AT HOME IN THE LAB

Ben-Gurion University of the Negev encourages women to excel in the sciences

By Melissa Gerr

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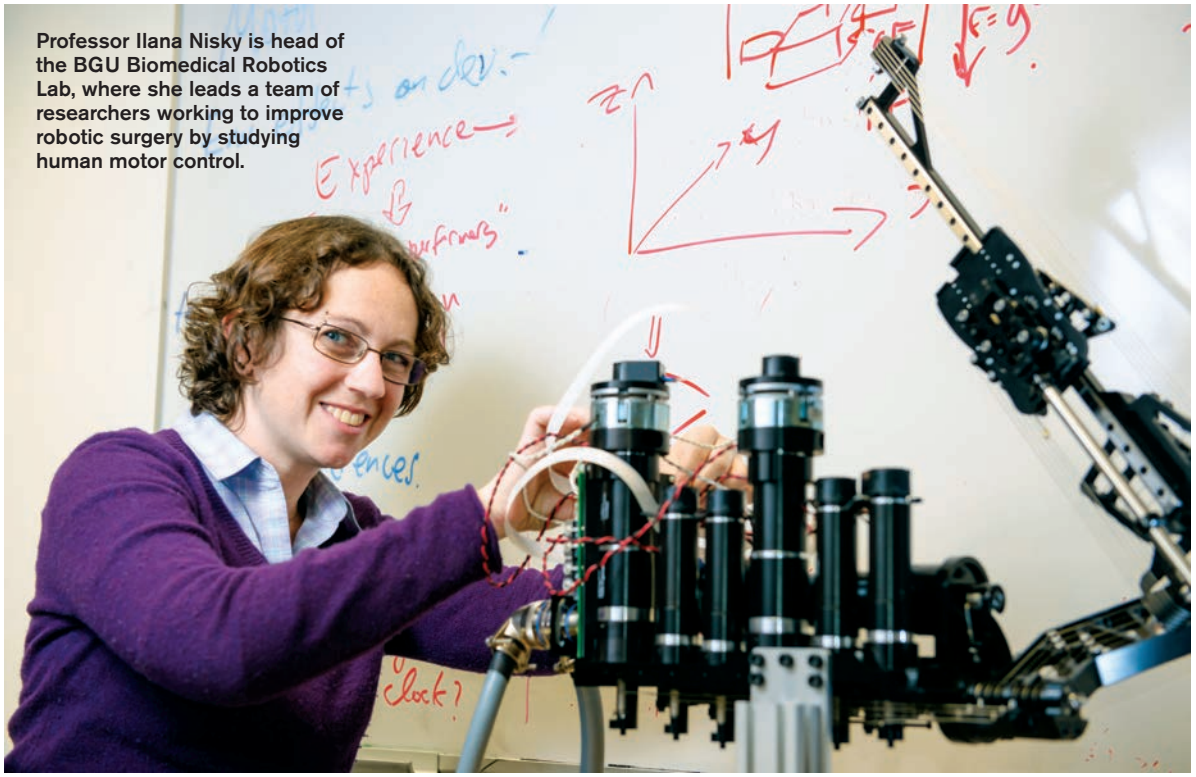

Professor Ilana Nisky is head of the BGU Biomedical Robotics Lab, where she leads a team of researchers working to improve robotic surgery by studying human motor control.

Dani Machlis

Dr. Rivka Carmi, president of Ben-Gurion University of the Negev, says it is her mission to help women advance their academic careers.

Melissa Gerr

BEERSHEVA, Israel — In sync with a worldwide momentum to attract more women to STEM fields — science, technology, engineering and math — for their study and career choices, Israel's Council for Higher Education (CHE) is spearheading a concerted nationwide effort to attract and retain more women into academia in those fields.

The results from a two-year study, begun in 2010 under the direction and urging of Dr. Rivka Carmi, president of Ben-Gurion University of the Negev, revealed that a greater number of Israeli women than men — approximately 58 percent to 42 percent — hold master's or Ph.D. degrees. But as academic rank goes up within a university system, that proportion drastically changes, showing that men hold about 85 percent of professor positions.

In order to rectify discrepancies revealed by the findings, a CHE committee recommended making the entire system more responsive to the particular biological needs and social realities of women in the modern-day Jewish state.

One of the greatest obstacles in the academic career path for women, the data showed, was time needed to accommodate for child-rearing and other family obligations. This can affect everything from postdoctoral study-abroad opportunities (a crucial part of a competitive researcher's curricula vitae) to tenure-track faculty positions, where a woman might "stop out" to have children. But tenure-track professors are under extreme pressure to complete requirements in an allotted time or lose the tenure opportunity. Also according to the study, Israeli female postdoctoral students tend to be older (about 37 years old on average) and are likely to have more children than their academic peers worldwide. The combination of these factors can lead to great challenges for women in academic careers.

Therefore, some of the committee's recommendations for all higher education institutions include adjusting the "tenure clock" to the "biological clock," a proactive recruitment policy, representation of women on major academic committees and designated scholarships for women researchers with families.

Less than two years after adoption of the plan, small improvements are starting to take hold. Carmi, a pediatric geneticist who became Israel's first woman university president in 2006 and is an accomplished researcher in her own right, was the first to adopt the recommendations at her institution.

Carmi said for her, "It's been a mission for many years" to promote higher-level academic opportunities to women, but she admits success isn't based solely on the numbers of positions women hold. She's also committed to the more difficult task to change perceptions and behavior of both men and women, who at times, she asserts, "don't even realize their biases about women's roles in academia."

Above all, her priority is "to empower young women" and "push them out of their comfort zone," she said, helping female students to understand early in their studies the options open to them for research and faculty career tracks as well as the support that is available.

Carmi pointed to Ilana Nisky, a senior lecturer in Ben-Gurion University's Department of Biomedical Engineering, as "one of the first women we helped, sponsoring her postdoc studies abroad." She added that without the push from the university — the centerpiece of the Negev desert capital that is Beersheva — Nisky may not have continued in a graduate program.

"The idea is to identify those excellent women early on and push them forward," added the president.

In addition to sponsorship from Ben-Gurion, Nisky also received postdoctoral financial support from the Marc Rich Foundation and the Weizmann Institute of Science National Postdoctoral Award for Advancing Women in Science. She recently returned to Ben-Gurion to head the Biomedical Robotics Lab, where her team is working to improve robotic surgery by studying human motor control.

Robotic surgery allows a doctor, with the use of a computer and handheld controls, to maneuver a mechanical arm equipped with small tools. A robotic

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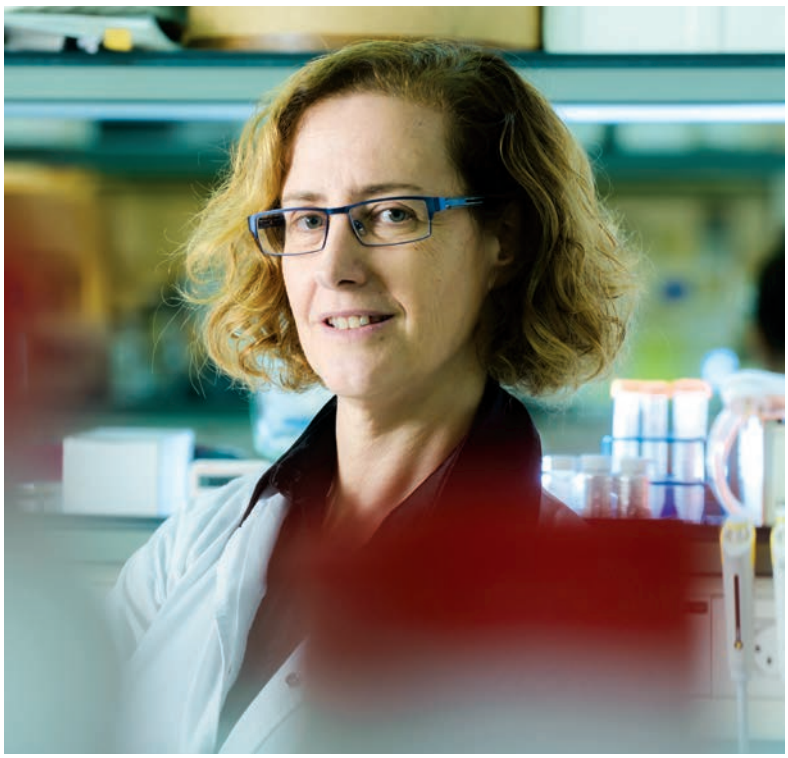

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Dr. Hanna Rapaport "models by example" for her team that includes several young female researchers. Among many other projects, Rapaport's lab has created an injectable peptide hydrogel that dramatically improves bone regeneration after a trauma.

arm or combination of arms performs the actual surgery on the patient. This type of procedure — local Baltimore examples include minimally invasive coronary artery bypass surgery performed at Johns Hopkins Medicine — happens about 500,000 times per year worldwide, Nisky said, and her team is working to improve the surgeon's experience.

What is missing when using a robotic tool is force feedback, Nisky explained, a sensation that is typically perceived through the sense of direct touch. For instance, if you reach to pick up a glass of water, you get the sensation of grasping the glass, sensing its texture and weight. But if you tried to perform that action virtually through use of a computer and a gripper device and viewed the glass of water on a screen, you could see and perform the action, but wouldn't perceive the sense of smooth glass against your hand or the heft of its weight.

The mission of Nisky's lab is to better understand "how our brain controls movement to improve [medical] robotic design and training," she said, and allow a robotic user to interact virtually but still experience a sense of touch. Their findings, she hopes, could also be applied conversely to improve the understanding of neuroscience.

Nisky's team has just begun their research, employing the use of sophisticated robotic machinery and controls like those used in surgery. Her team modifies the machines both mechanically and through software to enable them to record hand and — eventually — eye movements while a user performs a task, then compiles and processes the data.

Not every procedure can be performed robotically, but, according to Nisky, with improved user controls current procedures might one day be performed more efficiently and the list of approved robotic surgeries could grow. Others potential uses include tele-surgery, now in its early stages (a proof of concept was performed in 2001 in which a surgeon in New York performed procedures on a patient in Strasbourg, France) or for tele-mentoring, where a senior surgeon would guide a novice through specialized training at a distance.

In accordance with the CHE recommendations, BGU has also created formalized internal mentoring programs for young female researchers. Because Dr. Hanna Rapaport understands first hand that it is possible to raise and care for a family, obtain a Ph.D. degree and run a research lab, she is well placed as the mentor liaison for graduate students in the Department of Biotechnology Engineering and strives to "model by example." Rapaport supervises four young female students, who are all married and receive full support from their families, as well as passionate and successful in their research. Though Rapaport fully supports Israel's nationwide initiatives to attract and retain more women in research and faculty positions, she would prefer it not be necessary.

She acknowledges the strides Carmi has made at BGU and success at other institutions but added, "I believe the way the change should come is by simply hiring more women, and make the effort to support and encourage and recruit more women nationwide," said Rapaport, and added, that ultimately "it depends upon how much a young woman wants to develop her science career as well as the support that she has from her family. If she has the motivation and support, she can get anywhere."

Rapaport's straightforward attitude to empowering women within academics is echoed in her lab work.

"We design peptides," said Rapaport. "We [construct them] on a computer based on our understanding of principles of natural protein structures." In the simplest terms, she went on, we "mimic nature, then improve upon it."

Peptides consist of amino acids linked in a short chain. (A longer chain becomes a protein.) Amino acids, meanwhile, help perform important bodily functions and give cells their structure. Perhaps one of the most relevant properties in relation to Rapaport's research is that peptides can be essential for wound healing and tissue repair, especially for skin, muscles and bones.

"We are biotechnology engineers and build on the principles of what the body is already doing to build bones," said Rapaport. "We can come in and assist nature if there is a large bone defect that the body cannot deal with."

She cited orthopedic trauma, implants, dentistry and osteoporosis as applications for her bone generation research. For instance, if a patient requires a bone graft or other orthopedic surgery, often doctors prefer to harvest bone tissue directly from the patient, an approach that can result in high medical costs, extended time away from work and a longer healing process, Rapaport explained. With approximately $2 million of funding support to date, her team has designed an alternative to that scenario that employs peptides and other biomaterials to assist in bone regeneration and healing.

Through the use of an injectable hydrogel that contains the peptide biomaterials designed by her team, a molecular scaffold is created within bone to encourage the regeneration

Dr. Simona Bar-Haim's Re-Step technology helps cerebral palsy and brain trauma patients improve their efficiency and confidence when walking. At least half of the staff researchers and clinicians at Bar-Haim's treatment clinics, which are located in East Jerusalem, Hebron and Amman, Jordan, are women, a requirement built into the funding proposal.

Photos by Melissa Gerr

of tissue.

The hydrogel injection treatment helped bone trauma heal dramatically, in one trial 80 percent faster, said Rapaport, while other projected uses are as a delivery vector for cancer-fighting pharmaceuticals and as a treatment for osteoporosis. As the most fully developed and tested of several of her lab's projects, the next step is to set up a company to manufacture and market the hydrogel.

Dr. Simona Bar-Haim, head of the Laboratory for Rehabilitation and Motor Control of Walking at Ben-Gurion and a faculty member of its health sciences school, has taken the concept of empowering women in research and academia to another level with the Middle East Stepping Forward project funded in large part by U.S. Agency for International Development.

"We made a request [in the research proposal] that half of the researchers and medical clinicians we work with [must be] women," said Bar-Haim, "and that half of the people receiving the rehab [must be] women." The hope is that women on the team will be exposed to the idea "they [can] grow to become strong women. You know, it's a process."

As an extension of the work begun in her lab, Bar-Haim works with Israeli, Palestinian and Jordanian researchers to develop effective treatments for teens with cerebral palsy and brain trauma patients by way of re-patterning learning pathways in the brain. The goal is to help patients walk more efficiently and with more confidence, not to "normalize" a defective gait.

The Re-Step training technology, developed by Bar-Haim, is based on chaos theory. For therapeutic treatment, a patient wears specially designed shoes equipped with sensor pistons on the sole that emulate walking upon an unexpected environment. The movement of the pistons is generated by a chaos-based algorithm and creates the sensation of walking upon quickly changing terrain that causes slight uncertainty as the patient walks. The software adapts to each person's gait according to his abilities.

But visually for the patient, the look of the terrain doesn't change. For instance, as he walks using the therapeutic shoes down a hallway or sidewalk, all he sees is even terrain — but cognitively, his brain is processing the chaotic micro-movements created by the shoes. The patient compensates for the changes through balance, thus retraining the brain to adjust each step to walk with more ease and efficiency.

The movements created by the pistons are micro increments, "because the brain learns from small errors. If movement would be too big, it would be [registered as] artificial" by the brain, explained Bar-Haim. "So there are small changes for each step; up or down, left or right. ... We think this is the best training to target areas in the brain for creating plasticity of the [pathways] that control motor function."

Bar-Haim, who has been working with this technology since 2004, is conducting treatment at clinics in East Jerusalem, Hebron and Amman, Jordan.

"Every new project and new thing we're doing, we're asking that women will be involved," she said. "They are progressing, they are going forward, step by step." JT

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