A Quest to Understand How Memory Works

by Claudia Dreifus

New York Times March 5, 2012

At 82, the Nobel Prize-winning neuroscientist Dr. Eric R. Kandel is still constantly coming up with new ideas for research. This winter, he has been working on a project that he hopes will lead to a new class of drugs for treating schizophrenia. Last year he collaborated, for the first time, with Denise B. Kandel — his fellow Columbia University research scientist and wife of 55 years — investigating the biological links between cigarette and cocaine addiction. And this month his newest book, *The Age of Insight: The Quest to Understand the Unconscious in Art, Mind and Brain, From Vienna 1900 to the Present*, is to be released by Random House.

A condensed and edited version of our two interviews follows. As in his new book, the conversation begins with memories of Vienna, his birthplace.

*Q: How old were you when the Nazis marched into Vienna?*

Kandel: I was 8. Immediately, we saw that our lives were in danger. We were completely abandoned by our non-Jewish friends and neighbors. No one spoke to me in school. One boy walked up to me and said, “My father said I’m not to speak to you anymore.” When we went to the park, we were roughed up. Then, on Nov. 9, 1938, Kristallnacht, we were booted out of our apartment, which was looted. We knew we had to get out.

Fortunately, my mother had the foresight to apply for visas to the United States earlier. For more than a year, we waited in the terror of Vienna for our immigration quota number to come up. When it finally did, my older brother, Ludwig, and I made the Atlantic crossing alone. Our parents came later. On the trip, it’s amazing how unfrightened I was, considering that even before the Nazis, I was an apprehensive child. You rise to the occasion.

*Q: After you won the 2000 Nobel Prize in Physiology or Medicine, did the Austrians reach out to you?*

Kandel: Yes. Their newspaper people said, “Oh, wonderful, another Austrian Nobel Prize!” I said: “You’ve got this wrong. This is an American, an American Jewish Nobel Prize.” The president of Austria wrote me a note: “What can we do to recognize you?” I said, “I do not need any more recognition, but it would it be nice to have a symposium at the University of Vienna on the response of Austria to National Socialism.” He said, “That’s fine.” I’m very close to Fritz Stern, the historian, and he helped me put the symposium together. Ultimately, a book came out of it. It had a modest impact.

*Q: As a student at Harvard in the 1950s, you aspired to be a psychoanalyst. Was this because of your Viennese background?*

Kandel: In part I was drawn to it because it promised much. In the 1950s and early 1960s, psychoanalysis swept through the intellectual community, and it was the dominant mode of thinking about the mind. People felt that this was a completely new set of insights into human motivation and that its therapeutic potential was significant. It was seen as the treatment that solved everything in the world, from schizophrenia to ingrown toenails. It’s amazing how it was oversold. When this turned out to be more hope than reality, things flipped in the other direction. In my case, I didn’t pursue it because I fell in love with research.

*Q: Did this overselling discredit psychoanalysis?*

Kandel: I think so. And it’s a shame. There are many fantastically interesting components to it that are worthwhile. The problem of psychoanalysis is not the body of theory that Freud left behind, but the fact that it never became a medical science. It never tried to test its ideas. When you asked, “How come there are not outcome studies?” you were told, “You can’t study this. How are you going to measure it?”

*Q: Talk about your Nobel research on the biology of memory.*

Kandel: I’ve long been interested in memory. What does it look like on a physical level? When I was a very young man, my mentor Harry Grundfest said, “Look, if you want to understand the brain you’re going to have to take a reductionist approach, one cell at a time.” He was so right.

*Q: So what’s the biggest problem in psychoanalysis?*

Kandel: It’s memory! In the late 1950s, I and a colleague, Alden Spencer, had a very significant finding when we recorded the signals a hippocampus nerve cell puts out when it communicates with other cells. A psychologist named Brenda Milner had just shown that complex memory involves the hippocampus part of the brain, which is why we picked that type of cell to study. We were able to stimulate the various pathways coming into the cell and record the synaptic input. We saw how the hippocampus cell worked, but alas, that didn’t give insight into memory.

So in the 1960s, we went to a more reductionist approach. Instead of studying complicated mammalian brain cells, we studied the neural system of a simple animal — Aplysia, a snail with a very large nerve cell. We subjected them to learning and reflex tests similar to those that Pavlov had done. We’d stimulate the animals and see what kind of reflexes were produced, and then we tested them. We discovered that the snail’s reflexes could be modified by several forms of learning, and that learning involved alterations in how nerve cells communicated with one another.

We next looked at short- and long-term memory in the snail. I began to see what happens when you convert short-term memories to long-term ones. It would turn out that short-term memory involves transient changes of the connections between the cells. There is no anatomical change. Long-term memory involves enduring changes that result from the growth of new synaptic connections.

*Q: Did this surprise you?*

Kandel: It was astonishing! You could double the number of synaptic connections in a very simple neurocircuit as a result of experience and learning. The reason for that was that long-term memory alters the expression of genes in nerve cells, which is the cause of the growth of new synaptic connections. When you see that at the cellular level, you realize that the brain can change because of experience. It gives you a different feeling about how nature and nurture interact. They are not separate processes.

*Q: As neuroscience moves forward, there are all kinds of new possibilities emerging. There are people who are experimenting with ways to erase unpleasant memories. Do you approve?*

A: I have no difficulty about enhancing memory. Removing memory is more complicated. If it’s to reduce the impact of a particular trauma, I have no difficulty with that, but there are other ways to deal with it — cognitive behavior therapy, exposure therapy, drugs. To go into your head and pluck out a memory of an unfortunate love experience, that’s a bad idea.

You know, in the end, we are who we are. We’re all part of what we’ve experienced. Would I have liked to have had the Viennese experience removed from me? No! And it was horrible. But it shapes you.

<http://www.nytimes.com/2012/03/06/science/a-quest-to-understand-how-memory-works.html?ref=scienceandtechnology>