement quantity in the HB condition.

## Conclusions

- ❖ There is no difference in average head displacement whether the participants have the hands blocked or not when they speak.
- ❖ Maybe because they do no gesture a lot. The relationship between hands and head movement quantity suggests that when the speakers are free to move, the more they move their hands, the more they also move their head.
- ❖ When limbs and hands are blocked in a 50-minute conversation, the activity of eyebrows, eyes, mouth, and fingers increases (Rimé et al., 1984) vs a 2-minute story retelling with a much higher cognitive load → less communicative gestures.
- ❖ MoCap equipment may also affect speakers' motions. Eyebrows movements may be a more reliable indicator.
- ❖ Entrainment between body parts, rather than compensation, may support speakers' behavior.
- ❖ Motion capture will enable the exploration of different aspects of kinematics such as limb synchronization or rotation motion.