

Have you ever wondered how your brain knows which body parts belong to you? While this may seem obvious, it is not a trivial task. In psychology, a distinct and intuitive feeling that one's body belongs to oneself is termed *body ownership*. Multiple studies have demonstrated that the sense of body ownership is actually constructed by our brain in real time, integrating signals from different senses (mainly visual and tactile). This fascinating process can be studied using the rubber hand illusion. In this illusion, when people see a rubber hand being touched in sync with touches on their hidden real hand, they often begin to feel that tactile sensations come from the rubber hand, as if it was a part of their body.

This project aims to develop a mathematical model explaining how our brain combines visual and tactile information to create the sense of body ownership. While previous models have helped us understand some aspects of this process, they struggle to explain important features - like why the illusion becomes stronger when the pattern of touches is more complex, or why some people are more susceptible to it than others, and experience the illusion even when touches are slightly out of sync.

I propose that these aspects can be explained using a computational model called the Multisensory Correlation Detector, which calculates the correlation and lag between signals across their whole duration. It has been argued that the brain uses a similar mechanism to detect motion, and it is very likely that the brain processes multisensory information in this way. Through three experimental studies, I will test whether this model can predict: (1) how the strength of the illusion changes with patterns of touch of varying complexity, (2) why individuals differ in their susceptibility to the illusion, and (3) what conditions cause people to either incorporate external objects or lose ownership feelings over their real body.

This research could significantly advance our understanding of how the brain constructs our sense of bodily self. Beyond its scientific value, this knowledge could help develop better treatments for disorders involving disturbed body perception, improve the integration of prosthetic limbs, and create more immersive virtual reality experiences. Most importantly, the project would provide the first comprehensive explanation of how visual and tactile signals are integrated over time to give rise to feelings of what is part of our body - a fundamental aspect of human consciousness that we are only beginning to understand.