THE HEART AND THE BRAIN MAKING SENSE OF MATHEMATICAL PROOFS AND EMOTIONAL FRUSTRATIONS

AN EARLI RESEARCH STORY

In 2020, EARLI launched a new initiative to increase visibility for the excellent research conducted by EARLI members: the EARLI Research Story. Every other month, an EARLI member or group of EARLI members is offered the opportunity to share their research initiatives and findings in a short blogpost or video. This month: the differences in the heartbeat and the neural brain of participants making sense of mathematical proofs and emotional frustrations.

While investigating the emotional correlation between the heart and the brain, it is safe to say that both are interconnected in some levels and affect each other's functions and activities. We are interested in understanding heart and brain processes during different learning situations.

Imagine being a university student, going through the combined stress of learning, developing new skills, and maintaining academic levels. As students aim to reach higher every year, their emotional engagement reaches higher levels. The mood swings from frustration and dissatisfaction to happiness and accomplishment may impact the learning abilities and the process of learning unknown concepts.

When conducting our studies, we were interested in the emotional and the cognitive aspect of learning complex and not familiar concepts. We tried to focus on the differences of the heart and brain functions when experts of mathematics and novices of mathematics are trying to make sense of mathematical proofs.

The heart directly reacts to feelings and changes it's beating, while brain oscillations take a central role in human cognition. Thus, this research was conducted to find answers to questions like: Do heartbeats and brain oscillations change when we go through frustration or when we experience enhanced difficulty in the learning process? For example, when we try to solve mathematical problems without getting any instruction first. How do the heart and the brain interact in such scenarios?

To find some answers to these questions, we have set up two laboratory studies with electroencephalography (EEG) and electrocardiography (ECG). In the first study, mathematics experts and novices were exposed to mathematical demonstrations and asked to make sense of them while being connected to EEG and ECG.

In the second study, university students were given mathematical problems to solve. Half of them got an instruction first on how to solve the problem, while the other half only got the instruction after they tried to solve the problem. All students got an exam-like test in the end, to see how much they learned from the problem-solving and instruction. How do the heartbeat and the brain oscillations change in a challenging situation?

Our team aims to find answers to these and related questions to better understand how these correlations between the heart and the brain affect the academic learning setting. Our team plans to publish papers in the following years to share our vision of this nascent field further.

Further information
https://lse.ethz.ch