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

Hélène Serré[1], *Marion Dohen*[1], *Susanne Fuchs*[2], *Amélie Rochet-Capellan*[1]

[1]*Univ. Grenoble Alpes, CNRS, Grenoble INP, GIPSA-lab, Grenoble, France*
[3]*Leibniz-Centre General Linguistics (ZAS), Berlin, Germany*

Context and aim

Movements, including gestures, are ubiquitous in oral communication. They have been shown to interact with speech in different ways (e.g. McNeill, 1992) and in particular to support language-related cognitive processes such as lexical access (Krauss et al., 1999). Some studies tested the gesture-speech link by investigating if speech production is affected when speakers are not able to gesture with their hands. Results of these studies are mixed providing evidence for (Hostetter, Kita & Alibali, 2007; Finlayson et al., 2003) and against an effect (Hoetjes et al., 2014). But coverbal movements are not limited to the hands: speakers also move other body parts while speaking such as the head. One could then wonder whether movements of these other body parts also compensate for the hands not being able to move when the latter are constrained in any way. We tested this possibility by analyzing the kinematics of head movements in different conditions of hand movements during a narrative task.

Methods

Twenty-five native speakers of German participated in this study. Their task was to watch short cartoons while sitting on a chair. They were then invited to retell the stories in different conditions: hands free (HF), hands blocked (HB), arms biking on a mini-bike (ABi) vs. legs biking (LBi) on the same mini-bike (Figure 1). Participants were recorded twice in the same conditions, on two different days. Speech and movement were recorded synchronously using a microphone and a motion capture system. Head motion was characterized by calculating the average displacement over each trial. We quantified the movement of the rotation and position axes of all markers (Livingstone & Palmer, 2016). We expected more movements of the head if speakers compensate for having the hands blocked (HB) in comparison to the hands free (HF) condition.

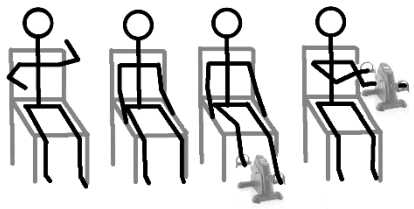

Figure 1. Experimental conditions, from left to right: Hands Free (HF), Hands Blocked (HB), Legs Biking (LBi), Arms Biking (ABi)

Results and conclusion

Average displacement of the head is displayed in Figure 2. We only display the rotation (nods), as results are comparable for the longitudinal translation. No significant difference is observed between HF and HB. Head movements were increased by biking motions and in particular when biking with the hands. Note that when biking with the arms or with the legs, head motion

could however be driven by the biking motion (motor entrainment) rather than by communication.

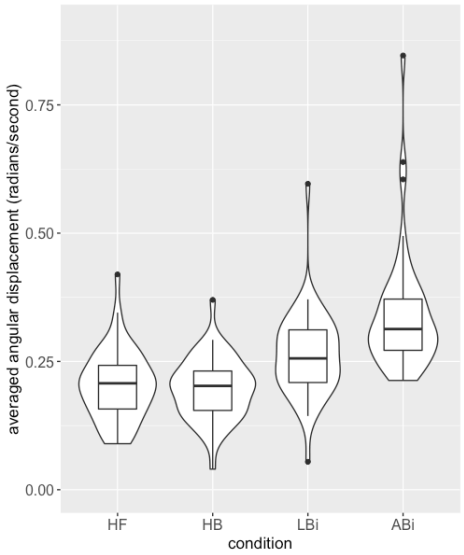

Figure 2: Box plot of average displacement of the head (y-axis) as a function of movement conditions (x-axis).

Several interpretations could explain the lack of difference between the HF and HB conditions. First, most of the participants did not move their hands much in the HF condition, with large between-subject variability. If the hands do not move in the HF condition, there is nothing to compensate for in the HB condition. To further assess this idea, we investigated whether the average displacement of the head correlated with the one of the hands in the HF and HB conditions. In other words, do the participants who gesture a lot with their hands in HF compensate more with the head in the HB condition than those who gesture less? If they do, the difference of average displacement of the head between HB and HF should be close to 0 for those who do not gesture a lot and increase as the displacement of the hands in HF increases (the head moves more in HB than in HF). The analyses suggest the opposite. In particular, the two participants who gestured the most with their hands in the HF condition were the ones who decreased the most their head movements in HB as compared with HF. This suggests that head movements do not compensate for hand gestures, and that rather having hands blocked inhibits head motion.

References

[1] McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. University of Chicago press. [2] Krauss, R. M., & Hadar, U. (1999). The role of speech-related arm/hand gestures in word retrieval. *Gesture, speech, and sign*, *93*. [3] Hostetter, A. B., Alibali, M. W., & Kita, S. (2007). Does sitting on your hands make you bite your tongue? The effects of gesture prohibition on speech during motor descriptions. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 29, No. 29). [4] Finlayson, S., Forrest, V., Lickley, R., & Beck, J. M. (2003). Effects of the restriction of hand gestures on disfluency. *Proceedings of Diss, Gothenburg Papers in Theoretical Linguistics*. [5] Hoetjes, M., Krahmer, E., & Swerts, M. (2014). Does our speech change when we cannot gesture? *Speech Communication*, *57*, 257-267. [6] Livingstone, S. R., & Palmer, C. (2016). Head movements encode emotions during speech and song. *Emotion*, *16*(3), 365-380.