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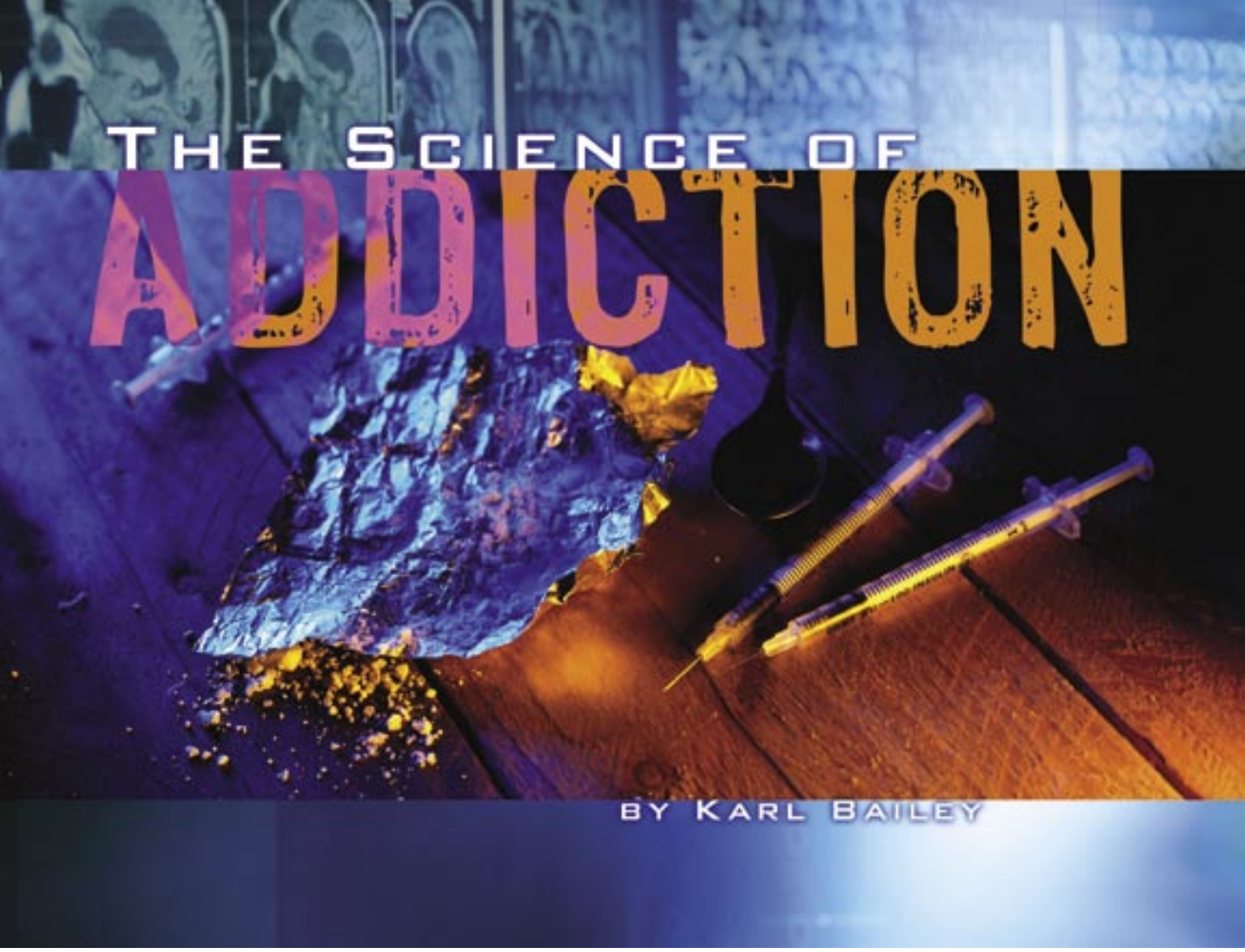
The Science of Addiction

Karl Bailey
Andrews University, kgbailey@andrews.edu



The Science of Addiction

BY KARL BAILEY

For many years, our understanding of addiction and the brain emphasized the brain's so-called pleasure or reward circuits: Drugs made people feel good so people took drugs. Over time, addicts' brains developed tolerance to their drug of choice so more and more of that drug was needed to get the same pleasurable effect. Eventually the brain could not function without the drug, leading to addiction.

However, in recent years researchers have been rethinking the role of pleasure in the formation of long-term addictions. The pathways believed to control pleasure and reward involve a particular signaling chemical called dopamine.

It has long been known that rats with damaged dopamine circuits will not voluntarily eat. In fact, when the rats are force-fed a tasty treat, their faces show clear signs of pleasure.

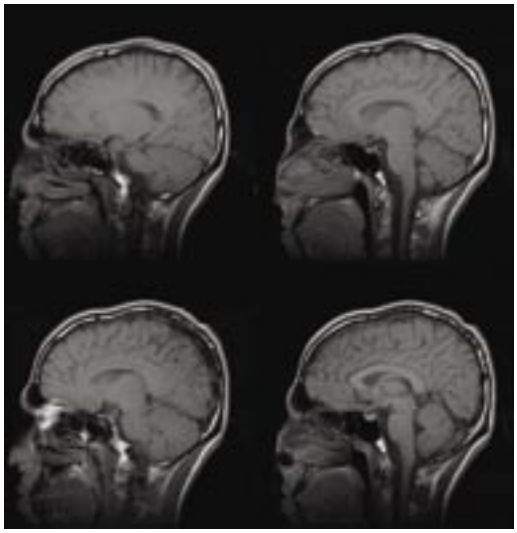
It appears that what prevents the rats from eating is a lack of desire to eat, not an inability to enjoy food. Likewise, addicts do not report the pleasure of taking drugs increases as they become more and more addicted, but rather that cravings get more and more intense. Thus, many scientists now believe dopamine circuits control desire or craving, rather than pleasure.

Drugs, of course, aren't the only thing that can induce desire or cravings. Hunger, wanting to do well on a test, and planning for a vacation all involve desire of some sort. Resolving any of these will involve a feeling of satisfaction. The desire and pleasure pathways are closely linked in the brain.

Humans are created for action and need some way to decide what, among dozens of options, to do next. When planning for a vacation weeks away, you are still able to take

care of your immediate needs because your brain's desire circuits are able to properly rank all your desires at any given time.

The addicted brain cannot properly perform this ranking. No matter what other desires an addict has, the desire to obtain the source of the addiction will always be paramount. This is a slightly different description of addiction than the pleasure principle given earlier. Addiction is driven by what occurs in the brain before the drug is taken (a craving), rather than what occurs after the drug has been taken (a flood of pleasure).



Structures in the lower and frontal parts of the brain make up the dopamine pathways. Magnetic resonance imaging, used to take these pictures in a normal subject, can be used to assess how these structures respond to various contexts.

But why would such a reordering take place? The answer appears to lie with the brain's ability to learn to associate initially unrelated contexts with the anticipation of events. This sort of learning happens all the time. Experienced drivers learn to anticipate what other drivers will do on the road.

Addicts' brains learn certain contexts mean an influx of alien chemicals is about to occur. Just as Pavlov's dogs responded to a learned context by salivating, addicts respond to certain contexts by preparing for the drug to enter the body. This is one reason heroin addicts tend to suffer severe reactions (sometimes leading to death) when taking their normal dose of heroin in unfamiliar circumstances.

One of the side effects of heroin use is reduced respiration. When heroin is taken in familiar circumstances, the body can anticipate, and will counteract, the heroin's effects on breathing. In unfamiliar circumstances, this anticipation does not occur, and breathing may be interrupted.

The same mechanism may also account for why addicts who have been drug free for many years may suddenly develop cravings. These cravings may themselves lead to relapse into addictive behavior. Not surprisingly, they tend to occur when addicts find themselves in similar situations to those in which they purchased or used drugs. Simply showing an addict pictures of people using drugs will cause their dopamine circuits to activate, even years after they last used drugs.

This long-lasting connection between drug use and motivation may be the result of the way the brain stores information. The brain learns by developing and strengthening connections between brain cells. These are physical changes; brain cells can be seen sending out new fibers to connect to surrounding cells in response to a stimulating environment. Being conscious of a relationship is not necessary, as the brain is able to automatically identify and store important patterns in the environment.

Drugs of abuse (such as amphetamines) have been shown to cause the same kinds of changes in brain cells as those that occur during normal memory storage. This may indicate the development of memories that link the context of drug use to anticipation of the drug itself. Over time, these links will get stronger and stronger, further tying the drug and surrounding environment together, while at the same time reducing the ability to do anything unrelated to obtaining and taking the drug.

Simple principles of learning, memory, and motivation give us a powerful understanding of the way addiction develops and continues to hold an addict in its bonds. Because drugs are foreign substances, they are able to take over these processes and upset the balance of normal learning and motivation.

Looking at addiction from this perspective tells us we can't just understand addiction by looking at chemicals in the brain. Instead, it is important to understand the entire addictive situation, from the level of the physiological effects of the drugs to daily behavior patterns, social circumstances, and future plans. Moreover, a learning perspective suggests freedom from addiction is not a cure for a disease, but rather a developmental process, where the addict is constantly aware of the possibility of relapse, and is alert to those circumstances which might induce cravings.

At the Andrews University Summer School of Addictions, our goal is to examine addictions from all of these directions. This year's workshop will be held May 2–5, 2005, and will cover the topic of drug and alcohol addiction in relation to causes, rates, and treatments. For more information, contact Derri Hanson at the Institute for the Prevention of Addiction at (269) 471-3558.

Karl Bailey is an associate professor of psychology at Andrews University.