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What's Up, Weelic? Talking Aloud

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percussions but rather how simple the science of memory erasure seems to be. The breakthrough here was twofold. First, the specific agent responsible for increasing the strength of the neuronal connection (the increase in membrane receptors) was found. This was mainly accomplished by Todd Sacktor in the 1980's through a series of experiments at Columbia University. Sacktor discovered that an enzyme called "protein kinase C, zeta" or PKMzeta, played a crucial role in LTP, specifically in the process of strengthening neuronal connections by increasing membrane receptor concentrations. The second breakthrough was simply the realization that by inhibiting PKMzeta one could inhibit the recollection of memories with astonishing specificity. The reason is almost too simple to be true — a freebie handed to us by nature. We know that consistent activation and strengthening of these neuronal connections, driven by PKMzeta, is necessary to keep memories strong. But Sacktor's theory is that the activation of PKMzeta only occurs in the neurons responsible for a memory while you are remembering it! So by inhibiting PKMzeta activation during the recollection of a specific memory, you can weaken or extinguish that neuronal connection, without impacting anything else.

Over the past 20 years, and most recently in his 2007 paper, Sacktor and other scientists have, in rats, been able to fully extinguish memories of taste preferences, taste aversions, and the association of certain tones with painful shocks. For example, in one experiment rats were trained to associate a single note or tone with a painful shock, so that just hearing the tone would cause the rats to "freeze" or stop moving for long periods of time — a telltale sign of fear. Then, researchers would elicit the memory of this fear by playing the tone and quickly administering the PKMzeta inhibitor. The rats would no longer freeze following the tone, even days, weeks, and months after the administration of the inhibitor. Many similar experiments were repeated with conditioned taste aversion and preference, all with equally successful results.

Exciting benefits and terrifying uses of this research are palpable. Never before have humans had such potential control over their own minds. With this new knowledge of memory, post-traumatic stress disorder can be an ailment of the past, and Alzheimer's disease may soon be solved. Yet, one's memories inform everything — emotions, decision-making, lifestyle, *etc.* It was once an undeniable and sometimes comforting truth that you could not choose what to remember and what to forget. Now, we have to face the terrifying fact that, as a species, we can tinker with things we once thought to be beyond even our most ambitious reach. Eventually, someone is going to have to decide how this scientific power should be exercised. But how can we possibly wield the power of gods before we have properly wielded the power of man?

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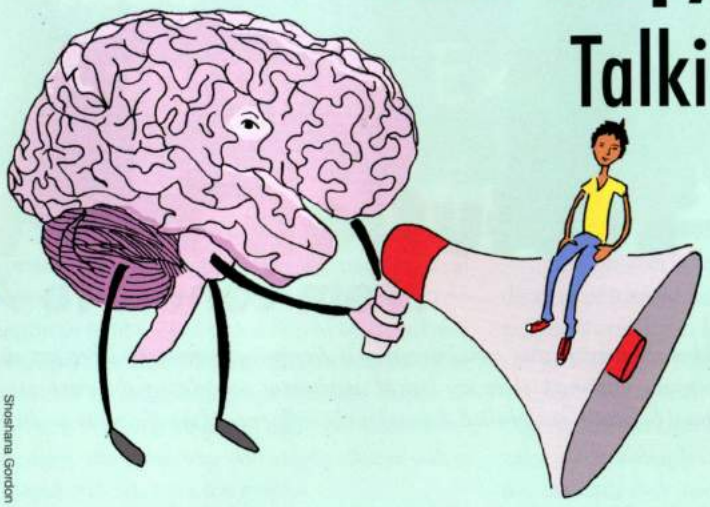

Shoshana Gordon

By Weelic Chong

My neuroscience research over Winter Term made me think. It made me think about poking needles in rat brains, it made me think about how rats might secretly like morphine injections, and it made me think about how terrible an evening commute in a city like Madison can be. (edit: But I still love Madison!) Anyway, it made me think so much that I just had to record my thoughts on the way home while standing in a bus with 60 other commuters. My caffeinated neocortex was in overdrive, and I dodged this way and that to keep pen on paper while the bus swayed. But finally, it was just too much for my wimpy vestibular system. I wasn't on a mission to write until I puked, so I stopped. Now, why couldn't this be easier?

Maybe I could use voice recognition software like Google Voice, Apple's Siri, or Android's Vlingo. Could I face the awkward, crimson faces on the bus while I dictate in lucid detail the going-ons of a typical college life? I guess not. So follow me as I dream a little bigger. What if someone could telepathically communicate with a device?

In my search for such a device, I discovered that NASA tackled this problem a decade ago. A basic biology class taught the NASA scientists that when muscles move, tiny currents are generated. With this information, they turned to the electromyogram, a common medical device that diagnoses muscle aches and used it to analyze the tiny currents at the nerve endings of the vocal cords. Using this, they hoped to discern what you are trying to say, even if you have a sore throat, a blocked nose, or are in a loud place, like the 'Sco.

Unfortunately, as with most NASA science, funding cuts have spelled doom for this endeavor. It was so bad that "subvocalization analysis" became a dirty word; it was as credible as say, "crystal healing". But it was not long before someone else tried a new approach. Rather than analyze throat muscle movements, the lab of Professor Frank Guenther, from Boston University, decoded signals directly from the motor region of the brain that controls nerves in the throat. Brain implants were inserted into the speech area of the left precentral gyrus, a part of the brain that controls the shape of the mouth, larynx, and throat. Brain waves were then recorded and sent wirelessly to a computer that decoded them into auditory signals in real time. However, with current technology, only vowels were distinguishable with sufficient accuracy.

What about locked-in patients who cannot control their muscles? To benefit such patients, other researchers are sidestepping the indirect approach of measuring motor activity altogether. One team is tapping directly into the superior and middle temporal gyri, which translate acoustic information into phonetic representations. At UC Berkeley, the lab of Professor Micheal I. Jordan pioneered this approach, and these scientists are now matching all kinds of acoustic information with brain recordings. However, according to Steven Laureys at the University of Liege in Belgium, it is crucial to develop evidence demonstrating that thinking words produces brain activity similar to that produced from the perception of those same words when spoken aloud. Indeed, such evidence is crucial for inventing products that may eventually read minds.

In the meantime, a company called Ambient Corp is marketing products based on NASA research to the public. One of these products, the Audeo, connects to an iPhone, wraps around the neck like a hairband, and is touted to be the future hands-free, "voice free" form of communication. It interfaces with Siri, too. An alternative to Futurama's eyePhone? Let's wait and see.