Drug Effects on the Brain

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There has been an abundance of research released over the past 18 months shedding new light on an old problem -- the effects of tobacco, alcohol and other drugs on the central nervous system. Perhaps fueled by funds available through tobacco settlement monies, we see a particular increase in the amount of nicotine research published.

Three main themes arise. First, all drugs effect the brain - some very substantially, particularly in adolescents. Second, the plasticity of the brain and its amazing ability to compensate for change, can lead to drug-crippled brains. Thirdly, certain neurons appear to be more resilient than others to drug effects. Most drugs (cocaine, alcohol, etc.) tend to work by increasing dopamine levels in the amygdala and other pleasure regions of the brain.

Any time a substance significantly changes a neurotransmitter (nerve cell communication chemicals), it will cause damage with chronic use. The reason for this is the brain's inherent need and ability to repair its own systems.

Here's what's going on. Think of a pleasant experience (a romantic evening, sunbathing on the beach, a double decker hot fudge sundae....). Feel the pleasure? What you are biologically doing is secreting dopamine, a major brain chemical, into the amygdala region of your brain. Receptor sites (dopamine doorways) open up to receive the chemical and cause that pleasure part of your brain to fire. It is nice, isn't it? That's what most drugs do, only on a much more intense basis. They cause huge amounts of dopamine to flood into the amygdala region.

The problem comes with repeated use. The brain is efficient and self-correcting. So once you start providing this intense surge of dopamine on a regular basis, the brain tries to compensate for the disturbance by either reducing production of dopamine or locking and removing dopamine receptor sites. (The brain, as living tissue, makes no value judgment on whether the feeling was good or bad, it is just seeking to correct an imbalance you have created). Now you have established tolerance. This means a person will have to use more of the drug to get the same effect because the brain has reduced its own production and limited the dopamine doorways or receptor sites.

Imagine what happens after long-term chronic use. Natural production of the neurotransmitter has all but been shut off as the brain realizes it is being provided artificially, so doesn't need to waste energy producing it on its own. Receptor sites or avenues for the neurotransmitter to attach in the brain have been limited and severely reduced in the brain's attempt to reduce the overactive region. The brain has now become crippled. It essentially has lost its natural ability for pleasure. The drug addict who is attempting to withdraw, is faced with a pleasure center that doesn't work. Not only does the brain not produce dopamine in natural quantities, it has removed many of the receptor sites or doorways in the pleasure regions.

A drug-free addict will feel no pleasure in imaging a candlelight dinner, sunbathing on the beach, or even eating a double decker hot fudge sundae. What has been created is a brain which can feel no pleasure in anything unless done through artificial means. It is easy to see how life would not feel worth living and why the suicide rate during recovery is so high and successful recovery rates are so low.

Another major effect of various drugs on the brain is the actual deterioration of brain nerve cells. Alcohol, nicotine, cocaine and ecstasy all are known to degenerate gray matter, and thereby reduce the volume of some key brain regions. This loss can cause processing problems in many
of the decision-making areas of the cortex as well as interfere with memory systems. Research is now even showing that different aged brains are affected in different ways. For example, it has been shown that alcohol reduces the volume of the hippocampus in adolescent brains, but apparently not in adult brains. The reduction is more severe in teens that start alcohol use early and often. The hippocampus is responsible for processing new information into memory.

Drugs do not affect all brain cells equally. There are two main types of neurons in your brain. Fatty and plain. Some nerve cells are covered in a fatty layer called a myelin sheath. These cells are able to transmit electrical signals ten times faster than than the uncoated neurons. The fatty covering lends a somewhat whitish appearance to the cells, hence the name white matter. Gray matter would be composed of unsheathed or plain neurons. When nerve cells in the brain are damaged from drugs, it tends to be the gray matter rather than the white. This would indicate that the myelin sheath may offer some protection against chemical substances.

Are there any "safe" drugs? Biologically speaking, it doesn't appear so. It seems the brain's natural healing powers and compensation skills can turn into our own worst enemy where drugs are concerned. Obviously the brain's ability to move into that compensation mode varies from person to person and it seems that those with the systems quickest to adjust are the brains most likely to become addicted.

If there is any good news to this story it could come from the pharmaceutical industry which is looking for some type of recovery aid for addicted brains. There is hope that medicines may become available to help persons through their recovery by helping the brain heal faster, restore receptor sites sooner or restore dopamine production. Until then, the only hope for the addicted brain is time and continued research.

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