

**NENS stipend awardee:** Alisha Vabba

**Home lab:** Cognitive, Social and Affective Neuroscience (CoSAN) lab, Sapienza University of Rome, Italy, supervised by Prof. Salvatore Maria Aglioti

**Host lab:** Department of Neuroscience, University of Sussex, Brighton, UK, supervised by Prof. Hugo Critchley

**Period of training stay:** 1<sup>st</sup> May 2021 – 31<sup>st</sup> October 2021 (NENS stipend for second half).

This report is to testify that I have successfully completed my training stay at the University of Sussex in the Department of Neuroscience and under the supervision of professors Hugo Critchley and Sarah Garfinkel (who followed the project remotely from UCL-London). My training stay lasted six months overall, and I am extremely grateful for having been awarded the NENS stipend, which will help cover the costs for the second half of my stay (August-October), which was incredibly useful for my research back in my lab in Rome and for my career in neuroscience.

During my time in Brighton, I conducted an experiment testing the effects of non-invasive (trans-auricular) vagus nerve stimulation and interoception on the experience of body ownership in a virtual version of the rubber hand illusion. In the RHI, when a person feels their hand (which is out of sight) being stroked, while watching a rubber hand being stroked in front of them, they can get the illusion that the rubber hand is part of their body. In virtual reality if the simulated (rubber) hand flashes in time with the person's heartbeat, this can enhance the illusion (Suzuki et al., 2013). Given the role of the vagus nerve in conveying internal body signals and preliminary evidence that stimulation of the vagus nerve can alter how we perceive interoceptive signals (Villani et al., 2019), we tested whether real vs. sham taVNS might increase the effect of cardiac feedback in the virtual reality version of the RHI. We also tested whether this effect is modulated by changes in autonomic arousal (heart rate and SKNA) or by how sensitive people are to their own heartbeat (measured using tasks of heartbeat detection).

During my stay, I set up the study (including ethics application, learning how to conduct vagus nerve stimulation, VR task preparation, online questionnaires, set-up for the physiological recording, piloting, and recruiting participants) and successfully completed two experimental sessions for 24 participants. Given some limitations due to Covid-19 (e.g., lab rotations, having to take turns with spaces and equipment, and difficulties recruiting during lockdown) I was not able to complete data analysis and write up of the project during my stay, which I am however happily working on currently alongside my duties back in Rome.

This training stay was incredibly useful for my career path in neuroscience for many reasons:

- 1) I successfully learnt how to conduct trans-auricular vagus nerve stimulation which, due to its potential to modulate cognitive and emotional function, is a promising tool in experimental research as a means to manipulate corporeal awareness. Indeed, after graduating in January, my laboratory back in Rome has awarded me a six-month bursary to conduct a project testing the effects of vagus nerve stimulation and interoception on honesty-related decision making, as part of the ERC grant eHonesty.
- 2) I learnt how to set-up and analyse physiological data using neuECG, which is a recent method for simultaneously and non-invasively (thus advantageously with respect to

microneurography) recording the electrocardiogram (ECG) and skin sympathetic nervous activity using high/band-pass filtering to separate the signals.

- 3) I increased my skills and developed new competencies in virtual reality programming and troubleshooting using Unity, particularly related to its interface with real-time motion capture systems (leap motion for recording and reproducing hand movements) and physiological recording and input (cardiac feedback integration using a custom-made Arduino based ECG sensor).
- 4) I had the chance to work not only with professors Hugo Critchley and Sarah Garfinkel who are leading experts in the study of body-brain interactions and the role of bodily signals in cognition and emotion, but also with Keisuke Suzuki (Hokkaido University, Japan) for the development of the task in virtual reality and with Tim Moeller (Berlin Mind & Brain Institute, Germany) for the development of an Arduino based ECG sensor which we used in the project to deliver real-time cardiac feedback to Unity. I greatly enjoyed these international collaborations, which also gave me the chance to have networking opportunities for future post-doctoral researcher. For example, I am applying to present this project at a conference at the Mind & Brain institute in Berlin which also offers the chance for young researchers to present a project for a three month stay in the institute, and in general I intend to consider both Brighton and Berlin as possible laboratories for future post-doctoral research.

I believe these competencies I have acquired will be useful both for my personal research career in neuroscience and for the research I will be conducting in the following months in my lab back in Rome, where I will be applying in taVNS and neuECG, as well as transferring my skills in these techniques to other members of my lab. The custom-made Arduino we built for this study will also remain in my lab in Rome, where it will be used in future studies for cardiac feedback.

I remain available for any further requests and would like to express my great appreciation for the NENS stipend, which helped to make this experience possible for me.

Best wishes,

01/12/2021

Alisha Vabba









