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Introduction

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The brain is often seen as critical to our identity, the organ of individuality and mind that gives us our unique thoughts, personality and behaviour (Kagan, 2006). Understanding the mind in biological terms has become a principal concern for biological science in the 21st century (Kandel, 2006). Scientists have uncovered many of the changes in the brain that are associated with thought, cognition and behaviour in healthy individuals and in those suffering from psychiatric and neurological disorders. From this new understanding, novel neurological technologies are emerging with the potential to manipulate brain function in the hope of ameliorating, curing or preventing neurological and psychiatric disorders.

Despite these epistemological and technological advances, there are important questions that remain unanswered:

- Does our brain explain everything about us, or about our mind?
- What are the implications of neuroscience research for our self-hood and agency?
- How do neurobiological explanations affect a mentally ill individual's self-understanding of their disease, their responsibility for their behaviour or their ability to overcome it?
- How do neurobiological explanations affect our beliefs about the origins or causes of mental illness?
- How should societies respond to mental illness in light of neurobiological explanations of mental illness?

For some, neuroscience raises doubts about some of our most fundamental assumptions about freedom of the will and agency. Do we act wilfully, or is this simply an illusion, an epiphenomenon of brain events outside our

consciousness? Are we simply neurobiological automatons at the mercy of the state of our neural circuits? This issue is particularly pertinent in the case of psychiatric disorders, such as addiction, where control over behaviour is seen by some as having been compromised by a 'disease of the brain' (Leshner, 1997).

In everyday life, most people act on an implicit folk psychology in which they assume that they control their own behaviour. Our social institutions (e.g. family, marriage, government, criminal justice and legal systems) are premised on the understanding that we generally control our own behaviour, and hence are responsible for it. Some philosophers and scientists, however, take a rigorously reductive or *neuroessentialist* approach to mind and brain, in which the mind *is* brain and the brain is both necessary and *sufficient* for explaining the mind (Churchland, 1986; Crick, 1995). They argue that our thoughts and actions will ultimately be explained as a series of neurochemical events, and that mental illnesses will be shown to be the result of disturbed brain processes.

The neuroessentialist view that a disorder is described solely by changes in the brain is more plausible in the case of neurological disorders where there is a direct relationship between changes in the brain and changes in behaviour. For example, the relationship between a trauma-induced lesion to the frontal parts of the brain and disinhibition in behaviour is simple and direct, notwithstanding the psychosocial factors that may make some people more likely to suffer a traumatic brain injury of this type, such as a propensity to take risks. In such cases we understand how the injury led to the observed changes in behaviour or cognition (e.g. loss of ability to form new memories following hippocampal lesions, or the inability to form successful social relationships following a lesion to the ventromedial frontal cortex).

The relationship between brain and behaviour is neither as clear nor direct in most psychiatric disorders, such as addiction. The changes in brain function observed in patients suffering from mental illnesses are, in comparison, extremely complex, subtle and variable. They often arise as a result of minor shifts in 'normal' brain activity. Even the concept 'normal' brain function may be misleading because there is great variability in brain structure and function between healthy individuals. Psychological and social factors also play a much greater role in the development and manifestation of psychiatric disorders than in the neurological cases described above.

Despite decades of increasing research into the neurobiological origins of consciousness, thought and behaviour, the fundamental questions of the relationship between brain and mind, self and society remain. Human beings

are highly complex, biological and psychological beings who are embedded within a web of dense social interactions that occur in a variety of overlapping spheres, such as family, government, the criminal justice system, the public health system, commerce and industry (e.g. the pharmaceutical, tobacco and alcohol industries).

Within this context, understanding and applying neuroscience can be complicated by a number of competing interests. Psychiatric disorders such as addiction are not just medical conditions that require treatment from health care professionals; they may also involve violations of social norms and laws, involving the criminal justice system. The behaviour of those affected can often cause significant social harm to others as well as themselves (e.g. adversely affecting communities and families). These disorders disproportionately affect certain subpopulations within society (e.g. socioeconomically disadvantaged and ethnic minority groups). In the case of alcohol and tobacco, there are commercial and other vested interests that profit from the sale and consumption of these addictive products who often seek to use addiction science to protect their interests.

Psychiatric disorders, such as addiction, also provoke strong moral responses from others that can influence how neuroscience is understood and applied (Pescosolido, et al., 2010; Read and Law, 1999; Rose, 2003; Sartorius, 2010). Mental illnesses are highly complex disorders that are difficult to understand, generating significant fear and opprobrium that can lead to discrimination against, and stigmatisation of, those that suffer from them. For all these reasons, addicted and mentally ill individuals are vulnerable, socially, economically and cognitively. They may be mistreated for reasons of social expediency in order to reduce harm to others. These social circumstances can influence the way in which neurobiological research and technologies are understood or applied, sometimes with unacceptable or negative consequences.

Neuroscience is a complex multidisciplinary field of research that crosses a number of interrelated, but methodologically diverse fields, from molecular and cellular biology to neuroimaging and cognitive and social neuroscience. Its findings also have a number of methodological limitations that can be difficult for the non-specialist to appreciate in popular media accounts of research findings. There is therefore significant potential for this research to be misused or misrepresented, or prematurely applied in ways that may cause serious harm to addicted persons.

When we interfere with a person's brain function, we have the potential to change his or her life not only for the better; we may change brain function in

profound ways that we may not be able to fully appreciate or predict. The advent of powerful new technologies that can image or interfere with brain activity has the potential to manipulate behaviour, cognition and mood in new ways. With the potential to do significant good comes the risk of significant harm. Consideration of positive outcomes needs to be balanced by consideration of less welcome consequences that may limit the translation of addiction neuroscience into effective and appropriate treatments for addiction, and hamper the prevention of harmful forms of drug use. Failure to anticipate and prevent such potentially adverse outcomes may delay the translation of this research into successful clinical treatments.

This book examines the social, ethical and public policy issues raised by neuroscience research and its potential applications in the treatment and prevention of addiction and the formulation of social policies towards drug use. If neuroscience research on addiction is to be translated into effective public health policies it is critical that we understand the ethical, philosophical and social contexts within which neuroscience research is conducted, understood and applied.

1.1.1. Neuroethics: the promises and perils of neuroscience research

Mental illnesses, such as addiction, impose an enormous personal burden upon sufferers and their families, and a substantial economic burden on society. In developed countries, such as the United States (US), Canada and Australia, disorders of the brain and mind account for over a quarter of the total burden of disease, that is years lost from premature death and years of life lived with disability (Begg, et al., 2007; Ezzati, et al., 2004; Murray and Lopez, 1996). The treatment and rehabilitation of those affected by brain and mind disorders already commands a significant proportion of health care expenditure. In Australia, for example, this accounts for approximately 18% of the total health care budget, or around AU$8.5 billion (US$9 billion) per annum (Begg, et al., 2007). A similar situation confronts most developed nations, such as the United Kingdom and other European countries and the US (EMCDDA, 2006; Ezzati, et al., 2004; McKeganey, et al., 2007).

It is clear that the effects of poor mental health and the costs of treating it present a major public health challenge. Increased funding of neuroscience research is often advocated because of the promise that its findings will reduce the incidence of mental illness and addiction and alleviate some of this burden.

Neuroscientists have begun to uncover the neurobiological bases of human behaviour, including the genetic, neurochemical and electrophysiological

mechanisms of major mental and neurological disorders.[1] More generally, this research promises to revolutionise our understanding of the origins of all human behaviour, the experiences of consciousness and mental illness, and immensely increase our ability to treat, and possibly 'cure' or prevent, psychiatric disorders. The emergence of sophisticated neurotechnologies such as neuroimaging, psychopharmacology, electromagnetic brain stimulation and genetic screening offers the promise of new and effective methods for diagnosing, treating and preventing mental illness.

Neuroscience research may also profoundly affect the way that citizens of developed societies think about and respond to people with addictive or other psychiatric disorders. Many scientists, clinicians and policy makers hope that neurobiological explanations of psychiatric disorders will reduce the stigma associated with mental illness, leading to better treatments, increased treatment seeking, greater investment in research and reduced social discrimination experienced by many mentally ill individuals. This view is summarised in the phrase: mental illness is 'a disease like any other' (Pescosolido, et al., 2010). Unfortunately, research suggests that these hopes remain to be realised (Angermeyer and Matschinger, 2005; Pescosolido, et al., 2010; Sartorius, 2010).

Neuroscience is also beginning to uncover many of the neural mechanisms and structures that are involved in normal behaviour and cognition. In doing so, neuroscience has the potential to undermine or overturn beliefs that are central to common-sense ideas about free will, autonomy, responsibility and justice that form the basis of criminal law. If mental illness, addiction and abnormal behaviour are the result of aberrant neurophysiology, how does this affect the way we attribute responsibility or blame for the actions of the mentally ill? Conversely, if individuals use psychopharmacology to enhance performance, can they take credit for their achievement? This research also has important consequences for how society responds to people who are mentally ill or addicted.

Sophisticated neuroimaging techniques may provide access to personal information that has not previously been available. Such information may

[1] We take neurobiology to include studies of the genetic bases of behaviour that can predispose some individuals to developing certain addictive behaviours. This reflects the view that genetic influences on neuropsychiatric conditions are ultimately expressed neurochemically within the brain (see Caspi and Moffitt, 2006; Gallinat, 2008). There has also been an increase in studies that integrate both neuroscientific and genetic approaches, or *neurogenetics* (Akil et al., 2010; Li and Burmeister, 2009).

be used by interested third parties, such as employers, educators, insurers and the courts, to discriminate against certain individuals (e.g. information about genetic risk of disease). The question of who should have access to this information and how it is used is of great public concern. In 2008, the US introduced the Genetic Information Non-discrimination Act to prevent the harmful misuse of genetic information. Very few countries, however, offer the same protections, and none have considered how to regulate the similar potential social uses of neuroscientific information about individuals.

Neurotechnologies may also be used for non-therapeutic reasons, such as cognitive enhancement. The prospect of the future use of cognitively enhancing pharmaceutical drugs raises concerns about equity of access and unintended side-effects of their use, the ethical and social acceptability of pharmacologically assisted performance, and fears about the development of a psychotropic 'arms race' (see Chapter 13) (Hall, 2004). Some commentators have argued that there is already a growing use of psychotropic drugs, such as the stimulants, methylphenidate and modafinil, to enhance cognition or performance; they see this use as evidence of a strong demand for better forms of cognitive enhancement (Chatterjee, 2006; Chatterjee, 2007; Greely, et al., 2008; Maher, 2008; Sahakian and Morein-Zamir, 2007).

The anticipation of the major ethical, social, legal and philosophical issues raised by neuroscience research on neuropsychiatric disorders has been given the name *neuroethics* (Illes, 2006). The influential American journalist, author and speechwriter for President Nixon, William Safire, defined neuroethics as 'the field of philosophy that discusses the rights and wrongs of the treatment or enhancement of the human brain' (Safire, 2002).[2]

While similar ethical issues have been addressed in genetic and stem cell technology, an ethical and philosophical analysis of the impact of neuroscience research is essential (Racine, et al., 2005). A small but dedicated community of researchers have begun to consider this task (Farah, 2010; Glannon, 2006a; Illes, 2006; Levy, 2007; Racine, 2010). The analysis of the ethical, social and philosophical implications of neuroscience research on addiction – which we will call *Addiction Neuroethics* – has received less attention (see Ashcroft, 2007; Carter, et al., 2009; WHO, 2004b for exceptions). Given the significant harm caused by drug addiction and abuse, there is an urgent need to investigate these issues in more detail to ensure that

[2] The term neuroethics was used by Pontius (1973), but it was Safire's definition that is associated with the formation of neuroethics as a field, the inauguration of a Neuroethics Society, and the publication of dedicated neuroethics journals.

advances in the treatment of addiction are translated into clinical practice in ways that minimise harms and maximise benefits.

Unlike other psychiatric disorders, addiction is, at least to some extent, the result of an individual's choices: a person has to try drugs before they can become addicted to them. Illicit drug use (e.g. cannabis, cocaine and heroin) and addiction is highly stigmatised. More so than many other psychiatric disorders, addiction occupies the complex intersection of medical, social and legal responses to abnormal and socially disapproved behaviour. Experiences with addictive drugs also have the potential to inform the regulation and promotion of an ever-growing market for psychotropic medications. For all these reasons, *Addiction Neuroethics* provides an important area of study informing the ethical, social and public policy issues raised by neuroscience research more generally.

1.2. Addiction enters the neuroscientific era

Drug addiction is a significant problem facing most societies. It is associated with increased violence, crime and mental illness, and is one of the leading causes of preventable mortality and disability in most developed societies (see Chapter 2). Significant costs are incurred in attempting to limit or regulate the use of both licit and illicit drugs, and in dealing with the physical, psychological and social costs of drug abuse and addiction. Despite over 150 years of scientific research into the nature of drug addiction and its treatment, a successful political or medical solution remains elusive. Significantly, there remains strong disagreement and debate over the nature and even the existence of addiction (Dalrymple, 2006; Szasz, 1975).

Since the 1950s, animal, and more recently human, research has increasingly suggested that human addictive behaviours have a genetic and neurobiological basis (Koob and Le Moal, 2006; Nutt, et al., 2007b). Twin studies have identified a substantial genetic contribution to liability to develop addiction to tobacco, alcohol and illicit drugs. Molecular genetic studies have begun to identify individual genes that may increase the risk of addiction (Ball, 2007; 2008). Neuroscience studies in humans and animals have also shown how the chronic abuse of addictive drugs can disrupt key neural circuits involved in motivation and reward, memory and learning, and executive control, such as the ability to inhibit impulses or judge consequences (Goldstein, et al., 2009). This research has led to the *brain disease model* of addiction: the belief that the chronic use of addictive drugs 'hijacks' the brains of those addicted and drives them to continue to use

drugs despite the harm that their use causes, and wishing that they could stop (Dackis and O'Brien, 2005; Leshner, 1997; Volkow and Li, 2005).

Many addiction neuroscience researchers argue that their work will lead to increased funding for more effective treatments for addiction (Dackis and O'Brien, 2005; McLellan, et al., 2000). These include: targeted new drugs or treatments that prevent the development of drug addiction (e.g. drug vaccines), reduce cravings or the strong desire for drugs, prevent relapse to drug use, or reverse drug-induced cognitive impairments (e.g. improve cognitive control or unlearn the habit of drug taking); new diagnostic tools to identify people vulnerable to developing addiction and prevent it (e.g. neuroimaging and genetic screening), or the use of these diagnostic tools to personalise treatments to match the individual, such as pharmacogenetics (see Chapter 12) (Insel, 2009).

There is also a growing belief that neurobiological research will provide *causal* explanations of addictive phenomena. Proponents of the brain disease model of addiction hope that an increased understanding of the neurobiological basis of addiction will lead to social policies that recognise addiction as a real neuropsychiatric condition that should be treated therapeutically (Dackis and O'Brien, 2005; McLellan, et al., 2000). This *medical* view of addiction contrasts with the more punitive approaches that have dominated policies towards illicit drug use and addiction for most of the last century, namely, the prosecution, detention or imprisonment of drug users and 'addicts', as well as sellers and suppliers of these drugs. Underlying the more traditional or *moral* approach is the view that compulsive drug use is simply freely chosen immoral behaviour best dealt with by using the criminal justice system to punish those who use illicit drugs and deter others from doing so (National Research Council, 2001). The impact that addiction has upon the capacity for addicted individuals to choose not to use drugs is at the centre of these neuroethical debates, and will be a major focus of this book. Neuroscience is often used in these debates to argue that addicted individuals lack the capacity to choose not to use drugs, and it is therefore important to carefully and critically examine the evidence for and against these claims.

While the potential benefits of neurobiological research point towards socially desirable goals that most would share, the aspirations of advocates of this research need to be tempered by critical consideration of less welcome potential uses of neuroscience, especially those that may result from an overly simplistic interpretation of what neurobiological research reveals about addiction. For example, an unqualified acceptance of the brain disease model of addiction may be seen to warrant increased use of coerced or forced treatment

of addiction because sufferers are seen as suffering from a disease that prevents them from choosing not to use drugs. Neurobiological explanations may also justify the use of risky and overly invasive medical interventions, such as neurosurgery, as has recently happened in Russia and China (Hall, 2006b), and deep brain stimulation (Carter, et al., 2010; Carter and Hall, 2011). It may also lead to an over-reliance on speculative or controversial policies to reduce addiction, such as the vaccination of genetically vulnerable adolescents, at the expense of alternative, less morally contentious social measures that aim to restrict availability or increase the price of legal drugs (see Chapter 14).

The use of novel technologies from addiction neuroscience also raises a number of ethical concerns. For example, new targeted drugs may have unexpected impacts upon cognition, mood and behaviour. Addiction is a highly stigmatised condition, and information gained from neuroimaging and genetic screening may be used by third parties, such as employers, educators, insurance companies and the courts, to discriminate against those with, or suspected of having, a drug addiction.

There are also competing public and social interests that can influence the way in which treatments are provided. Most advocates of the neurobiological model of addiction insist that emerging technologies will be used for the explicit purpose of treating an illness, or reducing the harm that addicted individuals cause to themselves. However, there are other competing social interests that may influence how these treatments are administered or provided. For example, a major justification for public and governmental support for some treatments of addiction is the reduced harm and social costs they offer, such as methadone maintenance treatment and other harm reduction programs. New treatments might be used with an aim of reducing social harm rather than treating the individual, and at the expense of their rights and freedoms.

More ethically contentious uses of neurobiological treatments may reduce the very large prison costs associated with the incarceration of individuals convicted of a crime to which their addiction contributed (e.g. drug dealing, theft to fund an expensive drug habit), or as a form of extrajudicial punishment. Such uses of medical treatments are considered by many to be ethically unacceptable and could cause significant harm to socially vulnerable individuals. High-profile misuses of neurobiological technologies could also lead to significant mistrust of neuroscience, and prevent more ethically acceptable uses of these technologies to the detriment of society generally, as well as those directly affected by addiction.

These are significant ethical and social challenges that need to be considered and balanced in the application of neuroscientific knowledge and technologies. They cannot be answered by scientific research alone, but need to be based on a thoughtful and transparent analysis of the ethical and public policy issues that neuroscience raises. It is critical that we consider the unintended negative consequences of neuroscience research of addiction if we are to realise its promise of reducing the burden and incidence of drug use, and in translating new advances into clinically meaningful treatments with minimal harm.

1.3. Aims and overview

The aim of this book is to provide a critical review of the scientific, ethical and public policy issues that may arise in applying findings from leading genetic and neuroscience research to the treatment and prevention of addiction research. A central issue in *Addiction Neuroethics* is the question of the impact that chronic drug use and addiction have upon an individual's ability to control their drug use. A major aim of the book is to examine how neuroscience research may affect our understanding of autonomy, self-control and agency in addiction. Are addicted individuals able to consent to research that involves a choice about whether to use their drug of addiction? Can they consent to drug substitution treatments that involve administering a drug with similar effects to their drug of addiction? Are medical interventions that intervene directly in brain functioning (such as neurosurgery and deep brain stimulation) justified for addiction? Can, or more controversially should, society coerce addicted individuals into accepting and complying with treatments that may involve implanting long-acting drugs?

This book is organised into four parts. ***Part 1: The Science of Addiction*** documents what is currently known about addiction. ***Part 2: The Ethical and Philosophical Implications of Neuroscientific Knowledge of Addiction*** examines how neuroscientific knowledge may impact upon the way in which we understand and treat those that suffer from an addiction. ***Part 3: The Ethical and Public Policy Implications of Novel Technologies for the Treatment of Addiction*** examines the practical ethical and public policy implications raised by the use of emerging treatment technologies to treat, prevent and possibly cure addiction. Finally, ***Part 4: The Future of Addiction Research and Policy*** considers the future implications of neuroscience for addiction research and public health policy.