Can you briefly explain how drug use has evolved over time?

Drug use can be considered as one of the oldest forms of human neurotechnology; the deliberate use of plant-based drugs to change thoughts, feelings and mood. The earliest discovered drug was alcohol, which was initially produced inadvertently but was subsequently replicated in numerous agricultural societies when its transformative properties were recognised. Nicotine, opiates and cocaine followed a little later. Ingenious humans have since found better ways to isolate and increase the concentration of active agents in these drugs, and get regular access to them.

What are the main economic costs and implications to wider society associated with addiction?

The major economic costs of addiction arise from two factors. The first includes the medical consequences of problem drug use, such as non-fatal drug overdoses, intoxication and drug dependence; accidents caused by alcohol and drug intoxication; suicide attempts, to which drugs often contribute; and mental and physical disorders arising from, or aggravated by, alcohol and other drug use that often emerges to deal with symptoms of these disorders.

The second includes the broader social effects of addiction on drug users and others such as harm caused by accidents and assaults; neglect of children by drug impaired parents; alcohol and drug impaired work performance; and acquisitive crimes such as theft, fraud and drug dealing that some addicted people engage in to fund their drug use.

Do you consider drug substitution to serve as an effective method for reducing dependency and what are the alternatives?

Many people disapprove of substitution treatments (such as methadone) because they see it as maintaining rather than treating addiction. These treatments can be defended as reducing harm in addicted people who are unable to desist from using drugs. This approach to treatment is not well developed or as successful in treating addiction to stimulant drugs, alcohol or cannabis. Nevertheless, substitution treatment is clearly the lesser evil when compared to injecting street heroin. Treatments that use drug-free methods, such as attending Alcoholics Anonymous groups or participating in residential treatment, do help the minority of addicted individuals who remain in them long enough to benefit. But these approaches are not attractive to many addicted people and they do not produce enduring abstinence in the majority who receive them.

What are the challenges associated with gathering accurate global statistics on drug use and how can the reliability of methods be improved?

The use of illicit drugs is illegal by definition, and is often heavily socially stigmatised so these forms of drug use are often well hidden by those who engage in them. The traditional methods of studying human behaviour, such as surveys, have limited value, even in developed countries that have the capacity to conduct such studies. We need to assist developing countries to generate expertise in studying illicit drug use. We may need to consider using less resource-intensive methods, such as measuring illicit drug residues in sewage waste water.

Can you explain some of the emerging technologies being designed and implemented to understand the neurological impacts of drug use?

The increasing use of sophisticated brain imaging technologies – non-invasive methods of visualising processes in the living human brain – promises to increase our understanding of the neurobiological impacts of drug use and addiction. The marriage of new neuroimaging methods with more traditional longitudinal epidemiological studies of representative samples of young people will be essential to distinguish between the causes and effects of drug use on the brain. More controversially, if proposals to use deep brain stimulation to treat addiction proceed, we may obtain more direct evidence on the role of key brain circuits in addiction.

What research do you think is needed to help further understanding of mental health and disease in the developing world?

We need to collect better data on the prevalence of common mental health and addiction problems in low- and middle-income countries. We cannot assume that these countries have the same types of problems as developed countries where these disorders have been most extensively studied. We also need research to find culturally appropriate and economically sustainable ways of effectively preventing and reducing these problems.
Kicking the habit

In response to the pressing issue of substance abuse, the Research Excellence group seeks to assess the impact of neuroscience on social ideas of addiction, including the development of new therapeutic options, and influence government policy towards these developments.

THE HISTORICAL AND archaeological record provides abundant examples of humanity’s use of substances to alter their state of being. Early agriculturists discovered how to produce alcohol by fermenting grains and grapes, and the effects of opium were known to the Greeks and Romans. With the development of powerful drug delivery methods, such as the cigarette and the hypodermic needle in the 19th Century and synthetic psychoactive pharmaceuticals in the 20th Century, the accessibility and addictive potential of a variety of substances has dramatically increased.

While treatment and rehabilitation options are available for those who develop an addiction, unfortunately many people who are addicted remain untreated or are imprisoned. By uncovering the neurobiological and genetic processes that underlie alcohol and other drug addiction, many researchers believe that science will transform current social perceptions of addictive and mental disorders and provide governments with more effective options to deal with addiction.

PROMISING DEVELOPMENTS

The Research Excellence group based in The University of Queensland Centre for Clinical Research, Australia, has explored the potential application of insights from the neurobiology of addiction. For nearly 30 years, the coordinator of this project, Professor Wayne Hall, has been involved in researching patterns of addictive drug use and the effects on individual drug users and society. Hall was teaching human behaviour and social sciences to medical students when he acquired a full-time position conducting research on addictions at the newly funded National Drug and Alcohol Research Centre. “I expected that I would move onto something else as I had so often done in the past. But I found my interest fully engaged by the technical and ethical challenges in researching addictions and have spent much of the subsequent years working on this topic,” he recalls. This path has taken him to great heights, including giving evidence to the House of Lords Committee in the UK on the health risks of using cannabis for medical purposes.

Over the last decade Hall has examined the ethical and policy implications of research on the genetics and neurobiology of drug use and addiction. In his explorations of these issues, Hall has been active in establishing and sustaining networks of researchers and groups at leading universities and research centres in Australia and internationally. He has sought to usefully combine disciplinary perspectives by building and participating in collaborations with environmental toxicologists, epidemiologists, geneticists, health economists, neuroscientists, philosophers, psychiatrists, psychologists and sociologists.

A NEW FIELD

Hall and his collaborators are combining their expertise to study the newly defined area of addiction neuroethics: the examination of the ethical and policy issues raised by addiction neuroscience. This field of research addresses specific ethical issues raised by conducting neuroscience research on humans and animals and applying these findings to treat or prevent addictive disorders.

Neuroethics also examines ways in which neuroscience and genetics may affect public understandings of addiction and thereby support for potential policies to address alcohol and drug addiction. Twin and adoption studies indicate that genetic factors substantially contribute to the risk or likelihood of developing addiction. However, understanding
the role of genetic contributions is not simple. Unlike certain disorders like Huntington’s disease where a single gene ‘explains’ the risk of developing the disease, the genetics of addictive disorders is much more complex, as Hall elucidates: “Large numbers of genes, each with small effects, contribute to addiction risk and these act in combination with features of the social environment within which individuals are raised”.

Despite this challenge, the significant level of substance use and associated burden of harm and disease on society makes assessing the potential impact of genetic research on public understanding of vital importance. Therefore, grasping how addicted people and their families understand the role of genetics, as well as social influences such as media reports, marketing and medical and government advice are among the issues that Hall’s Addiction Neuroethics group is currently exploring.

**ENHANCED TREATMENT**

A better understanding of the neurobiology of addiction promises to provide more effective ways of assisting the addicted to stop using drugs and remain abstinent. Among the options currently being explored are drug vaccines and implantable devices that release drug antagonists to reduce the effects of drugs on the users’ brains. The work undertaken at The University of Queensland focuses on the potential benefits and risks of new technologies, such as genetic prediction of addiction risk, drug vaccines to treat and possibly prevent addiction, long-acting implantable drugs, diagnostic neuroimaging and therapeutic brain stimulation. “The marriage of new neuroimaging methods with more traditional longitudinal epidemiological studies of representative samples of young people will be essential to distinguish the causes and effects of drug use on the brain,” Hall adds.

However, along with new treatments come new questions. The Addiction Neuroethics group seeks to grapple with the ethical and policy implications of these innovative therapeutics. These include the contentious use of the courts to force addicted individuals into treatment and proposals to trial invasive neurosurgical procedures, such as deep brain stimulation, to treat addiction. The researchers are also examining ethical issues raised by proposals to monitor the use of illegal drugs in the community by measuring illicit drug residues and metabolites in waste water.

Hall, along with Adrian Carter, has recently published a book entitled *Addiction Neuroethics: The Promises and Peril of Neuroscience Research on Addiction*. It provides an overview of the ethical and policy issues raised by applications of addiction neuroscience research including the use of vaccines against cocaine and nicotine, implantable opioid antagonists and predictive genetic screening for addiction liability.

**FURTHER AFIELD**

Australia is the focus of much of this research, but many of the same or related issues also arise in other developed countries. The work undertaken by the team has the potential to be internationally transformative, although its findings will need to take into account national differences in patterns of drug use and cultural beliefs about drug use and addiction. Developed countries may also benefit from this research by broadening their understanding of how mental health and addiction problems develop in a wider spectrum of cultures and societies.

The applicability of this work to developing countries remains uncertain – better data is needed on trends in drug use in these countries as well as studies of cultural understanding and attitudes towards drug use and addiction. Developed countries may also benefit from this research by broadening their understanding of how mental health and addiction problems develop in a wider spectrum of cultures and societies.

It is hoped that the work conducted by the Addiction Neuroethics group will provide comprehensive and accessible analyses of questions surrounding addiction in order stimulate informed policy debates and increase public awareness of ethical issues. Such analyses will assist policy makers to adopt better informed responses to reduce the harms caused by drug use and addiction while meeting community expectations of fairness and responsibility.

**INTelligence**

**NEUROSCIENCE AND GENETICS**

**OBJECTIVES**

To assess the impact of neuroscience on social ideas of addiction, including the development of new therapeutic options, and influence government policy towards these developments.

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**PROFESSOR WAYNE HALL** earned a PhD in Psychology from the University of New South Wales (UNSW). He was Director of the Office of Public Policy and Ethics at the Institute for Molecular Bioscience, University of Queensland (UQ), and Professor of Public Health Policy in the School of Population Health at UQ before moving on to lead the Addiction Neuroethics Unit at The UQ Centre for Clinical Research.

Hall is an NHMRC Australia Fellow and Visiting Professor at the UQ Queensland Brain Institute. He has also been an advisor to the World Health Organization (WHO) on numerous issues, and is currently a member of the WHO Expert Advisory Panel on Drug Dependence and Alcohol Problems. He has published over 750 scholarly articles, books, chapters, reports and other works.