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WEIZMANN INSTITUTE OF SCIENCE

Science Tips

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March 2016

People with Anxiety Show Fundamental Differences in Perception

People suffering from anxiety perceive the world in a fundamentally different way than others, according to a study reported in the Cell Press journal *Current Biology* on March 3. The research may help explain why certain people are more prone to anxiety.

The new study shows that people diagnosed with anxiety are less able to distinguish between a neutral, "safe" stimulus (in this case, the sound of a tone) and one that had earlier been associated with gaining or losing money. In other words, when it comes to emotionally-charged experiences, they show a behavioral phenomenon known as "over-generalization," the researchers say.

"We show that in patients with anxiety, emotional experience induces plasticity in brain circuits that lasts after the experience is over," says Prof. Rony Paz of the Weizmann Institute of Science in Israel. "Such plastic changes occur in primary circuits, and these later mediate the response to new stimuli. The result is an inability to discriminate between the experience of the original stimulus and that of a new, similar stimulus. Therefore anxiety patients respond emotionally to the new stimuli as well and exhibit anxiety symptoms even in apparently irrelevant situations. They cannot control this response: it is a perceptual inability to discriminate." The study was a collaboration between psychiatrist Dr. David Israeli and Paz, and it was led by Dr. Offir Laufer, then a PhD student in Paz's group.

Paz and his colleagues recruited anxiety patients to participate in the study. They trained the patients to associate three distinct tones with one of three outcomes: money loss, money gain, or no consequence. In the next phase, the participants were presented with one of several new tones and were asked whether the tone was one they had heard before while in training. If they were right, they were rewarded with money.

The best strategy would be to take care not to mistake (or over-generalize) a new tone for one they had heard in the training phase. But people with anxiety were more likely than healthy controls to think that a new tone was one they had heard earlier. That is, they were more likely to mistakenly associate a new tone with the earlier experience of money loss or gain. Those differences were not explained by differences in participants' hearing or learning abilities. The research shows that they simply perceived sounds that were earlier linked to an emotional experience differently.

Functional magnetic resonance images (fMRIs) of the brains of people with anxiety and those of healthy controls revealed differences in the activity of several brain regions. These differences were mainly found in the amygdala, a region related to fear and anxiety, as well as in the primary sensory regions of the brain. These results strengthen the idea that emotional experiences induce long-term changes in sensory representations in anxiety patients' brains.

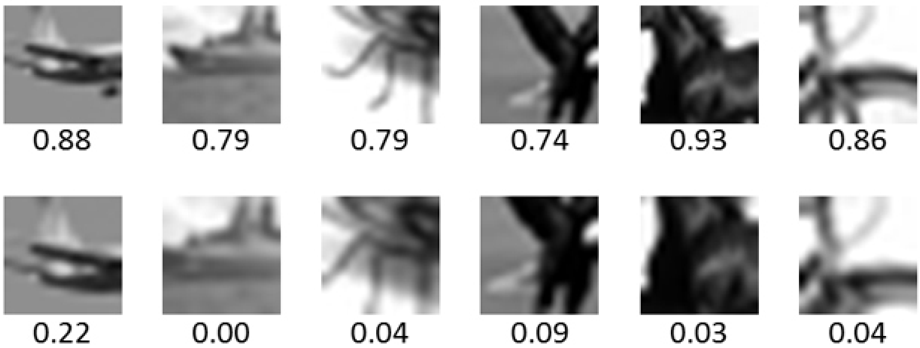
The findings might help explain why some people are more prone to anxiety than others. The underlying brain plasticity that leads to anxiety isn't in itself bad, Paz says. "Anxiety traits can be completely normal; there is evidence that they benefitted us in our evolutionary past. Yet an emotional event, sometimes even a minor one, can induce brain changes that can potentially lead to full-blown anxiety," he says. Understanding how the process of perception operates in anxiety patients may help lead to better treatments for the disorder.

This work was supported by I-CORE; ISF; the EP7 human brain project; and Minerva-Foundation grants. Prof. Rony Paz's research is supported by the A delis Foundation; the Sylvia Schaefer Alzheimer's Research Fund; the Irving and Dorothy Rom Family Discovery Endowment Fund; Pascal and Ilana Mantoux, Israel \ France; the Minna-James-Heineman Stiftung; and Gary and Kary Leff, Calabasas, CA.

http://www.cell.com/current-biology/fulltext/S0960-9822(16)00073-7

Less than Meets the Eye

We do not merely recognize objects – our brain is so good at this task that we can automatically supply the concept of a cup when shown a photo of a curved handle or identify a face from just an ear or nose. Neurobiologists, computer scientists and robotics engineers are all interested in understanding how such recognition works – in both human and computer vision systems. New research by scientists at the Weizmann Institute of Science and the Massachusetts Institute of Technology (MIT) suggests that there is an "atomic" unit of recognition – a minimum amount of information an image must contain for recognition to occur. The study's findings, which recently appeared in the *Proceedings of the National Academy of Sciences (PNAS),* imply that current models need to be adjusted, and they have implications for the design of computer and robot vision.



A small change in images at the minimal recognizable configurations (MIRC) level can cause a large drop in human recognition rate. MIRCs (top) and corresponding sub-MIRCs (bottom); numbers under each image indicate the human recognition rate

In the field of computer vision, for example, the ability to recognize an object in an image has been a challenge for computer and artificial intelligence researchers. Prof. Shimon Ullman and Dr. Daniel Harari, together with Liav Assif and Ethan Fetaya, wanted to know how well current models of computer vision are able to reproduce the capacities of the human brain. To this end they enlisted thousands of participants from Amazon's Mechanical Turk and had them identify series of images. The images came in several formats: Some were successively cut from larger images, revealing less and less of the original. Others had successive reductions in resolution, with accompanying reductions in detail.

When the scientists compared the scores of the human subjects with those of the computer models, they found that humans were much better at identifying partial- or low-resolution images. The comparison suggested that the differences were also qualitative: Almost all the human participants were successful at identifying the objects in the various images, up to a fairly high loss of detail – after which, nearly everyone stumbled at the exact same point. The division was so sharp, the scientists termed it a "phase transition." "If an already minimal image loses just a minute amount of detail, everybody suddenly loses the ability to identify the object," says Ullman. "That hints that no matter what our life experience or training, object recognition is hardwired and works the same in all of us."

The researchers suggest that the differences between computer and human capabilities lie in the fact that computer algorithms adopt a "bottom-up" approach that moves from simple features to complex ones. Human brains, on the other hand, work in "bottom-up" and "top-down" modes simultaneously, by comparing the elements in an image to a sort of model stored in their memory banks.

The findings also suggest there may be something elemental in our brains that is tuned to work with a minimal amount – a basic "atom" – of information. That elemental quantity may be crucial to our recognition abilities, and incorporating it into current models could improve their sensitivity. These "atoms of recognition" could prove valuable tools for further research into the workings of the human brain and for developing new computer and robotic vision systems.

Prof. Shimon Ullman is the incumbent of the Ruth and Samy Cohn Professorial Chair of Computer Sciences.

http://www.pnas.org/content/early/2016/02/09/1513198113.full.pdf?sid=77f3bfb3-628f-46cb-8006-dea3173b6e97

Jerusalem Girls Win the Telescope

Over 400 classes entered the competition in memory of Israeli astronaut Ilan Ramon

Yi So-yeon (center) and two members of the winning class from the Pelech Religious Experimental High School for Girls

A class of ninth-grade girls from Jerusalem were the winners of this year's Ilan Ramon Space Olympics for junior high school students. In addition to receiving a telescope for their school, they and the students from the other 11 classes that reached the final round of the competition had a day at the Weizmann Institute of Science that included a talk from a female astronaut – South Korea's Yi So-yeon.

Some 4,400 students from 404 classes entered the competition, which is now in its 12th year. To enter, students who are interested in science, especially physics, complete an online quiz. Those admitted to the final stage are presented with a mission; this year's mission was to design nanosatellites to probe either the Sun or Saturn's moons. Each group built a model demonstrating their idea and then presented it to the other groups – in outdoor booths on the Weizmann Institute campus – on the final day of the competition.

"Our idea was to send a spacecraft to asteroid 2007 EB26, which passes close to Earth on its way to the Sun," said Adi Orbach, a member of the winning team from the Pelech Religious Experimental High School for Girls, Jerusalem. "Once it reaches the asteroid it will scatter nanolabs over the asteroid's surface – one type to research the asteroid, another focused on the Sun to study pressure, radiation, magnetic fields, etc."

First prize (as well as second, third and fourth) was a telescope. Winning is great, of course, but the organizers of the Space Olympics have an ulterior motive: They hope that placing telescopes in schools will spark students' curiosity about nature and the universe. Yi So-yeon reinforced that message, telling the students to treasure the opportunities they have been given through this competition, as she had been given the opportunity to enter a similar competition as a young person.

The Space Olympics is named in memory of Ilan Ramon, Israel's first astronaut, who perished along with the rest of the Columbia space shuttle crew in 2003. It takes place every year with the support of his widow, Rona, and it is organized by Dr. Ilana Hopfeld, Dr. Zahava Scherz, Dr. Diana Laufer, Dr. Ronny Mualem and Prof. Bat Sheva Eylon, all of the Weizmann Institute's Science Teaching Department; the Ministry of Education; the Ministry of Science, Technology and Space; the Israel Astronomical Association; and the Ramon Foundation.