Acting on Impulse: Using the Neuroscience of Impulse Control to Improve the Law

by

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Abstract

This thesis investigates the potential legal utility of neurotechnologies which measure correlates of impulsive behaviors. Chapter 1 explains my philosophical position and how this position compares to others in the field. Chapter 2 explores some of the technical concepts which must be understood for the discussion of neurotechnologies and their applications to be fruitful. These chapters will be important for both explaining the capabilities of a neuroscientific approach to neural abnormalities as well as how they relate to the kind of regulation in which the law is engaged.

The purpose of Chapter 3 will be a descriptive account of Canadian law where I will begin to explore how to apply ideas and experiments from neuroscience to specific areas of law. Chapter 3 will look at actual examples of Canadian criminal law and will span topics from the creation of law to the construction of appropriate sentences.

Chapter 4 will debate if and how we should apply the neuroscientific perspective to the law given the ethical concerns surrounding the applications described in Chapter 3. The thrust of the chapter is that the development of the law does not occur in a vacuum and any alteration either to the laws themselves, how they are interpreted, or the technologies used to provide evidence, must have an ethical justification, that is, a way in which the proposed change will better meet the needs of society and the ethical objectives of the law. Sometimes these justifications can be drawn directly from constitutional documents, such as the *Charter*, or from the *Criminal Code*, while at other times these justifications depend upon arguments about furthering meaningful responsibility and therapeutic outcomes.

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Table of Contents:

List of Abbreviations:

AA: Alcoholics Anonymous
ADHD: Attention Deficit Hyperactivity Disorder
CAT: Computer Axial Tomography
CDSA: Controlled Drugs and Substances Act
DNA: Deoxyribonucleic Acid
DSM: Diagnostic and Statistical Manual of Mental Disorders
DTI: Diffusion Tensor Imaging
EEG: Electroencephalogram
fMRI: functional Magnetic Resonance Imaging
LSD: Lysergic Acit Diethylamide
MEG: Magnetoencephalogram
N. Acc: Nucleus Accumbens
NCR: Not Criminally Responsible
PFC: Pre-Frontal Cortex
QEEG: Quantitative Electroencephalagram
THC: Tetra-Hydro Cannabionol
VTA: Ventral Tegmental Area

Chapter 1: Philosophical Background

"*I will assume for the present that it is no illusion. My first act of free will shall be to believe in free will.*" - William James, *1870*

Chapter 1 examines the philosophical arguments important to neurolaw. I will position my approach within this literature and explain what makes my account unique. Doing so will require introduction to some basic concepts concerning human responsibility important to both neuroscience and the law and which will remain relevant throughout this work.

Section 1 – Philosophical Background and My Own Position:

Neurolaw is an emerging field which is slowly gaining in popularity and notoriety. Supporters and critics are engaged in discussions about whether and how our knowledge of the nervous system (neuroscience) should affect how we regulate behaviour in society (law). The infancy of the field is both a blessing and a curse. On one hand it means that most of the arguments are highly speculative and theoretical. On the other it allows a substantial amount of freedom to create a unique approach to combining our knowledge of the neurological basis of behaviour and the rules society uses to govern human conduct.

The basic philosophical difficulties within neurolaw are best explored through two leading and competing conceptions concerning the relationship between legal reasoning and the brain. One camp argues that the law is fundamentally based on folk psychological reasoning. The term "folk psychological" is an academic way of referring to the normal psychological reasons we give for actions using concepts such as intentions, beliefs, moods, and emotions. Morse, the clearest voice from this camp, argues that since these are the leading concepts within not only the law but our everyday experience, they must be the basic formula for our legal system. (Morse, 2011).

In opposition to this view is the one put forward by Greene and Cohen which begins with the paired ideas that the law is interested in regulating behaviour and that all behaviour is mediated by the

brain. Therefore when we make laws to alter behaviour we should be talking in the direct and declarative language of brains and the activations of their constituent parts, not in terms of whatever vague folk psychological concepts may or may not in fact underlie action. Since this view describes people in terms of neural phenomena worthy of study it naturally leads us to question the nature of responsibility, including the responsibility which we ascribe to criminals. Greene and Cohen contend that if an action can be wholly described in terms of the activities of the determined brain then there is no room for the kind of free will required for us to ascribe responsibility, and, more to the point, retributive justice (Greene and Cohen, 2004).

There are multiple complications which occur when one tries to combine these two views of the human behaviour. One centers around the concept of truth. If behaviour is what the law regulates, and what the brain generates, then the claims made by Green and Cohen seem to speak more directly about the reality they wish to describe. Surely the law, an institution with truth finding as one of its primary functions, should attempt to use the truest language to describe its subjects.

A difficulty arises, however, when one has to further consider the appropriateness or applicability of a scientific truth given the criminal trial context. One may know to a scientific certainty that in a scan given under laboratory conditions a certain action or triggered mind state will always present the same pattern on a neuroimaging output screen. There will be, however, any number of objections to how well that experiment maps onto real world criminal conduct. While these critiques should fade as technologies become more reliable, technological limits should not be ignored.

Furthermore, even a perfectly designed experiment must be presented by experts in a court context which, depending on the effectiveness of council, the funds available, and the understanding of the judge, may fail to appropriately present its findings. On the other hand folk psychology with its language of thoughts, emotions, beliefs, moods, desires, motivations, and impulses has allowed some societies to reach a state which is a fair approximation of a just system.

In large part my view sides with Morse. It seems clear that as long as the law regulates our behaviour within society, and as long as that behaviour consists of normal people interacting using folk psychological reasoning, then the law will itself be folk psychological. If the law is to model and guide human life then it must reflect the human experience, which is currently conducted in the folk psychological domain. As the language of neuroscience becomes more used and useful, and as society is educated in the nature of its conclusions, this way of doing things may well change. It may one day not be so strange for one to speak just as comfortably about their amygdalar activity as they do about fear, anger, or aggression. This is approximately the stance taken by several eminent neuro-philosophers including Dan Dennett and Paul and Patricia Churchland (Dennett, 2009; Churchland, 1985).

The position put forward by Greene and Cohen is surely an interesting philosophical abstraction but I can see no way of it reasonably mapping onto our current way of conceiving of our selves. By this I mean that there are some apparent psychological contradictions that occur when one tries to live one's life through certain scientific lenses. For example, we now know that we do not live in the clockwork universe described by Newton. Relativity and Quantum Mechanics have revealed that when things are very large, or very small, or moving very fast they are much stranger than we could have imagined. Non-Euclidean Geometry revealed that even how we mathematically describe space has a number of different non-intuitive forms. However when one tries to live one's daily life bearing these concepts in mind our psychology stumbles. To walk around knowing that light is both a wave and a particle, and that space and time are actually continuous and our travel through one limits our travel through the other, and that there could quite likely be dozens of spatial dimensions packed away so tightly that they we cannot see them but which are at the same time at every point in space, is a psychological non-starter (at least for those of us who aren't an Einstein or a Tesla).

Whether the difficulty of eschewing folk psychology is fundamental to human biology or

whether it is purely a cultural phenomenon which can be overcome is beyond the scope of this work. That question could perhaps best be answered from a sociological perspective studying what kind of society would be required in order to conceive of ourselves in purely neurological terms. Certainly the practices, rituals, and philosophy of such a society would be significantly different than those found in modern day Canada and the laws with which it governs.

If such a shift in culture and individual psychology is possible it is another question entirely whether it would be desirable. Traditional ways of understanding deviance giving way to more physical qua medical characterizations has been heavily critiqued by eminent sociological scholars (Conrad and Schneider, 1992; Pfohl, 1994). It is my hope that by attempting to take a middle position my theories avoid these dangers, however they must be kept in mind if we are to avoid emerging into a Huxlian future of good citizenship only through prescription. While the above topic is of unending interest this thesis is concerned primarily with the application of particular technologies to specific legal concepts and will not dwell on these broader macro-social concerns.

To return to the matter at hand, while I side with those who base the law within folk psychology I wish to separate myself from them in one important respect. Most of the papers written by this camp tend to show why current legal reasoning is incompatible with neuroscience and then say something like 'hence neuroscience will have only a limited usefulness in the near future' (Morse, 2011). This attitude rests primarily on two grounds. The first is the quite reasonable notion that given the novel nature of neuroscience, and the unpredictable ways it advances and is applied, it is foolhardy to make any sure predictions as to whether neurotechnologies will be able to answer some of the fundamental questions of human existence (e.g. Is this person trustworthy? Is this person telling the absolute truth? How is my consciousness and deliberation causally involved in the behaviours I engage in?). The second is a reaction to the overconfidence shown in neuroscience in recent years by those who are insufficiently informed. When a fervor is whipped up about how neurotechnologies are going to be able

to solve all of these fundamental problems it is the appropriate response of the loyal opposition to take an equally strong stance in the opposite direction.

I believe, however, that with the appropriate application and development of existing technologies, that is their development specifically to answer actual legal questions pertaining to actual events which concern the law, neuroscience could have a significant effect in the near future. It will not do so by overturning fundamental approaches to the law but by allowing us to clarify the folk psychological concepts we currently use and to see if these explanations make sense given what neuroscience is discovering about brains. It is my contention that the careful application of neurotechnologies and behavioural testing to investigate the concepts already found important to the law will allow us to use those concepts in a way which has both greater objectivity and is more in tune with ethical objectives.

Other authors have attempted to find a similar middle ground, some within the realm of impulse control (Penney, 2014) and others in distinct but important areas ranging from measuring pain and distress to making sense of the reactions of artificial intelligences (Kolber, 2014). These authors have one important thing in common, they recognize either an existing or extremely likely overlap between law and neuroscience and try to describe it in a way that will be practically useful in a legal context. While there is some philosophizing the reality of the problems on which these authors work means that the vast majority of their arguments are from a practical legal perspective. As such they have found a middle ground, a position from which all that neuroscience has found that can be practically useful to the law is fitted in to the model while making relatively few claims about the broader legal question of whether or not this science will fundamentally shift the entire law as we know it.

Furthermore, I argue that neuroscience can suggest applications of the law which are not currently available in Canada. Other jurisdictions have developed unique approaches to the problems of impulse control and responsibility and the adaptation of these approaches to the Canadian context calls

for significant discussion.

Finally, a few words on my thoughts about the primacy of ethical concerns. I argue that any time a change is consciously made it is made for reasons with ethical justifications. That is, changes are made because the person or group making the change believes that it will bring about some good. Whether or not that change is actually wanted, needed, or desirable upon a wider or longer view is up for debate. The field of ethics exists in order to engage in precisely this debate. Therefore, as I discuss how neurotechnology can affect the law, in order for this discussion to mean anything to the real world there must also be a related discussion of how it *should* affect the law. Though this content doesn't appear in full until Chapter 4 this brief word now better outlines my motivations.

Subsection 1 - Determinism, Neuroscience, and Responsibility:

Usually the first thing that makes the philosophically-minded excited about neuroscience is its position within the deterministic thesis. Basically put, if every effect has a cause, and the cause of our behaviour is the activity of our brains (as far as we can tell), then all behaviour can be reduced to brain activity over which we have no truly free control. If one follows the logic out to its end this conception holds no place for what we traditionally would call our 'self', that is the free agent who can make responsible decisions about how to behave. In other words, in order for freedom to exist there must have been the ability to do otherwise. In a fully determined universe this c*ausa sui* possibility simply doesn't exist such that one can "pull oneself up into existence by the hair, out of the swamps of nothingness" (Nietzsche, 1886).

It is my belief that, while deterministic debates work to get people excited, reducing neuroscience to determinism is just about the worst thing for the realistic characterization of the field. The first problem is that it sets the bar of utility too high. It puts people in the mindset that if the results of a test don't fit into a causal theory then the result is not useful. A causal theory is one which professes to explain each of the series of steps from initial cause to final effect. This can be understood

by analogy to dominoes. If a theory says that knocking down the first domino will cause the last one to fall, but makes no suggestion of how many dominos there are in the middle, or what their arrangement is, then it is correlative theory as opposed to a causal one. It makes the field extremely easy to critique when forcing neuroscience into the position of having to offer a causal theory that can completely map onto common sense concepts. Anything less than success in this enterprise implies 'limited usefulness in the near future'.

For example, one knows that turning the ignition in a car will turn it on, but one might have no idea why this is so. If we require a full causal explanation for how ignition happens before taking a drive then it could be a long time indeed before any movement takes place. However upon gathering a full explanation of ignition, while one may certainly be more informed and may now even be able to design a better ignition system, the full explanation was by no means required before the knowledge that turning the key turns on the car could have been put to use. This way of thinking primarily about correlation as opposed to causation has already proven useful for developing DNA related forensic technologies and, as will be explored later, should be a driving force behind the development of neurolegal applications.

Subsection 2 – A Middle Position:

Accepting this middle position there emerges the ability of neuroscience to significantly change our ideas concerning legal responsibility. It will do so not by disproving that responsibility exists but instead by extending the way we have always questioned responsibility: by providing alternate explanations for behaviour whose freedom we already question. If someone acts obviously against their own interests, or in a way completely uncharacteristic of our experience with them, or under the influence of drugs or strong emotions, then we have reason to question their responsibility for those actions, though our reasons in each case may be quite distinct. As neuroscience nuances our understanding of all of these concepts we will be better able to identify contradictions and

abnormalities which could not have been previously explained to a standard the law would accept.

Indeed neuroscience and its associated technologies may be required to further develop our ideas around responsibility. Even with carefully designed psychological experiments we may not be able to find sufficient evidence for a person’s peculiar actions, or evidence for what makes one person's level of responsibility different from another's. For example, someone could be objectively not fully responsible for a particular action, but we have no legally legitimate way of reaching this conclusion given our limited ability to interact with that person's brain. Neurotechnologies provide more and different paths of interaction through which information about a person's physiology and brain function will make their conscious role in such behaviour intelligible.

Chapter Conclusion:

This chapter serves as in introduction to the important philosophical concepts within the field of neurolaw. It also demonstrates a novel characterization of neuroscience, and the neurotechnological tools that it has developed, which both avoids the problems associated with determinism while maintaining the relevance of neuroscience for explanations of behaviour and responsibility.

Chapter 2: Introductory Concepts

"*As punishments are only inflicted for the abuse of that free will, which god has given man, it is just that a man should be excused for those acts, which are done through unavoidable force and compulsion.*" - Blackston, *Commentaries on the Laws of England, 1861*

In Chapter 1 I introduced the philosophical questions at issue within Neurolaw and some that arise more broadly within Neuroscience. I explained my own position as a middle ground between the two poles of opinion currently found within the field. In this chapter I will explore the concepts needed to understand how neurotechnologies can be useful to the law. I will explain how the law creates models, how these models use evidence of behaviour to prove their constituent elements, and how we can start to understand the results of neurotechnologies through closely designed studies.

Section 1 – The Law as a Model Generating System:

One can conceive of both the law (which uses common sense folk psychological reasoning) and neuroscience (which uses scientific and inductive reasoning) as model generating mechanisms. Legal statutes create models of mental and physical characteristics and then use evidence of various behaviours to fit an individual into those models. For example, committing murder after deliberation and committing murder on a spur of the moment impulse are two models into which an individual under investigation could be fit. The police and prosecution would use evidence related to the crime and the behaviour of any suspect under investigation to predict which model fits the crime. If there was a weapon involved, is there evidence to show that it was bought for that purpose or was it simply a weapon of opportunity? Was the accused being provoked? Did the accused leave behind any evidence of murderous intent such as notebooks or the like? Using the available evidence and previous experience with similar evidence, the prosecution can fit a charge to the crime and then an individual to that charge.

Neuroscience operates in a very similar fashion. A test of impulsiveness, for example, will present a choice between two options. Each option will represent a model of a type of brain, for

example one which can delay gratification, and one which cannot. We can then use evidence of that individual subject's specific neuroanatomy and functional imaging profile, along with previous experience of this type of evidence, to predict which model their brain fits into. While the law for the most part aims its predictions at events which may or may not have occurred in the past and neuroscience towards events in the future, there is no great difference in the approaches. Each relies on correlates of mind-state and behaviour and from then draws conclusions held to a standard accepted by the discipline.

When we look at the law as an arena for creating and testing the fit of certain models it makes it clearer how neuroscientific evidence can be useful. While maintaining our folk psychological criteria we can use neuroscience to accentuate the contours of these concepts by listening to components of their expression we have not previously been privy to. For example, imagine a statute which states that if a person was unable to control an impulse to act then they are not criminally responsible for their actions. Depending on how that law was enacted or empowered, in order to fit someone to that model one would have to provide evidence for that assertion which either leaves a reasonable doubt or shifts the balance of probabilities. Because so much of what we call impulse control happens without visible external behaviour one way of making this easier would be to catalog correlates of brain states and to show a significant departure from normal activity (that is the activity shown when the person is engaged in tasks which don't evoke strong or overpowering subconscious impulses) when stimuli like those encountered during commission of the crime are presented. This activity can then be compared to that elicited by tasks known to induce impulsive reactions. If the patterns can be argued to be sufficiently similar the results can be used to corroborate the claim that the accused was not able to control his or her impulse.

Subsection 1 - Components of the Legal Model:

There are many unanswered questions about how the activity and anatomy seen on a brain scan

relate to our normal experience of reality and to the concepts of import within the law. To perform our comparison a logical and straightforward approach is to first break down the concepts within the legal model of criminal behaviour and see how neuroscience has gone about or could go about studying the relevant correlates.

Just like any effort interested in uncovering the truth of a matter (to the best of the ability of the participants given the time and resource limitations), the criminal law has a general model which breaks down into individual components and then evidence and standards of evidence to speak to the likelihood of each component. The vast majority of criminal statutes break down into the Actus Reus (a voluntary action) and a Mens Rea (a state of mind), potentially also including circumstantial and consequential elements (Roach, 2011). Mens Rea can further be broken down into its constituent components. Mens Rea can be knowledge, intention, desire, recklessness, or negligence (with this list depending on the jurisdiction). Which of these concepts applies to the individual in question depends on the evidence which attests of their state of mind.

The Actus Reus breaks down into two components, the action itself and the internal workings of the mind such that we describe that action as voluntary (Roach, 2011). This differs from Mens Rea in that the mental content of the Actus Reus is not an attitude but instead a capacity. Both components of the Actus Reus have been studied extensively by neuroscience. Actions are mediated through the activity of our motor cortex, spinal cord, and peripheral nervous system and result in what neuroscientists call 'motoric behaviour' (Giovanna et al. 2012). The anatomy of each of these steps has been extensively studied in animals and significantly in humans and the characterization of the central and peripheral systems related to motor control is the closest we have come to a complete understanding of any part of our neuroanatomy and function (Kandel et al. 2014).

The volitional component of the Actus Reus will be the focus of this work. This area has not been as extensively delineated as motor function as it appears to comprise a number of interacting

capacities at least involving one's ability to attend to a stimulus, the power of that stimulus to bring about an impulse to act, the ability to suppress that impulse, how quickly this suppression can happen, and if this suppression can happen in distracting environments (and these are only those capacities of self-control which relate to impulse control and not problems of perception or delusion). A thorough description of these impulse related capacities will follow. It bears mentioning early that all Western courts agree that without either the motoric component (whence the crime will have gone uncommitted) or the volitional component, criminal culpability cannot attach (*R. v. Ruzic; R v. Lucki*).

Any determination of the truth or nature of these aforementioned components can be analyzed scientifically. Scientific evidence presented in the court room to prove an element must meet certain standards. Scientific evidence must be: Relevant to the legal concept at issue; the expert providing the evidence must be qualified to do so; and there must be evidence of scientific validity (Roach, 2011). This latter category itself must meet specific criteria but what those criteria are depend on the jurisdiction, the type of case, and the type of trial. Usually expert scientific testimony must at least be: sufficiently low in error rate, it must be falsifiable, it should have undergone some peer review, and the methods used must be generally accepted within the field (this is the “Daubert” standard) (Morse and Roskies, 2013). While applying current results from neuroscientific studies encounters problems with these rules, for example in terms of relevance to specific legal concepts, there is no reason to believe that a carefully designed experiment wouldn't be able to overcome at least some of these obstacles. The procedural issues alluded to in Chapter 1 should also be kept in mind.

Section 2 – Making Neuroscience Useful to the Law:

Above we have seen how the law is a system which creates models of unacceptable conduct which break down into constituent parts. Each of these components is shown to be true to a certain standard (usually beyond reasonable doubt) by providing evidence which must itself meet certain criteria. Before exploring actual statutes there are a few more concepts to explain related to either

applying neuroscientific evidence as it stands to the law or designing neuroscientific experiments which will be able to provide such evidence.

Subsection 1 – Neurotechnologies as Novel Behavioural Outputs:

Above I stated that the law uses evidence of behaviours to fit a person to one model or another. Just as we did with the model analysis above, we can distribute behaviours into different categories and doing so should clarify what makes neurotechnologies particularly useful.

The type of behaviour with which we are most familiar is motoric behaviour: the physical movements of our bodies mediated through our nerve impulses and muscle potentials (Kandel et al., 2000). This same model underlays most of the behaviours and evidence used by courts in the past. The brain activates in some fashion as a reaction to the external and internal environment, this activity is communicated to the muscles, and works through our bodies to produce externally visible behaviours which leave a trace on the environment. In the normal court circumstance, these behavioural traces are the evidence and are used to infer the relevant internal states. This evidence could consist in actions, words, reflexes, or secretions (for example increased sweat production as measured by the Galvanic Response), all of which, when understood properly, can be indicators of a relevant internal state.

As a direct complement to this way of gathering evidence, neurotechnologies allow us to gain greater resolution on the internal workings of the brain by providing another path by which a previously hidden set of behaviours can emerge. Instead of being conducted through the spinal cord and muscles, these behaviours are mediated through devices which detect electrical, magnetic, or metabolic changes in certain brain regions and subsequent analysis of the results.

With each new path from brain to environment the skilled observer can say with greater certainty whether a relevant mental state is or was present. For example, it becomes quite clear that someone is upset when they are: muttering, moving nervously, and are sweating heavily (given these are not normal behaviours of that individual). If neurotechnologies and their applications are developed

with rigor and care they will simply add yet another indicator such that the person would be muttering, moving nervously, sweating heavily, and have a high amygdular activity as revealed through an fMRI. In the end we are engaging in mind reading but only an accentuated version of the mind reading humans have always conducted through the observation of behaviours, the evidence thereof, and inference as to internal states of mind.

Subsection 2 - Blood Typing, Genome Analysis, Neuroscience, and the Law:

The skeptical reader may ask: if neurotechnologies don't signify a magic bullet in solving the problem of mind reading (notice the high bar set by determinism) then why dedicate so much time and effort to their development? I'll briefly illustrate why neurotechnologies are so important, and what makes them especially useful, via an analogy to blood typing evidence and DNA evidence. Both of these technologies have been used by the law in the past and how they developed might well enlighten us to the future development of neuroscientific evidence.

Blood typing as it was practiced for most of its existence consists in the analysis of the reaction of blood cells in solution. When two samples of blood are mixed together, with some other reagents, they are either compatible and mix or are incompatible and the blood cells aggregate (Muehlberger and Inbau, 1936). Through studying the reaction of samples of related subjects it was found that blood types were heritable and were thus candidates for determining heredity. Though it wasn't usually possible to confirm heredity it was possible to eliminate someone as a candidate if the proposed parent had a blood type which, given the known blood type of the other parent, could not have led to the child's blood type. Similarly it could eliminate or implicate a suspect if a sample of blood either at the scene of a crime or on a weapon was determined to have been of the accused’s type.

Blood typing is an excellent example of evidence which is useful through traditional folk psychological reasoning and natural observation insofar as they are both based on immediately available and natural explanations of the phenomena. It uses the reaction of blood as evidence to

predict naturally accessible relationship models (mother, father, the perpetrator's blood, etc). The components of the model are given by common sense experience, the basis of folk psychological reasoning, and the evidence used to predict those components relies on easily visible cellular biological reactions. By itself blood typing suggests very little. It does not help us write better laws (other than perhaps rules of evidence) and offers us nothing in terms of detecting novel and singular relationships between a sample and a person.

The role of DNA in heredity wasn't confirmed until much later (Hershey and Chase, 1952) and wasn't used as a forensic technique until 1988 (Freckelton, 1990). Since then DNA fingerprinting has essentially replaced blood typing within the court. Once its role in heredity was confirmed it proved to be a much more powerful tool than blood typing. DNA evidence could actually predict heredity and place suspects, as opposed to just implicate and eliminate. Depending on the test it can even suggest a suspect's race, sex, and physical characteristics, all being highly correlated to particular genes. Yet further the relationship between genetics and certain types of criminal behaviour is currently being explored and if adopted by the law would allow us to refine our current legal models with easily testable genetic components (Beecher-Monas and Garcia-Rill, 2006).

DNA is proving such a powerful and predictive discovery that it could one day be used beyond its current applications to actually shape how we create and deploy the law. This appears to be because DNA represents a kind of bedrock in terms of heritable information, that is, it is impossible scientifically to go any deeper than the working of DNA when it comes to heritable traits. The reason blood types could be used for heredity was because certain *genes* encoded them. The brain seems to represent a similar bedrock in terms of mental states, which is why the sciences that study its various expressions hold such potential for the law.

DNA fingerprinting, the type of test predominantly used by courts, relies on identifying many small sequences that have been found to be highly *correlated* with heredity (Treff et al., 2010). Here we

have a powerful scientific technique making clear the concepts of heredity already important to a folk psychological law and allowing for further expansion. Yet surprisingly, there are relatively few causal (that is, proven biomechanical) explanations. Due to their predictive power the results remain useful even if no causal mechanism is put forward for why Gene X predicts Phenotype Y with a 95% correlation. It is likely that a concerted effort from neuroscience would lead to at the least similar tests which identify structural, that is physical changes in the brain, and functional, that is changes in the electrical or metabolic activity of the brain, correlates of many of the mental and physical states that are already important to the law. What is required is to study *these states in particular* as opposed to making inferences from a field currently dominated by medical concerns.

Section 4 - Impulse:

Having explored in brief how neuroscience can be used by the law, we now need a subject matter on which these tools can be applied. For this purpose I have chosen impulse control/self-control. This subject matter represents a set of questions both neuroscience and the law have a vested interest in. It also represents an area where neuroscience can cause us to question responsibility without relying on a fully wrought deterministic thesis. The inability to control an impulse is as natural an excuse as they come and this is reflected in several areas of the law. I will now explain what I take impulse control to mean as well as outlining some of the known neural correlates. My view is in keeping with the general view of the field, though due to the abundance of the literature and the as of yet unsolved nature of impulse control there may be conflicting views in terms of the relative importance of each component of neurophysiology which I discuss.

Subsection 1 - What Do We Mean By Impulse?:

As to the legal meaning of impulse, the definitions are drawn from cases and legislation where common sense tells us that self-control and the related concept of impulse control is an important aspect, like in addiction or provocation. I pause here to stress that impulse control is only one aspect of

self-control and as such the terms are not interchangeable. Self-control is the interaction between a constellation of capacities which includes impulse control but may be related to, for example, a motoric issue (such as Huntington's) which causes flailing or uncontrolled ballistic movements. This is certainly a problem of controlling one's behaivours but has nothing to do with impulse control. Furthermore someone may have a perceptual problem or balance issue which leads to uncontrolled movement, or a psychiatric disorder which causes delusions, or a disorder of empathy which makes it hard for that individual to conform their behaviours to the requirements of society or the law. All of the above examples are issues related to self-control, but don't hinge in particular on impulsive drives.

Thus the legal concepts which I investigate herein are chosen because while they are couched in terms of self-control the specific deficit which appears to be determinative is one related to the impulsive drives, or the inability to control those drives, experienced by those who come into conflict with the law. However, since accurately defining self-control in folk psychological terms has proven difficult, many jurisdictions including Canada have chosen to neglect further developing appropriate legal language and tests around volition. Instead they have suggested stretching already existing concepts like 'intention', 'knowledge', and 'appreciation' to excuse behaviour (Penney, 2014). As we will see, this attempt, while reasonable given the perceived difficulty of measuring and defining impulsivity, leads to inconsistencies which could be ameliorated by adapting neuroscience to study legally-defined impulse.

As an example of these definitional problems it is undeniable that someone who reacts immediately, emotionally, and/or habitually to a situation or with little regard to the consequences is acting impulsively, but such a reaction can manifest itself in many ways. The impulsivity can be a general impairment, such that the individual acts impulsively towards many stimuli {as is the case with many traumatic brain injury cases (Greve et al., 2001)}, but it can also be highly specific where the impulse to act is towards a particular substance {as in addiction (Bachara, 2005)}, or towards a certain

act {such as kleptomania or pathological gambling (Grant and Kim, 2003)}. Furthermore, the impulse can be brought on (and/or the ability to suppress the impulse itself being suppressed) by emotions which are themselves highly contingent on the individual and the context in which they find themselves (Bachara et al., 2000). This last concern with the impact of emotions on impulsivity has a great many layers and, when designing experiments, will require sensitivity to the social and cultural perspectives of the individual concerned as to how emotions should be appropriately used and managed.

Impulsiveness also doesn't necessarily mean that a person acted without thinking or without delaying their impulse to act. In drug addiction the addict can undertake significant deliberation about how to go about obtaining their substance of abuse and delay gratification until their plan has come to fruition. The aspect of this behaviour that makes it impulsive then isn't that the person does not deliberate, but that the impulse to act towards a particular stimuli is so strong that they are blind to other important factors in their decision to act. There may be just as much reason to question the responsibility of someone in this scenario as there is when the choice is made without deliberation, but these are certainly different types of impulsivity.

While the law has had difficulty dealing with these important but hard to measure differences, neuroscience has already begun to shed light. In animal models researchers have been able to dissociate impulsivity into several categories. The tests used to discover this differentiation are wonderfully simple. In one scenario a rat is put in a cage with two buttons, one will give a single food pellet immediately, while the other will give 5 food pellets but only after a delay. Which button the rat preferentially chooses is a measure of how good they are at delaying gratification, that is resisting the impulse for the immediate reward. In a similar scenario there is only one button which releases a single food pellet, but this time the rat is trained such that if they hear a tone on approaching the button they have to cancel the behavior. This experiment tests the ability of the rat to cancel an already initiated action. One can further test whether the animal can maintain a goal despite distracting stimuli.

The most interesting result of all of these tests is that there isn't one group of rats who are good at all measures of impulse control and another that are not (Edmonds and Warburton, 2008). Instead some rats will be good at delayed gratification and cancellation, while others will be only good at one. Some might be good at those two but easily distracted from their goal. These results imply that the neural circuitry underlying these functions (if we maintain that behaviours are for the most and most significant part products of the brain or nervous system at large) are not all the same and that the functions are disassociable, that is they can be individually and predictably identified by using test which differ in small but significant ways. These results are precisely what studies of neural circuitry in these animals show (Winstanley et al., 2004). These same differentiable tendencies are no doubt represented in humans, and are likely important to consider when creating tests for criminal behaviour. Therefore, if we want to have legal standards which appropriately model behaviour we must develop language and tests which are capable of measuring not only the level to which one can control an impulse, but what type of impulsivity is relevant at the time of the crime. As we will see each of the types of cases I discuss throughout this work – Drug addiction, crimes of provocation, and mental disorders – are distinct in the type of impulse control deficits they display.

Subsection 2 - The Anatomy of Impulse:

Neural correlates for motivation and impulse have been extensively studied. This research has allowed us to identify areas of the brain highly correlated to impulsive behaviours. The groundwork provided by these studies eases the task of finding neural correlates of relevant legal concepts. Since we know the rough locations of many of the important impulsivity networks we can much more easily extract the signal from the noise by using this knowledge to tune our detection methods. I will here briefly explain what is currently known about this anatomy and its relationship to motivation through an analysis of the neural circuitry related to addiction. Keep in mind that the actual circuitry is still being studied and thus a full picture is both impossible at this time as well as consisting of many books

worth of description. The following picture should be sufficient to communicate the basic ideas.

Mechanisms of addiction:

Addiction and substance abuse have neural substrates which have been well classified. The major actors to pay attention to are the Meso-Limbic (reward) pathway and the Prefrontal Cortex (PFC). Drugs of abuse interface with the reward system of the brain found in the Meso-limbic pathway. In early addiction, taking a substance of abuse causes a significant increase in the release of dopamine from the Ventral Tegmental Area (VTA). Dopaminergic Axons (axons that release dopamine) from the VTA project, either directly or indirectly, to the Nucleus Accumbens (N. Acc), which is a major component of the Meso-Limbic pathway.

The N. Acc is an area important for integrating signals from all over the brain and gating behaviours, that is allowing a signal from the motor cortext to make it's way through the spine and peripheral nervous system to the muscles and from there to the outside world. When it receives the appropriate set of signals it influences, among other areas, the activity of the basal ganglia - a combination of deep brain regions important for controlling motoric behaviour (though they are suspected or shown to affect a litany of other functions). The usual functioning of this circuit is in learning. If an action is accompanied by a natural reward, for example food, water, or sex, then dopamine will be released. This causes the connections relating to the specific stimuli and context around this reward to be strengthened such that in the future one's motivation to act in the same way will be strengthened. This works both for actions (performing an action and getting a food item) or omissions (not approaching and receiving an award for doing so), and in both valances by encouraging movement away from negatively rewarding stimuli.

In the natural environment this process helps us to develop adaptive behaviours. If, for example, we have learned that by not eating a tasty food now we can acquire a larger proportion of it in the

future, then those with a properly adaptive reward system will wait for the larger reward. Projections from all over the brain converge on the N. Acc and the VTA to bring information about the nature of the reward. Studies, the most famous being the Mischel Marshmallow experiment, suggest that those with better abilities to consciously control impulses have better outcomes in society and social standing (Mischel et al., 1972).

Drugs of abuse are addictive specifically because they can bypass this normal learning process and interface directly with the reward circuitry. Some drugs, like cocaine, will act in an excitatory manner, increasing the amount of dopamine activity by directly activating dopamine receptors in the N. Acc. Cocaine will also decrease dopamine reuptake by the axon which released it. Opiates have an inhibitory function, but act to inhibit those neurons which themselves inhibit dopamine release, thus increasing dopamine activity within the Meso-Limbic Pathway.

Over time our brains learn and adapt. The neurons affected by drugs of abuse will regulate their dopamine receptors and neurotransmitter vesicles such that the same amount of drug leads to less dopaminergic activity. Part and parcel of this learning is altered connections between both the frontal cortex and the N. Acc, and the locus of activity within the basal ganglia.

Before addiction, connections between the medial PFC and the N. Acc are key to controlling the impulse to take a drug. The PFC is known as the executive part of the brain because it regulates which stimuli to pay attention to and which actions should be performed or avoided. Once addiction starts taking place, however, the inhibitory connections from the PFC which would dampen the dopaminergic activity in the N. Acc lose their strength. Furthermore, connections from the PFC which drive behaviours associated with acquiring and taking the substance of abuse are stronger.

The activity within the basal ganglia also changes. Before addiction, behaviours related to the substance of abuse tended to cause activity within the ventral parts of the basal ganglia. This is common in rewarding behaviours over which we have significant cognitive control. After dependence,

however, drug stimuli tend to cause activity in the more dorsal regions of the basal ganglia, which are associated with unconscious habit formation. All of the above information is available in any number of good neuroscience textbooks (Kandel et al., 2014).

How we act in any given scenario is determined by a fine balance of activity between the evolutionarily older limbic and basal ganglia structures, which underlay emotions and subconscious impulses, and the evolutionarily newer PFC underlying our rational behaviours (a rough but true approximation). If a drug of abuse is taken repeatedly, then this balance will shift away from a multi-targeted executive control and towards subconscious and single-minded impulses to continue activities which are associated with drug taking.

The case with impulse control disorders related to, for example traumatic brain injury or Fronto-Temporal Dementia, is a slightly different one. In these cases the individual may have pristine basal ganglia and limbic activity but some traumatic event or organic disease has caused significant damage to their PFC. As such the control and direction once exercised by the PFC becomes shifted or eliminated. A person with a traumatic brain injury could lose the ability to control impulses (a common symptom) but they may further develop talents in a direction which previously held no interest. (Miller et al., 1998; Gordon, 2005)

Equally important is that all of the topics discussed above have functional and structural correlates which can be non-invasively measured. Many of them already have been studied, though these studies are usually conducted on groups which makes it difficult to apply the results to individuals. Such studies remain useful because they provide targets for the kind of individual longitudinal studies, as well as the explicitly neural criteria for legal definitions, which I will discuss in the next chapter.

Chapter Conclusion:

In Chapter 2 we've explored how the law creates models, how evidence can be used to prove

the components of those models, and how neuroscience can provide sufficient proof by correlating structural and functional scan results with mental and physical states the law cares about. These ideas aren't fully novel. Functional and structural correlates to mental and physical phenomena are the basis of much neuroscience research. The idea has even been applied to the law. Structural scans have been used for decades to bolster claims of cognitive deficit, such as using an X-Ray to demonstrate traumatic brain injury caused by a car crash (Koshbin and Koshbin, 2007).

Functional scans have also been employed. There is a developing case law around using fMRI techniques to indicate deception (See: *United States v. Semrau* and *Wilson v. Corestaff Services, L.P.*) and psychopathy. Brain fingerprinting, a technique reminiscent of the commonly accepted DNA fingerprinting, uses EEG to correlate different brain activities to different mental states. EEG fingerprinting doesn't rely on a causal mechanism (that is it doesn't give a full start to finish cause and effect account) and only detects differences in results related to different stimuli. It amounts to saying that we know there is a detectable difference, but not why that difference exists. For example, an experimenter could present 100 images of landscapes to someone undergoing an fMRI scan and record that activity. The experimenter can then show them 100 images consisting of 90 novel landscapes and 10 from the old set and record the activity. It turns out that, depending on the magnitude of the difference between how a the brain reacts to old and new images, the experimenter can identify with good accuracy which pictures had been seen before based on the recording alone *even if the subject had no conscious memory of that scene (*Rissman et al. 2010*)*.

In the next chapter I will be looking at actual statutes within Canadian law. After a description of each I will outline both the work that has already been done and the ideal future experiments that could help us either in writing statues, interpreting them, or meeting their stated judicial objectives.

Chapter 3: Applications Of Neuroscience To The Laws Concerning Impulse

"*Considering how long society has been at it, you'd expect a better job. But the campaigns have been badly planned and the victory has never been secure. The behaviour of the individual has been shaped according to revelations of 'good conduct,' never as the result of experimental study. But why not experiment? The questions are simple enough. What's the best behaviour for an individual so far as the group is concerned? And how can the individual be induced to behave in that way? Why not explore those questions in a scientific spirit?*"

- BF Skinner, *Walden Two, 1948*

Section 1 – Introduction:

In this chapter I will be exploring how the neuroscience of impulse control can contribute to the creation of laws, the trying of cases, and the sentencing of criminals. I have chosen to concentrate on the criminal law because impulse control is important to our concept of responsibility, which is a subject of particular importance within the criminal law and its justifications for applying punishments or restorative efforts. (Lacey and Pickard, 2013; Pickard and Pearce, 2013)

I have chosen to explore legal concepts which are either already functional within Canadian criminal law or which could be based on reasonable extensions of currently accepted arguments. These arguments can be found within a cluster of laws and cases related to self-control and impulse control, namely crimes concerning controlled substances, crimes of provocation and other defenses, and mental health law.

In the first section on creating laws, I will touch on how the connection between addiction and responsibility can gain greater clarity through incorporating a neuroscience lens. In the section on trials I contend that the reasoning found within current legal interpretations should extend to include the complete defense of irresistible impulse as well as the partial defense of diminished responsibility. Finally, in the section on sentencing I will explore how meeting our sentencing objectives can be aided by paying heed to neuroscience.

Section 2 – Creation of Legislation:

Subsection 1: Laws Concerning Controlled Substances.

Addiction and substances of abuse are obviously an area of human life in which the law has taken a special interest. A significant number of Canadian laws exist in order to categorize various substances and to limit their production, sale, transportation, and possession. These laws share much of their rationale with those passed in the United States, as well as those found in international agreements (Erickson, 1992; Pietschmann, 2006). The modern criminal approach to addiction has been criticized for taking a harsh stance on what should ultimately be a public health issue (Goldberg, 2011; UN Global Commission on Drug Policy, 2011). While public health is certainly an aim of the law, it is but one among several considerations when making substances illegal.

I contend that one of the primary reasons a retributive justice based approach (and not one based in public health concerns) has been so universally used is the difficulty in determining via objective evidence who is actually addicted (and thus would qualify for some level of therapeutic assistance) and who is simply using substances of abuse for monetary gain. Those in the latter category are (at least under the current regime of justice) clear candidates for retributive justice, while those in the former category are clear candidates for a therapeutic approach. There are clear cases that current approaches, such as psychiatric evaluation, have been able to identify and directed towards drug courts. The evidence of the prevalence and incidence of drug addiction and impulsive disorders in the prison population, however, imply that the current approaches are far from perfect (Fazel et al, 2006). While some of this shortfall is certainly due to limited application of psychiatric assessment, there are surely other cases where subconscious impulsivity is the determinative element in substance abuse but which are not discernible through standard evaluative means.

The Controlled Drugs and Substances Act:

The drug laws in Canada are enumerated in a piece of legislation called the *Controlled Drugs and Substances Act* (CDSA). This document categorizes various substances into one of eight schedules, with greater penalties the smaller the schedule number. It also lays out the elements of possession

(CDSA s4), possession with the intent to traffic (CDSA s5), importing and exporting (CDSA s6), and production (CDSA s7), as well as punishment guidelines for each of these offenses depending on the schedule of the drug in question. Part of the purpose of these laws is to control substances which lead to substance dependence and which have a large social cost (See: Order Amending Schedule I to the Controlled Drugs and Substances Act).

Neuroscience and scheduling:

Addiction and substance abuse provide such an appropriate subject because they straddle the line between something which can be described in either behavioural or in neuroscientific terms. A perfect example of this is the classification system used in the DSM-V (the Diagnostic and Statistical Manual of Mental Disorders 5), the reference book for the disorders currently recognized by psychiatry. The DSM classifies addiction under substance use/abuse disorders and defines it in terms of behavioural criteria, but the disorders are organized into those relating to specific substances (cocaine, cannabis, opiates) which have been well described in terms of their interaction with our neuroanatomy (See: DSM-5 Substance-Related and Addictive Disorders), (Kandel et al, 2014). This approach in the DSM-V demonstrates that psychiatry, the major field on which the law relies in order to provide evidence of important mental states, is taking a hybrid approach to categorizing these disorders from which the law could well profit.

Both the DSM-5 and the CDSA offer little by way of objective standards for determining the addictive or dangerous potential of a substance of abuse, especially when applied on an individual level. Some individuals will find certain substances more rewarding (that is, they cause more powerful activation of their neurocircuitry sensitive to rewarding stimuli) than others, and there is no obvious way to predict how addictive behaviours will manifest without observing such behaviours in a population. Furthermore, different drugs which might be equally addictive (that is equally powerful in activating our impulse related neurocircuitry) can have drastically different behavioural outcomes. For

example, a stimulant (like amphetamine) and a depressant (like heroin) may both lead to dependence but to drastically different lifestyles and behaviours. Neuroscience, by defining addictive potential and dangerousness via the activity and structure of certain neuroanatomy, should be able to help with creating more appropriate legal classifications.

Neuroscientific Criteria for Scheduling:

Recall the section on the anatomy of addiction in the previous chapter. Any drug of abuse, or for that matter any rewarding activity, is mediated through this anatomy. This knowledge fashions us with excellent criteria for making decisions about how harshly to punish offences related to particular substances.

Reasoning from a public health starting point leads one to assume that the drugs we want to control to the highest degree are those which are either the most addictive, or have the worst long term health effects, or both. Both of these factors have measurable neural correlates. We can use cell culture, animal models, and functional scans of humans to assess these variables.

Animal Models:

Most of what we know about the brain's reward circuitry has come from animal models. In these experiments an animal is given some substance, often accompanied by a behavioural task. Then brain activity is measured directly either via electrical activity and/or dopamine release.

The addictiveness of any given substance is going to be related to: 1) the amount of dopamine a certain amount of drug given in a certain way can release, 2), the change in the connections of PFC, or, 3), the location of the basal ganglia activity. Based on this knowledge we have some solid criteria for determining the addictiveness of a substance of abuse (Hyman, 2007). A combination of these elements can then be reflected in which schedule the substance is classified under.

Furthermore, similar experiments could be used to study if there is any long term neurological damage associated with taking a certain substance. It is not necessarily true that the more addictive a

drug is the more likely it is to cause damage and therefore future impairment. Sectioning the brain of an animal can allow us to make counts of neurons and of receptor density, both measures of brain damage.

Human Experiments:

Human functional imaging experiments can be used to measure variables related to addiction in a non-invasive or minimally invasive way. PET scans which use radioactively labeled dopamine allow us to measure the density of dopamine receptors distributed throughout the brain (Volkow et al., 2014). Several of these scans taken over time can reveal how this density changes, which is an indirect measure of the addictive potential of a drug. Structural MRI scans can be used in a similar vein to see if the parts of the neuroanatomy related to substance of abuse are shrinking or changing in shape, which could be a measure of damage (Chang et al., 2007). Similar scans like Diffusion Tensor Imaging (DTI) can be used to study the changes to axonal connections both within the meso-limbic pathway as well as between the PFC and the N. Acc (Hanlon and Canterberry, 2012).

fMRI also allows us to study how the brain is connected. If we look at the oscillations of activity, the rate at which our measure of neural metabolic activity oscillates between higher and lower values, we can assume that areas oscillating in a similar fashion elsewhere in the brain are in some way connected (Greicius et al., 2003). Since we know that stimuli related to a particular drug of abuse causes craving for that drug (a picture of a needle for heroin, for example), if we pair a scan with the presentation of drug related stimuli we can measure how the activity in the PFC, Meso-Limbic pathway, and basal ganglia changes with this presentation. Depending on how long the individual has taken the drug, how often, and by what route of administration, we can draw conclusions about how that frequency of administration of that particular drug influences the activity of the brain (Goldstein and Volkow, 2002; Hester and Garavan, 2004).

Conclusion:

All of the information discussed above would be useful in classifying the dangerousness and

addictive potential of substances. It would likely be a significantly better alternative to the commonly used analog criteria, which make a novel substance illegal if it has a chemical similarity to a previously scheduled substance {See: Order Amending Schedule I to the Controlled Drugs and Substances Act (MDPV)}. Such evidence would further provide a part of an objective component to the rubric by which substances can be scheduled, which should force some clarification on the more subjective classification criteria.

Subsection 2: Mental Disorder And Irresistible Impulse.

This subsection investigates the possibility of developing a control-related variant of the mental disorder defense. The mental disorder defense is currently enshrined in Section 16 of the *Criminal Code*. Someone can use this defense only if, at the time of the crime, they were unable to 'appreciate' the nature and consequence of their actions. While this is surely an important criteria for reducing or removing criminal responsibility it is clearly not the only relevant criterion. If someone were to appreciate the consequences of their actions and yet found him/herself powerless to abstain, then there seems to be just as much reason to question responsibility.

Due to this reasoning some jurisdictions have included a 'control test' as a branch of the mental disorder defense. The legislation in the state of Maryland reads:

"Because of a mental disorder or mental retardation, [he] lacks substantial capacity to: [1] appreciate the criminality of that conduct; or [2] conform that conduct to the requirements of law."

Part [2] here provides the grounding for the control test. Morse details the control test as itself having two sub-branches (Morse, 1994). Under one sub-branch the defendant must have undergone an overwhelming force such that they were compelled to act. Under the other the defendant was presented with an extremely difficult choice that prevents the actor from having a "reasonable alternative".

Neuroscience and a Control Test:

The greatest contribution neuroscience can make to crafting irresistible impulse legislation is to

continue exploring the neural correlates of impulsive behaviour in the natural environment and in relation to currently used psychological tests for impulsivity and volition. This evidence can then be used to bolster the claims of psychiatrists that there are indeed specific disorders which completely hinder volition, and that these disorders are specific to certain situations and stimuli. Kleptomania would probably qualify along with extreme cases of Pyromania, Bipolar Disorder, types of Schizophrenia, and Compulsive Gambling. There is strong evidence to suggest that there are individuals who might be fully conscious of the consequences of their actions but nonetheless would be powerless to stop performing them (Donohue et al., 2008). Whether or not we want to legally excuse this type of behaviour is the type of ethical question we'll be examining in Chapter 4.

Subsection 3: Diminished Responsibility/Capacity Defenses.

There is another way that impulse can be empowered as a legal concept. Some jurisdictions have created a partial defense known as either a Diminished Responsibility or Diminished Capacity defense. In these jurisdictions this defense is most often used to reduce murder to manslaughter. Unlike the complete defense of mental disorder, diminished responsibility is a partial defense which mitigates an element of the Crown's case. While Canada does not currently explicitly accept a diminished responsibility defense, there are laws on the books which are highly related if not completely logically contiguous with it. An example is the law relating to crimes of provocation. The law for provocation is outlined in s. 232 of the *Criminal Code* of Canada and is as follows:

"**232.** (1) Culpable homicide that otherwise would be murder may be reduced to manslaughter if the person who committed it did so in the heat of passion caused by sudden provocation.

What is provocation

(2) A wrongful act or an insult that is of such a nature as to be sufficient to deprive an ordinary person of the power of self-control is provocation for the purposes of this section if the accused acted on it on the sudden and before there was time for his passion to cool.

Questions of fact

(3) For the purposes of this section, the questions

- (*a*) whether a particular wrongful act or insult amounted to provocation, and
- (*b*) whether the accused was deprived of the power of self-control by the provocation

that he alleges he received,"

With the defense of provocation, which is a partial defense just like diminished responsibility, the offense of murder is mitigated such that the accused is convicted of manslaughter instead (Roach, 2011; *Criminal Code* C-46 s232). The crucial wording in this statute is that the provocation must be "sufficient to deprive an ordinary person of *self-control*". This section makes no overtures to the rational state of the individual and instead is grounded in language of behavioural control of which impulse control is an important component. If the law had sufficient resolution to have different explicit types of Actus Reus you could reason that this element of the offence was partially mitigated. Unfortunately no such provision currently exists within the law and must instead be inferred.

This is not, however, because such a model is impossible or illogical. Neuroscience, Psychiatry, and Psychology have demonstrated that it is certainly the case that there are different kinds and levels of volutariness and impulse control. Other aspects of Canadian Law also already imply such distinctions. For example, the currently acceptable common law defenses of Duress, Necessity, and Self-Defense cause us to question not just whether the person had the right rational capacities when committing the act but whether they were acting in a truly voluntary fashion.

The diminished responsibility defense could be useful in many areas of the law outside of reducing Murder to Manslaughter. Any time a crime is committed and the defense can bring up a reasonable doubt that the accused was fully responsible for their actions, then they could instead be convicted of a version of the crime which reflects this reduced level of responsibility. This would imbue the law with a greater resolution and flexibility when ascribing criminal liability. A major aspect of the reasoning behind having a provocation defense is that the accused doesn't deserve the stigma of a murder conviction. It seems right that individuals with impulse issues should also deserve less stigma than is currently afforded by Canadian law.

The most important differences between the irresistible impulse defense discussed in the

previous subsection and the diminished responsibility defense discussed above are in: one, the kinds of differences in volitional control to which they are sensitive, and two, which parts of the current law of Canada they are building upon. The irresistible impulse defense, if met, completely removes responsibility (there is no sliding scale) and builds upon laws and decisions which rely on a complete absence of volitional control. The arguments for irresistible impulse are logically connected with the current mental disorder defense and import into this framework the idea that someone who is acting on an impulse they were powerless to resist is acting in a way for which they are at least as not responsible as those accepted cases which rely on a lack of rational appreciation.

The diminished responsibility defense, on the other hand, implies partial levels of volition and responsibility and is a logical extension of those parts of Canadian law which recognize this type of partial volition, namely the provocation defense (s. 232 of the *Criminal Code*). For example an addicted individual acting on the strong impulse to acquire drugs of abuse is unlikely to have been completely powerless to resist the impulse. In this case it would make no sense to apply an irresistible impulse defense. If the state, however, wants to recognize that this person is acting in a less voluntary fashion than non-addicted individuals who acquire drugs of abuse for the purposes of trafficking then having a defense which recognizes this difference makes sense.

Both diminished responsibility and the control test would rely on similar kinds of evidence from neuroscience (behavioural tests combined with evidence of functional and structural abnormalities), however the standard which must be met will be different. While a person who successfully meets the standards of the control test would escape all elements of a charge those who meet the standard for the diminished responsibility defense would only have one element mitigated. The ultimate effect of both of these defenses would be a more precise recognition by the law of the different kinds of impulse control. It is important to remember, however, that they are not equivalent. How these differences cash out in an actual judicial context is explored in the next section.

Section 3: Impulse on Trial

Now that we have become familiar with how the law models behaviour, and the importance of impulse to those models, it is time to look at the trial process. Much of this section will be hypothetical as the measures outlined above have not been incorporated into Canadian law. Neither an irresistible impulse branch of s. 16 in the *Criminal Code*, nor a diminished responsibility defense, is currently available. In this section I will consider two things: the role neuroscience would play in a trial if these defenses were available and some Canadian legal philosophy relating to the different ways these tests could apply.

Subsection 1: Irresistible Impulse In A Trial Context.

If someone in Canada wants to avail of the mental disorder defense as it is currently used the court has to rely on evidence presented by forensic psychiatrists. This evidence can either take the form of a psychiatrist interviewing the accused and applying behavioural tests, or it can take the form of a psychiatrist's interpretation of past behaviour suggested by other evidence. A combination of these approaches allows the psychiatrist to classify the accused as having certain deficiencies which meet the legal criteria for insanity, which currently only includes being unable to rationally appreciate the consequences or the moral wrongness of their actions.

If this standard is met the subject will almost certainly then be classified as having a mental disorder with reference to the most recent DSM. In cases of schizophrenia, bipolar disorder, other mood disorders, compulsions, and disorders brought about by injury rational capacities can be seriously impaired (Donohue et al., 2008). The mainstay of the psychiatric evaluation is the interview about, and analysis of, past behaviours and thoughts, particularly those around the time of the crime. Through these interviews the psychiatrist can develop a model of the accused's mental state at the time of the crime. Delusions, command hallucinations, and severe shifts in mood can all be reasons to seriously question someone's ability to rationally understand the action they are taking and the consequences of

that action.

Along with the interview, and looking at past behaviours, tests have been developed to investigate the specific nature of the mental deficit. Answers and reactions to different proposed scenarios and abstract concepts within these tests can help define the nature of the individual's impairment (Donohue et al., 2008). The results would then be combined with the rest of the behavioural evidence and the psychiatrist would give an opinion, based on their experience, as to whether the accused meets that jurisdiction's definition of mental disorder.

In jurisdictions where a control branch of the mental disorder defense is allowed, such as in Maryland, evidence works much the same way. The facts of the case, the interview, and the tests given in the interview all form the basis for the psychiatrist's testimony that the relevant capacities were inhibited at the time of the crime. Evidence suggests that very few people when assessed for being not criminally responsible by reason of mental disorder (NCR for short) are determined to be so on the basis of volitional impairment alone (Donohue et al., 2008; Penney, 2013). Most of the time these subjects meet the criteria for both rational as well as volitional impairment, that is, they are unable either to rationally appreciate the nature of their action or to resist performing the action.

The Contribution Of Current Neuroscience:

There is reason to believe that neuroscience can be useful in making these difficult determinations. Structural imaging revealing neural damage has been used for decades as evidence to corroborate a functional impairment (Khoshbin and Khoshbin, 2007). It has been recently put forward in a sentencing trial, albeit unsuccessfully, to corroborate the claim that a defendant was psychopathic, and thus had a greater difficulty in conforming their activities to the requirements of the law. (Phillips, 2013).

I am careful throughout this work to restrict my claims to how neuroscience might corroborate the claims of psychiatrists as opposed to assign a truth value to those claims. I do this for several

reasons, the first is an ancient legal principle which states that no piece of evidence may take the place of the finder of fact when answering 'ultimate questions'. By this it is meant that for questions such as: Is this person a trustworthy witness? Did this person have meaningful responsibility which allows us to assign criminal culpability? Or is this person guilty of this crime? That is the questions which would de facto answer the question the trial is attempting to answer.

This is the nature of psychiatric testimony as well. While the opinion of the psychiatrist is taken as an important element of the case it cannot by itself determine whether or not the person was responsible. Instead their statements must be considered by the finder of fact and they must decide whether the conclusions meet the legal definitions and burdens. This state of affairs may not always be the case of course. If a test came out which could infallibly, or nearly so, show that someone was lying, or was unable to control their actions, then the law may have to change to subordinate these questions such that they are no longer ultimate. Matching someone to a biological sample through DNA fingerprinting is an example of a scientific techniques which has essentially finally answered the question of whether or not a sample came from such and such a person (though this isn't really an 'ultimate question').

So, keeping this distinction in mind, alongside structural scan results experiments have also been performed that use functional imaging. Several studies of schizophrenia reveal that there are statistically significant functional indicators of certain forms of schizophrenia (Hill et al., 2004). A litany of data exists from fMRI and other EEG studies exploring addiction as well as disorders like ADHD, both of which have a significant interaction with impulse control (Yu-Feng et al., 2007).

The main issue with using these results is that it is uncertain how they relate to the specific legal criteria and how easily they can be used on individual subjects. To be truly useful in a legal context these neuroscientific methods would have to maintain sufficient ecological validity. Ecological validity equates to how well the results from the experiment relate to the behaviour of the phenomenon being

studied in the real world. To have perfect ecological validity the experiments would require no abstracted translation into the real world. For example dropping a rock in a lab to study the acceleration caused by gravity has near perfect generalizablity to the rest of the world (accounting for high mountains, deep trenches, and air densities) and thus has excellent ecological validity. For investigating legal phenomena then the experiment would have to be performed on single subjects, as criminal proceedings generally concern one or a few individuals, and would have to have as its aim the identification of volitional deficits pertaining to the context of the crime. It is this concept of ecological validity I invoke when I speak of 'appropriate use'.

Unfortunately neuroscience studies usually draw their results from group averaged data and are performed in a laboratory or hospital context. Group averaging data is an excellent way of increasing the signal to noise ratio, but since no individual brain looks or acts exactly like a group averaged brain the information proves of limited use. Furthermore it is exceedingly difficult to say how the brain activity related to a task performed while in a controlled environment relates to brain activity in a natural environment. These two difficulties together present the greatest hurdle to creating a neuroscience useful to the law.

Developing a More Useful Neuroscience:

A new type of approach could be developed capitalizing on existing neurotechnologies which would maximize ecological validity. In order to be relevant to the court this approach would have to pay special attention to both individual differences in activity as well as context dependent differences in activity. Thus, the neuroscientific evaluation must take place on the individual level and in as close to the natural environment as possible.

The neuroscientific experiments should also be designed such that the evidence produced is relevant to both the specific circumstances of the case and to the particular legal criteria of mental disorder. The behavioural tests and tasks given while undergoing the functional scans should be either

as much of a replication of the circumstances of the crime as possible or have extremely good arguments about why the capacities investigated by the test are relevant to that circumstance.

The conclusions based on such evidence should be carefully worded such that they remain corroborating evidence of a behavioural assessment. The neuroscience evidence should not take precedence simply because it is a novel 'brain based' approach. The trier of fact must be informed that the results of such a test do not make the psychiatrist's claim fundamentally 'true'. Instead, the test results would, when supplied with an appropriately strong argument, simply provide further corroborating evidence for that opinion.

Structural Testing:

Structural and functional imaging may allow just such an advance. Structural scans can reveal relative sizes of brain structures, which by itself may corroborate a theory. Structural imaging would be even more useful if they could be performed at multiple time points. If the accused has ever had a brain scan before for a medical reason related to their impulsivity then these records could allow a comparison of the relative sizes of certain structures over time. It is becoming increasingly possible and popular to perform CAT scans or MRIs when a structural abnormality is suspected. This evidence would not be determinative and would certainly be open to criticism, but could prove useful.

A structural scan may also allow for the detection of any abnormality, such as a tumor, which could interfere with impulse control. The now famous Burns and Swerdlow case, where a tumor caused a man to act sexually towards his step-daughter, is a perfect example (Burns and Swerdlow, 2003).

Functional Testing Design:

Keeping in mind the concerns about specific relevance, how might a properly designed functional experiment work? Let's use the example of schizophrenia. Someone is being charged with destruction of property because they destroyed their neighbour’s satellite dish (an example borrowed

from Morse) (Donohue et al., 2008). It comes out before the trial that this individual has a history of psychosis. The individual also has a persistent and unwanted paranoia that any satellite dish can read their thoughts. Assume that they are fully aware that there is no reason to believe the dish can read mind and that such thoughts are caused by their disease, as well as being aware of the physical, moral, and legal consequences of their action. None the less they were put in such a position by their mental disorder, perhaps to the point of existential terror, that they felt they had no choice but to destroy the dish.

Currently this person wouldn't qualify for a mental disorder defense. Because they knew the consequences of their actions and knew that their paranoia was an effect of their disorder they would be nothing less than fully responsible for their actions. But, given their disorder, it is quite likely that they were unable to resist the impulse to destroy the dish due to something like extreme discomfort. In view of this inability, and the fundamental importance of volition to responsibility, I along with several legal scholars would argue that the person should have full access to the mental disorder defense.

Neuroscientific evidence to support the use of this defense could be produced in the following way: the psychiatrist would apply a functional scan while the subject was experiencing something as close as possible to the actual event. If the scan occurs in a laboratory it could be an fMRI while wearing a virtual reality headset. The device would take recordings while the subject is exposed to various stimuli and asked questions. First they could be exposed to an innocuous object to get a baseline. Then various different objects that related to satellite dishes in one way or another. First a radio antenna, then a dish made of wood, eventually leading up to exposure to the actual object of the subject’s paranoia.

During the whole test the psychiatrist would both ask questions and make careful notes with time stamps about the person's current mind state (i.e. feeling safe, feeling unsettled, feeling the need to smash the dish, etc) as well as their observable behaviour (i.e. whether they appeared to be unsettled or

comfortable). A video recording of the whole event could also prove useful to note reactions that may have been missed in real time.

Back in the lab the data would be subjected to analysis. Work would be done to correlate patterns of activation to events of interest, for example, when the person said they were comfortable versus paranoid, exposed to innocuous stimuli versus active stimuli, feeling the urge to destroy the stimui versus feeling okay while in its presence. Of particular importance would be any activity correlated to times when the person appeared to be particularly uncomfortable and expressed a desire to do anything but be in the presence of the stimuli being presented.

After this analysis it *may* appear that there were patterns of activity specific to these scenarios. Further these correlations could be strengthened by filtering them through the correlations we are scientifically confident about. An example would be if there was a decrease in frontal activation, an increase in limbic activation both in terms of reward (meso-limbic) and emotion, or an increase in some central indicator relating to the activation of the peripheral sympathetic nervous system (the fight or flight reaction), when the person wanted to destroy the stimuli.

If such results could be obtained they could be quite convincing as corroboration of a psychiatrist's claim that when this person encounters this stimuli they are unable to conform to the requirements of the law and therefore qualify under the mental disorder defense. In borderline cases, or in cases where the accused is performing a highly skilled ruse, the psychiatrist might only feel confident in such a determination with the addition of the neurotechnological evidence.

Subsection 2 - Diminished Responsibility on Trial:

The defense of diminished responsibility relies only on showing that there is reason to believe the accused was not fully responsible for their behaviour, which, depending on the context, may be easier than showing that the person was completely helpless either because of compulsion or through

unreasonable choice.

In cases of drug possession, at least three types of people come into contact with law enforcement: the ones who sell, the ones who use casually, and addicts. Naturally accessible behaviours may not be enough to determine which one is which, so it might be best to play it safe and apply the same verdict to all. It is indeed currently the case that a criminal charge depends largely on how much of the illegal substance is in possession of the accused, no matter what use that quantity is actually going to be put to (See: CDSA S4-S7). However if the law can tell the difference between these groups through the use of neurotechnologies, it makes sense that it should attempt to gain such resolution. An appropriate testing design could very well do just that. Whether or not these techniques would identify a large number of people or a small number is important, but for the moment is almost beside the point. It is the duty of lawyers, judges, and law makers to identify injustices and to take steps to ameliorate them. This idea is putout in its fullest and best form by Amartya Sen in The Idea of Justice (Sen, 2011).

Structural Scanning:

Structural scanning would be useful in a way analogous to that discussed for irresistible impulse. These scans could prove useful in uncovering an injury or abnormality which could cause impulse issues. Traumatic brain injury, for example, is often associated with impulse control problems (Greve et al., 2001).

Another way would be for an accused to undergo one scan on their first offence and another for every subsequent offence. This strategy is the same layout as a longitudinal study conducted in research centers today. Longitudinal data would allow courts and law enforcement to make note of changes in structure, and to correlate structural changes with observed behavioural changes

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Functional Scanning:

A very similar approach could be applied which leverages functional imaging technologies.

Functional imaging is the converse of structural imaging and reveals correlates of ongoing brain activity with little information as to structure. Functional imaging from previous hospital visits would likely be of limited use because the results and conclusions depend on the type of behaviour being assessed, which is unlikely to be exactly that which is relevant to some criminal act. Scans taken after every offence and related to the nature of the offence could prove quite useful by showing that external behaviours are reflected in, and therefore corroborated by, the internal workings of the brain.

To conduct such a test on someone with drug related impulse issues would look much like the test for irresistible impulse discussed above. Drugs or drug related paraphernalia would be presented to the person either in real life or in virtual form. Careful notes would be taken of all behaviours and times of occurrence. Then the brain activity at those times could be compared with those at innocuous times and the results filtered through our current knowledge of causal neural mechanisms. While this strategy is not a diagnostic test which is able to prove that the person was hampered in their ability to control an impulse, it could well provide evidence which further allows potentially addicted persons to be distinguished from normal individuals.

Conclusion:

It is unknown how well experimental observations would relate to our legal definitions as the experiments have not yet been done. The law is also limited by the resources and technologies to which each jurisdiction has access. However such efforts as those described above, if performed carefully, could produce usefully predictive corroborating evidence for the diagnoses and testimony of psychiatrists.

Section 4 – Sentencing and Neuroscience:

It is unknown how well experimental observations would relate to our legal definitions. The relevant experiments have not yet been done. However such efforts as those described above, if performed carefully, could produce usefully predictive corroborating evidence for the diagnoses and

testimony of psychiatrists.

Subsection 1 - Sentencing and *The Criminal Code of Canada*:

The Criminal Code of Canada outlines the purposes and principles of sentencing for criminal offences as well as provisions which allow the case to be dealt with by alternative measures. The sections of the Criminal Code I will be concentrating on are: Section 718, Subsections (b), (d), and (f), Section 718.1, Section 718.2, Subsection (a), clause (iii.1), and Subsections (b), (d), and (e).

Section 718, Subsection (b):

Section 718 deals with the purposes and objectives of sentences. Subsection (b) reads that one objective is to "deter the offender and other persons from committing offences". This subsection separates deterrence into specific deterrence of the offender and general deterrence of the population.

The potential applicability of neuroscience to specific deterrence is promising. If we accept that consideration of the laws and punishments likely to occur if the offender is caught is a rational deliberative process, then we can inquire into how this individual's brain responds to certain stimuli and correlate these with behavioural observations. When presented with drug related stimuli, for example, one could see a marked change in activity related to reward. This change could further be accompanied by alterations in activity related to decreased conscious deliberation (likely in decreased frontal activity). If this data is combined with behavioural observations related to susceptibility to impulsive action and addiction, which is roughly the technique which we currently employ when a psychiatrist assesses someone for addictive traits, we might well be able to conclude to a greater certainty that the likelihood of conscious deliberation when faced with drug related stimuli is lower for one person then for another.

Using neurotechnologies in this way to probe brain activity would be especially effective if used on a repeat offender where the circumstances which lead to their re-offending are sufficiently clear. If there is evidence that the offender deliberated about how to go about obtaining a substance then scans

sensitive to immediate impulse wouldn't be useful. If, instead, the evidence suggested the defendant was enticed by circumstance preying on their impulsive tendencies then a functional scan might be able to add weight to this evidence, and we could be clearer on what part specific deterrence should play in sentencing this individual.

There is already some case law close to on point. In *R v. Preston,* Wood JA sentenced a defendant convicted of three counts of heroin possession to a suspended sentence which included rehabilitation and community service. His reasoning was that this sentence was the only way to "break the cycle of crime" (*R v. Preston*). This reference clearly has both a rehabilitative as well as specific deterrence objective. This case is also a good example of someone who was unable to control impulses towards substances of abuse and how these individuals might be best handled by the law. There are likely similar cases of impulsive action where the individual and society would get the most benefit from a similar rehabilitative approach but where the behavioural evidence isn't strong enough to warrant the same type of sentencing. If the case can be strengthened by neurological evidence then the impulse-prone population can be better understood and treated appropriately.

Once procedures sensitive to indicators of addiction have been developed for use on the individual, the possibility exists of coming to conclusions about overall group behaviour, which in turn could help craft sentencing policy. The study group would ideally be a group of similar offenders committing similar offences over time. If similar offenders react in a similarly non-rational way in like situations then we can begin describing them as a group or cohort. If the population that commits a type of crime, for example, drug possession, is made up of a number of different groups then information about how much of that population is made up by a particular group, and also how effectively that group can be deterred by punishment, should be relevant to our deliberations about general deterrence.

Section 718, Subsection (d):

This subsection of the Criminal Code states that one objective in sentencing is "to assist in

rehabilitating offenders". I alluded in the above deterrence section to how neuroscience could be useful in rehabilitation. If rehabilitation is one of the major objectives in a case, as it often is in drug possession cases, then once an appropriate experimental scanning procedure has been designed one could gain some insight into how effective a given rehabilitative effort might be in allowing the offender to control their impulses.

A technique that is currently used by some private rehabilitative services is to take what is essentially an EEG snapshot of the subject's brain and compare it to a large database of similar snapshots. Records are kept as to what rehabilitative efforts were most effective on each individual. If similarities are noticed between the snapshot of the new patient and other patients for whom a particular rehabilitative effort was effective, then the same approach can be applied to the new subject (See: Addiction Alternatives). A similar approach would not be hard to adapt to a certain percentage of accused individuals who demonstrate impulsive tendencies and who have indicators revealed through neuroimaging.

Section 718, subsection (f):

This subsection states that one objective is "to promote a sense of responsibility in offenders, and acknowledgment of the harm done to victims and to the community." If we become clearer about the level to which someone was really "responsible" for their actions we can improve the ability to promote a sense of responsibility in that person. In other words, the imperative to "promote responsibility" means that the offender must acknowledge their causal role in the crime. If we can be clearer about what impulsive tendencies were active during the crime (or during a sufficiently similar experimental situation) we can be more precise when attempting to instill a sense of responsibility.

What's more, if we can use the methods above to identify the best possible rehabilitative methods for that individual, then by applying the most effective rehabilitation we can give that

individual greater cognitive control over their previously unconscious impulsive behaviours. Promoting responsibility can be accomplished in this way by giving the offender the responsibility, or at least, opportunity, to overcome their subconscious and impulsive drives.

Section 718.1:

Section 718.1 is under the auspicious heading of Fundamental Principle and states "A sentence must be proportionate to the gravity of the offence and the degree of responsibility of the offender." While judges give little specific reference to this section it is important nonetheless. If our fundamental principle of sentencing is that the sentence should be "proportionate" to the gravity of the offence and the "responsibility" of the defendant, then any evidence which suggests they are not as responsible in the relevant sense would be important. If one can show that an offender was acting impulsively then, depending on the gravity of the crime, it may call for a reduced sentence.

This would be akin to a diminished responsibility defense but applied during a sentencing trial. A similar type of reasoning already exists in Canadian sentencing trials that allow a judge to give different punishments to people convicted of the same crime. For example, if one person was a largely unwilling lookout for a car theft they could be convicted of the full offence without incurring the same sentence because they were less responsible for the actual crime than the car thief.

Section 718.2, subsection (a), clause (iii.1):

This section deals with the idea that if there is evidence to suggest that the victim of the crime suffered a significant negative impact from the crime then the sentence can be aggravated. If we used behavioural tests combined with functional scanning to show that after the offence *the victim* was significantly more impulsive in a way that negatively affected their life then such evidence might be useful. For example a victim might be unable to control the impulse to get out of any room with someone who looks like the offender. Sexual assault which leads to an inability to cope with any type

of sexual attention could be a good target for such an approach. This section is particularly interesting because it relies for its justification in the consequence of the illegal action and not in the volition of the offender.

Section 718, Subsection (b):

This subsection indicates that "a sentence should be similar to sentences imposed on similar offenders for similar offences committed in similar circumstances". The most important word here is "similar". How we model what makes one offender similar to another is a matter of law which can draw from neuroscience. What characteristics are deemed relevant for comparison will depend on the type of case being presided over, but if structural and functional scans can show that two individuals who differ in some ways may be similarly susceptible to impulsive acts, then the punishments can be equalized accordingly.

Section 718.2, subsection (d):

This subsection enshrines liberty as a fundamentally important idea and reads: "an offender should not be deprived of liberty, if less restrictive sanctions may be appropriate in the circumstances". These "less restrictive sanctions" may be any of a number of approaches. However, which approach would be most effective for a particular offender could be made clearer by information about their impulsive tendencies.

For example, the impulse to have sex is powerful and can be overpowering. If someone has an attraction to children then there is a significant issue. There are several ways of dealing with offenses like this. The first is to incarcerate indefinitely either in a prison or a psychiatric institution. This punishment is, on its face, the safest approach, but also the one which most restricts liberty. A more nuanced view is to limit where these individuals can live and work. While this is less limiting such a sentence would both limit spatial liberty, like incarceration, as well as limiting freedom through public stigma.

Another approach could be to study the neurotechnological correlates of arousal in an individual and to fit them with a device to detect these correlates, similar to how an ankle bracelet relays information about a person's location. This device could be connected to a camera or a GPS locator which would activate upon detection of these signals. It is unknown whether such a technique would work, or how practical it would be even if it did, but it presents an area worthy of exploration.

I pause here a moment to underline the potential darkness of such a scheme. While an impulse detecting ankle bracelet could, for certain individuals, maximize freedom, if it was applied too broadly as a mechanism of social control the effect could be dystopian. This example represents an excellent exposition of how, when adapting neurotechnologies to the realm of social control, the consequences of over reliance could in effect reduce social liberty and disrespect individual human dignity.

Section Conclusion:

Sentencing presents a particularly exciting arena for neuroscience because of its flexibility. Judges have the power to individualize sentences based on the needs of the offender and the needs of society. Neuroscience can help us in being more accurate with the language of responsibility we use, to better tailor sentences to individuals, and can provide objective evidence for the punitive measures we employ. It can also help to indicate whether the offender should be directed towards alternative sentencing by providing objective measures which speak to the criteria surrounding drug abuse or mental disorder.

Chapter Conclusion:

This chapter explored how neuroscience can be used to create better laws, can allow for more objective and accurate trials, and can be used to tailor sentencing to the needs of the individual. None of these efforts require neuroscience to discover complex neural mechanisms or to disprove responsibility. All that is required is taking the established resources provided by neurotechnologies, with slight modifications, and applying them in a concept-specific manner.

The next chapter explores the ethical components of such an effort. It is common wisdom that just because something can be done doesn't mean it should be done. The field of applied ethics has developed in part to consider the possible ramifications of a technology before it reaches reality, in the hope of better preparing us for unwanted outcomes. In the next chapter I will undertake such an analysis of the techniques and ideas discussed in the previous chapters.

Chapter 4: Ethics of Using Neuroscience for Impulse Related Laws

"And not only ought this regulation to be in harmony with morality--for obviously, people ought not to be compelled to do what they ought not to do--but further, to an important extent the Law of a man's state will properly determine the details of his moral duty, even beyond the sphere of legal enforcement."

-Henry Sedgwick, *The Methods of Ethics, 1907*

Introduction:

So far we have explored the legal, scientific, and some of the philosophical, dimensions of neurolaw related to impulse control. To reconstruct, first we explored some of the important philosophical underpinnings of both the law and neuroscience. Doing so revealed how the law creates models that guide behaviour and uses evidence to prove that a person's behaviour, at the time of the crime, fits into that model. We also began figuring out how one could adapt the techniques of neuroscience to provide evidence by conducting carefully designed experiments. I argued that neuroscientific techniques could be applied to laws relating to controlled substances, the irresistible impulse defense, and diminished responsibility defenses.

It is now time to consider the ethical ramifications of such an effort. I will discuss how the neuroscientific techniques introduced in Chapters 1 through 3 will affect the law and society, including individuals and groups. Ethics is a complex field. There are numerous ethics lenses which can draw different conclusions about the utility of a scientific discovery. My analysis is one such lens. I investigate how neuroscience can make the Canadian pursuit of justice both more therapeutic as well as more accurate in its characterization of individual responsibility. I argue that the tools and techniques of neuroscience can be useful to the law and that the ultimate reason for implementing them in a legal context is in their ability to maximize the therapeutic outcomes and autonomy of all those involved in the judicial process.

Contained within these two key aspects of my analysis (therapy and freedom) are important concepts from the field of bioethics. Therapeutic maximization comes from the field of therapeutic

jurisprudence (to be discussed more below). The field emerged from concerns about how mental illness and the law interact. Significant work has been done by psychiatrists and therapists to bring theories behind the treatment of those with mental illness, which include considerations of beneficence, non-malfeasance, justice, and autonomy. (Pickard, 2013; Beauchamp and Childress, 2001). Legal writers have worked to adapt these theories, often under the title of restorative justice, to fields throughout the law, most predominantly the criminal law. (Pickard and Lacey, 2013)

Concerns about responsibility abound within the criminal law and take a central place in my analysis in this chapter. As mentioned in the preceding paragraph one of the major concerns in bioethics, and in ethics generally, has to do with autonomy - that is the ability someone has to freely make a choice which furthers their conception of their own good or interests. We have already briefly discussed in Chapter 3 how neuroscience can not only help to show when someone is not responsible, but to what extent they *are* responsible and how to build off those capacities. In doing so we gain a greater clarity into how autonomous an individual is given a certain context. In doing so, and especially when doing so to further therapeutic goals, we are taking a stance which attempts to maximize the autonomy of the subjects and to respect those decision making capacities which are intact.

The following material is organized into broad questions related to each of the neuroscience applications discussed in Chapter 3. The first section relates to the use of neuroscience when creating drug laws. The second section deals with the irresistible impulse defense. The third deals with diminished responsibility. Within each section I first take stock of the legal status quo and make note of its shortcomings. I then briefly explain how the appropriate use of neurotechnologies can aid the status quo. Once the above is clear, I examine the ethical justification for using neurotechnologies in these ways. I attempt to provide answers to, *inter alia*, the following questions: Who would be affected by the deployment of forensic neuroscience techniques? Would the effects of their use be maximally therapeutic? What technologies would be most effective given the legal concepts they aim to aid? After

considering all of these issues I make recommendations about both the development and deployment of neurotechnologies to the particular end in question.

Therapeutic Jurisprudence:

Before delving in the specifics I would like to provide a brief explanation of the primary ethical theory which I will be applying: Therapeutic Jurisprudence. Jurisprudence is the study of where law draws its power and what are the legitimate uses of that power. It may sound strange initially that this has to do with ethics, but a brief illustration should make the connection clear. No matter where one vests the power of the law eventually it must be grounded in some conception of the good. If one is a natural law theorist one believes that law is imminent in nature and it is good to follow it because the universe has decreed these laws to be how reality should function. One may also vest the power of the law in a deity, such that following the law and, for example, being a good Christian, are one and the same. I do not place myself in either of those camps but instead argue, or rather therapeutic jurisprudence argues, that the power of the law comes from its ability to make the lives of those that come under its auspices better, more fulfilling, more filled with free choice, filled with less pain, and generally promoting the good of the subject. Notice how this grounding corresponds to the principles of bioethics discussed earlier (which themselves draw from utilitarian, deontological, and virtue theories of ethics). Thus the ideals of bioethics and therapeutic jurisprudence accord with one another. Indeed they both developed out of the same areas of concern surrounding how we should treat people in a medical and psychiatric context.

Therapeutic Jurisprudence is a particularly pertinent approach when investigating the criminal law. In the criminal law we are considering how (and whether) the accused has wronged another person, and how the accused has harmed society as a whole by infringing upon the reasonable expectation of the rule of law. During such a procedure we want to accomplish several things: to make

sure the person takes on the responsibility they deserve, to compensate the specific individuals harmed, and to take measures to ensure the accused does not do the same things again.

Inherent in all of these goals is the desire to heal: to heal the accused, those affected, and society as a whole. The old approach would be to use punishment as a means of healing or gaining peace of mind by appeasing a retributivist desire and deterring future acts. However such an approach is at the very least incomplete. There can be many causes of behaviour that are not under the control of the accused and thus for which they cannot meaningfully be held responsible. Some such offenders can, however, be healed and helped to change their behaviour and to benefit society. It is similar to a case where someone steps on another's foot because of a balance control issue. It makes little sense to hold the one with balance problems fully responsible for treading on the other. It makes total sense, however, to try and heal that person’s balance problem so that it doesn't happen again.

The reasoning above is particularly pertinent when neuroscience (or whatever science) indicates that the behaviour can be better characterized as caused by a disease or disorder than as a voluntary action. This line between criminal and disease behaviour is constantly being negotiated and represents different arms of the same project to improve our lives (Conrod and Schneider, 1992). When behaviours are considered disorder- or disease-caused, as is the case with irresistible impulse and diminished responsibility, therapeutic considerations should begin to take precedence over other goals of the law.

It is further the case that a therapeutic approach is the one most likely to bring about a change in the internal patterns which generate behaviour. This effort to change internal patterns is essentially the fundamental aim of any form of therapy. A good therapeutic approach will attempt to identify the root of the problem, establish trust, find reasonable goals for change, and apply the best tools available to the end of achieving those goals.

Section 1 - Should We Create Drug Laws Which Rely Centrally on Neuroscientific evidence?:

Subsection 1 – The Status Quo:

The current status quo of controlled substance laws in Canada is an amalgamation of historical trends in drug enforcement, social pressures, and quasi-scientific reasoning (Erickson, 1992). Before drug prohibition substances which are currently illegal could be found in many household products. Cocaine and Heroin were both first synthesized in Europe in the 1800's and could be found in food products (the wine Vin Mariani and the original Coca Cola) and countless patent medications (opiates work as highly effective antitussives, analgesics, and antidiarrheals). Over the next century and a half Canada and the rest of the world began to recognize the possible danger of these and similar substances. These dangers, combined with cultural trends and ideologies, led to the scheduling system Canada now employs (Pietschmann, 2006).

Substances are organized into schedules based on several considerations including: Overall risk to public health and safety posed by the substance; Chemical and pharmacological similarity to other substances already regulated under the CDSA; Legitimate uses of the substance; Potential for abuse and risk of addiction associated with the substance; Extent of actual abuse of the substance in Canada and internationally; and International requirements and trends in international control {See: Order Amending Schedule I to the Controlled Drugs and Substances Act (MDPV)}. The Governor-in-Council, with advisement from the Ministry of Health, can then use arguments based on one or more of these considerations to place a substance in one of the Schedules; a vote from parliament is not needed for such an amendment to be made. A range of punishments are then attached to possession, trafficking, or production offences (See: CDSA s4-s7).

The different levels of responsibility which I suggest can be highlighted by neuroscience have already begun having an effect on the law, though only indirectly through sentencing. In many Canadian jurisdictions there are courts specifically designed to handle those charged with drug offences where there is evidence that the offence was motivated by an addiction (See: Drug Treatment Courts,

2007). If the trial judge is satisfied that an accused individual qualifies for treatment, a guilty plea is entered and they proceed through a multi-step assessment and treatment procedure.

Subsection 2 – Issues With the Status Quo:

There is important and ethically relevant commentary from many fields which has heavily criticized the project of prohibition (See: Report of the Global Commission on Drug Policy). While these arguments are certainly worth considering given the massive toll prohibition has taken on our society, I must stick to those critiques based on the discoveries of, and potential uses of, neuroscience. What neuroscience offers is the kind of increased resolution discussed in Chapter 3, so the question becomes: What harms or injustices are produced under the current justice system that are unnecessary given what neuroscience can tell us?

A naive approach would be to hold neuroscientific factors as the single most important criteria for scheduling. Such an approach would make scheduling much easier, but would fail to recognize the multi-modal project that the law must take on. Instead, neuroscience urges us to use its results to deliver justice with greater accuracy. This greater accuracy would be achieved by being able to tell with greater certainty both exactly how addictive a substance is as well as the neural and behavioural characteristics of the accused which indicate diminished responsibility. Our drug scheduling laws and sentencing guidelines could then be adapted with the help of neuroscience.

Subsection 3 – How Neuroscience Should Help:

When the Controlled Drugs and Substances Act and the Sentencing portion of the Canadian Criminal Code are considered in conjunction, Canada has a reasonable approach to drug enforcement given our current justifications. Furthermore, if one looks at the actual practices of sentencing and the use of specialized drug and mental health courts, those with serious impulse issues are often dealt with in a sensible manner since they are directed towards treatment programs instead of sent to prison. There

are, however, two ways in which neuroscience can help us to create better laws. Neuroscience can give us the best possible evidence for precisely how addictive and dangerous a substance is, and it can help to create further distinctions within the law concerning offenders with fundamentally different levels of responsibility. Both are discussed in the following paragraphs.

Using Neuroscience to Re-categorize Substances:

There are two separate and yet compatible ways in which neuroscience can help us change how substances are classified within the law. The first way is by providing further evidence for current justifications. Two of the most important considerations when a drug is scheduled are its level of addictiveness (the words reward and pleasure are often used interchangeably with addictiveness) and its short and long term health harms to the user. Both of these either have been or can be assessed using standard neuroscience techniques. Getting clearer on these justifications does the secondary duty of causing us to examine the concurrent justifications behind how a particular substance is scheduled.

Neuroscience evidence could prompt a re-examination of why certain substances are scheduled as they are and a discussion about whether the current justifications hold muster. As an example, I will discuss two classes of substances which are currently classified in ways not clearly compatible with neuroscientific reasoning: the Cannabinoids and the Psychadelics.

Cannabinoids make up the entirety of Schedule II, the one that carries the second harshest penalties (though it must be mentioned that Schedule II punishments are reserved for those possessing amounts most likely for trafficking). There is evidence, both behavioural and neuroscientific, to suggest that certain Cannabinoids (including the famous Teterahydrocannabionol or THC) stimulate the reward pathway (Lupica et al. 2004). The extent to which this stimulation occurs, however, is significantly smaller than other illegal substances (such as cocaine and heroin), or of many legal substances (such as nicotine, alcohol, and some over the counter medications) (Gable, 2004; van Amsterdam et al., 2010).

There is also little to no evidence of long term or short term dangerousness or neural degeneration posed by Cannabinoids. There has never been a verified case of Cannabis overdose. The LD50 (the dose at which 50% of people would die of overdose) is astronomical. There is of course the risk of adverse effects on the lungs, though this is true of any substance that is burned and then inhaled and could be largely if not completely eliminated by vaporizing or ingestion through doped foods. The evidence of long term structural as well as functional damage or impairment is debatable (Lorenzetti et al., 2010), with some studies suggesting that even chronic Cannabis users (those who have smoked at least 5000 joints worth) have no detectable cognitive deficits compared to the normal public after a month of cessation (Pope et al. 2001). There is evidence to suggest that Cannabis consumption can aggravate underlying psychiatric disorders such as anxiety and depression (Patton et al., 2002), but the cause and effect relationship in these cases is uncertain. Furthermore, Cannabadiol is a naturally occurring Cannabinoid, and is categorized as a Schedule II substance because of its similarity to other Cannabinoids. However, there is evidence concerning this substance suggesting that it is either minimally or completely non-addictive and it has been heralded as a potentially highly effective anti-psychotic and epilepsy medication (Devinsky et al. 2014).

Almost exactly the same analysis applies to the psychedelics (LSD, Psylosibin, and Mescalin), and makes us seriously question why they are currently Schedule III substances. There is little to no evidence of these substances presenting a significant addiction risk, with their rapid tolerance effects making continuous binging difficult (Shulgin, 1980). Psychedelics are certainly less addictive then some of the other substances found in Schedule 3, such as Methylphenidate (the major component in the medication Ritalin) (Parran and Jasinski, 1991).

The evidence of any short or long term brain damage resulting from the use of psychedelics is inconclusive mainly because no significant research has been conducted on the topic. There is significant anecdotal evidence of underlying psychiatric disorders being exacerbated by psychedelics,

however, there is a growing set to match it which suggests that controlled psychedelic experiences could provide effective treatment for certain disorders (such as depression) (Gasser et al., 2014). Once again insufficient research prevents one from forming definite conclusions.

The above evidence encourages two paths forward. The first is to continue research on these substances to become clear on their real dangers in terms of brain damage, exacerbation of psychiatric disorders, and addictive potential. Such research could be pursued through cell culture experiments, animal model based experiments, and functional and structural experiments on humans.

Some good research has been conducted and leads us to the second path: re-examination of how and why these substances are currently scheduled the way they are in light of what we know. As mentioned earlier, the test for whether a substance should be scheduled, and what schedule it should fall under, is a multi-pronged approach which takes into account social as well as medical harms. Given that Cannabis and the Psychedelics present little risk of significant harm, or of significant addictive potential, for the majority of people, maintaining those substances within their current schedule would rely on there being significant social harms coming from their use. While I cannot examine those justifications in detail, I can say a few things with some certainty.

First of all, no matter its current legal status, Cannabis is commonly consumed in Canada and all evidence suggests that its social consequences, both in terms of adverse effects on society and in terms of increased cost to our healthcare system, if not non-existent, are significantly lower than those for either Tobacco or Alcohol. Both Tobacco and Alcohol present more of an addictive risk as well as causing greater damage to the body and brain (van Amsterdam et al., 2010).

We cannot draw as clear a conclusion about the Psychedelics as they are simply not as commonly consumed or documented as Cannabis, but beyond some widely publicized hospitalizations it does not appear that our society is better for banning them or would be harmed by legalizing or at least rescheduling them. Reasoning from the starting premises that unless there is significant evidence

of harm a substance or act should not be prohibited (this is the maximization of liberty), and that prohibition often leads to an increased black markets and all of their associated harms, then prohibiting Psychedelics may well be causing significantly more harm than good. Furthermore making these substance illegal means that education is often limited and thus the people partaking in them are uninformed about how they can cause an adverse reaction and will avoid seeking help and medical attention of these adverse reactions occur for fear of legal repercussions.

I mentioned earlier that there were two compatible paths to the reclassification of drugs. The first we have just discussed and involves either re-scheduling of substances based on what is known, or a pro-active effort by neuroscience to find evidence for why certain substances are classified as they are given their dangerousness or addictive potential. The other path is to create another classification system based entirely on addictiveness to be used when someone is charged with possession or trafficking in small amounts. A method similar to this has been researched in the United Kingdom (Nutt et al., 2007). Such a document would act as a useful guide for judges when deciding whether to direct a person either towards treatment or towards prison. If there is evidence of addiction or addictive tendencies and the person is accused of possession a small amount of a particularly addictive drug then these pieces of evidence can combine and urge the judge to attempt the treatment approach. On the other hand, if there is no evidence of addiction and the person is simply trafficking a highly addictive substance then the other scheduling system would be consulted and their charge could be aggravated as they pose a higher risk to the public than those who traffic in only minimally addictive substances.

Using Neuroscience to Nuance Possession Charges:

The other way neuroscience can help change our drug laws is by helping to create a greater set of distinctions between possession by an addicted individual, possession by a person with an impulse control disorder, possession by a casual user, and possession for the sake of trafficking, producing,

importing, or exporting. Currently the legislation only makes the distinction between possession and possession for the sake of trafficking, producing, or importing and exporting. These distinctions are good because they recognize that there is a different level of wrongfulness between simple possession and the other offences. Such a simple distinction, however, implies that the law recognizes an equal level of responsibility for individuals in each of these groups. An ideal law, however, would attempt to recognize at the earliest possible moment exactly how responsible, that is, how rational and non-impulsive, a person is for an act.

As we saw in Chapter 3 there is good reason to doubt that someone acting on an addictive impulse is truly fully responsible for their actions. People acting on an addictive impulse also do not usually exercise the kind of long term rational thinking and conscious deliberation present in those who produce, import, or export a substance. If the law hopes to faithfully recognize true responsibility in its categorizations of crime, which is an important aim in the creation of our laws, something must change.

This change can happen in one of two ways. The first would be to enshrine a diminished responsibility defense in law, and allow it to be applied to cases where there is evidence of diminished responsibility due to mitigated impulse control. Such evidence would include evidence from neuroscience. This path will be discussed further in the section on diminished responsibility below. The second way is to change the wording of our drug laws such that diminished responsibility is implicitly recognized.

Such an approach would lead to changes in the section of the CDSA related to possession offences for substances that have been found to have significantly addictive properties and where the person shows signs of being addicted. Currently the law (that is Section 4 of the CDSA) indicates that all possession, or seeking to gain possession, of a given substance is equally blameworthy. Only once the accused has pleaded guilty and taken full responsibility are they directed towards alternative treatments.

The law could be changed, however, to include elements related to addiction and limited impulse control. For example the charge of possession reads as follows:

Possession of substance

- 4.(1)Except as authorized under the regulations, no person shall possess a substance included in Schedule I, II or III.

Obtaining substance

(2)No person shall seek or obtain

- (a)a substance included in Schedule I, II, III or IV, or
- (b)an authorization to obtain a substance included in Schedule I, II, III or IV

from a practitioner, unless the person discloses to the practitioner particulars relating to the acquisition by the person of every substance in those Schedules, and of every authorization to obtain such substances, from any other practitioner within the preceding thirty days.

Punishment

(3) Every person who contravenes subsection (1) where the subject-matter of the offence is a substance included in Schedule I

- (a) is guilty of an indictable offence and liable to imprisonment for a term not exceeding seven years; or
- (b) is guilty of an offence punishable on summary conviction and liable
  - (I) for a first offence, to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding six months, or to both, and
  - (ii) for a subsequent offence, to a fine not exceeding two thousand dollars or to imprisonment for a term not exceeding one year, or to both.

...

To this formulation could easily be added a clause which works similarly to that of provocation in s. 232 of the *Criminal Code*. If there is evidence that the individual has an addiction and has difficulty controlling impulses towards substances of abuse, the clause would take effect. For example, the "punishment" clauses could state that a person,

- Is guilty of a mitigated form of the offence called "possession under the influence of powerful impulse" if
  - (i) there is evidence that the accused suffers from a disorder which

interferes with the ability to control impulses, and/or
    - (ii) there is evidence that the individual's actions are substantially motivated by addictive impulses.
- [Therefore the person] is liable, on the first offence, to mental health and addictions assessment and treatment for such, and
    - for a subsequent offence to assessment, treatment, and further measures possibly including: confinement in a treatment facility, probation restrictions, or whatever measures are just and necessary to pursue effective changes in behaviour.

Adding such a clause and sub-clauses (those above I have written myself) would do the dual duty of recognizing as early as possible in the judicial process a more accurate characterization of individual responsibility, as well as directing people into appropriate treatment paths. It would also make it clear that while the law maintains that the activity is illegal it recognizes the significant public health component. The proof that an accused has either of the characteristics outlined in (i) and (ii) could be provided by his or her previous criminal record, and by the psychiatric and neuroscientific methods discussed in previous chapters.

Subsection 4 - Ethics Analysis:

A fair amount of ethics analysis has been performed in the previous two subsections. Therein I discussed the harms related to inappropriate scheduling. Furthermore I discussed how it is inherently unjust for a legal system to ascribe full responsibility to a person where there is evidence to suggest that their rational responsibility is reduced in some significant fashion either by mental disorder or by addiction.

I would like to briefly discuss here some further ethically relevant effects the changes above would have. For much of this discussion I will use the lens of therapeutic jurisprudence. This approach to the law was born out of mental health law. It finds laws most justified when they are maximally therapeutic for all parties (Goldberg, 2011). As such this perspective concentrates on the people affected by judicial paradigms.

The most obviously affected individual is the accused themselves. All of the changes mentioned above attempt to reflect the actual responsibility of the accused, and to direct the accused towards the treatment that will be maximally therapeutic. A change in the wording of the law, as suggested in the previous subsection, would inherently recognize the need for treatment and the need to accurately portray the responsibility (or lack thereof) of the accused. Such a change would also remove some of the retributive language within the current law.

Such a recognition places the justice system in a specifically therapeutic position with respect to addicts and those with impulse control disorders. Instead of an adversarial system worked out to punish these people, the legal system can be used to protect and treat those with addictions issues, while also taking a prohibitory stance. This repositioning is likely by itself to have a therapeutic effect on the relationship between the justice system and this vulnerable population.

This more nuanced approach could be further therapeutic to the family of the accused and their local community as a whole. Families and close relations could be confident that interactions with the justice system will be motivated by treatment and compassion as opposed to imprisonment and retribution. For communities, further therapeutic effects can be imagined. Addictions treatment is a more effective means of reducing addiction than imprisonment (Gossop et al., 2005). A society with fewer addicts is a happier and healthier one.

Section Conclusion:

The suggestions made above would move the law towards a more ethically justifiable position. Neuroscience has either already provided evidence for why these changes should be made, or has offered us an opportunity to explore whether our current justifications meet ethical muster. I have argued for the following options as changes to the law: (1) We should reschedule those substances where doing so is indicated, (2) We should create a new legally recognized document which orders substances based on neural dangerousness and addictive potential, (3) We should change the law itself

such that diminished levels of responsibility are inherently recognized. These changes would ensure that our justice system is as just as possible and would increase the therapeutic value of these laws for every party involved.

Section 2: Should We Create an Irresistible Impulse Defense?:

Subsection 1 - The Status Quo of Irresistible Impulse:

An ideal mental disorder defense would allow for any person who is morally innocent by reason of irregular neural activity to avail of it. Such innocence can be realized in several different ways. One example is if the person was suffering from some delusion which prevented them from appreciating or knowing what they were doing or what the consequence of their actions would be. For example, if someone suffering from a psychotic episode truly believed that a neighbor's garbage can was a monster from hell, and thus destroyed the can, they would in no reasonable sense have understood or appreciated the nature or quality of the act or its consequences. In cases such as this the current mental disorder defense (s. 16) is applicable and justly employed.

There is another set of cases, however, that an ideal mental disorder defense would recognize as innocent. These are the disorders of impulse we have been discussing so far. For example, if someone found themselves compelled, beyond their power to consciously resist, to destroy the garbage can, it would seem that such a person would also be innocent of an offense. There are many examples of individuals with mental irregularities who feel compelled beyond their control to perform an action. These people can be well aware of the nature of the act and yet none the less be helpless to resist. However, the current mental disorder defense does not apply to irresistible impulse (as opposed to lack of awareness).

Furthermore, the current mental disorder defense, as illustrated by Penney, does not apply to those who suffer from fixations caused by mental irregularity that force them to make impossible choices between prohibited actions and acute suffering. (Penney, 2013) Nonetheless, criminal liability

should not attach to such actions. As an example, imagine someone suffering from a persistent and nagging belief that their neighbour's garbage can was going to have a bomb planted inside of it. After waking up in the middle of the night in a cold and shaking sweat, the person destroys the garbage can. Since the person suffers from such distress, not acting was not really an option. Therefore the act was not meaningfully voluntary which means that the person is morally innocent. In this scenario the person may know full well that there are potential legal and moral consequences to their actions. So the current mental disorder defense would not apply. Yet the person should escape criminal liability.

Currently, courts use case histories, accounts of long time relations, and forensic psychiatric evaluation as evidence in making decisions about the applicability of the mental disorder defense (Roach, 2011).

Subsection 2 - Issues With the Status Quo:

The major reason an impulse-based branch of the mental disorder defense has not been legitimized in Canada is a perceived inability to reliably detect the irregularities that give rise to them. The legal scholar Stephen Penney has nicely laid out the status quo of the irresistible impulse defense in Canada and the issues with its current application, or lack thereof.

In his most comprehensive paper on the subject (Penney, 2013), Penney describes the current jurisprudence around irresistible impulse. He first establishes the idea that an action caused by uncontrollable impulse cannot reasonably be considered morally voluntary. He then demonstrates through examination of several important cases (i.e., *R. v Ruzic*, *R. v Creighton*) how the Supreme Court of Canada has established voluntariness as a fundamental principle of justice covered under section 7 of the *Charter*.

Through his argument Penney establishes a perspective on the legal status quo that leaves room for an irresistible impulse branch of the mental disorder defense. He then goes on to discuss the

neuroscientific evidence which suggests that those with impulse control issues have different neuroanatomy and function than control subjects or those with disorders of rational functions.

As a final step Penney investigates the use of the defense in other jurisdictions that currently allow it. One of the major worries attached to the irresistible impulse defense is that it will allow people to fake the symptoms and thereby avoid a guilty plea. Penney goes through several jurisdictions that have had their use of the defense cataloged and demonstrates that a finding of Not Criminally Responsible (NCR) based on impulse alone is rare and almost always co-occurs with an established psychiatric diagnosis. He further demonstrates that psychological tests for impulse control exist, are used in a professional psychiatric environment, and are not fundamentally less effective than tests used to demonstrate the rational and cognitive capacities the law currently excuses. The implication is that the fear of mental malingering in these jurisdictions seems to be, as of yet, unfounded.

According to Penney, the irresistible impulse defense should only be extended to those who found the act or omission completely irresistible. This sets the limits of the argument on more established and indisputable grounds, rather than arguing for intermediate levels of impulse control and their moral and legal ramifications. He admits that such a bright line might seem strange to neuroscientists but is required when working with a legal system like ours.

Out of Penney's analysis we can draw several important issues that deserve ethical consideration. First, we can be relatively certain that, based on the neuroscientific and psychological evidence, there does exist a population that has neural irregularities which make impulse control difficult or impossible but which don't demonstrate the deficits in rational capacities required by the current interpretation of the mental disorder defense in s. 16 of the *Criminal Code*. Second, other jurisdictions which have recognized the irresistible impulse defense seem to be able to detect individuals from this population without an undue amount of error.

I will argue below that by not recognizing irresistible impulse as a defense, our legal system is

causally implicated in harms which could be ameliorated. Our legal system is taking a punitive approach where a therapeutic one is warranted. Prison, and the adversarial trial which precedes incarceration, cause more harm than they must. First, however, I would like to briefly discuss exactly *how* neuroscience is urging us to change the law. There are several different scenarios and each has its own unique content and context that will bear on the ethics discussion to follow.

Subsection 3 - Changing the Law:

If we want to change how the law interacts with people who have impulse control issues, there are two paths: amending the legislation itself, or allowing a common law defense of irresistible impulse. It is not at first obvious how neuroscience bears on either of these options beyond indicating that one of them should be taken. A deeper investigation reveals that there are some important points to consider from a neuroscientific perspective.

The first possibility (which Penney suggests) is to allow a broader interpretation of the mental disorder defense such that it encompasses those who may suffer from an irresistible impulse leading to criminal behavior. The advantage of such a scheme is that it would not require an act of parliament for implementation. Most likely a new interpretation of Section 16 would be accepted by a trial judge somewhere and, after multiple appeals, make it to the Supreme Court of Canada. The justices would then have to determine whether new knowledge allows us to re-interpret the reading of the law.

Another approach would be to legislatively create another branch of the defense specific to irresistible impulses. If we were to amend the law it would most likely take the form of adding extra clauses to Section 16 of the *Criminal Code* that are sensitive to irresistible impulse. Several different versions have been enacted in different jurisdictions., however by and large the execution is similar, with the major difference being in the level of detail given to each branch. The majority of the jurisdictions in the United States which allow irresistible impulse use the test in the Model Penal Code,

which goes as follows:

> "a person is not responsible for criminal conduct if at the time of such conduct as a result of mental disease or defect he lacks substantial capacity either to appreciate the criminality of his conduct or to conform his conduct to the requirements of the law."

This version (West's Encyclopedia of American Law, 2005) is sensitive to the different types of mental disorder defense, however it doesn't use clause based format to define the branches as is the common format of Canadian laws. For that type of approach we could look at the Southern Australian formulation (*Criminal Law Consolidation Act* 1935 s269C).

> "A person is mentally incompetent to commit an offence if, at the time of the conduct alleged to give rise to the offence, the person is suffering from a mental impairment and, in consequence of the mental impairment
> (a) does not know the nature and quality of the conduct; or
> (b) does not know that the conduct is wrong; or
> (c) is unable to control the conduct"

This test is in a clause-based format, however, leaves significant area open for interpretation of sub-section (c). Unable to control conduct, if narrowly interpreted, could only cover actions caused by overwhelming compulsion and not by forced choice. For a more specific version yet we could turn to the Tasmanian legislation (See: *Criminal Code Act 1924. s16*).

> "(1) A person is not criminally responsible for an act done or an omission made by him –
> (a) when afflicted with mental disease to such an extent as to render him incapable of –
> (i) understanding the physical character of such act or omission; or
> (ii) knowing that such act or omission was one which he ought not to do or make; or
> (b) when such act or omission was done or made under an impulse which, by reason of mental disease,he was in substance deprived of any power to resist.
>
> (2) The fact that a person was, at the time at which he is alleged to have done an act or made an omission, incapable of controlling his conduct generally, is relevant to the question whether he did such act or made such omission under an impulse which by reason of mental disease he was in substance deprived of any power to resist.
>
> (3) A person whose mind at the time of his doing an act or making an omission is affected by a

> delusion on some specific matter, but who is not otherwise exempted from criminal responsibility under the foregoing provisions of this section, is criminally responsible for the act or omission to the same extent as if the fact which he was induced by such delusion to believe to exist really existed.
>
> (4) For the purpose of this section the term mental disease includes natural imbecility."

This version presents the best formulation in my estimation for several reasons. Sub-section (b) captures both those who were compelled by some internal force, or by an extremely difficult choice causing them to be "*in substance* deprived of any power to resist". Section (2) also captures this feature in greater detail. This formulation mirrors that proposed by Morse as discussed in Chapter 3 (Morse, 1994).

Subsection 4 - Ethics Analysis:

Now that the two paths have been made clear let us discuss some of the ethics ramifications of the approaches. For the most part the results will be the same, however, once again there are some differences worth noting.

If we were to expand the current definition then the judiciary itself would have to take an active role in designing the defense, applying its standards of evidence, and affirming it through several different decisions. This activity would require a significant partnership between lawyers, judges, psychiatrists, and neuroscientists, and would present a united front of these parties in developing the defense.

One practical problem with this approach is that it relies on an unnatural interpretation of the word "appreciating". Section 16 of the *Criminal Code* states that,

> No person is criminally responsible for an act committed or an omission made while suffering from a mental disorder that rendered the person incapable of *appreciating* the nature and quality of the act or omission or of knowing that it was wrong.

If it comes to expanding the definition of "appreciating" to include delusions, psychosis, mood disorders, impulsive acts, and so on then "appreciating" runs the risk of meaning essentially anything.

The other issue is that this approach does not engage the representatives of the public through parliament, and as such is vulnerable to new reactionary laws limiting or eliminating the defense.

Beyond these considerations either path would lead to improved therapeutic outcomes for the population of people with impulse control problems who are in legal trouble. Instead of being put into a highly stressful prison environment they would instead be directed towards a psychiatric evaluation and treatment. Furthermore the position during the trial would turn from an assessment of guilty or not guilty to one of how to best treat this vulnerable individual. Psychiatric resources could then be employed throughout the trial, sentencing, and treatment with the best outcomes for the accused in mind the whole time. The judge and lawyers appear in this context as parties who are positioned to fight for what is best for the accused and society and not simply as those who dole out punishment.

Lastly, the family members of impulsive individuals are often the ones who take the brunt of the suffering, and who must advocate for the proper treatment of their loved one. The family members in these cases are left having to argue for the humanity and dignity of the patient. Psychiatric and legal institutions would likely be seen as the opposition rather than as members of the treatment team. If we can, by enshrining irresistible impulse in the law, prevent such an oppositional attitude we are aiding all parties.

Critiques:

These last paragraphs deal with two critiques pertaining to the conclusions I have drawn above which must be discussed before this section is complete. The first is the possibility of continuous and extended detention in a psychiatric facility, and the second concerns what types of impulsive behaviour we as a society want to excuse.

For some people a psychiatric hospital will not be the most therapeutic environment. Especially for those with mood disorders or paranoia who may be able to realize better outcomes in a home environment with those they know and trust. However, once someone has committed a crime and avails

of the Section 16 it is the decision of the hospital and a review board, in consultation with various parties, if and when the person can be released. This consideration must take into account not just the patient but also the safety of the public, which might be most easily accomplished by keeping the patient at the facility. As such a patient may end up staying for far longer in what is ultimately a less than therapeutic environment than they would have had to with a standard prison sentence (depending on the crime of course), after which they could have returned home to an ultimately more therapeutic environment. This issue is a persistent one when it comes to involuntarily committing patients for whatever reason and has important implications when attempting to maximize both therapeutic outcomes as well as the liberty of the accused person.

The second concern is the possibility that enshrining an irresistible impulse defense could lead to excusing certain types of disorders which are dangerous to society. The impulse disorders within the DSM include Kleptomania, Pyromania, Pathological Gambling, and a number of other disorders which pose either a physical or financial risk to others within society. While legally excusing these behaviours may at first seem unpalatable we must consider a long term perspective. The only way of stopping these unwanted behaviours is to empower the affected individual to overcome these impulses. A prison environment will almost certainly not help people regain control over their impulses but, if the person does not have the means for private treatment, prison is often the only option. By allowing these populations to avail of a Section 16 defense they would be funneled towards treatment environments where the goals of rehabilitation and specific deterrence are much more likely to be successfully accomplished.

Section 3 - Should We Create a Diminished Responsibility Defense?:

Introduction:

In the last section we discussed the possibility of developing an irresistible impulse defense that would shield people who are fully morally innocent of a crime due to uncontrollable impulses. I argued

that this is a just and ethically commendable move which will produce significant therapeutic gains for the population it affects. There is a problem with this approach, however, if we take a strictly neuroscientific perspective. The issue is that while there are certainly those who are fully morally innocent due to their impulses, and there are those who are fully able to control impulses, there is a large and understudied swath of people who fit somewhere in the middle of this distribution. These people will have impulse control issues but only at certain times, in specific contexts, and after exposure to particular stimuli.

The issue is further complicated by the fact that there doesn't appear to be a single capacity for impulse control but that it is an effect of the balance between several different neural modules, each underlying some portion of the control over our actions. An ideal law would be able to recognize these differences, weigh them alongside specific and general deterrence concerns and studied effects, and come up with a law that is tailored to recognizing, analyzing, and changing the undesirable behaviour. I will argue in what follows that there are certain impulse deficits for which we already have sufficient information, others where more information could be gathered, and move on to discuss what appropriate legal recognition of this knowledge would look like.

Subsection 1 - The Status Quo and Issues:

For the most part, at least at the trial phase, Canada does not recognize differing levels of responsibility based on the ability to control impulse. There are some exceptions to this trend. If you recall Chapter 3 we discussed the inherent recognition within Section 232 of the *Criminal Code* dealing with crimes of provocation. To summarize, this section allows the charge of murder to be reduced to manslaughter if the accused was sufficiently provoked so as to lose the ability to control himself or herself.

As a logical extension of this section I contend that there should be available a defense of diminished responsibility that reflects differing levels of impulse control. This defense would allow the

court to recognize at the trial phase different levels of responsibility and thus to recognize from the earliest possible moment the correct amount of liability to attach to the individual.

In much the same way as has been discussed in the previous two sections the diminished responsibility could either be developed by creating affirmative legislation or by allowing the defense at common law.

Subsection 2 - What is Neuroscience Telling Us to Do?:

From a neuroscience perspective there are two complimentary paths forward if we accept that diminished responsibility is legitimate. The first is to develop the defense in areas where we have significant reason to question responsibility based on what we already know. Drug laws present the best example. We know, that is we have demonstrated through many neuroscientific and psychological studies, that addictive substances have significant effects on the brain and that, especially where addiction is powerful, people have a reduced ability to control their impulses to acquire and consume substances of abuse (Hyman, 2007; Brewer and Potenza, 2008; Fox et al., 2007; Fox et al., 2008).

The question then is, recalling the different options discussed above, how should we develop the law? In the case of addiction there is an obvious external cause of the impulsive actions, namely the substance of abuse. In a case like this, where the behaviour and the external factors are well known, we should change the law in the most specific way possible.

The best approach would be to only change the laws specific to drug possession as opposed to developing a more general defense. I demonstrated what such an approach might look like in Section 1 of this chapter and doing so would be equivalent to creating a diminished responsibility defense which was only applicable to drug addiction cases for which we can be reasonably sure there is substance dependent interference with impulse control.

There should also be a general defense of diminished responsibility which could be applied to basically any law depending on what we know about the impulse control of the accused. If it could be

determined that for this particular individual the stimuli they encountered is one to which they are particularly sensitive, then the defense could allow the court to diminish the charges. Precisely the same machinery is currently in place to allow the provocation defense, where the judge can consider if insults to particular personal characteristics (race, sex, belief system) or based on some details about the accused's biology (age) allow for a legitimate loss of control. Further legal-concept specific research may well be required before this version of the defense is rightly empowered.

Subsection 3 – Ethics Analysis:

Many of the ethics arguments for establishing a diminished responsibility defense are in substance the same as those discussed for irresistible impulse. In summary: taking a more therapeutic approach leads to better outcomes for the accused, a more justifiable position for our society to take, and better outcomes for the family and local environment of the accused. There are, however, unique elements specific to the diminished responsibility defense.

The first is the therapeutic utility of maintaining that the individual is still, to some extent, responsible for their actions. By paying attention to the level of control someone has, and by finding that level experimentally, we can begin to develop therapies and strategies which capitalize on the control someone can exercise and to extend that capacity to other areas of their life through association and learning.

As a brief example and aside let us consider the different approaches to addiction currently used. For almost a century the 12 step AA program has been an effective method for some people to overcome their addictive tendencies. Part of this approach is the admission that one is totally powerless when it comes to alcohol (or whatever substance) and that total abstinence is the only way to exist (Bill W, 2012). More modern approaches (See: Addiction Alternatives and the work of Dr. Andrew Hill), however, are being developed which allow people to find, using both psychological and neuroscientific knowledge, the level of control they do actually have and to develop the ability to consume in

moderation. This approach allows people to have much more control over their lives as it avoids either the overwhelming presence or complete absence of a substance being a determinative part of their existence and happiness. The reason this approach works is that it recognizes that the person is both to some extent unable to control their actions, but to other extents are able to control them, and to use the best techniques we have to investigate and develop these natural capacities.

A diminished responsibility defense, by more naturally modeling human control mechanisms, would similarly allow for a more accurate picture of responsibility, as well as allowing for specific sentencing guidelines which, given that picture, would be most effective. Furthermore it would sustain some aspect of the deterrence effect by maintaining that, while the law is sensitive to impulse, it will still hold those responsible to the extent that their responsibility can be recognized or demonstrated.

Critiques:

Some critiques bear on this section that should be discussed. The first is the claim that when it comes to actually measuring the level of responsibility we are unable to do so with sufficient accuracy. However, in some cases we can measure it, like measuring the lack of impulse control in irresistible impulse cases, while in others, such as drug addiction, we can be relatively sure that there is a significant interference with impulse control even if we cannot know that exact level in every situation. Further, in those cases where we cannot be so sure, we have the tools to develop tests which we can use to be more certain. If the judiciary were to take an active approach and use the techniques discussed in Chapter 3 then eventually we can begin to recognize the true level of responsibility inherent in any criminal act.

There is some worry that developing these laws will undermine the deterrence effects of holding people fully responsible regardless of impulse control. If we tailor our laws to a small aberrant population they may not apply as well to the population as a whole. Potential harms can be largely ameliorated by careful development of the law so as to not make them over-broad and applicable to

everyone outside of the selected population, and by developing tests such that we can recognize normal levels of impulse control within individuals.

Section 5 - Should We Use Neurotechnologies in Sentencing?:

Introduction:

The discussion in Chapter 4 so far has centered around the trial. The trial is the part of the judicial process that is most widely publicized and draws the most sensation. However, the phases that come after the determination of guilt are also important when it comes to actually altering illegal behaviour. To use a medical metaphor, the trial can be likened to a diagnosis, sentencing to deciding on a course of action, and the punitive phase to the actual course of treatment. While the diagnosis is important, only by deciding the best course of treatment for the particular individual can the illness be overcome.

Outside of the *Charter* I have found no piece of legislation that has more inherently ethical content than the sections of the *Criminal Code* concerning sentencing. Within its principles and guidelines exist, either explicitly or implicitly, a number of significant ethical concerns. My major task in this section will be to show how neuroscience can help us meet these legal and ethical objectives.

Subsection 1 – The Status Quo:

Sentencing is the phase where a judge has the most discretion. Unless limited by a minimum or maximum sentence, judges can exercise broad discretion to assign punishments or treatment programs (as long as they accord with those used in like cases. See: s. 718 of the *Criminal Code*) (Roach, 2011). There are several sections of the criminal code which also limit punitive discretion, for example the guidelines to maximize liberty, making sure the principles of punishment are met, and ensuring that the punishment is proportional to the responsibility and severity of the crime. If the accused is willing to take full responsibility for the act, there are also alternative sentencing procedures which may be availed of depending on the specifics of the case. For example, if the accused shows signs of

overwhelming addiction, he or she can be directed towards drug treatment alternatives.

Subsection 2 - Issues With the Status Quo:

Even with this broad discretion there remain significant issues with the current system. The major underlying issue is that during the sentencing trial the specific needs of the convicted individual need to be assessed. This assessment includes determining what will provide the best environment to encourage a change in behaviour. Using traditional methods (mainly questioning the guilty party and observing case history) it can be difficult to assess these needs. Furthermore, the ability to assess individual punitive needs is almost an entirely subjective process with few objective measurements from which to draw conclusions.

This inability to properly assess individual needs means that there is uncertainty about how effective a punishment will be at achieving its goals. If we are to protect society and maximize the liberty of the offender, then a better understanding of when offenders must be restrained and when offenders can make their own decisions will allow us the best possible balance of these objectives.

Subsection 3 – What Does Neuroscience Suggest?:

Luckily neuroscience offers a potential solution to the problem of determining an appropriate sentence based on individual characteristics. The initial problem is to decide what types of treatment are most appropriate for the specific case. If irresistible impulse or diminished responsibility defenses were offered during the trial, evidence from psychiatric testimony (preferably with neuroscientific corroboration) could be helpful in determining a sentence. Even if the defense was not successful the information gained could still be useful in the sentencing trial. In fact, as the standards for evidence are often less stringent in sentencing trials, the evidence that was turned down when determining guilt, or newly generated evidence that wouldn't have been allowed in trial, could still be quite useful when determining the appropriate sentence.

A first step would be to measure brain activity in a way that allows for a determination of

particular deficits and capacities. These measurements could be made during trial or during sentencing. Such a snapshot can be taken by several different technologies. MRI offers a way to get functional and structural data, but is exceedingly costly. EEG offers an alternative. Though EEG does not allow for structural scans it does have several advantages (Evans and Abarbanel, 1999). First and foremost there are already significant libraries of EEG scans (QEEG libraries) that contain images from thousands of people's brains. These people may have mental disorders, or they may be normal but in a number of different states (after consuming certain substances, for example Caffeine). A defendant with a suspected impulse-related deficit (including drug addiction) could undergo an EEG procedure in order to compare the result to the existing QEEG database. This comparison may not prove useful if the offender is sufficiently dissimilar to the subjects currently in the database.

A legal neuroscientific research remedy to this problem could include taking similar QEEG scans for a large sample of prisoners, both with and without impulse issues and throughout their incarceration or treatment. This data could be correlated with some notes about what conditions they are under, treatment they are receiving, and any relevant incidents and outcomes. Such an approach would create a database which would be much more directly applicable to the criminal population and the particular offender and could offer useful information and advice about the most effective courses of treatment for these types of brains. By engaging in this evidence-based approach to punishment, neuroscience could add a markedly more objective set of data from which to draw conclusions.

Subsection 4 – Ethics Analysis:

As I indicated above there is a significant amount of ethical content in the sections of the *Criminal Code* dedicated to sentencing. I discussed the relevant sections and clauses in the last section of Chapter 3 and will examine their ethical import in the following and make special note of any gains in therapeutic value offered by the application of neuroscience.

The first sentencing guideline I discussed in Chapter 3 stated that one of the purposes of

sentencing is towards specific and general deterrence. Meeting the goals of specific deterrence, that is making sure the accused does not engage in the illegal behaviour again, can certainly be aided by the application of neurotechnologies sensitive to impulsivity. If deterrence requires that an individual must think of the possible penal consequences of their actions, then sentences intended to deter illegal behaviours brought about by subconscious impulses are destined to fail. Instead the sentence must take into account these subconscious impulses and suggest a course of punishment that will give the offender greater control over their actions.

It may be that the only way to deter a particular impulsive offender will be to sentence them to the most effective therapeutic treatments that allow them to gain control over their impulses. Section 718 (d) of the *Criminal Code* states that rehabilitation is one of the major objectives of punishment. Objective impulsivity measurements that allow one to categorize offenders into different therapeutic groups would significantly aid in the rehabilitative effort. As an analogy, consider other diseases, such as cancer. If one only knows that a given set of patients has cancer, it is difficult to prescribe the appropriate treatment that will be most effective for an individual. In such a case a doctor would have to half-blindly prescribe the medication that will most help the greatest number. Instead, if one can say that one person has melanoma, one has leukemia, and one has a glioblastoma, then more specific and therefore effective treatments can be given.

Section 718 (f) and Section 718 of the *Criminal Code* make explicit reference to the "responsibility of the offender". Data about subconscious impulse can significantly aid judgments about how responsible someone was for an offence. Such information will be multifaceted in its aid. First, the information allows the judge to see how meaningfully responsible the offender was for acting, which in turn allows the judge to determine how much the offender deserves retributivist punishment versus therapeutic treatment. Second, any information about when the offender could or could not control their actions would be useful to the offender themselves if they are interested in altering their

behaviour. Thus, by allowing both judge and judged to gain clarity as to the true level of responsibility both are aided in improving the lot of the individual and society.

Clause iii.1 of Section 718.2 (a) of the *Criminal Code* deals with aggravating circumstances. If the victim suffered significant negative impact, then the sentence of the offender can be made more serious. For example, an assault may leave a victim with lasting fearful impulses. In such a case, the charge could be aggravated. Such an approach would be a logical extension of the "Thin Skull" rule. This rule states that, no matter the intention of the offender, if the victim is severally harmed because of an innate piece of their biology, in this case a brain which rapidly develops powerful and fearful impulses, then the offender must take full responsibility for the damage done (Roach, 2011). Thus, if the sentence must be proportional to the gravity of the offence and the responsibility of the offender (section 718.1) this evidence could aggravate the sentence significantly.

Section 718 (b) embodies the ethical concept of justice. Essentially the section states that like offenders must be treated in a like manner, which implies that individual offenders must be treated in an individual manner. How offenders differ and how they are similar is difficult to ascertain and the effort could be significantly supplemented by objective data which indicates similar brains and neural reactions to stimuli. Doing so would normalize treatment across individuals who, at first glance, may not seem to be similar but, upon deeper inquiry, have similar impulsive deficits.

Finally 718.2 (d) embodies the concept of liberty. The section says that liberty should not be limited any more than necessary as permitted by the circumstances. Understanding an individual's impulsive tendencies should allow the sentence to restrict freedom in areas where there is doubt that control can be maintained, but at the same time allow freedom in those where control can be maintained. For example, probation often comes along with certain conditions which restrict liberty. There may be a curfew, a prohibition on alcohol consumption, or areas which are off limits. A better understanding of someone's control capacities would allow such a program to be tailored to maximize

freedom while at the same time safeguarding society.

Conclusion:

Of all the areas of the law I have discussed it is for sentencing that neuroscience holds the most helpful promise. The inaccuracy of assessing the needs of offenders subjectively through naturally accessible behaviours means that even the best intentioned sentencing guidelines can fall short. Neuroscience holds the promise of adding objective data to these judgments which can help organize the offender into a treatment category as well as further ensuring that liberty and justice are maximized.

Thesis Conclusion:

Throughout this thesis I have attempted to show how the proper use of neurotechnologies can be helpful in making legal determinations. I argue that neuroscience is not going to overthrow our ideas of free will. Instead, neurotechnologies can be useful in the attempt to read the minds of others through increasing the number accessible correlates to the workings of the brain. I explored how we can put this increased access to the brain to use in cases where we have reason to suspect that criminal activity was influenced by impulses beyond the individual's control. The approach argued for throughout represents a middle ground between determinism and pure folk psychology. It grounds the usefulness of neuroscience in correlation and practical legal concerns. Similar approaches are currently being explored by other scholars and this thesis joins them in trying to create a workable synthesis between the law and neuroscience. At this point, however, no approach has moved beyond a rough exploratory theory. The fuller picture will have to wait until these paths of exploration have been scientifically examined in earnest.

I examined several areas of the criminal law for which neuroscience could prove a useful tool. Criminal cases dealing with illegal substances are one such area of the law. In these cases neuroscience holds the potential of strengthening some of our current justifications for scheduling illegal substances and for sentencing, and of causing us to question our other justifications. I also discussed irresistible

impulse defenses and diminished responsibility defenses. A successful irresistible impulse defense would fully shield from criminal responsibility those who performed an action over which they had no substantial control. A successful diminished responsibility defense would partially shield those who were partially hindered in their ability to control impulses. Finally I discussed how our sentencing guidelines can be aided by more accurate characterizations of brains.

To summarize, this thesis shows that in order to be ethically justified, the criminal law must endeavor to accurately characterize the people it brings up on charges. We now have technologies, provided by neuroscience, which allow us to gain ever greater accuracy in modeling behaviour. I argue that the law should take full advantage of these capacities.

Neuroscience is developing quickly. In the final chapter I provide ethical arguments for how and why these changes within neuroscience should be applied to the law given how they will affect the individual, the judiciary, and society as a whole. It is important that work in this area of intersection between neuroscience and the law continues and that the likely ethical outcomes continue to be weighed from the start.

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