What are inhalants? What is inhalant abuse? Why are inhalants being abused? What are the short- and long-term effects of inhalant abuse on the body and brain? While drug abuse continues to be one of the most devastating social and medical problems in our society, very little is known about the mechanisms by which drugs regulate behavior, including drug seeking/taking behavior itself. This is particularly true for inhalant abuse which remains a significant public health problem throughout the U.S. and the world, especially among children and teenagers. Dr. Scott Bowen and his research group are focusing on these and other questions in an attempt to help those that have been effected by this type of drug abuse.

Dr. Bowen first became interested in the behavioral effects of commonly abused drugs while an undergraduate at the University of Mississippi. It all began with a class in Biological Psychology which developed into a volunteer position in the laboratory of Dr. Mary Jeanne Kallman. Here he began to study drug effects on behavior under carefully controlled laboratory conditions where the pharmacological and psychological determinants of drug action can be isolated and investigated. Dr. Bowen was so intrigued by the work going on in the laboratories that he decided to stop his plans to attend medical school and refocus his studies into Psychopharmacology. He continued working with Dr. Kallman, earning a Master’s degree for a project focusing on the conditions in which drug tolerance develop. Dr. Bowen continued this line of work in the laboratory of Dr. Stephen Fowler, earning his PhD in 1993.

For his postdoctoral work, Dr. Bowen relocated to the Medical College of Virginia where he began working in the Behavioral Pharmacology/Toxicology laboratory of Dr. Robert Balster. Here Dr. Bowen began working on projects focusing on inhalant abuse. After several very productive years, Dr. Bowen decided to extend his postdoctoral work and accepted a position in 1997 with Dr. Alice Young at
Wayne State University. Here Dr. Bowen expanded his knowledge of psychopharmacology by focusing on research investigating opiate tolerance and dependence. However, the continued lack of research into inhalant abuse issues drew Dr. Bowen back and he began securing funding from the National Institute of Health (NIH) to continue his previous research. Dr. Bowen was appointed to a faculty position in 2001.

Since then, his innovative research program has overcome many of the technical demands associated with this type of drug abuse. As a result, he has received several NIH grants (National Institute on Drug Abuse: Two R01’s and an R21) since 2002. One critical factor in understanding substance abuse is the neurobehavioral impact of those drugs. The models that he has developed allow him to probe underlying behavioral, pharmacological, neurochemical, and genetic mechanisms of the use/misuse of organic solvent inhalants. The overall goal of this research is to better model clinical features of drug abuse with the ultimate goal of developing new therapeutic approaches for preventing and treating this form of drug abuse.

For example, in one series of his investigations, he is employing drug discrimination procedures as a tool to study the neuropharmacological mechanisms of action for commonly abused inhalants. He previously reported that a number of abused solvents have behavioral and pharmacological effects similar to those of abused depressants such as the barbiturates and alcohol. However, he has recently found that one abused inhalant, toluene, shares stimulus effects with a Central Nervous System stimulant. These results support the hypothesis that binge toluene exposure may be rewarding in the way that other drugs of abuse (e.g., amphetamine & cocaine) that alter brain dopamine levels are rewarding. These exciting results were published in *Psychopharmacology* (Bowen, 2006). Additional studies are currently underway in his lab investigating other abused inhalants.

Another area of his research is focused on systematically characterizing the developmental neurobehavioral consequences of *in utero* exposure to inhaled organic solvents. Because the population abusing solvents includes more and more women in their childbearing years, there is concern about the potential negative impact of these inhalants on pregnancy outcome and the life-long physical and mental development of children. Indeed, there is emerging evidence of a *Fetal Solvent Syndrome*, which is a constellation of birth defects, and developmental delays that have been attributed to maternal abuse of organic solvents. Dr. Bowen’s lab published several invited reviews on this (Bowen & Hannigan, 2006; Hannigan & Bowen, 2010). For this ongoing research he developed a model of inhalant exposure in pregnant rodents and assessed developmental delays and biobehavioral birth defects in the offspring. A key objective of this research is the design and implementation of a clinically relevant model of gestational inhalant administration that mimics the episodic, high-dose exposure pattern in women who abuse toluene. Dr. Bowen and his lab have been successful in characterizing the maternal and fetal neurotoxic effects of toluene during specific “critical periods” of development that mimic maturational stages of human brain development and he has been publishing these results (Bowen et al., 2005; 2007; 2009; Bowen & Hannigan, 2013). They also examined the ontogeny and alteration of postnatal development and behavior in rats exposed to neonatal toluene in a model of third-trimester
developmentally equivalent exposure and they have begun publishing these results as well (Bowen et al., 2006). Dr. Bowen believes that this research with toluene will have important implications for understanding the impact of gestational inhalant abuse of a variety of organic solvents on development and behavior.

A third area of interest concerns the negative impact that adolescent inhalant abuse can have on life-long behavioral and cognitive maturation. Unfortunately, there is a relative paucity of systematic studies of the developmental consequences of adolescent binge exposure to inhaled organic solvents. In addition, the clinical picture of adolescent inhalant abuse can be confounded by use of multiple solvents, exposure to other drugs, and maturational and environmental variables. An initial goal of this NIH-funded grant was to develop a rodent model of adolescent inhalant exposure, using an established model of clinically relevant abuse patterns of repeated, brief, episodic, high-dose exposures typical of human’s inhalant abuse, and to assess behavioral and neurochemical effects. A key strength of this proposal is the use of a preclinical model of inhalant administration that mimics how toluene and other solvents are abused. His lab has begun to characterize, in rats, behavioral, neurobiological, and psychopharmacological consequences of adolescent binge exposure to inhaled organic solvents during defined “critical periods” of postnatal development that mirror maturational stages of human development: juveniles, adolescents, young adults and adults. Dr. Bowen’s research is also examining the developmental profiles of behavioral and neurochemical sensitivity to toluene using behavioral assessments (e.g., motor function and learning) and state-of-the-art brain imaging techniques. These include magnetic resonance imaging (MRI) scans to measure regional changes in brain size, and high-resolution “magic-angle”-spin proton magnetic resonance spectroscopy (i.e., a very powerful magnetic field) to examine the age-dependent effects of toluene exposure on neurochemistry. Dr. Bowen and his lab have been publishing results from this work (O’Leary-Moore et al., 2009; Perrine et al. 2011) with the hope that this research will generate a clinically relevant model with which neuroanatomical and biochemical outcomes, along with the mechanisms of adolescent inhalant abuse may be studied. The model also has the potential to assist in devising effective treatments and prevention strategies for adolescent inhalant abuse.