
Latency, Sensorimotor Feedback and Virtual Agents: Feedback Channels for Motor Learning Using the ICSPACE Platform

Cornelia Frank¹, Iwan de Kok², Irene Senna³, Thomas Waltemate⁴, Felix Huelsmann^{2,4}, Thies Pfeiffer⁵, Marc Ernst³, Stefan Kopp², Mario Botsch⁴ & Thomas Schack¹

¹Neurocognition and Action at CITEC, Bielefeld University, Germany

²Social Cognitive Systems at CITEC, Bielefeld University, Germany

³Cognitive Neuroscience at CITEC, Bielefeld University, Germany

⁴Graphics and Geometry at CITEC, Bielefeld University, Germany

⁵Central Lab Facilities at CITEC, Bielefeld University, Germany

Effective motor skill learning requires sensorimotor learning based on appropriate multi-modal feedback. We developed a virtual environment that allows us to boost the learning process with different kinds of augmented feedback and coaching strategies. On this poster, we present three lines of research on effects of (a) feedback delay as well as (b) nonverbal and (c) verbal feedback strategies. In a first study, we assess how visual feedback delays affect synchrony perception, sense of agency, ownership, as well as motor performance during the execution of movements in front of a virtual mirror. In a second experiment, we investigate the impact of different kinds of augmented visual feedback on the trainee's motor performance and cognitive representation structure of squat movements. In particular, different manipulations involving the superposition of the avatar of a skilled person onto the one of the trainee are assessed.

In a third step, we introduce a conversational virtual coach, which guides the coachee's learning process by providing verbal instructions and non-verbal augmented feedback. Development of coaching strategies is done by combining corpus analysis of human-human coaching interactions and sports science literature. We focus on designing a good structure of the coaching sessions, selecting the right coaching instructions - in terms of tone, modality and content - and adapting these to the expertise of the coachee. Finally, we need a baseline to assess the performance of our virtual coach. This baseline consists of a real coach who performs the coaching session together with the coachee in the virtual environment. To this end we connect our main setup to a second similar environment. The coachee uses the original environment, whereas the coach is placed in the second similar setup. This enables the coach and the coachee to share the same virtual scene. On the poster we provide insights on ongoing experiments and preliminary results.