



# ELSC

The Edmond & Lily Safra  
Center for Brain Sciences

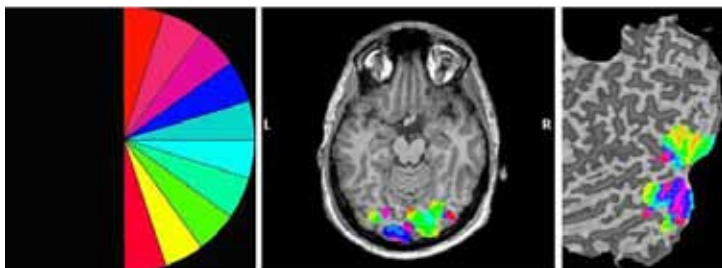
## Fusing Mind and Brain



The Hebrew University of Jerusalem

## A New Brain Research Agenda at the Hebrew University

It is widely accepted that the enigma of the brain is the most challenging intellectual endeavor of the 21<sup>st</sup> century. At the Hebrew University of Jerusalem's new Edmond and Lily Safra Center for Brain Sciences (**ELSC**), scientists are exploring the causal relationship between genes, nerve cells, brain circuits, cognition and behavior. Interdisciplinary scientific teams decipher the secrets of the brain, starting with fundamental discoveries and often leading to practical applications.



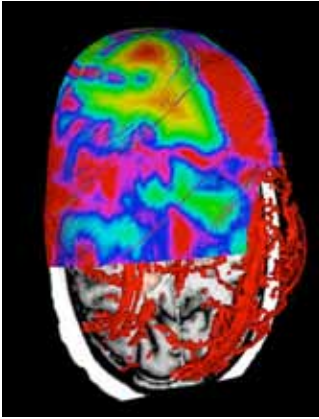
Watching the brain in action: An fMRI brain scan maps the activity of functioning human brains by measuring changes in blood flow to active neurons. The scans in the middle and right show brain regions responding to different parts of the visual field. © T. Orlov.

## Building on Excellence

True insight into the brain can only be made by combining knowledge from multiple scientific fields. The Hebrew University is well known for its pioneering interdisciplinary and multi-level approach to understanding the brain, leading to an excellent record in brain research. In both 2000 and 2004, Hebrew University's Interdisciplinary Center for Neural Computation was recognized by the European Commission as a Center of Excellence – the only brain research center in Israel and Europe to ever win this award. Recently, Hebrew University neuroscience was reviewed by an international group of scientists, including two Nobel Prize Laureates, and judged highly promising, with the potential to become one of the top five brain research centers worldwide. This led to the launch in June 2009 of the Edmond and Lily Safra Center for Brain Sciences – which is poised to take Hebrew University neuroscience to the next level of excellence and discovery. **Join us for a fascinating glimpse into the world of modern brain research at the Hebrew University's new Center for Brain Sciences.**

## Neurosurgery and Neuronal Disorders

In neurosurgery, it is vital to find a safe operational trajectory, one which will not hit major blood vessels or damage functional brain areas. **ELSC** scientists create computer-aided methods to enable neurosurgeons to perform safer brain surgery through visualization of individual patients' exact brain anatomy and the calculation of neurosurgical "risk maps" of the brain. These methods enable neurosurgeons to perform operations such as Deep Brain Stimulation, one of the most promising treatments for Parkinson's patients, pioneered at the Hebrew University. **ELSC** scientists are making similar advances towards therapies for diseases such as schizophrenia, depression, and Alzheimer's.

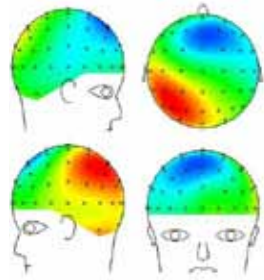


Computer simulations showing blood vessels and functional brain areas for each patient allow neurosurgeons to perform safer brain surgery. © L. Joskowicz.

## Consciousness and cognition

Our brain constantly perceives large amounts of information. Not all of this information enters conscious awareness; sometimes, we perceive things without being aware of it. Scientists at **ELSC** investigate the split-second process by which information enters conscious awareness through the use of advanced EEG brain scans. This scan measures the electrical activity collectively generated by thousands of neurons, and monitors active, living brains instantaneously.

Right: The EEG scan - noninvasive electrical recordings from the human skull - provides a real-time glimpse into the living brain. © L. Deouell.



## Reorganizing the Brain for Sensory Substitution

Can a brain that has lost a certain ability compensate for it? Can brain regions take on new functions? Sensory substitution, the use of one sense to replace another, provides hope for the blind at **ELSC**. Blind subjects are taught to use specially designed sound recordings to "hear" a shape, such as a horse. Brain scans are made while they are engaged in hearing shapes. These show that brain areas that process visual information in seeing individuals can become involved in "hearing" the shape in the blind – proof of the remarkable ability of the brain to reorganize itself. Insights from this research may also help in other cases in which brain reorganization is vital, such as after a stroke.



Right: Visual brain areas (shown as orange spots on the image of the brain, bottom) are involved when blind subjects recognize shapes by listening to soundscapes (top). © A. Amedi et al., Nature Neuroscience, 2007.



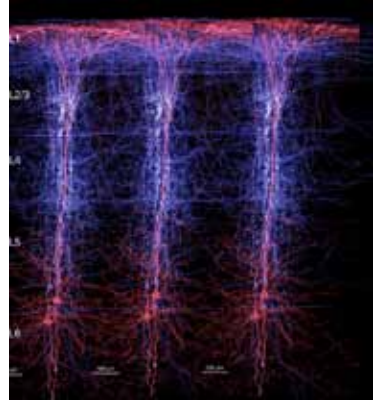
A model of microRNA 132, the micro-gene that indirectly influences mind-body communication. © H. Soreq.

## Genes: a Key to Curing Neurological Disease

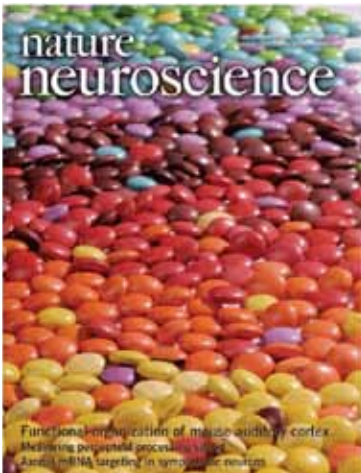
A micro-gene discovered at the **ELSC** molecular neuroscience labs may help explain how the brain controls mind-body communication. The micro-gene regulates the levels of acetylcholine, a neurotransmitter influencing body and brain which is involved in neuronal disorders such as Alzheimer's disease, but also in plasticity – the ability of the brain to rewire itself. This discovery may lead to new cures for neuronal disorders, alleviate the reactions of body and mind to stress, and improve neural plasticity.

## Discovering the Fundamental Laws of the Brain

The human brain contains over one hundred billion nerve cells. How do these neurons interact to enable perception, action and consciousness? The answer to this question is the holy grail of brain science and a major research focus at **ELSC**. To discover the fundamental laws that govern brain function, **ELSC** scientists create mathematical models and theories of the brain, based on the latest experimental findings. **ELSC** is a trailblazer in this new field of computational neuroscience, which aims to use mathematics as the unifying language in the quest to understand the brain. **ELSC** scientists play a central role in the international Blue Brain Project, which uses a supercomputer to realistically model extremely complex brain networks.



A Blue Brain model of a 1 mm cube of mammalian cortex. This tiny cube contains around 10,000 cells and 1 billion neuronal connections. © BBP/EPFL



Using candies to illustrate their findings, ELSC scientists discover how sound is represented in the brain. © Rothschild et al., Nature Neuroscience, 2010.

## Understanding Hearing: New findings on the auditory cortex

ELSC scientists designed this cover for the prestigious journal "Nature Neuroscience" to illustrate their groundbreaking study on the organization of nerve cells in the auditory cortex. Monitoring the activity of dozens of neurons simultaneously, they showed that neighboring neurons may respond very differently to different sounds. The colored candies represent neurons responding to different ranges of tones. This finding sheds new light on the organizational principles of the auditory cortex.

## Learn More about ELSC

Scientists at **ELSC** are leading the scientific community in the acquisition of knowledge that will shape human understanding of the brain. A new Center which brings together outstanding young faculty recruits, world-renowned experts, talented students, ample research funding, state-of-the-art equipment and a new modern facility, **ELSC** will serve as a powerful intellectual home for cutting-edge research and brain-related technologies.

The Edmond and Lily Safra Center for Brain Sciences is one of the only places in the world where scientists from different fields work closely together in an interdisciplinary approach towards understanding the brain. Research at **ELSC** encompasses molecular, cellular, circuit and behavioral levels, with particular emphasis on brain theory and modeling. This approach is also reflected in the Center's highly ranked and pioneering interdisciplinary PhD program - where promising young neuroscientists are being trained in the most comprehensive neuroscience curriculum worldwide. These students are poised to become a new generation of true Renaissance brain scientists, at home in all theoretical and practical aspects of brain research. This outstanding study program also places a strong emphasis on the communication of new scientific findings to the public.

The Center will include a new state-of-the-art facility which will house advanced laboratory spaces, seminar rooms, common areas, computer facilities, a 3D video conference room, and the largest brain sciences digital library in Europe and the Middle East. Meaningful philanthropic opportunities exist to help promote brain research. For further information, please visit our website [http://elsc.huji.ac.il/](http://elsc.huji.ac.il) or contact:



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