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Richard A. Millstein

Alan I. Leshner

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THE SCIENCE OF ADDICTION: RESEARCH AND PUBLIC HEALTH PERSPECTIVES

RICHARD A. MILLSTEIN, J.D.*

ALAN I. LESHNER, PH.D.**

INTRODUCTION

Drug abuse and addiction are among the most serious and costly problems facing our society. Fortunately, advances in science made over the last several decades have dramatically increased our understanding of these disorders and led to the development of effective strategies for their prevention and treatment. This article focuses on the biological, behavioral, and social mechanisms of drug abuse and addiction and their implications for prevention, treatment, and policy.

Drug abuse and addiction are among the most serious and costly problems facing our society. The estimated cost of illegal drugs alone is \$110 billion a year.¹ When the costs of alcohol abuse and addiction are added, this estimate comes to \$276 billion a year.² And these numbers exclude the costs of nicotine.³ These problems are very costly to address, and impact every sector of society. As Figure 1⁴ illustrates, this pervasiveness is seen in virtually every domain.⁵

In addition to being costly, Americans consistently consider drug abuse to be a pressing issue, according to public surveys of national concerns throughout the 1980s and 1990s.⁶ Nonetheless, despite

* Mr. Millstein is the Deputy Director of the National Institute on Drug Abuse, at the National Institutes of Health.

** Dr. Leshner is the Director of the National Institute on Drug Abuse, at the National Institutes of Health.

1. See Henrick Harwood et al., *The Economic Costs of Alcohol and Drug Abuse in the United States, 1992: Executive Summary* (visited Sept. 20, 1999) <<http://www.nida.nih.gov/EconomicCosts/Chapter1.html#1.10>> [hereinafter *Economic Costs of Alcohol and Drug Abuse: Executive Summary*].

2. See *id.*

3. See *NIDA Infobox: Costs to Society* (visited Sept. 20, 1999) <<http://www.nida.nih.gov/Infobox/costs.html>>.

4. See generally, NATIONAL INSTITUTE ON DRUG ABUSE AND NATIONAL INSTITUTE ON ALCOHOL ABUSE AND ALCOHOLISM, *THE ECONOMIC COSTS OF ALCOHOL AND DRUG ABUSE IN THE UNITED STATES* (Sept. 1998).

5. See *Economic Costs of Alcohol and Drug Abuse: Executive Summary*, *supra* note 1.

6. See Bureau of Justice Statistics, *Sourcebook of Criminal Justice Statistics: Public Attitudes Toward Crime and Criminal Justice-Related Topics* (visited Oct. 27, 1999) <http://www.albany.edu/sourcebook/1995/toc_2.html>; Bureau of Justice Statistics, *Drug and*

FIGURE 1: ECONOMIC COSTS OF SUBSTANCE ABUSE

Health Care Expenditures
Alcohol and Drug Abuse Services
Medical Consequences
Productivity Impacts (Lost Earnings)
Premature Death
Impaired Productivity
Institutionalized Populations
Incarceration
Crime Careers
Victims of Crime
Other Impacts on Society
Crime
Social Welfare Administration
Motor Vehicle Crashes
Fire Destruction

these two major reasons justifying attention, there are barriers to giving these issues the attention they merit. Much of this is due to the belief that addicts “did it to themselves,” and thus are undeserving of care, let alone compassion.⁷

The fact is that drug abuse and addiction affect everybody, either directly or indirectly. Some seventy million Americans have used an illegal drug at some time in their lives.⁸ Because of this pervasiveness, everyone believes he or she is an expert. Because so many people have direct or indirect contact with this phenomenon, they approach it from an intuitive, heavily ideological, and moralistic point of view. Indeed, there are ideologies galore about drug abuse and addiction that much too frequently drive the responses to this problem. Fortunately, we also have scientific data.

Over the last two decades, advances in science have totally revolutionized our fundamental understanding of drug abuse and addiction.⁹ Hopefully, those changes will bring to bear a more rational

Crime Facts: Public Opinion About Drugs (visited Oct. 27, 1999) <<http://www.ojp.usdoj.gov/bjs/DCF/poad.htm>>.

7. See *An Interview with Alan I. Leshner, Ph.D.* (visited Sept. 27, 1999) <<http://www.pbs.org/wnet/closetohome/science/html/leshner.html>> [hereinafter *Interview with Alan I. Leshner, Ph.D.*].

8. See *The National Drug Control Strategy: Fewer Americans are Using Illegal Drugs* (visited Sept. 21, 1999) <<http://www.ncjrs.org/html/chapter2.htm#note1>>.

9. See *Interview with A. Thomas McLellan* (visited Sept. 27, 1999) <<http://www.pbs.org/wnet/closetohome/treatment/html/mclellan.html>> [hereinafter *Interview with A. Thomas McLellan*]; Mona W. Brown & Sheryl Massaro, *Scientists Identify Brain Systems Involved in Drug Craving* (visited Sept. 21, 1999) <<http://www.nih.gov/news/pr/oct96/nida-14.htm>> [hereinafter *Scientists Identify Brain Systems Involved in Drug Craving*].

approach to this problem, not only at a national level, but at an individual level as well.

The slogan of the Partnership for a Drug-Free America, "Drug abuse is a preventable behavior. Drug addiction is a treatable disease,"¹⁰ is both a very simple and a very sophisticated statement. Drug abuse is a decision, a voluntary decision, someone makes and, therefore, it is a voluntary, preventable behavior.¹¹ At the same time addiction is a qualitatively different state. It is, in fact, a disease, and it is a treatable disease.¹²

Whether you begin from a focus on prevention or on treatment, ultimately you need to start out with the question, "Why do people use drugs in the first place?" Scientists have devoted a tremendous amount of effort to this.¹³ Not surprisingly, people speak very frequently about risk.

Part I of this Article examines the factors which are understood to lead to drug use.¹⁴ Part II explains the results of recent studies that show the effects of drug use, both long-term and short-term, on the brain.¹⁵ Part III discusses the importance of memory in addiction,¹⁶ while Part IV recommends treatment approaches based on the science of addiction.¹⁷

I. FACTORS LEADING TO DRUG USE

There are over seventy risk factors posited for drug abuse and addiction.¹⁸ They operate at the individual, peer, family, and community levels.¹⁹ The risk factors for drug abuse and addiction are the same risk factors as for many other behavior problems,²⁰ as shown in Figure 2.

10. *Drug-Free Resource Net: Partnership for a Drug-Free America* (visited Sept. 21, 1999) <<http://www.drugfreeamerica.org/under.html>>.

11. *See Addiction Is a Brain Disease* (visited Sept. 21, 1999) <<http://www.usia.gov/journals/itgic/0697/ijge/gj-2.hum>> [hereinafter *Addiction Is a Brain Disease*].

12. *See id.*

13. *See Robert J. Pandina, Risk and Protective Factor Models in Adolescent Drug Use: Putting Them to Work for Prevention* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/MeetSum/CODA/Risk.html>> [hereinafter *Risk and Protective Factor Models in Adolescent Drug Use*].

14. *See infra* footnotes 18-41 and accompanying text.

15. *See infra* footnotes 42-94 and accompanying text.

16. *See infra* footnotes 95-107 and accompanying text.

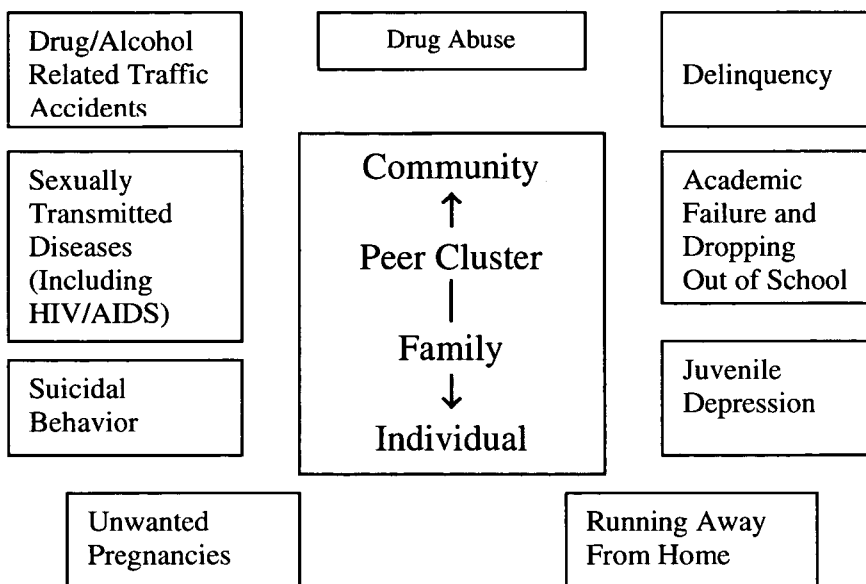
17. *See infra* footnotes 108-128 and accompanying text.

18. *See Addiction Is a Brain Disease, supra* note 11.

19. *See id.*

20. *See id.*

FIGURE 2: RISK FACTORS FOR DRUG ABUSE AND ADDICTION



The problem with an excessive focus on risk is that risk is a probability statement.²¹ It predicts that people with certain characteristics are more or less likely to have one of these negative outcomes, such as drug use.²² However, it does not reveal the behavioral outcome in any particular individual.²³ Moreover, the majority of people who have the majority of those risk factors never use drugs.²⁴ Therefore, a focus on risk is not enough.

For these reasons, prevention researchers in the last few years have placed a far greater emphasis on what are called protective, or resiliency factors,²⁵ to explain what protects people who have a tremendous number of risk factors from using drugs.²⁶ The most well known protective factor is family involvement in the life of the child.²⁷ This is not family involvement just in the child's drug use.²⁸ Accord-

21. *See id.*

22. *See id.*

23. *See id.*

24. *See id.*

25. *See Risk and Protective Factor Models in Adolescent Drug Use, supra* note 13.

26. *See id.*

27. *See Meyer Glantz, The Application of Resiliency and Risk Research to the Development of Preventive Interventions* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/ResilandRiskWG/ResilandRiskWG.html>>.

28. *See id.*

ingly, a lot of prevention programs have incorporated family strengthening approaches.²⁹

While protection and risk tell you about the probability that someone will engage in a specific behavior, they do not tell you very much about why the individual uses drugs.³⁰ To simplify, we posit two very different reasons why people take drugs. They are dichotomous, and reflect different distributions of people.

One group of young people uses drugs simply for the sensation of it.³¹ These people are novelty seekers.³² They just want to have a new experience, be perceived as “cool,” and feel good.³³ A second, separate group of people feels terrible in the first place, and uses drugs to cope with their situation, “normalize” themselves, and feel better than they feel.³⁴ They “medicate” themselves with illicit drugs the way others use anti-depressants or anti-anxiety drugs.³⁵

Obviously the optimal prevention and treatment strategies are vastly different for those two groups of people.³⁶ However, prevention programming has focused almost exclusively on the first group, the attention seeker, and has not paid much attention to the second.³⁷ The problem with self-medication is that although drugs initially do make you feel better, over time they compound the problem,³⁸ not just because they affect lifestyle but because they act as depressants instead of antidepressants.

Regardless of which reason someone is using drugs, he or she is doing it in order to modify mood, perception, and emotional state.³⁹ There is really only one way to do that. Drugs modify mood, perception, and emotional state because they modify brain function.⁴⁰ Science has taught us that a major reason why people take a drug is because they like what it does to their brain—initially at least.⁴¹

29. *See id.*

30. *See Scientific Exchange: Child's Drug Use Can Go Way Beyond 'Recreational'* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/International/INVESTWinter99/INVEST3.html>>.

31. *See id.*

32. *See id.*

33. *See id.*

34. *See id.*

35. *See id.*

36. *See id.*

37. The normal preventive programs that “educate about the harmful effects of drugs on their bodies” and seek to teach “alternative ways of having fun” to resist the temptation of drugs are not effective prevention programs for young people medicating themselves to feel better. *Id.*

38. *See id.*

39. *See Addiction Is a Brain Disease, supra* note 11.

40. *See id.*

41. *See Interview with Alan I. Leshner, Ph.D., supra* note 7.

II. EFFECTS OF DRUGS TO THE BRAIN

A. *The Immediate Effects of Drug Use on the Brain*

We no longer need to use inexact metaphors of eggs in a frying pan. A study at the Massachusetts General Hospital utilizing functional Magnetic Resonance Imaging (MRI) brain scans provides a modern day depiction of your brain on drugs.⁴² MRI permits you literally to look into the brain of a living, breathing, awake human being while that individual is experiencing cocaine,⁴³ and to see the "signature" in the brain of the drug experience as compared to that of the same individual given an infusion of saline.⁴⁴ The MRI in the Massachusetts General Hospital study was an aggregate over a drug experience.⁴⁵ The nucleus accumbens, an area at the base of the brain that is very important in drug abuse, not only because it is in an area that is activated during any pleasurable experience,⁴⁶ but also because every drug of abuse has an effect on it,⁴⁷ showed increased activity.⁴⁸

Once imaging technologies became available, essentially only within the last six to eight years, it enabled us to examine different areas of the brain that had not been looked at before. Most of drug abuse research had focused at the base of the brain, but once these technologies became available, researchers knew to look at areas like the amygdala,⁴⁹ which is involved in emotional memory.

Now we know, in fact in excruciating detail, why people like to take drugs. What happens when you take a drug like cocaine, is that it literally concentrates at the base of the brain in the nucleus accumbens,⁵⁰ and causes the release of a chemical neurotransmitter called dopamine.⁵¹ See Figure 3.

42. See generally Hans C. Breiter et al., *Acute Effects of Cocaine on Human Brain Activity and Emotion*, 19 NEURON 591 (1997) (discussing the investigation of cocaine-induced euphoria and craving using functional magnetic resonance imaging (fMRI)).

43. See *id.*; see also NIDA News Releases: *Preventing and Treating Heroin Use Is Focus of National Research Conference* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/MedAdv/Mas-yr97b.html#9-25>> [hereinafter *Preventing and Treating Heroin Use Is Focus of National Research Conference*].

44. See Breiter, *supra* note 42, at 591.

45. See *Preventing and Treating Heroin Use Is Focus of National Research Conference*, *supra* note 43.

46. See *id.* See also Breiter, *supra* note 42, at 602.

47. See *Preventing and Treating Heroin Use Is Focus of National Research Conference*, *supra* note 43.

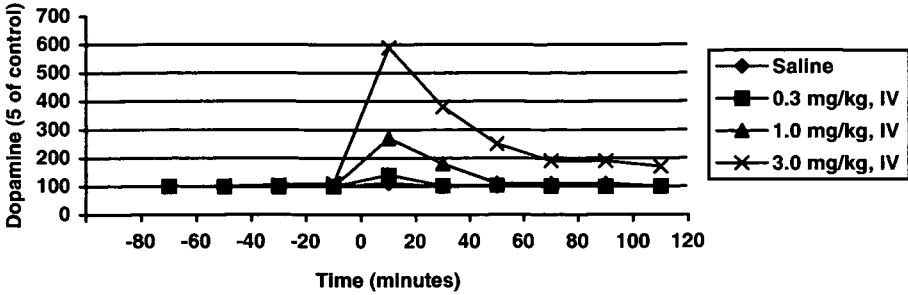
48. See *id.* See also Breiter, *supra* note 42, at 602.

49. See Anna Rose Childress, Ph.D. et al., *Limbic Activation During Cue-Induced Cocaine Craving*, 156 AM. J. PSYCHIATRY 11, 15 (1999).

50. See *Addiction Is a Brain Disease*, *supra* note 11.

51. See *id.*

FIGURE 3: EFFECT OF ACUTE COCAINE ON EXTRACELLULAR DOPAMINE



Although each has its own idiosyncratic mechanisms of action, every drug of abuse causes a spike in dopamine levels in the brain.⁵² Researchers are starting to believe that this may be a part of the common essence of abuse and of addiction.⁵³ It is true that every pleasurable experience causes at least a small increase in dopamine.⁵⁴ Dopamine is needed for the normal experience of pleasure.⁵⁵ Eating, having sex, or watching a movie—all increase dopamine.⁵⁶ But taking cocaine causes, not just a small increase, but a big spike.⁵⁷ That big spike is perceived as very pleasurable.⁵⁸ However, it is not very long lasting, so people want to repeat it. Animal studies assist researchers in understanding these effects.⁵⁹ For example, a human being bingeing on crack cocaine is trying to produce that spike over and over.⁶⁰ By comparison, you do not binge on methamphetamine.⁶¹ Both cocaine and methamphetamine produce a very rapid rise in dopamine, and with cocaine the increase falls off rapidly,⁶² while with methamphetamine it falls off very slowly.⁶³

52. See *id.*

53. See *id.* (stating that the “positive experience of drugs comes through the mesolimbic-dopamine pathway.”).

54. See *id.*

55. See *id.*; Interview with Alan I. Leshner, Ph.D., *supra* note 7.

56. See *Addiction Is a Brain Disease*, *supra* note 11; Interview with Alan I. Leshner, Ph.D., *supra* note 7; Childress, *supra* note 49, at 12.

57. See Interview with Alan I. Leshner, Ph.D., *supra* note 7.

58. See *id.*

59. See *id.*; *Addiction Is a Brain Disease*, *supra* note 11.

60. See *Addiction Is a Brain Disease*, *supra* note 11.

61. See *id.* But see Una D. McCann et al., *Reduced Striatal Dopamine Transporter Density in Abstinent Methamphetamine and Methcathinone Users: Evidence from Positron Emission Tomography Studies with [¹¹C]WIN-35,428*, 18 J. NEUROSCIENCE 8417, 8417 (1998).

62. See *Addiction Is a Brain Disease*, *supra* note 11.

63. See *id.*

Dopamine, of course, is not the sole explanatory phenomenon. There is also a role for serotonin,⁶⁴ and other neurotransmitters.⁶⁵ However, dopamine is intimately involved with the core of this phenomenon of drug taking.⁶⁶

B. *The Long-Term Effects of Drugs on the Brain*

People take drugs because they like this euphoria. The problem is that, over time, prolonged drug use actually changes the brain in fundamental and long-lasting ways—even persisting long after the individual has stopped taking drugs. Initially drugs produce one kind of effect. Over time, they produce a different effect.

Researchers are now clearly seeing the long-lasting effects that drugs can have on the brain and how these may have lasting effects on an individual's emotional responses and on his or her learning and memory capacity.⁶⁷ For example, MDMA,⁶⁸ or Ecstasy, and methamphetamine both are becoming increasingly popular with young adults who attend organized all night social gatherings or "raves."⁶⁹ Based on animal studies, both drugs have long been thought to be neurotoxic at doses similar to those being used by these young adults,⁷⁰ but direct evidence in humans was lacking.⁷¹ Recently, alarming data filled that research gap.⁷²

64. See Steven Stocker, *Cocaine's Pleasurable Effects May Involve Multiple Chemical Sites* (visited Sept. 27, 1999) <http://www.nida.nih.gov/NIDA_Notes/NNVol14N2/Cocaine.html>.

65. See *id.* (defining neurotransmitters as chemicals released by neurons to send messages to other neurons within their vicinity).

66. See *id.*

67. See *Long-Term Brain Injury From Use of "Ecstasy"* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/MedAdv/99/NR-614b.html>> [hereinafter *Long-Term Brain Injury From Use of "Ecstasy"*]. See generally U.D. McCann et al., *Positron Emission Tomographic Evidence of Toxic Effects of MDMA ("Ecstasy") on Brain Serotonin Neurons in Human Beings*, 352 LANCET 1433 (1998).

68. See McCann, *supra* note 67, at 1433 (defining MDMA as (±)3,4-methylenedioxy-methamphetamine). See also *Long-Term Brain Injury From Use of "Ecstasy," supra* note 67.

69. See *Popular Rave Drug "Ecstasy" Impairs Memory, Apparently Related To Brain Damage* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/MedAdv/98/MA-1221.html>> [hereinafter *Popular Rave Drug "Ecstasy" Impairs Memory*].

70. See McCann, *supra* note 67, at 1433; McCann, *supra* note 61, at 8417; *Long-Term Brain Injury From Use of "Ecstasy," supra* note 67.

71. See McCann, *supra* note 61, at 8418; McCann, *supra* note 67, at 1433 (describing previous studies of human MDMA users using indirect markers to determine possible brain injury).

72. See *Popular Rave Drug "Ecstasy" Impairs Memory, supra* note 69. See generally McCann, *supra* note 61; McCann, *supra* note 67.

PET⁷³ scans from George Ricaurte's laboratory at Johns Hopkins University in Baltimore⁷⁴ showed images of two human brains, one of an individual who has never used Ecstasy and the other of an individual who had used Ecstasy heavily for an extended period but was abstinent from drugs for at least three weeks prior to the study.⁷⁵ Researchers could clearly see that the brain of the Ecstasy user had been significantly altered. The specific parameter measured was the brain's ability to bind the chemical neurotransmitter serotonin.⁷⁶ Serotonin is critical to normal experiences of mood, emotion, pain, and a wide variety of other behaviors.⁷⁷ The PET scan showed a decrease in the Ecstasy user's ability to remove this important neurotransmitter from the intracellular space,⁷⁸ thereby amplifying its effects within the brain. This decrease lasts at least three weeks after the individual has stopped using Ecstasy.⁷⁹ Given serotonin's critical role in many behavioral characteristics,⁸⁰ one can speculate that this abnormality of the serotonin system might be responsible for some of Ecstasy's long-lasting behavioral effects.⁸¹

Researchers can also view the long-lasting effects that drugs can have on the brain. Dr. Ricaurte and his colleagues⁸² examined dopamine transporter binding in four different adults: a non-drug user; a chronic methamphetamine user who was drug-free for about three years when this image was taken; a chronic methcathinone⁸³ abuser who was also drug free for about three years; and an individual

73. See McCann, *supra* note 67, at 1433 (defining PET as positron emission tomography, a neuroimaging technique that makes it "possible to assess the status of chemically-defined populations of neurons in the living human brain.").

74. See generally McCann, *supra* note 67.

75. See *id.* at 1434.

76. See *id.* at 1433 (stating that the status of brain serotonin (5-HT), 5-hydroxy-indoleacetic acid, neurons were investigated in MDMA users).

77. See FRANK J. AYD, JR., *LEXICON OF PSYCHIATRY, NEUROLOGY, AND THE NEUROSCIENCES* 581 (David C. Retford ed. 1995) (stating that serotonin is involved in "pain perception, aggressive and impulsive behavior, anxiety, sleep, circadian rhythms, sexual behavior, hormone secretion, thermoregulation, cardiovascular function, motor activity, food intake, and mood." Serotonin has also been implicated in disorders such as "anxiety, depression, migraine, and epilepsy.").

78. See McCann, *supra* note 67, at 1436 (finding that "decreases in 5-HT transporter binding positively correlated with extent of previous MDMA use.").

79. See *id.*; *Popular Rave Drug "Ecstasy" Impairs Memory*, *supra* note 69.

80. See *supra* note 77 and accompanying text.

81. See, e.g. McCann, *supra* note 67, at 1437 (stating that depression, anxiety, memory disturbance, and other neuropsychiatric disorders may be a consequence of disorders involving brain 5-HT).

82. See McCann, *supra* note 61.

83. See generally McCann, *supra* note 61.

newly diagnosed with Parkinson's Disease.⁸⁴ When compared with the control, non-drug user, researchers observed a significant loss in the brain's ability to transport dopamine back into brain cells.⁸⁵ Dopamine function is critical to emotional regulation, is involved in the normal experience of pleasure, and is involved in controlling an individual's motor function.⁸⁶ Thus, this long-lasting impairment in dopamine function might account for some of the behavioral dysfunctions that persist after long-term methamphetamine use.⁸⁷

What is believed to occur in addiction is that an individual voluntarily begins to use drugs and then, at some point, something happens.⁸⁸ A metaphorical "switch" flips, in reality a cascade of biochemical events at the molecular, cellular, and systems levels, at different times for different people based on biological and other factors, and an individual moves from a state of voluntary drug use to become a compulsive drug user.⁸⁹ Compulsive drug use is the essence of addiction: compulsive, often uncontrollable, drug craving, seeking, and use in the face of negative consequences.⁹⁰ It is this compulsion that is responsible for the disruption, crime, and other negative correlates of drug use that follow in its wake.⁹¹

Because addiction comes about as a result of what drugs do to the brain, and causes these long-lasting changes, at its core, addiction is a brain disease.⁹² It is, however, not that simple. Drug addiction is not just a brain disease.⁹³ There are contributions of biology, behavior, and environment.⁹⁴

84. *See id.*

85. *See id.*

86. *See Addiction Is a Brain Disease, supra* note 11.

87. *See McCann, supra* note 61, at 8421.

88. *See Scientists Identify Brain Chemicals Involved in "Switching On" Cocaine Addiction* (visited Sept. 21, 1999) <<http://www.nida.nih.gov/MedAdv/99/NR-915.html>> [hereinafter *Scientists Identify Brain Chemicals Involved in "Switching On" Cocaine Addiction*].

89. *See generally* Max B. Kelz et al., *Expression of the Transcription Factor Δ FosB in the Brain Controls Sensitivity to Cocaine*, 401 NATURE 272 (1999).

90. *See Interview with Alan I. Leshner, Ph.D., supra* note 7.

91. The "[c]osts of crime attributed to illicit drug abuse were estimated at \$59.1 billion, and costs of crime attributed to alcohol abuse were estimated at \$19.7 billion. These costs include reduced earnings due to incarceration, crime careers, and criminal victimization; and the costs of criminal justice and drug interdiction." *Economic Costs of Alcohol and Drug Abuse: Executive Summary, supra* note 1.

92. *See Addiction Is a Brain Disease, supra* note 11.

93. *See id.*

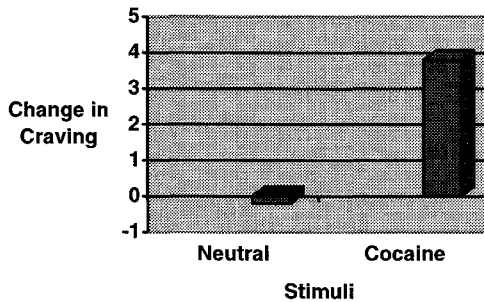
94. *See id.*

III. THE MEMORY OF DRUGS

In Alcoholics Anonymous they say that alcoholics need to avoid the “people, places, and things” that surrounded their initial alcohol use because these people, places, and things will cause relapse.⁹⁵ Interestingly, it is only relatively recently that drug abuse researchers have also begun to focus on memory as an important part of addiction.⁹⁶ That is because drug taking is a learned behavior, a conditioned phenomenon, where all of the contextual stimuli that surround initial drug use literally become conditioned to it, and then exposure to those cues all by itself can elicit phenomenal craving and therefore relapse.⁹⁷

Figure 4 illustrates the results of a University of Pennsylvania study.⁹⁸ The study measured craving in cocaine addicts presented with either a nature video or with what is called a cocaine video, which is a depiction of cocaine paraphernalia, powder, and somebody preparing to use cocaine.⁹⁹ After being exposed to the neutral stimuli, not surprisingly, there is no craving.¹⁰⁰ But after merely viewing the cocaine video, research subjects experienced phenomenal craving.¹⁰¹

FIGURE 4: CRAVING INDUCTION IN PET SETTING



The work of Anna Rose Childress, published in the January 1999 issue of the *American Journal of Psychiatry*¹⁰² illustrates the memory of drugs. A tremendous activation occurs in both the amygdala, the area

95. Interview with Alan I. Leshner, Ph.D., *supra* note 7. See also *Scientists Identify Brain Systems Involved in Drug Craving*, *supra* note 9.

96. See *Scientists Identify Brain Systems Involved in Drug Craving*, *supra* note 9. See generally Childress, *supra* note 49.

97. See *id.*

98. See generally Childress, *supra* note 49.

99. See *id.* at 12.

100. See *id.* at 13.

101. See *id.*

102. See *id.*

involved in emotional memory,¹⁰³ and in the anterior cingulate, which is involved in cognitive processing and memory processing.¹⁰⁴ This is a biobehavioral phenomenon. It shows the brain's signature of craving in a living, breathing person, compared to a non-craving state. This demonstrates that addiction is a disease in which the brain has become conditioned to the surrounding variables. This is a brain disease that has literally embedded within it behavioral and social context aspects.¹⁰⁵

When dealing with addicted people, one is dealing with people who are in a different brain state.¹⁰⁶ This compulsive behavior is real, is biologically based, and is an illness. The compulsion that characterizes addiction comes about because something has been changed in the addict's brain.¹⁰⁷

IV. TREATMENT FOR DRUG USE

A major task for treatment is to either change the brain back or compensate in some way for that brain change.¹⁰⁸ As drug addiction is a biobehavioral disorder, the best treatments will attend to all aspects of the addiction: the biological, the behavioral, and the social context aspects simultaneously.¹⁰⁹

Figure 5 depicts work performed at the University of Pennsylvania by Thomas McLellan and colleagues.¹¹⁰ This research shows that combined treatment, pharmacotherapy plus behavioral therapy, is better than medication alone.¹¹¹ The subjects are heroin addicts who are on methadone,¹¹² so they all are getting a biological treatment.¹¹³ This explains why some of the problem behaviors measured are at very low levels to start with.¹¹⁴ Methadone reduces criminality

103. See *supra* note 49 and accompanying text.

104. See Childress, *supra* note 49, at 15.

105. See *Addiction Is a Brain Disease*, *supra* note 11.

106. See *id.*

107. See *id.*

108. See *id.*

109. See *Addiction Is a Brain Disease*, *supra* note 11.

110. See generally A. Thomas McLellan et al., *The Effects of Psychosocial Services in Substance Abuse Treatment*, 269 JAMA 1953 (1993).

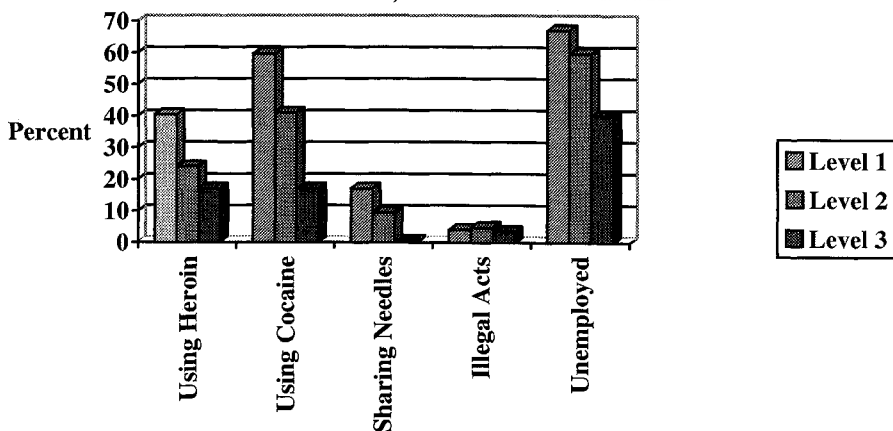
111. See *id.* at 1959.

112. See *Interview with Alan I. Leshner, Ph.D.*, *supra* note 7 (describing methadone as the equivalent of the nicotine patch for heroin addiction; it works by occupying brain receptors that heroin would normally occupy.).

113. See McLellan, *supra* note 110, at 1954. The study was designed with three treatment groups, all receiving a methadone dose of at least 60 mg/d. See *id.* at 1953.

114. See *id.* at 1958.

FIGURE 5: METHADONE LEVELS STUDY: TARGET BEHAVIORS AT SIX-MONTHS, BY LEVEL OF SERVICE



and needle sharing.¹¹⁵ The result is a dose response curve in terms of using heroin, a very systematic step decrease of heroin use, cocaine use, sharing needles, and illegal acts.¹¹⁶ An examination of employment factors, such as the number of days worked, income, and percent of patients working, shows that adding increasing doses of behavioral treatment makes the biological treatment better.¹¹⁷

We have in the clinical toolbox a range of very effective drug treatments.¹¹⁸ Of course, there is no one size fits all, and they are not perfect. The National Institute on Drug Abuse¹¹⁹ would not be trying to improve existing treatments and develop new ones if the existing drug treatments were perfect.¹²⁰ The bottom line is that drug addiction can be treated as readily as other diseases with major medications and behavioral compliance issues.

Understanding drug abuse and addiction from a health perspective forces society to think about these conditions in fundamentally different ways. Having a health perspective influences treatment out-

115. See *Interview with A. Thomas McLellan, supra* note 9.

116. See *id.*

117. See McLellan, *supra* note 110, at 1958.

118. See *Interview with Alan I. Leshner, Ph.D., supra* note 7.

119. The National Institute on Drug Abuse (NIDA) was established in 1974, and became part of the National Institutes of Health, Department of Health and Human Services in October 1992. See Dr. Alan I. Leshner, *Welcome from the NIDA Director* (visited Sept. 27, 1999) <<http://www.nida.nih.gov/NIDAWelcome.html>>. NIDA "supports over 85% of the world's research on the health aspects of drug abuse and addiction." *Id.*

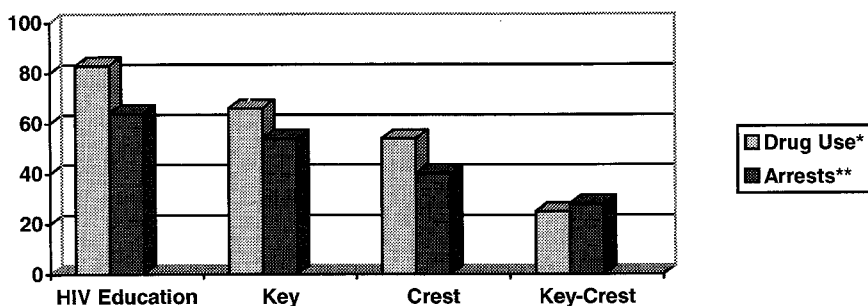
120. See *NIDA's Future* (visited Sept. 27, 1999) <<http://www.nida.nih.gov/AboutNIDA.html>>.

come expectations, criminal justice approaches, and drug use pattern expectations.¹²¹

For example, treatment can have a significant impact on drug use and recidivism in drug abusers within the criminal justice population.¹²²

Figure 6 depicts the results of a study at the University of Delaware on treatment in prison.¹²³ As this chart on eighteen month follow-up shows, although well over sixty percent of untreated drug users who have been imprisoned revert to both drug use and criminality within very short periods of time, incorporating treatment into the incarceration and post-release strategy reduced recidivism by as much as seventy percent.¹²⁴ With no aftercare, and just a little bit of AIDS education, at eighteen months after release seventy percent of the subjects are back using drugs,¹²⁵ and fifty-two percent are back in

FIGURE 6: DELAWARE THERAPEUTIC CONTINUUM ASSESSMENT:
18 MONTH FOLLOW-UP



Key:

HIV Education — no TC

Key — in-prison TC only

Crest — work release TC only

Key-Crest — both TCs

* Used drugs one or more times during the last 18 months

** One or more new arrests and/or probation violations during the last 18 months

121. See *Interview with A. Thomas McLellan*, *supra* note 9.

122. See Robert Mathias, *Correctional Treatment Helps Offenders Stay Drug and Arrest Free* (visited Sept. 22, 1999) <http://www.nida.nih.gov/NIDA_Notes/NNVo110N4/Prison.html> (referring to the figure showing the drug-free and arrest-free percentages).

123. See *id.*

124. See *id.*

125. See *id.*

jail.¹²⁶ On the other hand, with a comprehensive program, only twenty-four percent are back using drugs¹²⁷ and twenty-nine percent are back in jail.¹²⁸

The bottom line is that it is foolish not to treat addicts while they are in prison, because otherwise many of them will be back. So, not surprisingly, the biggest advocates for treatment in this country right now are people in the criminal justice system. From a societal point of view, getting a handle on crime in this country will require treating the addicts who are responsible for a large amount of it.

CONCLUSION

We know a tremendous amount about drug abuse and addiction and what to do about it. The dilemma is that the problems we still face require more than increasing the understanding of drug abuse and addiction. Unfortunately, there is a disconnect between the public's perception of the nature of this disease and the scientific bases we have discovered through research. Pervasive misconception about the nature of drug abuse and addiction have created barriers to its adequate treatment coverage under most health care systems. If we are going to make any real progress in this country we need to overcome that disconnect between the scientific facts and the ideology, intuition, and so-called common sense-based approaches to dealing with this problem. Now that we have the science base, we can in fact mount a much more rational approach, and science can replace ideology, as the foundation for drug abuse and addiction prevention, treatment, and policy strategies. However, we as a society need everyone's collective will in order to accomplish this.

126. *See id.*

127. *See id.*

128. *See id.*