The Edmond and Lily Safra Center for Brain Sciences takes great pleasure in participating in the exhibit "Tomorrow: State of Mind" as part of the Israeli Presidential Conference "Tomorrow: 2013"

The future of humankind is unequivocally linked to solving the enigma of the human brain.

Visitors at the Israeli Presidential Conference were participated in the brain science experience through interactive exhibits that spotlight the research of Israel's top brain scientists, and by voting on the brain research of tomorrow, in a competition amongst the next generation of new renaissance scientists for the title "Brain Researcher of Tomorrow".

In this era, when life expectancy had increased far beyond ever before, the demystification of the brain is the link to the prevention and treatment of neurological and psychological disorders. Understanding the brain is the key to ensuring that we lead healthy and meaningful lives as individuals and as a society.

Join us for a fascinating journey into the brain that highlights the role of Israeli science in this worldwide endeavor.

Young researchers participating in the competition represent universities throughout Israel: The Hebrew University of Jerusalem; Ben-Gurion University of the Negev; Haifa University; Tel Aviv University; and Bar-Ilan University.

The multimedia exhibits present scientific breakthroughs from senior researchers at Tel Aviv University, The Hebrew University of Jerusalem and Ben-Gurion University of the Negev.

1. Eye Opener: Sight Following Congenital Blindness  
(Prof. Udi Zohari, The Hebrew University)

Visual perception matures mainly through experience during the first years of life and involves functions such as perceiving motion, recognizing objects, guiding actions, etc. But what if one is deprived of any visual experience during the first years of life and regains sight only later? To answer this question, a program has been established in Ethiopia to reach children with bilateral congenital cataracts and to treat them surgically. We monitor these children and observe which visual functions can be gained post-operatively, at what pace, and the changes that occur in the visual pathways that mirror these changes. Ultimately, the hope is that this research will lead to a better understanding of the development of visual capacities, and their neural correlates.

video

2. Taming the Brain: Machine-guided Self-control of Electrical Brain Activity
How much control do you have over your own brain? Can you change the electrical activity of the brain in any way you want? In our research we have developed a new method that enables subjects to directly change their brain activity in a specific manner. We use a tiny chip implanted in the brain to present users with real-time feedback of their brain activity, and a computer algorithm helps users learn to control their brain activity in the "correct" way. Using this system, subjects can control brain waves related to various brain disorders, and generate healthy brain activity. Our system also allows control at the resolution of single neurons, providing a powerful tool for medical treatment and scientific research.

video

3. "Human Cell Restart" - The Magic of Transforming Skin Cells to Brain Cells
(Prof. Eran Meshorer and Dr. Dorit Cohen Carmon, The Hebrew University)

Huntington's disease (HD) is a genetic disease that manifests itself late in life, and results in progressive brain deterioration. The patient's neuronal loss leads to impaired movements, behavior and mental functioning. No cure is currently available for HD; HD animal models have not been able to reveal the mechanism(s) of neurodegeneration, and human brain tissue is not accessible.

In 2006, it was discovered that skin cells (and many other cells) can be reprogrammed into an embryonic stem cell state, called "pluripotent". The pluripotent cells have the ability to become any cell type, including neurons. Here we show how skin cells from HD patients were reprogrammed into pluripotent cells, and then converted into neurons. Those neurons serve as an excellent model to reveal disease mechanisms and to screen for potential drugs.

video

4. Emotions in Motion: Depicting the Neural Dynamics Underlying Human Emotional Experience
(Prof. Talma Hendler, Tel Aviv University)

Mental illness is a major concern for modern society. One in six Israelis suffers from depression or anxiety; a constant struggle that for some ends in defeat. Is it possible to harness one's brain for self-treatment? A better understanding of emotion generation in the human brain is a necessary step for assessing such a notion. Evidence suggests that emotions emerge from the dynamic dialogue between neuronal networks. Our lab developed novel methods for the detection of key emotional features, namely, the unfolding interactions between hierarchal brain networks. Using vivid emotion-eliciting stimuli, we captured brain patterns related to emotional experiences; profiling both healthy and pathological populations. Neurofeedback tools for brain self-modification have thus been developed, enabling the regulation of subjective emotional experiences.

video

5. Rescuing Nerve cells and Protecting the Brain
(prof. Illana Gozes, Tel Aviv University)

One common reason for nerve cell damage in degenerative and psychiatric disorders is the breakdown of microtubules - protein cylinders that form a scaffold a "railway system" - within the cell. Professor Gozes' laboratory discovered an activity-dependent neuroprotective protein (ADNP). ADNP is essential for brain formation, with partial loss resulting in microtubule pathology/nerve cell death and cognitive impairment. Professor Gozes derived NAP (davunetide) from ADNP and the laboratory has shown that through
microtubule protection, NAP rescues compromised nerve cells. Intranasal NAP protects learning, memory and motor activity in multiple relevant disease models, including Alzheimer's and Parkinson's diseases as well as schizophrenia. Phase II clinical trials validated partial preclinical results, indicating NAP protection during daily activities in schizophrenia patients.

6. Confessions of a Primitive Mind
(Prof. Ronen Segev and Prof. Avishai Henik, Ben-Gurion University)

The ability to detect an object in space and react according to changing circumstances are important survival skills across species. The source of these abilities has been assumed to lie in the cortex - the most evolved part of the brain. Studying the archerfish - an animal without a developed cortex - we ask whether the cortex is necessary for such abilities. We have found that the archerfish performs visual search and cognitive control tasks in a similar way to humans. Our results suggest that the source of abilities that are considered to be "high cognitive functions" lies in the more primitive brain areas. We believe that science will benefit from further study of the primitive brain structure in this context.

7. Adapt, Learn, and then Walk: A Novel Concept in Neurorehabilitation of Teenagers with Cerebral Palsy
(Dr. Simona Bar-Haim and Prof. Amir Karniel, Ben-Gurion University)

Mobility means freedom, flexibility and autonomy for everyone, including persons with disabilities. Although the human motor system has an outstanding capacity to adapt and to learn new motor skills, recovery from motor impairments is still one of the most troubling issues in the neuroscience field. We hypothesize that motor improvement in everyday activities is basically determined by error-induced therapy. Here we used an intensive error-induced adaptation protocol to investigate the development of the motor learning process in adolescents with Cerebral Palsy (CP) during locomotion. Participants were exposed to progressive sessions of adaptation to a split-belt treadmill. The results suggest that long-term locomotor rehabilitation via error-induced therapy can promote motor learning and improve walking in persons with cerebral palsy.

8. "The Journey to the Lost Words" - Using Transcranial Direct Current Stimulation (tDCS) to Improve Naming Abilities among People with Chronic Aphasia Due to Stroke
(Dr. Nira Mashal, Bar Ilan University)

Stroke is the third leading cause of death in the western world, including in Israel. One of the most common post-stroke impairments is aphasia - a language impairment caused by neurological damage that is often followed by a fundamental difficulty in retrieving words. tDCS is a noninvasive, painless technique to induce neuromodulatory changes using a low intensity electrical current. We used individually tailored protocol to test for the effects of tDCS on the naming abilities of Hebrew speakers with chronic aphasia. Preliminary results from 7 patients showed significant improvement in naming accuracy. These encouraging results may have important clinical implications for finding a new tool, outside of the existing speech therapy methods, to enhance naming abilities among aphasic patients after a stroke.
Neurodegenerative Diseases  
(Prof. Kobi Rosenblum, University of Haifa)

Following our basic research approaches to understand better the underlying mechanisms of the different temporal phases of learning and memory, we identify molecular cascade which serves as a knob or dimmer for memory function in the mammalian cortex. These molecules can serve as targets for cognitive or memory enhancers but in addition have a potential to attenuate the progression of currently incurable Alzheimer Diseases. In order to understand better the function and control these targets molecules, we identify and develop small molecules (drugs) and use in parallel gene therapy approach. We believe that our research shade new light on molecular and cellular mechanisms underlying the transformation of short to long term memory and has a potential to enhance learning abilities.

[video]

10. Breaking barriers: From a Diseased to a Healthy Brain  
(Prof. Alon Friedman, Ben-Gurion University)

Vascular dysfunction is associated with most neurological pathologies. The blood vessels in the brain are unique, as they must actively and efficiently control the transport of substances into and out of the brain. This strict regulation is possible thanks to a complex structure known as the "blood-brain barrier" (BBB). Breakdown of the BBB is common in many neurological diseases, including stroke, traumatic brain injury and Alzheimer's disease.

While BBB breakdown in itself is sufficient to elicit neurological dysfunction and damage, we have discovered that the leakage of the most common serum protein, albumin, into the brain initiates a chain of events resulting in neurological and cognitive disorders. We found that albumin binds to receptors on glial cells and activates a specific signaling pathway that modulates inflammation and neuronal excitability. These findings have motivated us to develop new clinical diagnostic tools and to explore the blockage of albumin as a novel target for treatment. Our combined animal and clinical studies strongly highlight BBB dysfunction as a crucial mechanism underlying common brain diseases and a new diagnostic and therapeutic target.

[video]

The Winning Presentations

First Prize: Breaking barriers: From a Diseased to a Healthy Brain  
(Prof. Alon Friedman)

Second Prize: "Human Cell Restart" - The Magic of Transforming Skin Cells to Brain Cells  
(Prof. Eran Meshorer and Dr. Dorit Cohen Carmon)

Third Prize: Eye Opener: Sight Following Congenital Blindness  
(Prof. Udi Zohari)

We thank all the students and researchers for their participation in the competition!

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