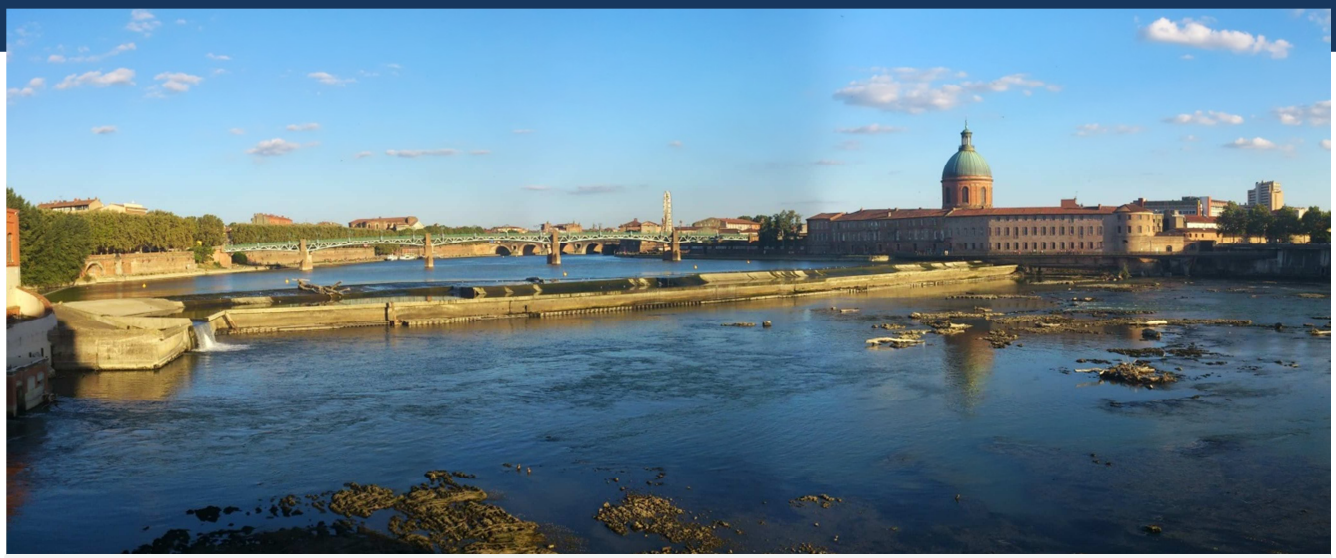

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Hyperscan Project: investigate the physiological and neural markers of teammates cooperation.

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Content

Introduction

Servicemen are now by far engaged in complex operations involving cooperation with multiple actors and specialists under time pressure in uncertain and highly dynamic hostile environments. Moreover, military operators will be more likely to interact with advanced artificial intelligence (AI) based technology. There is a need to implement monitoring solutions to objectively assess the efficiency of human-human and human-AI teaming on the battlefield. The Hyperscan research project forms part of this perspective and aims to investigate the physiological and neural markers of cooperation between human teammates and as well as between humans and artificial agents.

Material and Method

In the present study, we designed eight scenarios whereby JTACs had to their pilots to fly over a location. JTACs and Pilots were genuinely interacting together in four of these scenarios ('Coop scenarios'). In two of the missions, the pilot and the JTAC were notified that they would actually interacting respectively with a simulated PilotBot and a simulated JtacBot ('No coop scenarios'). In two of the missions, the pilots and the JTACs were not informed that they were performing the mission with their artificial counterpart ("Fake coop scenarios"). This approach allowed to control for potential confounds but also to compare participants' physiological and neurophysiological responses when interacting with a human or an artificial agent. Electrophysiological, physiological and subjective data were collected during each scenario. Ten couples (20 participants) took part in the experiment. This work was approved by the Institutional Review Board (IRB) of the Comité d'Ethique de Recherche de l'Université de Toulouse (IRB00011835-2019-05-28-149)

Results

Our preliminary findings disclosed that human JTAC-Pilot dyads performed as well as Human-Bots dyads whether the humans were aware that they were playing with a Bot or not. These findings indicated that the design of our protocol was successful and that 1) humans can be fooled by AI, and that 2) humans can behave in a natural way with AI. Interestingly enough, our analyses revealed that the cardiac activity of the JTACs and pilots was more synchronized when they were collaborating together than when they were playing with AI. Similarly, EEG analyses disclosed increased cerebral efficiency and connectivity between the two brains of the teammates when they were actually cooperating compared to when they were cooperating with AI. Further analyses revealed that the missions that were successfully achieved led to higher brain connectivity that the one who failed, suggesting better cooperation at the 'neural' level between the two brains. These preliminary results open promising perspectives for the design of neuroadaptive technology on the battlefield. The next steps of the Hyperscan project will consist in collecting data from more participants and to implement an online analysis pipeline.

Keywords : Eye tracking, EEG, fNIRS, Other measurement methods, Brain computer Interfaces