Engineering Neurobiological Systems: Addiction

Brian Johnson, MD[a,b]

KEYWORDS

• Addiction • Biological engineering • Neuropsychoanalysis • SEEKING • Opioid • Tobacco

KEY POINTS

- Psychodynamic treatment of addiction must take into account that there is an addictive drug industry, both legal and illicit, and that huge profits are made by injuring and killing people. This fact propitiates the therapeutic alliance between patient and analyst and minimizes countertransference stigma and frustration.
- Psychodynamic treatment of addiction requires an understanding of drug effects on the brain. Neuropsychoanalysis involves correlation of psychoanalytic psychology and clinical patient experiences with neurobiology and therefore fulfills this requirement.
- Engineering models are based on neurobiology. Models facilitate efficacy of treatment.
- A drug cannot be addictive unless it can change the ventral tegmental dopaminergic SEEKING system, resulting in changed thinking by the drug user. This change is best described as "mind control," meaning the drug user brings the drug seller money despite the user's knowledge of being injured and possibly killed by the drug.
- The SEEKING system is the neurobiological correlate of the will, the experience of drive operating within us. Knowledge that the will of the patient has been taken over by a drug dealer is required of the psychodynamic treater and must be interpreted to the patient.

INTRODUCTION

One hundred million people were killed by tobacco in the 20th century, and we are on track for 1 billion killed in the 21st century.[1] The chance of someone using illicit drugs is 80 times higher if they start inhaling cigarettes before the age of 15.[2] Given that the average age of onset of smoking is 13,[3] most victims are captured as children. Alcohol, the other addictive drug legal when the United States was founded in

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[a] Boston Psychoanalytic Society, Newton Centre, MA, USA; [b] Department of Psychiatry, State University of New York (SUNY) Upstate Medical University, 750 East Adams Street, Syracuse, NY 13210, USA
E-mail address: johnsonb@upstate.edu

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1789, kills 4% of the population.[4] Twenty-five percent of Americans die from using drugs (Table 1). Selling addictive drugs in the United States generates $845 billion per year, 5% of the gross domestic product (Table 2).

We know this, but not consciously. We act as if we have not noticed. The size of the mass killing is an order of magnitude greater than the holocaust or Stalin's murders. It is going on right now. The wish not to know is powerful. Words, the polar opposite of unconsciously driven destructive behaviors, are our solution. The psychoanalytic enterprise is to help make our patients and our society conscious.

The definition of addiction is, "Repeated use despite harm." If one inhales sticks of dirt, carcinogens, and nicotine, every stick creates harm. Social cigarette use is rare. Alcohol is more variable. One can drink every day and live to an old age. Alcohol and marijuana are drugs that usually affect people adversely when they start using in the morning. Most users do not become addicted. One of the problems about understanding drug addiction is that one cannot simply project one's own experience into another. The effect of drugs with addictive potential depends on the character of the person using the drug. Character function is complex and includes genetic predispositions. But genes are designed to undergo epigenetic changes, as humans develop in a social surround. We could say as an approximation that we are going to use psychoanalytic models to simplify the complexity of behaviors that have contributions from biological, psychological, and social sources.[5] However, in addiction, the neurobiology of addictive behaviors is so important that it is more accurate to call them engineering models.

ENGINEERING MODELS

"The purpose of an abstraction hierarchy is to hide information and manage complexity. To be useful, biological engineering abstraction hierarchies must allow individuals to work at any one level of complexity without regard for the details that define other levels, yet allow for the principled exchange of limited information across levels."[16] As defined by the International Council on Systems Engineering, "A system is a construct or collection of different elements that together produce results not obtainable by the elements alone."[17] Here we combine elements of neurobiology, psychoanalytic psychology, and the grim reality of the addictive drug industry and its victims, to construct a systems engineering approach to treatment and research.

Neurobiological concepts are used here to build engineering models. Arguments over whether every aspect of the model is correct are not important. Engineers

Table 1
Drugs kill one-fourth of Americans

Drug	American Deaths/Year
Tobacco	480,000
Alcohol	88,000
Opioid overdose	59,000
Benzodiazepine overdose	9000
Cocaine	6784
Methamphetamine	5740
Total deaths from drugs	648,524
Total deaths in United States	2,626,418

Data from Refs.[6–8]