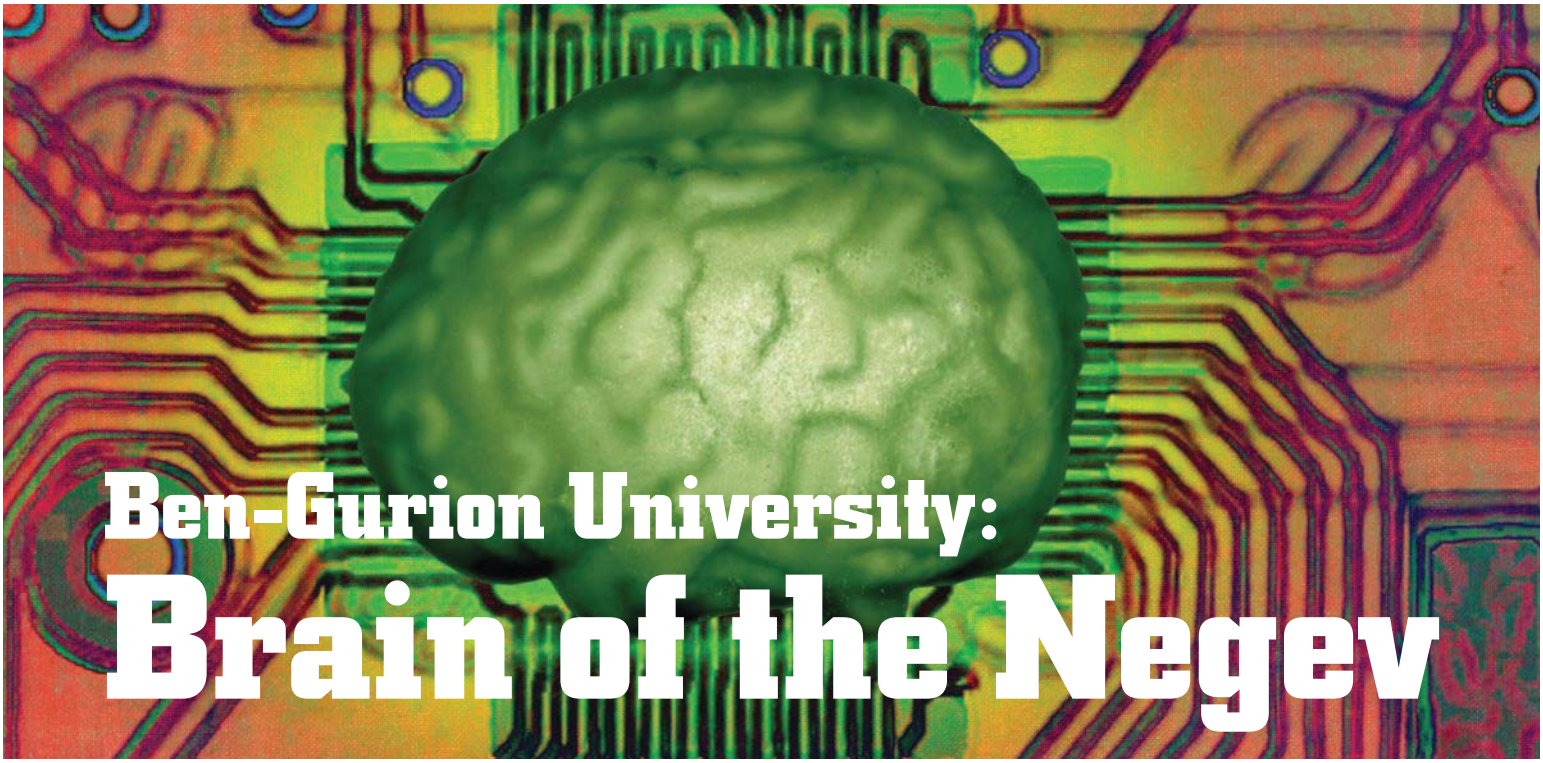


Ben-Gurion University: Brain of the Negev

By Maayan Jaffe

Founded 46 years ago, Ben-Gurion University of the Negev is Israel's youngest university. Located in the southern Israeli city of Beersheba in the Negev desert, BGU also plays a role as Israel's leading center for medical and neuroscience research.

Over the last decade, especially, BGU has become the center for cutting-edge exploration of the brain and how it relates to everything from sports-related concussions to dementia to autism. Its doctors and scientists have been making discoveries outside the classroom that hold out hope for millions who suffer from brain disorders.

"Despite our youth in comparison with leading universities in Israel and abroad, we are very much present on the international academic stage," says BGU President Rivka Carmi. BGU is the country's fourth-ranked and is 292 worldwide, according to the QS World University Rankings, which rates 800 such institutions around the globe.

For years, BGU was overlooked by young Israelis enrolling for a university degree. Those who did choose BGU were likely to leave Beersheba upon graduation. Today, however, BGU is Israel's fastest-growing institution of higher learning. It has also developed an international reputation for multidisciplinary research.

In the last 10 years, its student population has tripled to more than 20,000 on three Beersheba campuses. Its students come from all over Israel and include native born Israelis, Jews and Arabs, including Bedouins, and new immigrants from Ethiopia, the former Soviet Union and other countries. In a recent survey of 280,000 Israeli students, BGU ranked number one in the country for its ambience and individual attention.

BGU scientists and doctors work together at the adjacent Soroka Medical Center. Affiliated with the university, it serves residents of southern Israel, as well as Palestinians who come for treatment from the Gaza Strip, a mere 28 miles from Beersheba.

"We really live on the border, with this tension," said Dr. Opher Donchin of BGU's Zlotowski Center for Neuroscience. The tension, he said, drives faculty to undertake deeper analysis of their work, balancing basic research with the applied and clinical needs of the area's diverse population. "That is how we teach our students: to examine all projects in a scientific and clinical light," Donchin said.

On a tour of the neuroscience and neurotechnology facilities at BGU, Donchin's shows labs that do low-tech brain mappings and three-dimensional plastic renderings, and also machines that conduct some of the most sophisticated and expensive magnetic resonance imaging (MRI). It is here that graduate students, scientists, doctors and behavioral health clinicians work to determine the roots of some of the most traumatizing brain disorders: Alzheimer's, schizophrenia, autism, epilepsy and traumatic brain injury.

Breakthrough Israeli Brain-Mapping Technology

"Looking at the structure of the brain is like looking at [a] Google map," says Ronen Gadot, CEO of a new Israeli company, ElMindA, which is powered by a technology developed by BGU professor Amir Geva. Gadot explains that a basic MRI examines a brain's biology. To understand brain disorders, he says, one has to look at a brain's diseased nervous system tissue.

"Brain disorders cause a change in traffic, in flow of information," explains Gadot. ElMindA "is looking at the traffic."

A simple helmet with dozens of tiny plastic receptors smothered in sonogram jelly, ElMindA's octopus-like headgear provides a comprehensive look at the brain. The technology—trademarked as BNA, for Brain Network Activation—helps clinicians understand and visualize the complexity of the brain's function, dysfunction, disease progression and response to therapies.

Geva, whose background is in computer engineering, said he became interested in the brain when he realized it was operating like the central processing unit of a computer, via billions of neurons, organized into complicated interconnecting neural networks.

"I realized that you cannot study the brain only by looking at its biology," Geva explained. "The only way to understand brain functionality is to measure these electrical fields. I threw myself into understanding the sources of our brain activity, and this [led to] with ElMindA."

Courtesy of Dani Machlis

Simona Bar-Haim, head of BGU's Laboratory for Rehabilitation and Motor Control of Walking observes a subject on a treadmill.

ElMindA has focused on trauma-induced concussions. Gadot explained that before ElMindA, when athletes were diagnosed with concussions, their readiness to return to the field was based on subjective testing. These tests are affected by environmental factors such as fatigue, hunger or other distractions and can be "gamed" by the athlete taking them.

"Sometimes, while the symptoms would get better, the brain was not fully recovered. Growing evidence shows that going back to play or hitting the head before full brain recovery can cause permanent brain damage," said Gadot.

ElMindA, in contrast, measures brain changes during the sports season in both athletes who suffer concussions and those who don't. This ensures players stay on the field when they can and keeps them safe until full recovery.

Geva said the company has conducted thousands of baseline tests of athletes who haven't suffered concussions, which can be compared to those who later suffer injuries.

What's next? Geva is using the mapping technology to learn more about the brain activity in people who suffer from depression and attention deficit hyperactivity disorder. "It sounds like science fiction," says Geva, "but it's not."

Advances in Alzheimer's Research

In another area, Alon Friedman, head of the university's Laboratory for Experimental Neurosurgery, is focusing on injury-related epilepsy and neuro-degeneration in animals and humans. His latest experiments point to the possibility that brain diseases and injuries could be treated through the blood-brain barrier, a filtering mechanism of the capillaries that carry blood to the brain and spinal cord tissue. When intact, the blood-brain barrier prevents damaging chemicals or bacteria from leaking from the blood stream into the brain.

In contrast, "once the barrier is abnormal, diseased, 'leaky,' there's a tendency for seizures and epilepsy and eventually cell death," explained Friedman.

The professor believes some untimely deaths of professional football players in recent years could be linked to concussions, which led to leaky blood-brain barriers and ultimately vascular disease that the players didn't know about.

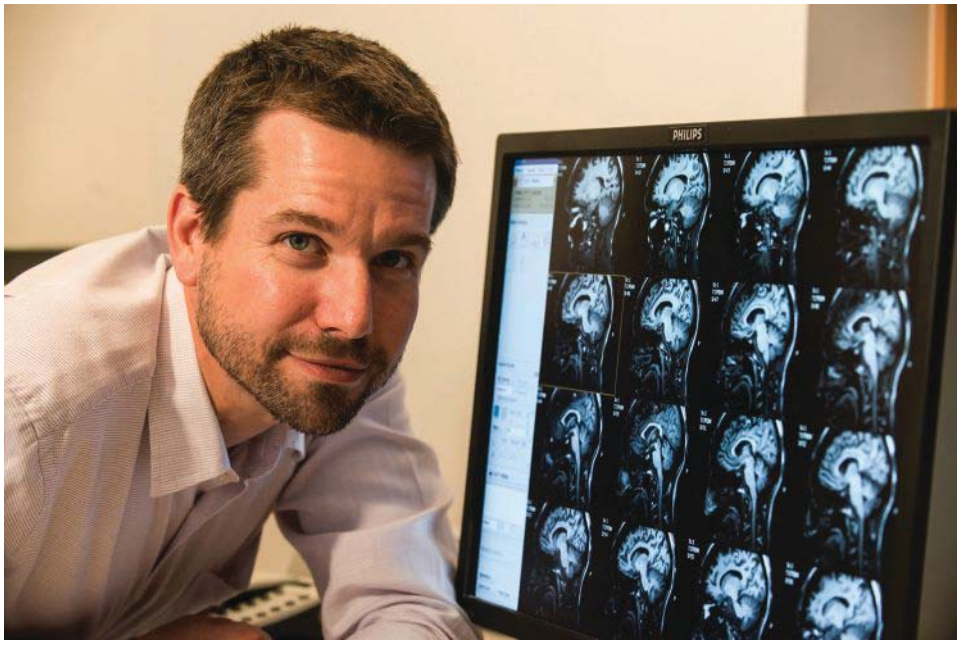
This research could also have an impact on the diagnosis of and eventual prevention of Alzheimer's, which, according to the National Institute of Health, plagues as many as 5 million Americans age 65 and older.

Friedman found the hypertension drug losartan prevents a majority of cases of post-traumatic epilepsy, when tested on diseased rodents. Losartan was found to block the protein called albumin from leaking through the barrier and leading to inflammation, which appears to permanently alter the brain's wiring. Friedman also worked with scientists from Soroka's Brain Imaging Group. Together, the group discovered an advanced MRI imaging technique to diagnose whether the blood-brain barrier has been breached—after trauma, or sometimes simply from age.

If clinicians can see the leak, Friedman explained, they could administer losartan to slow or stop the damage.

"Today, it is difficult to identify those patients at risk for dementia," said Friedman. "Once we can diagnose it, we can develop a way to protect them from it, repair [the brain damage causing it] and even prevent it."

Dr. Ilan Dinstein, a member of Zlotowski Neuroscience Center, is searching for objective measures that would allow clinicians to identify toddlers who will later develop autism.

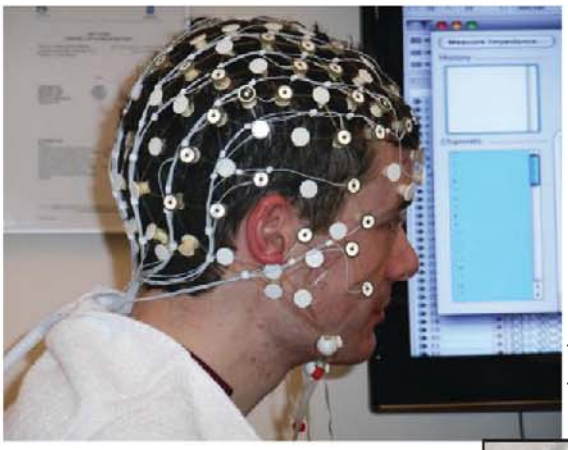


Courtesy of Dani Machlis

Tackling Autism from All Angles

One in 68 children is on the autism spectrum, according to the U.S. Center for Disease Control. Despite these numbers, there are currently no objective biological measures to identify autism; it is diagnosed predominantly by behavior—language dysfunction, social difficulties—which can be subjective.

Dr. Ilan Dinstein, a member of BGU's Zlotowski Neuroscience Center, is searching for objective measures to identify toddlers who will later develop autism, based on



Courtesy of Majan Jaffe

A patient at the ElMindA headquarters in Herzylia undergoes Brain Network Activation analysis, a system founded by Ben-Gurion University.

MRI scans and/or electroencephalography (EEG) exams conducted as early as age 1.

Dinstein has been using sophisticated imaging to look at the brain structure and function of toddlers with and without autism. He recently found that 2-to-3-year-old toddlers with autism exhibit reduced synchronization of the left and right sides of the brain.

In a separate but related study, he found that autistic individuals have "noisy" or inconsistent brain activity.

Dinstein said that those with noisier brains have a harder time making the subtle associations necessary for proper social interactions.

Idan Menashe, a senior lecturer in BGU's public health department, has been studying the genetics of autism. He has managed to identify seven "hotspots," duplication of a particular gene in a human's genetic makeup, which he believes are linked to autism.

"Our study helped prioritize these regions, so doctors know where to look for [these genetic variations] that might be associated with autism," Menashe said. Combining this new tool with psychiatry, the diagnosis becomes more reliable.

Dinstein and Menashe are part of a BGU team opening a first-ever multidisciplinary center in Israel for autism. It will bring together neuroscientists, geneticists, clinicians and biologists to look at the disorder from different angles, using the Negev population to examine any possible ethnic link to autism.

"Sometimes it seems that when it comes to autism there is nothing promising, no known

Courtesy of Dani Machlis

Professor Alon Friedman's revolutionary research may help prevent Alzheimer's and other forms of dementia.

cause and no effective treatment," said Menashe. "When we join forces, the possibilities are endless."

Stepping Up to Assist Teens with Cerebral Palsy

Simona Bar-Haim, head of BGU's Laboratory for Rehabilitation and Motor Control of Walking, combines math, neuroscience and physical therapy in her work with teenagers with cerebral palsy. She found that the brain of a healthy person is flexible and adaptable, enabling the individual to walk on uneven ground. Using a combination of tactics, including a split treadmill, where right and left treads operate at different speeds, Bar-Haim believes she can increase the plasticity of her patients' brains.

"The challenge is to find a way to train a damaged brain," said Bar-Haim.

Bar-Haim has been conducting her study with partners in Jordan, Morocco, Hebron and East Jerusalem, and comparing results among teenagers from those areas with Israeli teens. The results have been consistent.

Bar-Haim said her work is equally about science and humanity, women's empowerment and peace. Her vision of "universal design" is a hope that there will be scientific solutions that allow people with disabilities to accomplish everyday tasks.

"There's a huge amount of peace and good will here," she said of BGU and her work at the university. "We are all very motivated."