

Speech and breathing in different conditions of limb movements and over time

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Physical activity with the lower limbs is known to improve cognitive performances (Schmidt-Kassow et al., 2010; Opezzo & Schwartz, 2014). Gesturing with the hands affects speech production and comprehension (Cassell, McNeill & McCullough, 1999; Cook et al., 2008; Goldin-Meadow & Wagner, 2005), and improves cognitive performances as well (Goldin-Meadow & Singer, 2003). Therefore, while thinking, learning or speaking, it would be better to gesture than to constrain our hands (Cook et al., 2010). But what about when the hands are constrained by a physical activity? Does a periodic cycling movement with the hands demand more cognitive resources, or does it support cognition and speech production? Does the effect improve with learning?

To provide some answers to these questions, we suggest to consider a third actor, involved in both speech and motion: breathing. Speech, breathing and limb movements seem interconnected in different ways. The cognitive and physiological demands of the speech task as well as the movement task affect breathing profiles (Wang et al, 2010; Fuchs et al., 2015). For example, speech production increases the duration of breathing cycles in comparison to rest (Conrad & Schönle, 1979) while physical effort shortens it. Muscle activity also shapes the dynamics of the lungs and the breathing cycle (Pouw et al., 2018). At the same time, in reading and spontaneous speech, inhalation depth and duration are positively correlated with the length of the upcoming utterance (Fuchs et al., 2013; Rochet-Capellan & Fuchs, 2013). This suggests that breathing cycles would also be involved in speech planning.

Breathing can therefore be a good indicator of the interactions between speech and limb movements. In line with this idea, we analyzed breathing during speech over time in different conditions of limb motion.

We carried out a study in which movement, breathing and speech were recorded under four movement conditions and over three days. Twenty-five native speakers of German participated in this study. Their task was to watch short videos while sitting on a chair. They were then invited to retell the stories in different conditions: hands free, hands blocked, hands biking on a mini-bike vs. legs biking on the same mini-bike. Participants were recorded twice in the same conditions, on two different days. They also came back ten days later to retell the story in the hands free condition only.

We analyzed changes in breathing cycles and breath groups according to the conditions and the days, measuring to what extent speech and limb movements shape breathing. The results of these first analyses will be presented and discussed as well as some perspectives on this work.

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