



BGU'S BRAIN TRUST

Where brain
health is
always on our
minds



אוניברסיטת בן-גוריון בנגב
Ben-Gurion University of the Negev

A Global Problem

The brain is a complex organism shrouded in its own mysteries, susceptible to diseases and neurological disorders, yet countered by strong mechanisms and untapped potential for protection and restoration.

As the world's population grows older, more people are affected by neurological diseases such as Alzheimer's, Parkinson's and stroke. Mental disorders such as schizophrenia, autism and depression are also increasingly recognized as major health, social and economic burdens.

Together, neuropsychiatric disorders pose the top global health challenge of the 21st century, with over 30 percent of the world's population suffering from a brain related disorder and millions affected to the extent of disability.

One of every four families in the United States has a loved one with a debilitating brain disorder. Millions are affected to the extent of severe disability: approximately 2 million people by schizophrenia; 3 million by Alzheimer's Disease; 2 million from Parkinson's Disease and 8 million from depressive illnesses, and many millions more from other brain diseases and disorders.

The European Union estimates that the total cost of direct medical expenses, direct non-medical costs and indirect costs has risen to a staggering 800 billion euros per year.



The BGU Brain Trust

Despite remarkable therapeutic advances, brain science still faces enormous challenges, particularly in understanding and treating brain-related diseases and injuries. Researchers at Ben-Gurion University of the Negev are gaining access into the secret passageways of the brain through collaborative research that spans many scientific disciplines. Working together, they are able to gain insight into how the mind works, what causes the brain to malfunction, and how to fix it when something goes wrong.

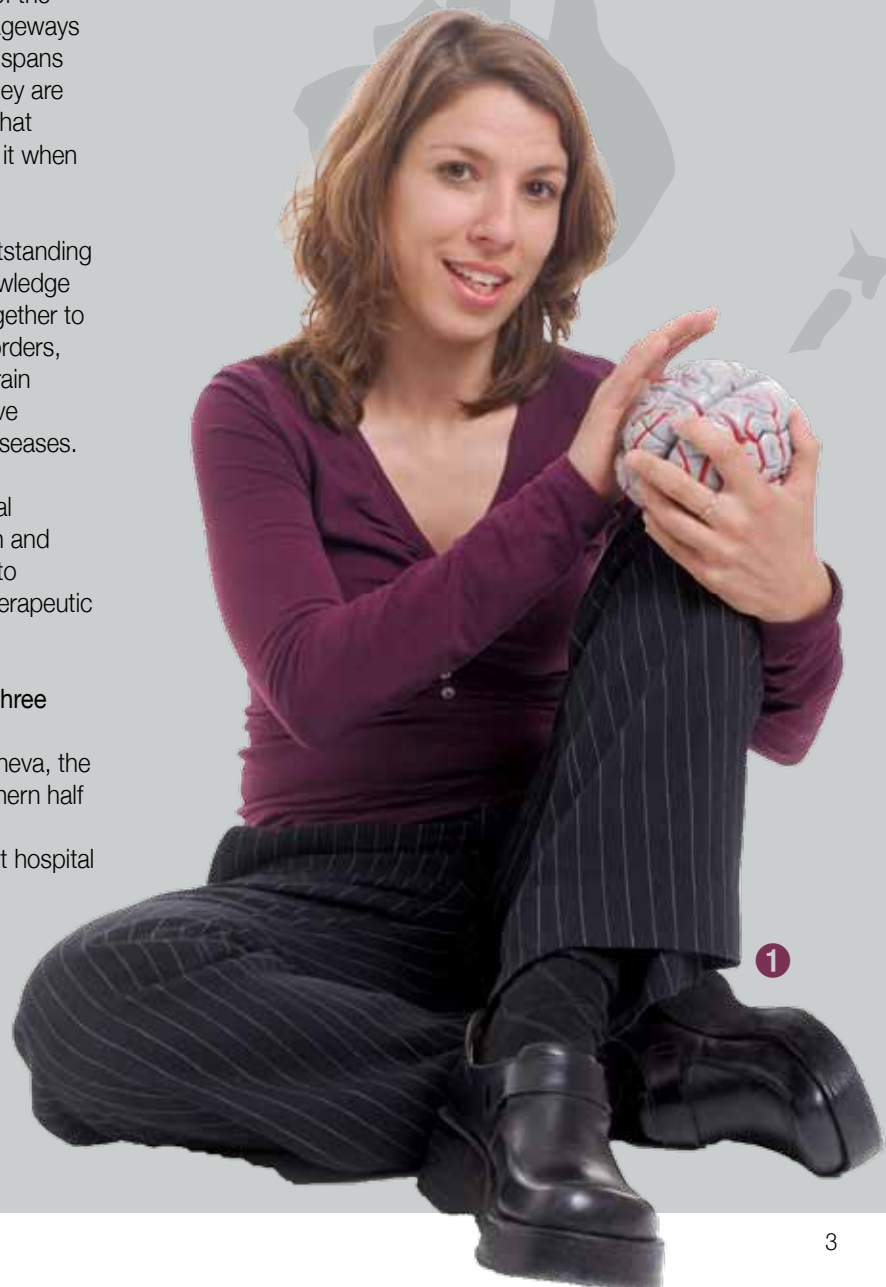
The **BGU Brain Trust** has brought together an outstanding international team that is at the forefront of knowledge in this critical field, with researchers working together to develop pioneering methods for a range of disorders, focusing primarily on ischemic and traumatic brain injuries, Alzheimer's and other neurodegenerative diseases, epilepsy, autism and stress-related diseases.

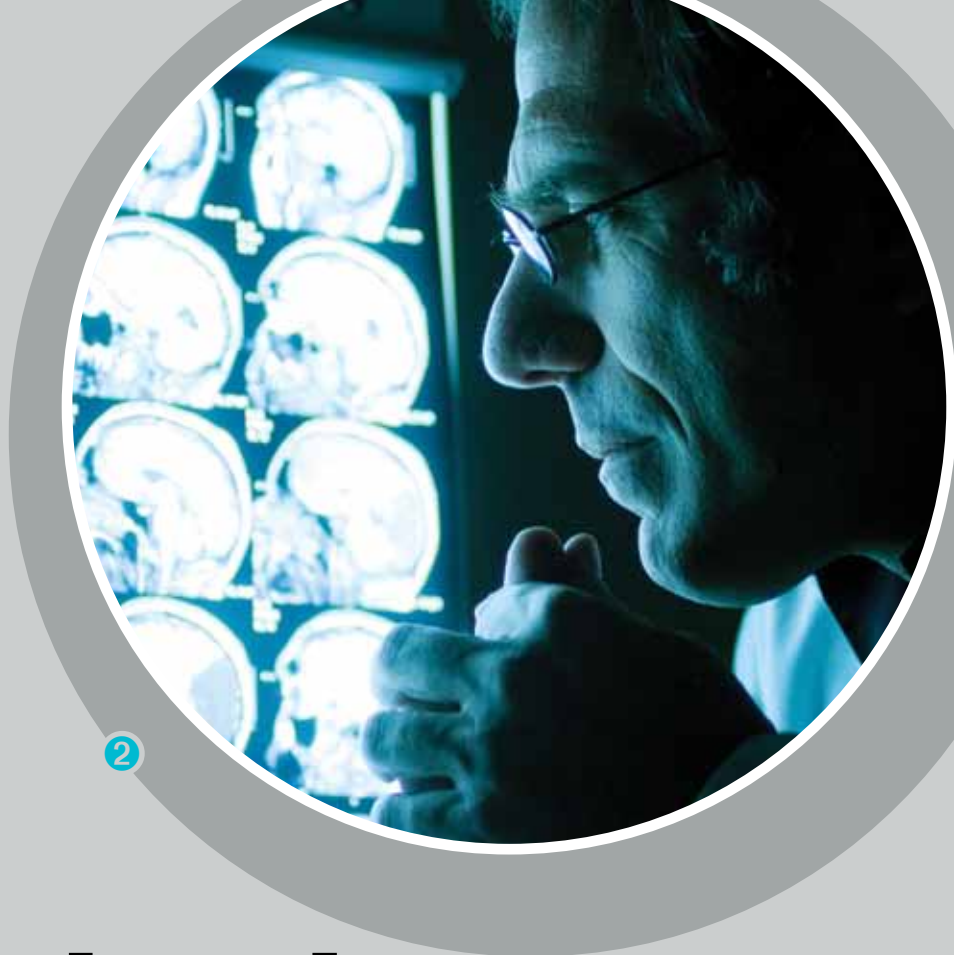
BGU emphasizes the importance of translational research – going from the bedside to the bench and back – seeking to translate scientific findings into medical treatments and research results into therapeutic intervention.

We benefit from professional affiliations with three comprehensive teaching medical centers:

- Soroka University Medical Center in Beer-Sheva, the only major medical center in the entire southern half of Israel
- Barzilai Medical Center, the Ashkelon district hospital
- Ministry of Health Mental Health Center in Beer-Sheva

❶ *Dr. Galia Avidan, Department of Psychology*





A Comprehensive Approach

The **BGU Brain Trust** is a group of dedicated BGU researchers, doctors, clinicians and scientists mobilized to replace brain disease with brain health. This group includes over 50 dynamic faculty members and 130 graduate students from four University faculties. In 2011, these impressive researchers received over \$8 million in grants and produced more than 100 peer-reviewed publications.

The Brain Trust builds upon the collective expertise and existing scientific infrastructure of BGU's unique existing research groups, particularly the Zlotowski Center for Neuroscience. Created 15 years ago thanks to the vision of Suzanne Zlotowski, UK, the Center has earned an international reputation for its interdisciplinary approach to the field. Researchers come from varied disciplines, including psychology, linguistics and philosophy of the mind, cellular neuroscience – including molecular biology, physiology and imaging, system neuroscience, electrical and biomedical engineering and computer sciences, clinical neurology and psychiatry.

In 2011, the Center's founder and the incumbent of the

Zlotowski Chair in Cognitive Neuropsychology Prof. Avishai Henik received the European Research Council's most prestigious research prize for his pioneering work in numerical processing, word processing, attention (spatial and selective) and synesthesia. Dr. Galia Avidan, a young investigator who joined BGU in 2004, was awarded the 2011 Toronto Prize for excellence in research and accepted as one of 10 "Rest of the World" members in the exclusive International Neuropsychological Symposium (INS), which includes only 124 members worldwide. Prof. Alon Friedman, the present Chair of the Zlotowski Center, won the 2008 International Michael Prize for his discoveries related to epilepsy.

It is this interdisciplinary approach that has made BGU the number one choice for Israeli students in the field of brain science. The highly competitive undergraduate and graduate programs in brain and cognitive sciences attract students from around Israel. A combination of scholarships, summer research programs and research funding ensures that BGU has the highest caliber students pursuing advanced degrees by creating a supportive environment that nurtures innovation and excellence.

② *Prof. Alon Friedman, Head of the Laboratory of Experimental Neurosurgery*

Neurobiology of Disease

The Neurobiology of Disease Group focuses on understanding common neurological diseases. It includes researchers from the Faculty of Health Sciences, Soroka University Medical Center, the Mental Health Center in Beer-Sheva, the National Institute for Biotechnology in the Negev and the Faculty of Humanities and Social Sciences. It explores the interactions between the brain and the immune system and its contribution to stroke, Parkinson's, Alzheimer's disease and epilepsy. Specifically, the profound social and economic impact of an ageing population highlights the need to understand the factors that influence cognitive health and the decline that occurs with age.

BGU's group of neuroscientists are investigating the hallmarks of ageing in the brain, the mechanisms

underlying brain aging with particular attention to blood vessels integrity, the blood-brain barrier and the immune system, and the implications for brain function and disease susceptibility.

BGU researchers hope to achieve a clinical application that will provide a quantitative and reliable measure for vessels permeability within the brain within the next year. The new method will be tested and validated in a group of healthy controls and in a cohort of neurological patients.

Principal investigators

Galia Avidan, Ilya Fleidervish, Alon Friedman, Daniel Gitler, Avishai Henik, Gal Ifergan, Alon Monsonogo, Ilan Shelef, Ran Taube, Abraham Zangen



Researchers from the Neurovascular group have developed a patented novel diagnostic tool for diseases of the retina. The blood supply to the retina is comprised of distinct vessels which are separated from the retinal extracellular space by the blood-retinal barrier (BRB). Changes in retinal blood flow and BRB properties accompany common diseases of the retina including those frequently found in diabetes mellitus, retinal vein occlusion and age related macular degeneration – all of which result in blindness. This new diagnostic method is the first computer-aided approach that accurately quantifies and assesses both blood flow and permeability in specific vessels within the retina during fluorescent angiography, allowing early detection and treatment (preventing visual loss).

Robotics and Neuro-Rehabilitation

The Motor Research Group includes researchers and clinicians from the fields of physiotherapy, neurology, life sciences, computer sciences and engineering. The Group studies how the brain controls movement in health and disease and develops new therapeutic devices. For those in recovery from stroke and traumatic brain injury or living with cerebral palsy and Parkinson's disease more efficient rehabilitation methods are required.

In Israel, due to war and terrorist attacks there are a large number of trauma injuries among young people. These injuries can lead to severe motor disabilities which also require new approaches for rehabilitation.

Principal investigators

Simona Bar-Haim, Ohad Ben Shachar, Opher Donchin, Amir Karniel, Itshak Melzer, Ronen Segev, Ilan Shelef



The Cognitive Robotics team is working on a number of projects that study the brain during sensory, motor and cognitive tasks and implement this knowledge in the design of "sentient robots." As a result of collaborative research with members of the Department of Biomedical Engineering and Faculty of Health Sciences, we are developing mechanical aids for people with movement disabilities, as well as computer-aided robotics for rehabilitation of patients after traumatic brain and spinal injuries and stroke.

③ Dr. Amir Karniel, Department of Biomedical Engineering

Stress-related Illnesses

The Stress Group is working towards a better understanding, diagnosis and prevention of stress-related brain diseases. Studies have shown that one in eight Israeli soldiers return home from war with Post Traumatic Stress Disorder (PTSD). Terror leaves at least 42 percent of all children exposed with PTSD. Located in the Negev region, where the population is prone to significant stressful life experiences, from poverty to missile attacks, a team of researchers from all fields of neuroscience and experienced clinicians are looking to understand the unseen effects of stressful life events on brain development and functions, which may increase the risk of mental and neurological disabilities.

Principal investigators

Hagit Cohen, Alon Friedman, Shahar Golan, Ora Kofman, Hadar Shalev, Ilan Shelef, Doron Todder



While stress-related diseases — particularly PTSD — pose a significant problem, there are still no efficient therapeutics for its prevention. Researchers from the Ministry of Health Mental Health Center in Beer-Sheva and the Zlotowski Center for Neuroscience recently showed that high doses of corticosteroids may prevent the development of PTSD. In a placebo-controlled pilot clinical study with 25 patients who displayed acute stress symptoms, the findings were clear: high-dose hydrocortisone treatment given in the first few hours after a traumatic experience was associated with significant favorable changes in the trajectory of exposure to trauma, as expressed by the reduced risk of the development of PTSD post-trauma. A parallel comparative study demonstrated that there is a “window of opportunity” in the early aftermath of trauma to help those who are vulnerable to the development of chronic PTSD.

4 Prof. Hagit Cohen, Ministry of Health Mental Health Center in Beer-Sheva



The Brain Matters



The **BGU Brain Trust** embodies the University's mission to reach out to the community, in the Negev and around the world. The Zlotowski Center for Neuroscience organizes community-wide programs to promote brain health and distributes knowledge on brain functions in health and disease.

Victims of War

Contribution of the Cholinergic System to the development of PTSD in Children and Adolescents

This joint project of German, Palestinian and Israeli researchers, funded by the German Science Foundation, studies the effect of stress on the children's brains, in particular the children of Gaza and the town of Sderot, which have suffered almost constant missile attacks for the past eight years. Stressful events, especially life-threatening situations, have been known to cause long-term neurological and biological damage on adults. This project explores how stress influences brain structure and the ability of children and adolescents to process intense emotions or form new memories. Overall, the goal of this project is to identify exposed children and adolescents who are at a greater risk to develop stress-associated brain diseases, allowing follow-up, earlier diagnosis, prevention and treatment.

Early Diagnosis of Malaria

Malaria is a prevalent disease affecting more than 515 million people every year, 70 percent of them in sub-Saharan Africa. While most malaria patients can be safely treated with anti-parasitic drugs, a substantial percentage of patients will develop Cerebral Malaria – an acute, severe form of the disease involving the brain, mainly affecting children under 10 years of age, Cerebral Malaria is the main cause of death from malaria, with a 25 percent death rate even with the best of treatment, making early diagnosis and prompt appropriate medical care a life-saving goal. Despite this, the etiology and mechanisms underlying Cerebral Malaria remain unknown, which prohibits the development of appropriate diagnostics and treatment methods for the disease.

BGU's research team has established an international collaboration with Ethiopian clinicians and European scientists to find novel mechanism-directed diagnostic aids and treatments for the disease. The research focuses on the role of blood-brain barrier dysfunction and brain inflammation in the initiation of seizures as the marker for new therapeutic targets.





Advanced Technologies Saving Lives

BGU's Brain Imaging Research Center (BIRC) combines anatomical and functional modalities for advanced imaging of the brain's inner workings, answering a variety of clinical medical needs. Located at the Soroka University Medical Center, the BIRC serves a catchment area that spans from Kiryat Gat to Eilat, providing state-of-the-art neuroimaging capabilities to the local population while advancing the University's research programs.

The BIRC integrates several cutting-edge technologies for brain imaging including high-density electroencephalographic (EEG), and both anatomical and functional magnetic resonance imaging (fMRI).

In 2012, we acquired a new 3T MRI which will significantly increase the Center's research capacity. This functional MRI offers us the opportunity to overcome the limitations and opens us up to a whole new perspective to study the brain and assist in the diagnosis of some diseases by enabling the simultaneous investigation of both electrical activity and the vessels' response to brain activation.

Its purchase was made possible thanks to the partnership between Ben-Gurion University of the Negev and Soroka University Medical Center and the generosity of dedicated friends and supporters.

5 *Dr. Ilan Shelef, Soroka University Medical Center*



Ben-Gurion University of the Negev

aspires to fulfill the vision of Israel's first prime minister, David Ben-Gurion, who believed that Israel's future lay in the development of the Negev, a desert area comprising more than sixty percent of the country. Today, at its campuses in Beer-Sheva, Sede Boqer and Eilat, close to 20,000 students are enrolled in the Faculties of Engineering Sciences, Health Sciences, Natural Sciences, Humanities and Social Sciences and the Guilford Glazer Faculty of Business and Management, the Joyce and Irving Goldman Medical School and the Kreitman School of Advanced Graduate Studies. Major University research institutes include the National Institute for Biotechnology in the Negev, the Jacob Blaustein Institutes for Desert Research with the Albert Katz International School for Desert Studies, the Ilse Katz Institute for Nanoscale Science and Technology and the Ben-Gurion Research Institute for the Study of Israel and Zionism. Repeatedly voted the most popular choice of Israeli undergraduate students, the University is known for its dynamic atmosphere and commitment to excellence in teaching and research.

Ben-Gurion University is a world leader in arid zone research, offering its expertise to many developing countries. In keeping with its mandate, it plays a key role in promoting industry, agriculture and education in the Negev. Thousands of its students take part in community-oriented activities and special tutoring projects. The University welcomes exciting challenges in innovative fields of research and strives to bring new opportunities to Beer-Sheva and the Negev while continuing its pursuit of academic excellence and expanding its contribution to the community.

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BGU has undertaken a new mission – to promote brain research here in the Negev – guided by a philosophy of actively seeking our “brain health” by working along the full spectrum of diagnostics, preventive measures and treatment schemes.

I am convinced that BGU, together with our affiliated hospitals, other concerned partners, and of course with the help of our committed supporters, can succeed in improving the quality of life for those affected (and potentially affected) by brain-related diseases and disorders.

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R. Carmi

Rivka Carmi, M.D.

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