BRAINS THAT FIRE TOGETHER WIRE TOGETHER

Decoding the interactive learning process in the brain

Weighing in at three pounds, on average, the brain is the most complex and least understood organ in the human body. Made up of approximately 86 billion neurons and woven together by an estimated 100 trillion synapses, it holds the secret to our cognition, consciousness, emotions, ability to act, produce language and retain memories.

Possessing a remarkable capacity for reorganizing pathways and forming new connections — a concept called neuroplasticity, or brain plasticity- the brain's ability to rewire itself plays an important role in learning, repairing damaged regions and adapting to new circumstances.

"Traditionally, neuroplasticity research was focused almost exclusively on investigating changes in brain structures and synaptic networks within an individual brain," explains Prof. Simone Shamay-Tsoory head of the newly established **Haifa Brain and Behavior Hub**. "Our research contends that the human brain cannot be studied in isolation. Given that humans are social beings and that social interactions play a major role in the acquisitions of skills and knowledge, I am pursuing a new approach to understanding learning that focuses on inter-brain plasticity."

The European Research Council agreed with Prof. Shamay-Tsoory and saw fit to award her a prestigious ERC Advanced Grant to further our understanding of brain-to-brain coupling and how the brain changes during interaction -based learning.

"Studies show that most people learn better when they interact with other people. We want to explore the biological processes that underlie interaction-based learning. We believe that this line of research will improve our understanding of long-term memory consolidation in 'neurotypical' brains and play a role in enhancing the learning experience for students with autism spectrum disorder (ASD) and other conditions that affect social learning."

Prof. Shamay-Tsoory's lab, The Social and Affective Neuroscience Laboratory, has garnered international recognition of late for its pioneering emphasis on inter-brain synchrony. In an article published in *The Proceedings of the National Academy of Sciences*, Shamay-Tsoory together with a team of colleagues showed that the simple act of holding your loved one's hand can reduce pain. "Touch is very powerful," states Shamay-Tsoory. "We found that holding hands creates a connection between brains that can measurably reduce physical pain being endured by one of the parties."

Currently, Shamay-Tsoory is teaming up with Prof. Shlomo Wagner (Sagol Department of Neurobiology) and researchers from Germany to examine the changes that take place in the brain during social isolation. The topic has gained momentum in the scientific community as researchers are trying to understand the psychological risk factors associated with COVID-19 lockdowns.

"We are just beginning to understand the role that inter-brain synchrony plays in education, psychotherapy, group creativity and conflict resolution. We believe that this approach will provide scientific insights that will cut across academic disciplines, healthcare services and policy areas. Ultimately, I see this as a growing trend that will continue to evolve and make a significant contribution to improving society."

A When an individual learns how to dance from videos, there is no feedback.
B In interaction-based learning, the partners create a mutual feedback loop.

Prof. Simone Shamay-Tsoory (School of Psychological Sciences) is a pioneer in the field of social neuroscience.

The newly inaugurated Haifa Brain and Behavior Hub will serve as the transdisciplinary focal point for UoH's neuroscience program, bringing together faculty from different fields to develop interdisciplinary solutions for medical, educational and social problems.

Innovative research areas include: Learning (from the molecular level to real-life behavior); Pain Neuroscience (measuring, preventing and treating chronic pain); and Computational Neuroscience (optimizing novel therapeutic strategies to alleviate the symptoms of neuropsychiatric disorders, such as autism, schizophrenia, bipolar disorder and depression).

Thanks to the generous support of Bradley Bloom and his family, the Hub will award scholarships to graduate, doctoral and postdoctoral fellows to inspire their careers in neuroscience. The gift will also help fund the establishment of a Multimodal Neuroimaging Unit that uses an array of imaging methods to study brain functions and dysfunctions, ranging from molecular and cellular neuroimaging to human structural and functional imaging and imaging of brains of humans in real-life situations.