The Camp*aign Comments on ramifications of Apr 5, 2009, NYTimes OPED (below), “Editing Memory.”

Humans are delivered into this world as neurologically unsynchronized beings, thrashing about, flailing spastically in every direction. The brain reserves the right to hard-wire itself until it has an opportunity to measure its immediate environment. The brain marches to the unwavering command: hard-wire yourself so as to maximize potential for survival in your present surroundings.

For a babe delivered into the arms of quite and tender love this is good. What about the babe delivered into a crack house? The data received by the brain are quite different. The sounds: gun fire, screaming, sirens, shouting, cursing, striking. The smells? Rot, filth, exhaust, dung, blood, smoke. The language? course, vulgar, nonsense, mumbling, defensive, frightening. Touch? Perhaps none at all … or hitting, terrifying sensations of sudden acceleration/stops, sexual abuse, pain. The job of the dispassionate brain is to receive stimuli from the outside, about the outside. All such stimuli, and confluences of stimuli, are then "embossed," as it were, on tissue (all is matter; even electro-chemical energy). Don't kill the messenger. The brain is only following pre-programmed instructions.

A lovely, innocent babe, destined for a lifetime of heartache, misery, and tortured memories. In the chaos of the classroom, s/he is told, "you will leave this institution in one of three ways: a cap & gown, a wooden box. or an orange jump suit. For our child, one option seems as good as the other.

To be able to excise the daemons that ravage the heart and mind of an innocent child … without restraint or mercy … is there any thing on earth more compassionate that we should do?

Jon Sherry
www.ForAmericanKids.org

New York Times

April 5, 2009

Brain Researchers Open Door to Editing Memory

By BENEDICT CAREY

Suppose scientists could erase certain memories by tinkering with a single substance in the brain. Could make you forget a chronic fear, a traumatic loss, even a bad habit.

Brain Power

The Speed-Dial Molecule

For all that scientists have studied it, the brain remains the most complex and mysterious human organ — and, now, the focus of billions of dollars' worth of research to penetrate its secrets.

This is the first article in a series that will look in depth at some of the insights these projects are producing.

Research by Dr. Todd C. Sacktor, and André A. Fenton has demonstrated a chemical's effect on memory with potential implications for treatment of trauma, addiction and other conditions.

Researchers in Brooklyn have recently accomplished comparable feats, with a single dose of an experimental drug delivered to areas of the brain critical for holding specific types of memory, like emotional associations, spatial knowledge or motor skills.

The drug blocks the activity of a substance that the brain apparently needs to retain much of its learned information. And if enhanced, the substance could help ward off dementias and other memory problems.

So far, the research has been done only on animals. But scientists say this memory system is likely to work almost identically in people.

The discovery of such an apparently critical memory molecule, and its many potential uses, are part of the buzz surrounding a field that, in just the past few years, has made the seemingly impossible suddenly probable: neuroscience, the study of the brain.

"If this molecule is as important as it appears to be, you can see the possible implications," said Dr. Todd C. Sacktor, a 52-year-old neuroscientist who leads the team at the SUNY Downstate Medical Center, in Brooklyn, which demonstrated its effect on memory. "For trauma. For addiction, which is a learned behavior. Ultimately for improving memory and learning."

Artists and writers have led the exploration of identity, consciousness and memory for centuries. Yet even as scientists sent men to the moon and spacecraft to Saturn and submarines to the ocean floor, the instrument responsible for such feats, the human mind, remained almost entirely dark, a vast and mostly uncharted universe as mysterious as the New World was to explorers of the past.

Now neuroscience, a field that barely existed a generation ago, is racing ahead, attracting billions of dollars in new financing and throngs of researchers. The National Institutes of Health last year spent $5.2 billion, nearly 20 percent of its total budget, on brain-related projects, according to the Society for Neuroscience.

Endowments like the Wellcome Trust and the Kavli Foundation have poured in hundreds of millions of dollars more, establishing institutes at universities around the world, including Columbia and Yale.

The influx of money, talent and technology means that scientists are at last finding real answers about the brain — and raising questions, **both scientific and ethical**, more quickly than anyone can answer them.

Millions of people might be tempted to erase a severely painful memory, for instance — but what if, in the process, they lost other, personally important memories that were somehow related? Would a treatment that "cleared" the learned habits of addiction only tempt people to experiment more widely?

And perhaps even more important, when scientists find a drug to strengthen memory, will everyone feel compelled to use it?

The stakes, and the wide-open opportunities possible in brain science, will only accelerate the pace of discovery.

"**In this field we are merely at the foothills of an enormous mountain range,"** said Dr. Eric R. Kandel, a neuroscientist at Columbia, "and unlike in other areas of science, it is still possible for an individual or small group to make important contributions, without any great expenditure or some enormous lab."

Dr. Sacktor is one of hundreds of researchers trying to answer a question that has dumbfounded thinkers since the beginning of modern inquiry: **How on earth can a clump of tissue possibly capture and store everything — poems, emotional reactions, locations of favorite bars, distant childhood scenes?** The idea that experience leaves some trace in the brain goes back at least to Plato's Theaetetus metaphor of a stamp on wax, and in 1904 the German scholar Richard Semon gave that ghostly trace a name: the engram.

What could that engram actually be?

The answer, previous research suggests, is that brain cells activated by an experience keep one another on biological speed-dial, like a group of people joined in common witness of some striking event. Call on one and word quickly goes out to the larger network of cells, each apparently adding some detail, sight, sound, smell. **The brain appears to retain a memory by growing thicker, or more efficient, communication lines between these cells**.

The billion-dollar question is how?

In the decades since this process was described in the 1960s and 1970s, scientists have found scores of molecules that play some role in the process. But for years the field struggled to pinpoint the purpose each one serves. The problem was not that such substances were so hard to find — on the contrary.

For all that scientists have studied it, the brain remains the most complex and mysterious human organ — and, now, the focus of billions of dollars' worth of research to penetrate its secrets.

In a 1999 paper in the journal Nature Neuroscience, two of the most prominent researchers in brain science, Dr. Jeff W. Lichtman and Joshua R. Sanes of Harvard, listed 117 molecules that were somehow involved when one cell creates a lasting speed-dial connection with a neighbor, a process known as "long-term potentiation."

They did not see that these findings were necessarily clarifying the picture of how memories are formed. But an oddball substance right there on their own list, it turned out, had unusual properties.

"You know, my dad was the one who told me to look at this molecule — he was a scientist too, my dad, he's dead now but he had these instincts — so anyway that's how it all started," Dr. Sacktor was saying. He was driving from his home in Yonkers to his laboratory in the East Flatbush neighborhood of Brooklyn, with three quiches and bag of bagels bouncing in the back seat. Lunch for the lab.

The father's advice led the son, eventually, to a substance called PKMzeta. In a series of studies, Dr. Sacktor's lab found that this molecule was present and activated in cells precisely when they were put on speed-dial by a neighboring neuron.

In fact, the PKMzeta molecules appeared to herd themselves, like Army Rangers occupying a small peninsula, into precisely the fingerlike connections among brain cells that were strengthened. And they stayed there, indefinitely, like biological sentries.

In short: PKMzeta, a wallflower in the great swimming party of chemicals that erupts when one cell stimulates another, looked as if it might be the one that kept the speed-dial function turned on.

"After that," Dr. Sacktor said, "we began to focus solely on PKMzeta to see how critical it really was to behavior."

Running a lab is something like fielding a weekend soccer team. Players come and go, from Europe, India, Asia, Grand Rapids. You move players around, depending on their skills. And you bring lunch, because doctoral students logging 12-hour days in a yellowing shotgun lab in East Flatbush need to eat.

"People think that state schools like ours are low-key, laid back, and they're right, we are," said Robert K. S. Wong, chairman of the physiology and pharmacology department at SUNY Downstate, who brought Dr. Sacktor with him from Columbia. "You have less pressure to apply for grants, and you can take more time, I think, to work out your ideas."

To find out what, if anything, PKMzeta meant for living, breathing animals, Dr. Sacktor walked a flight downstairs to the lab of André A. Fenton, also of SUNY Downstate, who studies spatial memory in mice and rats.

Dr. Fenton had already devised a clever way to teach animals strong memories for where things are located. He teaches them to move around a small chamber to avoid a mild electric shock to their feet. Once the animals learn, they do not forget. Placed back in the chamber a day later, even a month later, they quickly remember how to avoid the shock and do so.

But when injected — directly into their brain — with a drug called ZIP that interferes with PKMzeta, they are back to square one, almost immediately. "When we first saw this happen, I had grad students throwing their hands up in the air, yelling," Dr. Fenton said. "Well, we needed a lot more than that" one study.

They now have it. Dr. Fenton's lab repeated the experiment, in various ways; so has a consortium of memory researchers, each using a different method. Researchers led by Yadin Dudai at the Weizmann Institute of Science in Israel found that one dose of ZIP even made rats forget a strong disgust they had developed for a taste that had made them sick — three months earlier.

A Conscience Blocker?

"This possibility of memory editing has enormous possibilities and raises huge ethical issues," said Dr. Steven E. Hyman, a neurobiologist at Harvard. "On the one hand, you can imagine a scenario in which a person enters a setting which elicits traumatic memories, but now has a drug that weakens those memories as they come up. Or, in the case of addiction, a drug that weakens the associations that stir craving."

Researchers have already tried to blunt painful memories and addictive urges using existing drugs; blocking PKMzeta could potentially be far more effective.

Yet any such drug, Dr. Hyman and others argue, could be misused to erase or block memories of bad behavior, even of crimes. If traumatic memories are like malicious stalkers, then troubling memories — and a healthy dread of them — form the foundation of a moral conscience.

For those studying the biology of memory, the properties of PKMzeta promise something grander still: the prospect of retooling the engram factory itself. By 2050 more than 100 million people worldwide will have Alzheimer's disease or other dementias, scientists estimate, and far more will struggle with age-related memory decline.

"This is really the biggest target, and we have some ideas of how you might try to do it, for instance to get cells to make more PKMzeta," Dr. Sacktor said. "But these are only ideas at this stage."

A substance that improved memory would immediately raise larger social concerns, as well. "We know that people already use smart drugs and performance enhancers of all kinds, so a substance that actually improved memory could lead to an arms race," Dr. Hyman said.

Many questions in the science remain. For instance, can PKMzeta really link a network of neurons for a lifetime? If so, how? Most molecules live for no more than weeks at a time.

And how does it work with the many other substances that appear to be important in creating a memory?

"There is not going to be one, single memory molecule, the system is just not that simple," said Thomas J. Carew, a neuroscientist at the University of California, Irvine, and president of the Society for Neuroscience. "There are going to be many molecules involved, in different kinds of memories, all along the process of learning, storage and retrieval."

Yet as scientists begin to climb out of the dark foothills and into the dim light, they are now poised to alter the understanding of human nature in ways artists and writers have not.