

European Monitoring Centre
for Drugs and Drug Addiction

ISSN 2314-9264

EMCDDA
INSIGHTS

Models of addiction

14



European Monitoring Centre
for Drugs and Drug Addiction

EMCDDA
INSIGHTS

Models of addiction

Author
Robert West

14

Legal notice

This publication of the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is protected by copyright. The EMCDDA accepts no responsibility or liability for any consequences arising from the use of the data contained in this document. The contents of this publication do not necessarily reflect the official opinions of the EMCDDA's partners, any EU Member State or any agency or institution of the European Union.

Information on the European Union is available on the Internet. It can be accessed through the Europa server (http://europa.eu).

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*):
00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

Cataloguing data can be found at the end of this publication.

Luxembourg: Publications Office of the European Union, 2013

ISBN: 978-92-9168-652-0
doi: 10.2810/99994

© European Monitoring Centre for Drugs and Drug Addiction, 2013

Reproduction of this publication is authorised provided the source is acknowledged.

Printed in Spain

PRINTED ON WHITE CHLORINE-FREE PAPER



European Monitoring Centre
for Drugs and Drug Addiction

Cais do Sodré, 1249-289 Lisbon, Portugal
Tel. (351) 211 21 02 00 • Fax (351) 218 13 17 11
info@emcdda.europa.eu • www.emcdda.europa.eu

Contents

Foreword **5**

Acknowledgements **9**

Executive summary **11**

Chapter 1: Background, scope and aims **17**

Chapter 2: Defining addiction **21**

Chapter 3: Summarising theories and models of addiction—methods **29**

Chapter 4: Modelling in the individual **33**

Chapter 5: Modelling populations **79**

Chapter 6: Towards a comprehensive theory of addiction **87**

Chapter 7: Implications of theory for assessment and measurement of addiction and related constructs **105**

Chapter 8: Implications of the comprehensive theory for intervention strategies **115**

Chapter 9: Implications for policy and practice **127**

References **135**

Foreword

It is a great pleasure to introduce this EMCDDA *Insights* publication on models and theories of addiction. Addiction continues to be one of the key concepts in the scientific and policy debate around drug use and interventions, and lies at the very heart of the responsibilities of this agency. The diverse approaches presented here have been developed by different academic disciplines and are a reminder of the fact that addiction is a multifaceted problem. Without doubt, both understanding it and developing interventions to combat it will benefit from a broad perspective—one that goes beyond the 'brain disease' model or purely sociological or economic approach. With a view to encouraging debate, as well as a common understanding of this complex concept, this report presents a compendium of models of addiction placed within an integrated framework.

The EMCDDA commissioned this report in order to increase understanding of the nature of addiction, highlighting the lessons that alcohol, tobacco and non-pharmacological addictions can provide for understanding addiction to illicit drugs, and vice versa. The addiction concept is central to our work, and the various models and theories are presented here against a background of recent debates in the scientific community. While it is clear that drug problems are correlated with a range of factors, addiction is undoubtedly a central factor. It is also apparent that in many ways addiction is a phenomenon that is not limited to illicit psychoactive substances, indeed, pharmacological agents. This discussion does not stop at substance-based problems and includes phenomena such as gambling or compulsive use of the Internet. We note that a number of European countries have established centres of addiction that potentially cover the full range of addictive behaviours. One important conclusion is, therefore, that it is both possible and desirable to undertake a broader analysis of addictive behaviours than is currently practised. For those in the business of drug research and monitoring, it raises some central questions, such as whether we should continue to monitor addictive use by substance or at a more general level.

Importantly, this report progresses from a presentation of addiction theories to an exploration of their consequences for interventions. Utilising an integrative framework, it is proposed that combating addiction requires an analysis of the capabilities, opportunities and motivations needed for change in an individual or target population, followed by a selection of appropriate responses from a range of

interventions. Making use of this approach not only provides the reader with the possibility of keeping an overview on the perspectives taken by the existing different models of addiction, but also allows for the selection of policy and practice interventions based on the behavioural targets, and which in the long run, should enable the development of more effective response strategies.

Wolfgang Götz
Director, EMCDDA

Acknowledgements

This publication was authored by Robert West from University College London. The author is very grateful to Simon Christmas, an independent consultant, Susan Michie from University College London, Wayne Hall from the University of Queensland and Roland Simon from the EMCDDA for their helpful comments on the draft of the report. He also thanks Sarah Dowling and Christopher Russell from University College London for locating the appropriate references and for input to the draft of the report.

Executive summary

Addiction is a global problem that costs many millions of lives each year and causes untold suffering. It can involve ingesting licit and illicit psychoactive drugs (e.g. alcohol, nicotine, opioids, stimulants, steroids, prescription painkillers, sedatives or cannabis) or other kinds of activity (e.g. gambling, computer gaming). The science of addiction has advanced to a point at which it is timely to examine the wide range of underlying mechanisms that have been identified and assess what these imply for the development of a comprehensive strategy for combating the problem. This report reviews theories of addiction that have been proposed, with a view to generating an overarching framework or model that captures all the main elements. It then examines how this model can be applied in assessment, prevention and treatment. The main conclusions are given below. The analysis and conclusions in this report are offered as a framework for discussion.

Definitions of addiction vary, but all involve the notion of repeated powerful motivation to engage in an activity with no survival value, acquired through experience with that activity, despite the harm or risk of harm it causes. Definitions of addiction include 'a primary, chronic disease of brain reward, motivation, memory and related circuitry … reflected in the individual pursuing reward and/or relief by substance use and other behaviours' (American Society of Addiction Medicine) and 'a condition of being abnormally dependent on some habit, especially compulsive dependency on narcotic drugs' (www.thefreedictionary.com). Although these definitions do capture important features of addiction, they either focus on just one aspect of it or use terms that cannot be interpreted clearly. Analysis suggests that the key features that definitions attempt to capture are that addiction involves repeated powerful motivation to engage in an activity; it is acquired through engaging in the activity; the activity does not involve innate programming because of its survival value; and there is significant potential for unintended harm. This need not be limited to substance use or abuse.

Numerous mechanisms underlying addiction have been discovered, and these have spawned a multitude of models, each of which addresses a part of the problem. A large number of models of addiction describing these mechanisms have been proposed. The models are very heterogeneous and do not fall into a neat hierarchical classification. However, for heuristic purposes they can be classified in terms of whether they focus on individuals or populations. Those that focus on

individuals can be grouped into (1) those that focus on what has been termed 'automatic processing' (associative learning, drives, inhibitory processes and imitation, none of which requires self-reflection and which can be investigated using studies with non-human animals) and (2) those that focus on reflective choice processes (conscious decisions to behave in a particular way after a comparison of the costs and benefits), whether 'rational' (involving reason and analysis) or 'biased' (subject to emotional or other processes that distort the decision-making process). Cutting across the automatic–reflective distinction are theories that (3) focus on different types of goal (positive reward, acquired need and pre-existing need). In addition, there are (4) integrative theories that combine elements of automatic and reflective choice models, (5) theories that focus on change processes and (6) biological theories that describe the neural mechanisms thought to be involved in addiction. Models that take a population perspective include (7) social network theories, (8) economic models, (9) what might be termed communication/marketing models and (10) 'systems' models.

An overarching model of behaviour (the COM-B model, which recognises that behaviour arises out of capability, opportunity and motivation) can be usefully applied to understanding addiction. It is evident from the research literature that an integrated model merits consideration that can encompass the full range of concepts in the above models. This would ideally recognise both the intra- and extra-individual factors involved and the interactions among them. An overarching model of behaviour has been proposed that recognises that behaviour (B) arises from three necessary conditions: capability (C), opportunity (O) and motivation (M). Such a model could potentially address this need. The model would not be a replacement for specific theories but rather provide a framework in which they could be understood and applied. Under this COM-B model, addiction could be viewed in terms of the psychological and physical capabilities possessed by individuals (e.g. the capacity for self-regulation, the ability to learn from punishment, the ability to formulate and adhere to personal rules), opportunities afforded by the social and physical environment (e.g. social and environmental cues, availability of alternative sources of reward, financial costs of the activity) and the competing motivations operating at relevant moments (e.g. need for emotional blunting, need for belonging, anticipation of pleasure or satisfaction, anticipation of relief from craving, fear of disapproval). The motivations may be 'reflective' in the sense that they involve analysing the costs and benefits of a given course of action (e.g. the belief that an activity is 'wrong' or 'harmful') or 'automatic' in the sense that they

involve drives, emotional processing and habits (e.g. an intense feeling of the need to engage in an activity).

The PRIME theory of motivation may provide a useful framework for understanding the motivational aspects of addiction. It is an integrative model of motivation that describes how 'reflective' and 'automatic' processes interact to control our behaviour and how these can promote addiction and recovery. Motivation is an important component of the COM-B model and consists of all the brain processes that energise and direct behaviour. The PRIME theory of motivation integrates existing models including learning theory, decision theory, self-control theory, identity theory and drive theory. It provides a framework for understanding how capability, opportunity and motivation interact and how the system as a whole can become disordered, as in the case of addiction.

It is useful to distinguish factors that influence (1) initial enactment of the behaviour, (2) development of addiction, (3) attempts at recovery or mitigation and (4) relapse; however, there is also some commonality. Different factors have been found to influence the four phases of the addiction life cycle. These factors vary across different cultural contexts and different individuals. There is also considerable overlap in the factors that influence the different phases. This means that certain interventions (e.g. population-level interventions to restrict access or increase the financial cost) can impact initiation, development, attempts at recovery from addiction and the success of those attempts.

Population estimates of the prevalence of addiction based on diagnostic criteria present considerable challenges. Consideration should be given to estimates based on the numbers of people engaging in a particular activity that is known to have significant addictive potential at a level which, in a population, involves significant harm. The multifaceted nature of addiction and involvement of intra-individual and environmental factors limits the value in seeking to determine the prevalence of addictions per se in populations. The resulting figures will vary substantially in terms of the thresholds of harm and strength or chronicity of motivation to engage in the behaviours. For the purposes of assessing the extent of the problem and need for interventions for different types of addiction, an alternative approach (and the one most commonly used in practice) is to assess the number of people engaging in a behaviour which is known to have significant addictive potential at a level that, on average, will cause significant harm (e.g. the prevalence of any tobacco use or alcohol consumption above a risk threshold). Assessment of addiction in individuals

and populations for the purposes of understanding and intervention could potentially involve all aspects of the COM-B system including capacity for self-regulation, environmental drivers, and wants and needs met by the addictive behaviour.

A comprehensive framework for developing behaviour change interventions has been developed that could potentially be used to develop an intervention strategy for combating addiction. The COM-B model of behaviour has been linked to a system for developing an intervention strategy to achieve behaviour change. This identified a set of nine intervention functions (education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement) and a system for selecting these on the basis of an analysis of what is driving the current behaviour and what is needed to achieve the new 'behavioural target'. The initial selection of intervention functions then leads to identification of specific behaviour change techniques (BCTs) that deliver these functions and policies (e.g. legislation, fiscal measures, service provision, communication/marketing) that enable them.

Different intervention strategies might be needed for different addictive behaviours, different populations and individuals and different contexts. For example, if there is only weak motivation to cease the activity because of lack of a true understanding of the harms, it may be sufficient to educate about those harms. In a situation in which an individual's behaviour is strongly under the control of immediate environmental triggers, environmental restructuring interventions may be appropriate. If an addictive behaviour is being driven powerfully by the need to relieve or blunt emotional distress, then enabling interventions that provide an alternative source of relief may offer a solution. If an addiction is being driven largely by an acquired self-perpetuating drive arising out of the pharmacological actions of a drug, recovery may be promoted by alternative medications such as partial agonists. In general, however, a multifaceted approach that addresses the system as a whole is likely to be needed.

Multiple addictions and co-morbidities can arise from mutually interacting processes within any part of the COM-B system. The presence of more than one type of addiction concurrently, and the combination of addiction and other psychological problems, can be viewed as arising from common aetiology in terms of capabilities, motivation and opportunities and from the way in which these interact with each other. For example, child abuse, leading to low self-esteem, can have multiple effects in terms of a lack of self-protective motives or even motives for self-harm as well as impaired skills for self-regulation, a need for relief from depression or anxiety and

engagement with a subculture that provides opportunities for particular kinds of activity including use of particular licit or illicit drugs depending on social and other factors. From such a perspective, an important starting point for prevention and treatment would be to identify appropriate entry points into the COM-B system to achieve change that spreads throughout the system.

Conclusions. The diverse models of addiction reflect the fact that it is a multifaceted problem. Understanding it and developing interventions to combat it may benefit from a broad perspective that goes beyond the 'brain disease' approach or purely sociological or economic approaches. One way to bring these approaches together is to understand behaviour in terms of the interaction between the motivations and capabilities of individuals and the opportunities afforded to them. Particular types of activity, including the use of some psychoactive drugs, lead to changes in that system, resulting in repeated powerful motivations to continue the activity despite the potential harm. Under such an integrative framework, combating addiction would involve an analysis for a given target population or individual of the capabilities, opportunities and motivations concerned and the necessary changes to achieve the desired change in behaviour, then selecting from the range of intervention functions (e.g. education, coercion, environmental restructuring, enablement) best suited to achieving that.

Making use of this complex approach not only provides the reader with the possibility of keeping an overview on the perspectives taken by the existing different models of addiction, but also allows us to systematically analyse and select approaches at policy and intervention level based on the behavioural targets of the intervention.

Chapter 1: Background, scope and aims

1.1 The EMCDDA 18

1.2 Scope 18

1.3 Aims 19

Chapter 1: Background, scope and aims

1.1 The EMCDDA

Illicit psychoactive drug use, excessive alcohol consumption, tobacco use and problem gambling create serious harm both to those individuals who engage in such practices and to society as a whole (World Health Organization, 2002). The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) was established in 1993 to provide the European Union (EU) and its Member States with up-to-date information on European drug problems and a solid evidence base on which to develop policies to combat these. It also helps practitioners and researchers working in the field to identify best practice and fruitful avenues for future research. Although the EMCDDA is primarily European in focus, it also works with partners in other world regions, exchanging information and expertise. Collaboration with European and international organisations in the drugs field is also central to its work as a means of enhancing our understanding of the global drugs phenomenon.

As part of its role in establishing the evidence base on drug problems, the EMCDDA is interested in developing a better understanding of the psychological and social causes of those problems. While it is clear that drug problems do not stem exclusively from addiction, addiction does play a major role. It is also apparent that addiction is a phenomenon that is not limited to illicit psychoactive drugs or, indeed, pharmacological agents. A number of European countries have established centres of addiction that potentially cover the full gamut of addictive behaviours. Therefore, the EMCDDA commissioned this report in order to provide a clearer understanding of the nature of addiction, the lessons that addiction to alcohol and tobacco and non-pharmacological addictions can provide for understanding addiction to illicit drugs and the extent to which understanding illicit drug addiction can shed light on other addictions.

1.2 Scope

The report reviews models specific to addiction as well as more general ones that have been widely used to help understand addiction. What constitutes a 'model' is interpreted quite broadly in order to encompass general theoretical approaches as well as specific theories. The terms 'theory' and 'model' are often used interchangeably, although in some cases one term is slightly more appropriate — a

theory being a specification of a set of hypothetical causal connections between a set of elements or constructs and a model being a description of links between observable elements or constructs. Thus, theories are explanatory whereas models can be purely descriptive.

The report does not examine detailed specific mechanisms relating to individual addictive behaviours, such as the role of the gamma-aminobutyric acid system in nicotine reward (Berrendero et al., 2010). Addiction and dependence are considered synonymous (see Table 2.1 on p. 22). Addictive behaviours that do not involve psychoactive drugs are included.

This report covers some of the issues that are also the subject of ALICE RAP, a large European Community (EC)-funded project aimed at assessing the conceptualisation and assessment of addiction within the current European context (ALICE RAP Project, 2011). ALICE RAP involves a much more extensive series of investigations, but it is hoped that this report will help inform the project.

1.3 Aims

This report aims to:

a. summarise the main theoretical approaches to understanding addiction and create a complete set of key concepts that need to be captured by a comprehensive theory of addiction, including what might be termed 'behavioural addictions';

b. present an overarching model as a framework for capturing the concepts and evidence and compare different addictive behaviours in terms of the overarching framework; and

c. discuss the possible implications of this framework for assessment and measurement and for intervention strategies.

Following these aims, the EMCDDA wishes to support drug policy with a comprehensive definition and understanding of the term 'addiction', reflecting scientific developments and debates over recent years. This publication should help to answer the question not just of how far different types of addiction are similar in phenomenological and aetiological respects, but also of how we can target interventions to stop 'addiction' or at least limit its negative effects.

This report will aim to broaden the views of this field, which has caused numerous problems in the past, by bringing together constructs that have been developed around illicit and licit substances, substance- and non-substance-related forms of behaviour and by making use of biological, sociological and psychological concepts.



Chapter 2: Defining addiction

Chapter 2: Defining addiction

Before considering the range of models of addiction that have been proposed, it is necessary to define how the term will be used in this report. Addiction has been defined in different ways at different points in recent history and even now there are numerous partially overlapping definitions in the technical and general literature (see Table 2.1). This is because it is a multifaceted, socially defined construct rather than a physical entity with clear, uniquely defined boundaries. Some people and organisations prefer to avoid the term 'addiction' altogether because of pejorative connotations, while others make a distinction between 'addiction' and 'dependence'. This report uses the term 'addiction' rather than dependence, but it incorporates into the term the features covered by major definitions of dependence.

Table 2.1: Examples of definitions of addiction

Definition (source)	Comment
Addiction is a primary, chronic disease of brain reward, motivation, memory and related circuitry. Dysfunction in these circuits leads to characteristic biological, psychological, social and spiritual manifestations. This is reflected in the individual pursuing reward and/or relief by substance use and other behaviors. Addiction is characterized by impairment in behavioral control, craving, diminished recognition of significant problems with one's behaviors and interpersonal relationships, and a dysfunctional emotional response. Like other chronic diseases, addiction often involves cycles of relapse and remission. Without treatment or engagement in recovery activities, addiction is progressive and can result in disability or premature death (American Society of Addiction Medicine)	This considers addiction as a brain disease, which implies that it requires treatment. It neglects environmental and social forces at play and the facts that it involves a continuum and that many individuals 'recover' without treatment
Compulsive physiological and psychological need for a habit-forming substance or the condition of being habitually or compulsively occupied with or involved in something (*The American Heritage Dictionary*, 4th edition)	Broadly based, but transfers the burden of interpretation onto words such as 'compulsive', 'need' and 'habit'

Table 2.1 (continued)

Definition (source)	Comment
A physical or psychological need for a habit-forming substance, such as a drug or alcohol. In physical addiction, the body adapts to the substance being used and gradually requires increased amounts to reproduce the effects originally produced by smaller doses. A habitual or compulsive involvement in an activity, such as gambling (*The American Heritage Science Dictionary*)	As above, but provides a clear definition of 'physical' addiction, which represents only a small part of the problem of addiction as it is currently construed
The condition of being abnormally dependent on some habit, esp[ecially] compulsive dependency on narcotic drugs (*Collins English Dictionary*)	Transfers the burden of interpretation onto 'abnormal' and 'compulsive'
Addiction is a persistent, compulsive dependence on a behaviour or substance. The term has been partially replaced by the word *dependence* for substance abuse. Addiction has been extended, however, to include mood-altering behaviours or activities. Some researchers speak of two types of addictions: substance addictions (for example, alcoholism, drug abuse, and smoking); and process addictions (for example, gambling, spending, shopping, eating, and sexual activity). There is a growing recognition that many addicts, such as polydrug abusers, are addicted to more than one substance or process (*Gale Encyclopaedia of Medicine*)	Brings in the concept of persistence but transfers the burden of interpretation onto 'compulsive' and 'dependence'
A compulsive, uncontrollable dependence on a chemical substance, habit, or practice to such a degree that either the means of obtaining or ceasing use may cause severe emotional, mental, or physiologic reactions (*Mosby's Medical Dictionary*, 8th edition)	The use of the term 'uncontrollable' rules out cases in which an individual is struggling but is successfully (for the time being, at least) controlling the behaviour
(Substance dependence) A preoccupation with and compulsive use of a substance despite recurrent adverse consequences; addiction often involves a loss of control and increased tolerance, and may be associated with a biological predisposition to addiction. 1. A physiologic, physical, or psychological state of dependency on a substance — or pattern of compulsive use, which is characterised by tolerance, craving, and a withdrawal syndrome when intake of the substance is reduced or stopped; the most common	Deals with only substance use and includes a set of features that, although common, are not always present

Table 2.1 (continued)

Definition (source)	Comment
addictions are to alcohol, caffeine, cocaine, heroin, marijuana, nicotine — the tobacco industry argues that nicotine's addictive properties are unproven, amphetamines. 2. A disorder involving use of opioids wherein there is a loss of control, compulsive use, and continued use despite adverse social, physical, psychological, occupational, or economic consequences. 3. A neurobehavioral syndrome with genetic and environmental influences that results in psychological dependence on the use of substances for their psychic effects; addiction is characterised by compulsive use despite harm (*McGraw-Hill Concise Dictionary of Modern Medicine*)	
(Substance dependence) Repeated use of a psychoactive substance or substances, to the extent that the user (referred to as an addict) is periodically or chronically intoxicated, shows a compulsion to take the preferred substance (or substances), has great difficulty in voluntarily ceasing or modifying substance use, and exhibits determination to obtain psychoactive substances by almost any means. Typically, tolerance is prominent and a withdrawal syndrome frequently occurs when substance use is interrupted. The life of the addict may be dominated by substance use to the virtual exclusion of all other activities and responsibilities. The term addiction also conveys the sense that such substance use has a detrimental effect on society, as well as on the individual; when applied to the use of alcohol, it is equivalent to alcoholism. Addiction is a term of long-standing and variable usage. It is regarded by many as a discrete disease entity, a debilitating disorder rooted in the pharmacological effects of the drug, which is remorselessly progressive. From the 1920s to the 1960s attempts were made to differentiate between addiction and 'habituation', a less severe form of psychological adaptation. In the 1960s the World Health Organization recommended that both terms be abandoned in favour of dependence, which can exist in various degrees of severity. Addiction is not a diagnostic term in ICD-10, but continues to be very widely employed by professionals and the general public alike (World Health Organization Lexicon of Alcohol and Drug Terms)	Includes a detailed description of substance dependence including features that are not always present

Table 2.1 (continued)

Definition (source)	Comment
(Substance dependence) When an individual persists in use of alcohol or other drugs despite problems related to use of the substance, substance dependence may be diagnosed. Compulsive and repetitive use may result in tolerance to the effect of the drug and withdrawal symptoms when use is reduced or stopped (*Diagnostic and Statistical Manual of Mental Disorders*, 4th edition)	Introduces the notion of continued use despite harmful effects

It is apparent that some definitions focus exclusively on drugs, yet it is clear that behaviours such as gambling can become problematic and dominate people's lives. Some definitions refer to withdrawal symptoms even though these need not occur nor be a primary driver behind the compulsive behaviour. Some refer to the development of tolerance, again despite the fact that tolerance need not occur. Some focus on brain abnormality, even though individuals can clearly exhibit all the signs of addiction in one set of circumstances and yet, with the same brain, not in others. Loss of control, or impaired control, is another common theme, even though this would exclude the possibility of addiction where no attempt was being made to exert control.

Definitions serve a purpose, so different definitions may be needed for different purposes. The key purpose of the definition used in this report is to provide a basis for describing and explaining repeated occurrence of behaviours that appear to be purposeful and not aimed at causing harm but from which harm typically ensues and where ignorance of this, or lack of concern about it, is not an adequate explanation. The explanation lies in a distortion of the individual's motivational system and/or an environment that promotes the behaviour pattern. Such a broad definition is needed in order to develop a comprehensive intervention strategy to combat it.

It is widely recognised that, for many people, the use of drugs such as alcohol, nicotine, heroin, cannabis, amphetamines, benzodiazepines and cocaine falls into this category (National Institute on Drug Abuse, 2011). It is also recognised that eating palatable foods, gambling, using the Internet, purchasing behaviour and sexual behaviours can also be addictive (Padwa and Cunningham, 2010).

The definition needs to exclude behaviours for which there appears to be no purposeful motivation, such as tics and mannerisms, dysfunctional breathing and seizures. Bulimia nervosa involves aspects of addiction (Davis and Carter, 2009; Speranza et al., 2012), but it is generally considered to be at its margins. It may be suggested that bulimia should be excluded because there appears to be an element of self-harm as a motive (Claes and Vandereycken, 2007). However, the same could be said to be true of more prototypical addictive behaviours. A more important distinction is that it involves dysregulation of innately programmed behaviour patterns that are important to survival rather than acquisition, through learning, of behaviour patterns that have no adaptive biological function. Obsessive–compulsive disorder also involves aspects of addiction (Modell et al., 1992), but is similarly typically excluded because the behaviour appears to be driven by anxiety relief. Psychopathic behaviour involving a desire to harm others is excluded because the problem arises from the nature, rather than the strength, of the desire.

One feature of addiction that is implicit, and not included in prevailing definitions, but which is nonetheless fundamental, is that it arises as a result of engaging in the addictive behaviour. Thus, enacting the behaviour and experiencing the consequences of the behaviour are essential to the development of addiction. Moreover, while dysregulation of innately programmed behaviours important to survival can have important commonalities with addiction, the term is usually restricted to learned behaviours with no adaptive biological function.

Table 2.2 shows a number of examples that test the concept of addiction and help define its boundaries. This can help us to arrive at a definition that meets the needs of policymakers and clinicians, whose goal is to reduce the harm to individuals and society caused by particular kinds of activity.

Table 2.2: Scenarios to test definitions of addiction

An individual is addicted if he or she...	An individual is not addicted if he or she...
• feels a need to take benzodiazepines every evening in order to sleep when, in fact, they do not help. • is engaging in antisocial and personally harmful activities in order to be able to smoke crack cocaine. • experiences powerful desires to smoke cannabis, which overwhelm prior decisions to desist. • has his or her life dominated by using heroin and obtaining the money to buy heroin. • develops a powerful need to drink alcohol in an escalating pattern of consumption. • continues to engage in a behaviour to an extent that he or she recognises it as harmful despite having tried to stop. • regularly experiences a powerful desire to engage in the behaviour. • has not smoked cigarettes for 4 weeks but still experiences strong urges to smoke. • does not smoke every day but has tried to stop smoking completely and failed several times. • drinks alcohol in the mornings to relieve feelings of anxiety. • has not drunk alcohol for 3 months but still gets strong cravings for it. • spends hours each day gambling online and steals to cover the costs.	• eats too much food high in saturated fats. • feels a strong motivation to try alcohol but has not yet done so. • does not feel a powerful desire to engage in the behaviour in situations when it would normally occur. • takes medication every day to relieve chronic pain. • has antisocial personality disorder, Tourette syndrome or obsessive–compulsive disorder without other behavioural problems. • takes a psychoactive drug for the pleasurable experience but does not experience a powerful desire to take the drug when it is not available. • gains satisfaction from an activity and self-consciously decides that the benefits outweigh the costs, and shares this analysis with society. • drinks heavily but can easily go for several months without drinking. • gambles heavily but not to a point where it is causing significant harm. • is motivated to harm others.

Putting all of the above together, the definition of addiction adopted in this report is therefore as follows:

> A repeated powerful motivation to engage in a purposeful behaviour that has no survival value, acquired as a result of engaging in that behaviour, with significant potential for unintended harm.

Note that, unlike some existing definitions, this definition does not mention impaired control, conflict, need, withdrawal symptoms, craving or other putative mechanisms. The reason is that the definition has to be able to define the domain of interest but, as far as possible, avoid prejudging the underlying mechanisms, which may vary from case to case. The accumulated evidence indicates that impaired control, conflict, craving and so on are not necessary features of addiction even though they are frequently observed and have to be accounted for in any comprehensive theory.



Chapter 3: Summarising theories and models of addiction — methods

Chapter 3: Summarising theories and models of addiction — methods

In order to gain a comprehensive mapping of the main models of addiction, a systematic literature search was conducted using Web of Science and Scholar Google with the following search terms:

> *addiction* or *dependence* or *alcohol* or *nicotine* or *smok** or *tobacco* or *cannabis* or *gambling* or *opiat** or *stimulan** and *theory* or *theories*.

There may be models specific to other addictive behaviours (e.g. to Internet games) but the behaviours canvassed cover the core addictions that are widely recognised as such. Sources included articles, books, reports or book chapters. Summaries and abstracts were used to identify unique theories or models and these were catalogued. In addition, experts in the field were consulted and theories added if these had not previously been identified.

The process of identifying and reviewing theories is made problematic by the fact that some descriptions are very general and involve little more than a statement of an approach or orientation, whereas others are very specific. Theories may also be described slightly differently across various accounts or may differ in their formulations. Many also evolve over time. Some theories are clearly labelled as such, whereas others express theoretical ideas but are not explicitly labelled as theories. The review also included theories that had been, or could be, applied to addiction even if they were not specifically developed for that purpose.

The approach taken in this review was to attempt to extract key ideas from both explicit theories and theoretical ideas not explicitly labelled as theories, and to classify them using an updated version of the system adopted in West (2006).

Figure 3.1 shows the classification system that has been in development since 2006 using an iterative process of drafting, discussion with colleagues and redrafting. Clearly this is not the only classification that could be adopted and it involves a number of compromises. It does not follow a neat hierarchy but has some element of hierarchical structure. Thus, some of the theories could be located in more than one category. In those cases, the choice of category has been determined by what appears to be a dominant feature of the theory, but it is important to recognise that the theory could have been included under a different heading. Where conceptual

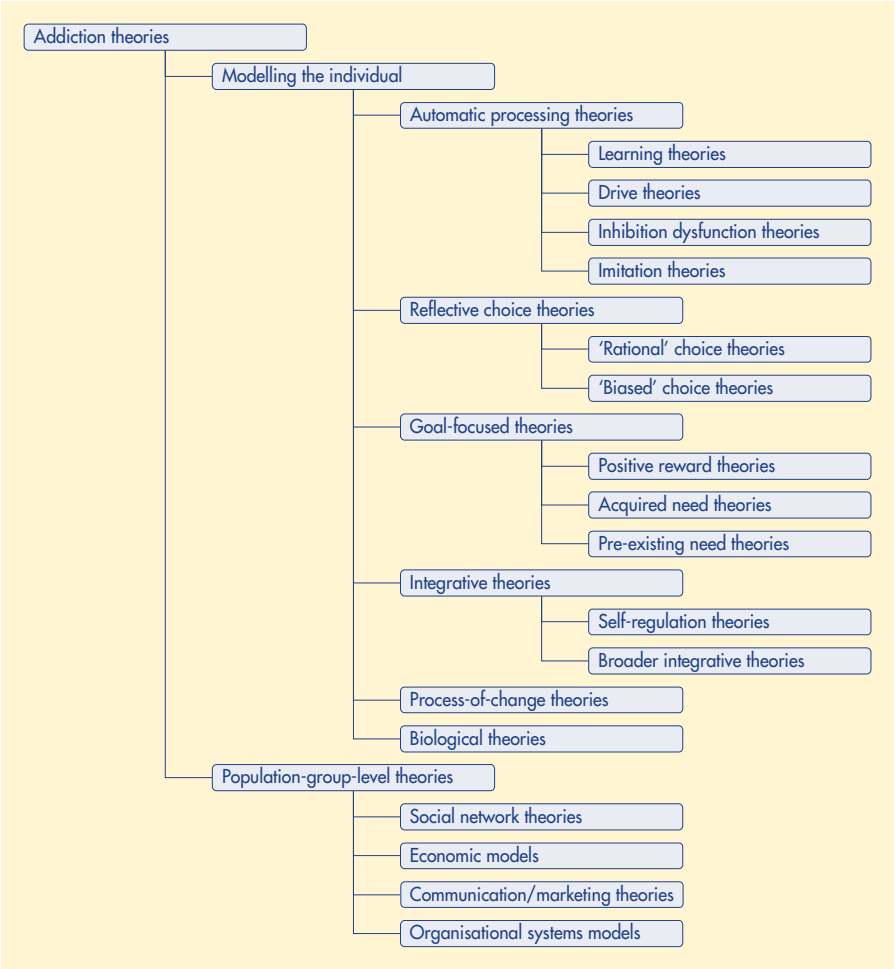
overlaps between models exist, we have attempted to focus on the specific characteristics of each model. When a model could have been subsumed under different groups, it was classified on the basis of the characteristics that were understood as being at the very core of a concept.

The choice of labels for the categories requires justification. For example, the terms 'rational' and 'biased' are value laden, but in this review they are used only for their denotative meaning. Thus, for example, the term 'rational' relates to the use of reason and analysis to arrive at judgements about the preferred course of action, whereas 'biased' refers to influences from emotional and other factors in the decision-making process. No assumption is made in the use of these labels that one approach is inherently better than another.

Most of the models focus on the individual and his or her circumstances. Thus, they describe characteristics (e.g. frequency of injecting heroin, impulsivity, acquisition of abnormal drives, need to escape from anxiety) possessed by the individual, mechanisms that lead to those traits or how particular traits interact with environmental circumstances to generate the powerful motivation to engage in the addictive behaviour. There are others that focus on population-level variables, such as incidence of drug-related crime, incidence of opiate overdose, aggregate alcohol consumption, cigarette smoking prevalence and average price.

Overall, the author has followed a behavioural understanding of addiction, reflecting the broad scope of models found in the literature. This approach was thought to both include and value quite different theoretical concepts without making a judgement. An a priori definition of addiction, for example as a brain disease (Leshner, 1997), might have set a hierarchy of relevance for models, which could have limited an open discussion of all concepts found.

Figure 3.1: Classification of models of addiction



Chapters 4 and 5 provide summaries of the main theoretical approaches and examples of each. Each chapter and description of a theoretical approach begins with a summary of the key proposition from the point of view of developing interventions to counter the addiction. It then briefly summarises some of the specific theories. Most of these theories are complex and contain many facets, so only the central themes have been drawn out.



Chapter 4: Modelling in the individual

4.1 Automatic processing theories 35

4.2 Reflective choice theories 45

4.3 Goal-focused theories 52

4.4 Integrative theories 60

4.5 Biological theories 70

4.6 Process-of-change theories 73

Chapter 4: Modelling in the individual

Addiction arises out of either pre-existing characteristics of individuals or the acquisition of characteristics that, together with a given set of environmental circumstances, result in powerful motivations to engage in harmful behaviour patterns.

Prevention involves protecting individuals from factors that promote addiction. Recovery involves changing individuals or their circumstances to redress the motivational imbalance.

Individual-level theories attempt to explain addiction by reference to concepts that apply to individuals and their circumstances. Individuals are regarded as possessing particular dispositions and/or inhabiting particular environments that promote addiction, through either initial engagement in the addictive activity or susceptibility to the development of addiction once the individual has undertaken the activity and been exposed to its consequences. Recovery from, improvement in or management of addiction involves changes to one or more of these.

The main classes of theory can be differentiated in terms of those that focus on what are termed 'automatic processes', which do not involve self-conscious analysis of the options or reflective choice. Cutting across this are theories that emphasise positive reward seeking versus acquisition of needs, or the presence of pre-existing needs. Some models seek to integrate these different approaches to different degrees. These include self-control theories (which reflect conflict between reflective and automatic processes) and broader integrative theories. There are also theories that focus exclusively on change processes. The above theories are usually framed at the psychological, sociological or economic level of analysis, but there are numerous theories that are framed at the biological level as well. Many of these theories cut across the categories indicated above, so they are addressed separately in this report.

4.1 Automatic processing theories

Addicts acquire addictive behaviours through mechanisms that shape human behaviours without the need for conscious decisions or intentions and/or influence our capacity for self-regulation.

Prevention and promotion of recovery involve changing the environment to alter exposure to cues and/or reinforcers, cueing and reinforcing competing behaviours and/or improving the efficiency of inhibitory mechanisms.

4.1.1 Learning theories

Learning theories derive from studies, mainly in non-human species, in which behaviour can be shaped by applying rewarding or noxious stimuli. This area of theory is extremely well developed and has been applied to humans as a way of explaining a wide range of behaviours (Mook, 1995). This body of theory differs from theories of reflective choice in that the processes involved do not need to result in self-conscious decisions. The rat is presumed not to think to itself, 'If I press this lever I will receive some food; I am hungry and I want food; therefore I will press this lever.' The rat may experience pleasure or pain in some sense and that may be important in the learning process, but it does not reflect on that experience and use that information in an analysis of the pros and cons of lever pressing.

When learning theory is applied to humans, the presumption is that we have retained the brain mechanisms that lead a rat to learn to press a lever for food or avoid an electric shock. Furthermore, these mechanisms continue to shape our behaviour. Therefore, the positive experiences, or avoidance of or escape from negative experiences, afforded by addictive behaviours drive behaviour through the creation of motivational states (e.g. wanting, needing, craving, urges, impulses, etc.) that are not reflective or based on reflective analysis.

Addiction arises because certain activities are powerfully rewarding and become more so through exposure.

Theory

Addiction involves learning associations between cues, responses and powerful positive or negative reinforcers (pleasant or noxious stimuli).

Evidence

- Non-human species can acquire addictive behaviour patterns through repeated pairing of cues, responses and reinforcers (Ahmed, 2011).
- At least some human addictive behaviours appear to show acquisition and extinction patterns predicted by operant and classical conditioning theory — see below for examples of learning theory (Hyman et al., 2006).
- At least some addictive behaviours appear to involve automatic habit mechanisms (Tiffany, 1990).

Limitations

- This kind of theory does not account for the role of self-conscious intentions, desires or beliefs that have not been acquired through experience (Vuchinich and Heather, 2003).
- Treatments aimed at promoting recovery using cue-exposure techniques have not proved successful to date (Conklin and Tiffany, 2002), although promising lines of research continue (Kaplan et al., 2011).

Examples

Operant learning theory (operant conditioning): This is a general theory of behaviour change in which, in the presence of particular cues, experience of positive and negative 'reinforcers' increases or decreases the likelihood of occurrence of a behaviour on which it is contingent (Mook, 1995). Positive reinforcers are events that increase the frequency of prior behaviours, whereas negative reinforcers are events that decrease that frequency or which will lead to behaviours that achieve avoidance or escape from them. Operant conditioning is a very widely studied subject and probably the single most powerful body of theory in motivational psychology. The paragraphs that follow provide only a very broad overview.

A trainer might get a dog to stand on its hind legs at his or her command by giving it highly palatable food for doing so. The tasty food is a positive reinforcer. The process is 'automatic' in the sense that the dog is presumed not to self-consciously decide to rear up because it weighs up the costs and benefits of doing so; rather, the command acts as a stimulus that triggers the 'image' of the food, which leads to anticipated 'pleasure' (although the dog would not be able to reflect on this emotion), which in turn triggers the behaviour.

Negative reinforcement involves inducing behaviour which terminates or avoids an aversive stimulus. Thus, most animals will readily learn to respond in order to avoid electric shocks as long as it is made clear by means of some kind of signal that the shock will be delivered if the animal does not respond. This is known as 'signalled avoidance' learning. Unsurprisingly, it is much harder for animals to learn to avoid aversive stimuli when no signal is given ('unsignalled avoidance'); in such situations, the animal will often develop 'learned helplessness' (Seligman, 1972), in which it simply takes the aversive stimulus and makes no attempt to avoid it. 'Escape learning' is the term given to a situation in which an animal learns to engage in a particular action in order to terminate or reduce an aversive experience.

Punishment is the term used when the frequency of a behaviour is reduced because it is followed by an aversive stimulus or termination of a positive stimulus. Table 4.1 shows the major terms used in operant learning theory. For a more detailed description see Mook (1995).

Table 4.1: Major terms in operant learning theory

Type of reinforcement contingency	Description	Example
Positives reinforcement	A neural adaptation which increases the likelihood of a response to a given cue when, in response to the cue, a behaviour is followed by a positive reinforcer or reward	At a party the positive experience following nasal ingestion of cocaine increases the likelihood that this activity will be repeated in similar situations in the future
Negative reinforcement	A neural adaptation which increases the likelihood of a response which leads to avoidance of, or escape from, a negative reinforcer or aversive stimulus	Heroin addicts learn to seek out and ingest heroin to avoid or escape from aversive heroin withdrawal symptoms
Punishment	A process in which a behaviour becomes less likely to occur as a result of it being followed by an aversive stimulus or termination of a positive stimulus	For some teenagers, the coughing, nausea and other symptoms experienced when they first try to inhale cigarette smoke deters them from doing it again
Extinction	A process whereby, when a response that was maintained by a positive reinforcer is no longer followed by a reinforcer, its likelihood of occurrence is reduced	Pharmacological blockade of the opiate receptors by naxolone can decrease the rate of heroin injecting

Some major discoveries in operant learning theory have provided important insights into addictive behaviours. For example, it has been found that when a positive reinforcer is applied intermittently and unpredictably it can lead to very high rates of response that are resistant to extinction. This is known as a 'variable ratio schedule of reinforcement'. Gaming machines make use of this principle by timing the quantity and frequency of delivery of payouts (Haw, 2008).

Classic (Pavlovian) conditioning theory: Classic and operant conditioning are very closely connected. Both involve associative learning. While operant conditioning involves forming associations between cues and responses involving the so-called 'voluntary muscles' through the experience of reinforcement, in classic conditioning the association is formed between stimuli and feeling states or reflex responses by virtue of the stimuli being immediately predictive of other motivationally or emotionally significant stimuli (Mook, 1995).

Thus, in classic conditioning, stimuli that would normally be only weakly motivating at best can come to have motivational power by being associated with more powerful reinforcers. This can lead to an addictive behaviour becoming more powerfully established than it would have done otherwise. For example, the sensation of smoke in the throat and the sight and tactile sensations associated with smoking acquire reinforcing properties by virtue of being associated with the rewarding actions of nicotine. This establishes the whole behaviour chain involved in smoking more powerfully than would be the case were it to rely on only the nicotine reward.

This is a highly developed area of theory and important nuances have emerged. For example, a distinction has been drawn between associative learning, in which liking and disliking a stimulus is influenced by associations between that stimulus and liked and disliked stimuli (termed 'evaluative conditioning'), and traditional classic conditioning, in which a stimulus that predicts a motivationally significant stimulus acquires a response that anticipates it; for example, a stimulus that predicts a pleasurable stimulus may come to generate excitement (Hofmann et al., 2010). There is also discussion about whether, or in what circumstances, people need to be aware of (or able to articulate) a contingency between two stimuli for conditioning to occur (Olsen and Fazio, 2002; Pleyers et al., 2007). There is a body of evidence that suggests that, even if awareness is not essential, it is probably facilitatory (Bar-Anan et al., 2010).

Incentive-sensitisation theory: Variants of this theory have become dominant in the biological models of addiction or contributed significantly to more integrative biological models (see point 4.5, pp. 70-73). This theory proposes that repeated self-administration of addictive drugs leads to neuroadaptation in which the behaviour becomes less and less under the control of anticipated pleasure ('liking') and more under the control of 'incentive salience', the subjective manifestation of which is 'wanting' (Robinson and Berridge, 2001). Thus, in the development of addiction, a dissociation can be observed between 'wanting' and 'liking' (Berridge et al., 2009).

Behavioural momentum and inertia theory: According to this theory, the relation between response rates and resistance to change is akin to the velocity and mass of a moving object. The momentum of a behaviour, which is its tendency to continue in the absence of reinforcement or when already satiated, is proposed to reflect the strength of stimulus–reinforcer associations rather than response–reinforcer associations (Nevin and Grace, 2000). This means that contexts in which an addictive behaviour occurs may play a greater role in maintaining the behaviour than would be expected from classical operant conditioning models. This theory is relatively new but has been applied to research into both cocaine (Quick and Shahan, 2009) and alcohol addiction (Jimenez-Gomez and Shahan, 2007).

Implications for prevention and promoting recovery

The main implications of learning theory approaches are that prevention of addictive behaviours must focus on removing the opportunities for potential addicts to become exposed to the behaviours, and treatment should involve attempting to loosen the associations between cues and rewards or cues and behaviour. For example, one might use 'cue exposure' to loosen the association between reward and the behaviour or medications that block the reinforcing actions of the addictive drug (antagonists) (Ferguson and Shiffman, 2009).

4.1.2 Drive theories

Drive theories invoke the concept of homeostatic mechanisms that seek to keep certain physiological parameters within specified limits (Mook, 1995). In drive theory, automatic processes result in heightened motivational states that energise and direct behaviours that reduce those states. Once homeostasis is reached, there

is satiation and no need for further activity. Addictive behaviours are those that reduce drive states — whether these are artificially induced by the behaviour or through other means.

Theory

Addiction involves the development of powerful drives underpinned by homeostatic mechanisms.

Evidence

- Many addictive behaviours appear to follow temporal patterns suggestive of drive states, for example abstinence-induced desire, 'kindling' and satiation (Kostowski, 2002).
- Many addictive behaviours influence, and are influenced by, naturally occurring drive states, for example hunger (Kokavec, 2008; Yeomans, 2010).
- Subjective reports of urges to engage in many addictive behaviours have characteristics similar to naturally occurring drive states (Shiffman, 2000).
- Physiological and neuroanatomical evidence suggests that central nervous system (CNS) changes would lead to acquisition of abnormal homeostatic processes, for example chronic receptor upregulation (Koob, 2008).

Limitations

- Not all addictions appear to follow a pattern suggestive of need for homeostasis, and even addictions that suggest a homeostatic drive mechanism also show evidence of other important influences (Koob and Le Moal, 2008).

Examples

The 'disease model' of addiction: This model is general and has many features that go beyond drive theory, but at its heart is the idea that addiction involves pathological changes in the brain that result in overpowering urges to engage in the addictive behaviour. This model has been very influential in 'medicalising' addiction because it construes it as a medical disorder — an abnormality of structure or function that results in impairment (Gelkopf et al., 2002). The addicted individual may express a sincere desire to stop the addictive behaviour and show

evidence of making strenuous efforts to do so while at the very same time carrying on with it.

The loss of control may be manifest over short and long time spans. Over a period of a few hours, an alcoholic may begin a drinking session with the intention of having one or two drinks, but finds that it is impossible to stop and more and more drinks are consumed: the power to resist has gone. Over a longer time span, the alcoholic, smoker, gambler or other addict may formulate a plan not to engage in the activity, but after a time does in fact engage in it. The addict chooses to do one thing but repeatedly fails to put that intention into effect.

At the heart of this theory is the concept of 'craving'. In the disease model this has been defined as an 'urgent and overpowering desire' (Jellinek, 1960). One way of thinking about this is as a feeling that impels the addict to take whatever steps are necessary to achieve the object of the addiction. It can also be construed as a motivational state that goes beyond feelings: it overwhelms the individual, dominating his or her thoughts, feelings and actions to the exclusion of everything else.

The serotonin theory of nicotine addiction: This theory arose out of the observation that many of the symptoms of nicotine withdrawal (increased appetite for carbohydrates, depressed mood and aggression) appeared similar to those of low serotonin concentrations in the CNS (Hughes, 2007). It was also noted that smokers often reported their cravings for cigarettes as feeling like hunger, which raised the possibility that they might — at least in part — reflect a physiological drive state very similar to that of hunger. It came to be labelled as craving because smoking a cigarette relieved it. This led to the theory that craving for a cigarette and some other nicotine withdrawal symptoms arose from serotonin depletion in key parts of the CNS, which leads to an acquired drive state of 'nicotine hunger' (Balfour, 2004; West, 2009). This depletion was proposed to result from disruption of the regulation of serotonin pathways resulting from long-term nicotine use.

Control systems dynamical model of smoking urges: One of the problems with classic drive theory accounts is their failure to take account of the highly dynamic and fluid nature of drives. A recent theory, which uses concepts from fluid mechanics to model the strength of 'smoking urge' in a time-variant manner, has sought to address this issue (Riley et al., 2011). 'Sensors' monitor negative affect (e.g. depression, anger) and other variables such as medication, exercise, positive

affect and smoking behaviour. These and a system of 'valves', which adjust the weighting applied to each variable to measure on a moment-to-moment basis, define the strength of urges. These in turn control the decision to smoke.

Implications for prevention and promoting recovery

Drive theories of addiction imply interventions that prevent the development of acquired drives, mitigate the impact of other drives or reduce the addictive drives acutely during attempted recovery. On the assumption that the addictive drive states will subside eventually if the behaviour does not occur, this kind of theory also implies treatment by means of a period of enforced abstinence. These kinds of theory provide insights into how naturally occurring drives such as hunger and acquired drives relating to addiction might interact. Thus, it has been established that craving for cigarettes is greater when smokers are food deprived (Leeman et al., 2010) and that ingesting glucose can reduce cigarette craving (West et al., 1999).

4.1.3 Inhibition dysfunction theories

'Impaired control' is a prevailing theme within current definitions of addiction and particularly those set at the neurobiological level. The control may be impaired because the motivational forces promoting the addictive behaviour are very strong, but it could also be because the mechanisms that lead to inhibition of such activities are impaired ([1]).

Theory

Addiction involves impairment of the mechanisms needed to control impulses.

Evidence

- Impulse control disorder is an important risk factor for addiction (Perry and Carroll, 2008).
- There is neurophysiological evidence to suggest that impairment in brain pathways involved in behavioural inhibition is involved in addiction (Goldstein and Volkow, 2002).

([1]) This theme is returned to later because theories in this area tend to be expressed in terms of biological processes that involve more than just inhibition dysfunction.

Limitations

- Addiction often occurs in the absence of evidence of inhibitory dysfunction — the association between inhibition dysfunction and addiction is moderate (Crews and Boettiger, 2009).
- Evidence of an increase in general inhibitory dysfunction during addiction development is present but limited (Poulos et al., 1998).

Examples

Dysfunction of inhibitory brain circuitry: The theory (Lubman et al., 2004) proposes that in chronically addicted individuals, maladaptive behaviours and high relapse rates should be thought of as being 'compulsive' in nature because of dysfunction within inhibitory brain circuitry.

Orbitofrontal gyrus (OFG) dysfunction in cocaine addiction: This theory proposes that repeated use of cocaine reverses the role of the OFG in response inhibition (Goldstein et al., 2001).

Implications for prevention and promoting recovery

An obvious implication of inhibition dysfunction theories is that training in, or medication to improve, inhibitory control may help with prevention and treatment of addiction. Self-control training has not figured strongly in the addiction research literature but it has been used in other areas, such as the control of aggression (Denson et al., 2011). Medications that can improve impulse inhibition may include methylphenidate (Ritalin) (Goldstein et al., 2011), although it should be noted that there are reports that this drug may in itself have addictive potential (Kollins et al., 2001).

4.1.4 Imitation theories

There is a body of literature that is not directly focused on addiction, but is potentially highly relevant, which is concerned with acquisition of behaviour patterns and ideas as a result of direct exposure to models. It is well established that humans are highly imitative in many aspects of behaviour. Obvious examples are accents and mannerisms, but there is reason to believe that this can extend to behaviours that have the potential to become addictive. It is also plausible that ideas and identities can be influenced by this process. Identification (the process of creating aspects of

one's own identity based on the observation of others) is a well-established phenomenon and, if that involves a potentially addictive behaviour on the part of the model, it could be an important route into this behaviour pattern.

Theory

Addiction involves, or at least begins with, imitation of behaviour patterns and assimilation of ideas and identities.

Evidence

- There are strong associations between exposure to models (whether parental, sibling or peer group) and uptake of addictive behaviours (Kandel and Andrews, 1987).
- Exposure to models in the media is associated with greater motivation to engage in addictive behaviours (Anderson et al., 2009; Lovato et al., 2011).

Limitations

- Addictive behaviours can clearly develop without direct exposure to models, and many of those who are exposed to models do not take on that behaviour pattern.
- There is limited evidence to date that interventions based on this model are effective in combating addiction, although it is proposed to be one component of 12-step treatment programmes.

Examples

Social learning theory: This theory proposes that people can learn by observing others' behaviour and the outcomes of these, that it can occur even though there may be no change in behaviour (through observation alone) and that cognition plays a role in learning with attention playing a critical role (Bandura, 1977). The theory proposes that individuals need to be motivated to imitate models and that the

process involves reward and punishment or observation of reward and punishment being applied to others. The status of the model can have a powerful effect. The concept of self-efficacy emerges as important in determining whether or not behaviours occur or individuals persist with them (Gwaltney et al., 2005) ([2]). Social learning theory has become a dominant theory in psychology and has been applied to areas as diverse as education and criminal behaviour, but as yet there has been relatively little application to addiction.

Automatic imitation: There is a body of theory around the idea that we are programmed to mirror or mimic aspects of behaviours or stimuli that have features that can be present in behaviours without necessarily being aware of doing so and without the need for motivation by reward and punishment (Heyes, 2011). This 'automatic imitation' is conceived of as a type of 'stimulus–response compatibility' effect in which features of action stimuli promote similar responses. Automatic imitation is subject to input modulation by attention and output modulation by inhibitory processes; it is also mediated by learned associations that cannot be altered directly by intentional processes.

4.2 Reflective choice theories

Reflective choice involves self-conscious analysis of the options and a decision to enact one of those options. It is widely assumed, or even taken as given, that human behaviour results from this kind of process. Despite the common observation that most of our behaviour in fact involves a flow of stimuli and responses, it is still held to the case that important patterns of behaviour are governed by it. Some proponents of this view accept that the choice is, at least to some degree, influenced in some manner by mechanisms that lie outside conscious awareness, but they still hold up 'choice' as the core process governing behaviour. For example, 'Nudge' doctrine proposes subtle interventions that invoke non-conscious process to shape the 'choice architecture' of a situation and so foster healthy or adaptive decisions (Thaler and Sunstein, 2008).

([2]) Social learning theory is one of a number of theories that could have been classified differently under the system used in this report. It is put with other automatic processing theories because at its heart is the concept of learning as an automatic process through vicarious experience and there is no claim that this involves reflective analysis. However, the theory also involves other processes that do involve reflection. Social cognitive theory evolved out of social learning theory and places greater emphasis on reflective processes.

Addicts choose to engage in the addictive behaviour, and recovery involves choosing not to engage in it. The choice may be rational or biased, but always involves a comparison of the costs and benefits.

Prevention and promotion of recovery involves altering the actual or perceived costs and benefits and/or improving the decision-making process.

4.2.1 'Rational' choice theories

Rational choice theories are commonly applied in the field of addiction and form a basis for many of the education campaigns, legislation and fiscal policies aimed at combating addiction. The term 'rational' in these theories does not mean 'reasonable' or 'sensible'; it merely refers to a process whereby individuals weigh alternative courses of action against each other and seek to apply reason and analysis to choose between them.

According to these theories, for at least some 'addicts' engaging in the addictive behaviour may be preferable to the same existence without doing so. They may not accept, or to some degree may be unaware of, the adverse consequences of the behaviour or they may consider that the benefits outweigh the possible or actual costs.

'Expectancies' (sometimes referred to as 'subjective probabilities') are judgements about how likely the various outcomes arising from the options are to occur. 'Utilities' in this kind of model are the perceived positive and negative values attached to the possible results of adopting particular options. In a rational theory of addiction the full weight of the explanation for the addiction lies in the 'expectancies' or 'utilities' that the addict applies to the choice process. Having encountered a drug, for example, that provides a strong euphoriant action, it may be that the addict simply believes that repeating the experience is worth the potential cost. If the addict puts a low value on his or her life or health or the harm done to society or friends and family, this would compound the problem. Similarly, the addictive behaviour may serve a range of needs and desires that together outweigh the perceived costs.

Note that rational choice theories and the 'biased choice' theories in the following section are concerned with the process by which preferences are arrived at. The extent to which addiction involves different kinds of preferences (what might be termed 'inputs' to the choice process), such as positive reward or relief from discomfort, are addressed in subsequent sections.

Theory

Addiction involves making a rational (in the sense that preferences are decided using reason and analysis and then acted upon) choice that favours the benefits of the addictive behaviour over the costs.

Evidence

- Many addicts perceive life as better with their addictive behaviour than without it (Davies, 1997).
- Incentives and disincentives can be effective in modifying addictive behaviours, at least in the short term (Lussier et al., 2006).

Limitations

- Expected utilities are poor at predicting relapse following decisions to cease the addictive behaviour (Mooney et al., 1987).
- Educational interventions aimed at informing addicts or potential addicts of the consequences of their actions often have little or no effect (Flay, 2009).

Examples

Subjective expected utility (SEU) theory: This is the most general version of rational choice models. According to this model, individuals seek to maximise their expected utilities by looking at the consequences of alternative courses of action and assigning each a 'utility' and then weighting this by the likelihood of it occurring under the different options (Edwards, 1961). They then choose the option with the highest sum of the weighted utilities. Addicts choose a particular lifestyle because in their estimation, and for some in reality, it is better than the alternative as they perceive it. There is nothing special about addiction except that it may involve highly attractive experiences and susceptible individuals may have limited alternative sources of pleasure. Addicts expect to receive what, for them, are more personally valued outcomes (e.g. enjoyment, feeling of belonging to a subgroup, relief from anxiety) as a result of continuing with their behaviour rather than ceasing it (e.g. lower risk of dying prematurely).

Multi-attribute utility (MAU) theory: A broad decision theory that proposes that individuals make choices based on the positive or negative features or attributes of those objects, with each feature being weighted by its importance (Keeney and Raiffa, 1976). This does not necessarily involve looking forward. Thus, a person may weigh up the extent to which inhaling cocaine is 'potentially harmful', 'exciting', 'cool', 'fun', 'rebellious', etc. and in each case how important that is for them before deciding to do it.

Prospect theory (Kahneman and Tversky, 1979)**:** This is similar to the SEU theory but notes that the function relating actual value (e.g. amount of money) and perceived utility is distorted by counting losses as of higher utility than gains of equivalent value, and the higher the absolute value, the smaller the difference in utility from differences in value (Tversky and Kahneman, 1991). For example, avoiding a loss of EUR 50 is more motivating than gaining EUR 50, and the difference between EUR 50 and EUR 60 is greater than the difference between EUR 5 050 and EUR 5 060. 'Loss-chasing' in gamblers is an example of taking risks to avoid coming away from a session with a loss that is particularly aversive. Thus, the way that a decision is 'framed' can make a difference to what is decided. If an option is framed in terms of the losses it will avoid, it will have a greater utility than if it is construed in terms of a gain of equivalent size (Tversky and Kahneman, 1986).

Theory of planned behaviour (Ajzen, 1991)**:** According to this theory (derived from the theory of reasoned action, see Fishbein and Ajzen, 1975), we mostly act on our intentions, which are driven by three factors: an SEU-type analysis of the consequences, perceived control over the behaviour and perceptions of what those who are important to us would want us to do. Persistence of addiction may be fostered by low perceived behavioural control and/or involvement with a normative group that approves of the addictive behaviour (Verkooijen et al., 2007).

Protection motivation theory: Protection motivation theory is a theory originally developed to explain responses to fear appeals (Rogers, 1975). It proposes that the intention to protect oneself depends upon the following four factors: (1) the perceived severity of a threatened event (e.g. a heart attack); (2) the perceived probability of the occurrence or vulnerability (in this example, the perceived vulnerability of the individual to a heart attack); (3) the efficacy of the recommended preventative behaviour (the perceived response efficacy); and (4) the perceived self-

efficacy (i.e. the level of confidence in one's ability to undertake the recommended preventative behaviour).

Theory of rational addiction (Becker and Murphy, 1988)**:** This is an economic theory that directly applies SEU theory to addiction but with some specific additional concepts relating to this class of behaviour. This includes the notion of 'discounted utility' in which the addict consistently and deliberately (rationally) applies a lower utility to events that happen further in the future. The assumptions in this theory conflict with what is known about addictive behaviours and has not performed well in predicting these behaviours, but it remains one of the most widely cited theories in the field. This type of theory is used by what might be termed 'self-serving rationalists' (e.g. apologists for the alcohol and tobacco industries and neo-conservatives) to argue that the state should refrain from interfering in the market for legal addictive products.

Positive and negative expectancy theories: There are a range of 'expectancy' theories, mostly concerning alcohol use, which seek to explain consumption by analysing its perceived positive and negative consequences (Jones et al., 2001). These are usually simplified versions of SEU theory applied to this domain because they usually treat the consequences as certain rather than probabilistic.

Implications for prevention and promoting recovery

These theories all predict that combating addiction involves altering the actual or perceived costs and benefits of engaging in the behaviour. Education in schools should tell young people about the harms of drugs, and if they are not adequately deterred by this the criminal justice system or fiscal policy should be used in addition to coerce addicts or potential addicts to 'see sense'. Interestingly, in western capitalist countries, these latter policies tend not to be used, or be used in only a modest way, in the case of products such as alcohol, tobacco and gambling, in which the industries involved are deeply embedded in the economic structure.

4.2.2 'Biased' choice theories

Biased choice theories are clearly more realistic than the rational choice models described above in reflecting the facts that preferences are unstable over time, even with no new information being available, and that the very process of making decisions is subject to well-demonstrated emotional and cognitive biases.

Theory

Addiction arises at least in part from the influence of emotional and other biases on the process by which options to engage or not engage in addictive behaviours are compared.

Evidence

- Addicts exhibit cognitive and motivational biases that could promote the addiction (Field and Cox, 2008).
- Preference changes and intransitivities ([3]) are commonplace (Skog, 2000; Andreou, 2008).
- Emotional states as well as utilities influence decision-making processes (Pfister and Bohm, 2008).

Limitations

- There is limited evidence to date that such biases substantially influence the course of addictive behaviours (Wiers et al., 2010, 2011).
- Attempts to 'debias' nicotine addicts have had limited success in producing lasting change in tobacco-seeking behaviours (Field et al., 2009).

Examples

Unstable preference theory: This theory is very general but notes that addicts exhibit unstable preferences according to their current situation (Skog, 2003). In a rational addiction model, preferences remain unaltered in the absence of additional incentives and costs, whereas in this model the utilities vary as a function of time and circumstances. This is clearly much more realistic than the rational addiction model and can reflect the fact that addicts often express very different preferences on different occasions according to, for example, their abstinence state or the social situation (Skog, 2000). This theory could possibly have been included under the rational choice models because unstable preferences may arise out of reason and analysis, but it has been included in the biased choices model section because there

([3]) Intransitivities are situations in which A is preferred over B and B is preferred over C but A is not preferred over C.

is an implicit assumption that the source of the unstable preferences and the degree of instability arises from factors that lie outside a reasoned evaluation of the situation.

Temporal discounting models: The phenomenon of temporal discounting is well established in decision-making. It reflects a tendency to assign greater utilities to events that are nearer in time. This is not necessarily irrational, and indeed it is included in the rational theory of addiction. It becomes 'irrational' when the discounting function follows particular patterns that lead to preference instability. The classic form of this curve in humans is 'hyperbolic'. In the hyperbolic discounting curve, the fall-off in utility with time is much steeper earlier than is warranted, so the rate at which values are discounted is itself time sensitive. It has been shown in some studies that addicts tend to have steeper discounting curves than non-addicts (Ainslie and Monterosso, 2003). Thus, addicts' utilities are located more in the present than the future and this could partly explain why they became addicted or how the addiction is maintained.

Cognitive bias models: These models argue that addiction is maintained, at least in part, by information-processing biases that favour positive reactions to, and tendencies to seek out, the addictive behaviour (McCusker, 2001). 'Attentional bias' models postulate that addicts show a tendency to pay closer attention to stimuli related to the target of their addiction than would be the case for non-addicts. Thus, in the case of individuals dependent on alcohol, for example, stimuli in their environment that are linked to alcohol achieve greater prominence and can trigger cravings in a way that would not be the case for other individuals. There may also be 'recall biases' in which addicts differentially forget the negative effects of their addictive behaviour and remember the positive effects. Thus, a person who suffers from alcohol dependence may have forgotten, the day after a binge, the adverse effects experienced at the time.

The affect heuristic: This is a tendency for positive and negative feelings about something to influence judgement relating to it, as in the case of 'wishful thinking' (Slovic et al., 2002). Thus, for example, addicts may underestimate the risks of their behaviours because of their feelings of attraction to those behaviours. They may go so far as to deny what, under other circumstances, they would consider to be strong evidence.

Gateway theory: The gateway theory is a particular form of the theory of unstable preferences, in which exposure to one form of a particular activity changes the

preferences for a more extreme or potentially damaging form (Kandel et al., 1992). Classically, it has been proposed that cannabis use can be a gateway to the use of 'hard' drugs. Evidence for this is currently weak (Degenhardt et al., 2011), but there is stronger evidence that cigarette smoking can lead to cannabis use (Beenstock and Rahav, 2002). Gateway effects could occur through a variety of mechanisms, including greater exposure to opportunities to take harder drugs or habituation to the effects of the milder version of the behaviour leading to a desire for more extreme versions to gain the same effect.

Conflict theory: This is a general theory of decision-making which specifies conditions in which different types of decision-making strategy are used. These strategies include vigilance, hypervigilance and defensive avoidance. Most relevant to addiction is the hypothesis that, where the decision-maker is confronted with a decision in which none of the outcomes is perceived as positive, he or she will abrogate responsibility for the decision and continue with the status quo (Janis and Mann, 1977).

Implications for prevention and promoting recovery

This class of theory has been taken to imply a set of interventions that aim to mitigate the effect of the irrational biases. For example, there is research under way seeking to evaluate the effects of getting addicts to undergo training to reduce their attentional biases or tendency to engage in irrational discounting (Fadardi and Cox, 2009; Wiers et al., 2010). It would also be logical to seek to deploy training interventions that mitigate emotional distortions of the decision process.

Individuals with vulnerabilities that result in maladaptive emotional influences on their decision-making could be taught skills for dealing with such emotions or those emotions could be addressed so that they are weaker or less salient. Where the irrationality arises from aspiration to what may be considered inappropriate social images, interventions may be targeted at reducing the attractiveness of such images. Finally, if an addictive behaviour arises out of a failure of a clear self-protective intention, prevention could be bolstered through education and persuasion.

4.3 Goal-focused theories

The preceding sections described theories that focus on the processes governing behaviour and choice. The next four types of goal-focused theory concern the kinds of stimuli and events that provide inputs to those processes. These theories are

typically agnostic regarding whether the inputs work through automatic or reflective processes. The models are quite heterogeneous, but three main types of input dominate: attaining positive rewards, usually in the form of pleasure or euphoria; avoiding or escaping discomfort caused by absence of the drug; and avoiding or escaping discomfort caused by factors that lie outside the addictive activity. In addition to these, there is a fourth kind of theory, which focuses on the role of identity as a source of desire.

Addiction arises out of pleasure seeking or avoidance of distress or discomfort or, at least in part, out of identification with others engaging in the addictive behaviour. Prevention and promotion of recovery involves limiting access to the sources of these goals, reducing their reward value, meeting the needs in other ways or boosting the impact of conflicting goals.

4.3.1 Positive reward theories

A large body of addiction theory focuses on the positive experiences or rewards provided by the addictive behaviour. In automatic processing theories these positive experiences control behaviour through associative learning and do not require conscious deliberation. In reflective choice theories the individual notices the positive benefits of the addictive behaviour and makes a conscious decision to try to repeat those. The positive experiences may involve feelings of well-being or simple enjoyment arising directly out of the behaviour (e.g. as in the pharmacological effect of drugs) or they may arise from other factors such as the sense of belonging or sharing that may arise from the activity. The positive reward may also arise from functions that the activity performs, such as maintaining a low body weight (e.g. in the case of stimulants) or achieving a particular type of body image (e.g. in the case of steroids).

Theory

Addiction arises out of the pleasure and satisfaction caused by the activity. The greater the pleasure and satisfaction, the greater the risk of addiction.

Evidence

- Addicts report strong euphoriant effects from many addictive drugs and activities (Wise and Bozarth, 1987).

- The pattern of learning addictive behaviours in non-human species is often very similar to that of learning to respond for natural positive rewards (Self and Nestler, 1995; Kelley and Berridge, 2002; Koob and Le Moal, 2005).
- Many addictive behaviours provide sought-after functions such as maintaining a desired body shape (Cawley et al., 2004).

Limitations

- In at least some addictions (e.g. smoking), enjoyment has not been found to predict success of attempts to cease the activity (Fidler and West, 2011).
- There is little direct evidence in humans linking the degree of pleasure from a behaviour with its addictive potential (Volkow et al., 1999).
- In some addictions at least, reports of the importance of functions of the addiction, such as weight control, are not predictive of success at ceasing use (Herd et al., 2009).

Examples

The pleasure/positive reward theory of addiction is very generic and forms an assumption underpinning a number of explicit and implicit models, particularly biological models, which are addressed later in the report. Some specific theories related to positive reward are as follows.

Failure of habituation to positive reward: Under this theory, contrary to popular belief, some addictive drugs maintain a powerful hold over individuals because the brain does not habituate to the pleasurable effects in the way it does to naturally occurring rewards (Koob and Le Moal, 2001). This means that the drug continues to be highly rewarding even after repeated exposure.

Body image theory of steroid addiction: This theory proposes that steroid use, in many cases, is driven by attraction to the body image that is created, alongside a regimen of physical activity (Kanayama et al., 2009).

Weight control theory of tobacco smoking: It has been proposed that a number of smokers specifically seek a low body weight as an attractive image and use tobacco smoking as a means to achieve that image (Cawley et al., 2004).

Implications for prevention and promoting recovery

If addiction involves an element of pleasure-seeking, then prevention should involve limiting access to the source of pleasures that run that risk, at least for vulnerable individuals; strengthening motivation or capacity to resist the temptations; or providing alternative sources of pleasure or the functions being sought. Promoting recovery would involve blocking the pleasurable effects (e.g. with medication), restricting access, bolstering countervailing motivation, providing substitute sources of pleasure or the functions provided by the addictive behaviour and/or boosting capacity and skills for self-control.

4.3.2 Acquired need theories

Acquired need theories are prevalent in the field of addiction and conform to the popular image of addiction as a disorder in which an individual begins taking a drug because of its positive effects and then habituates to these effects, and therefore needs to escalate the dose. However, at the same time, the physiological adaptation means that when the drug is not present in sufficient concentrations in the CNS, he or she needs to take the drug to stave off aversive withdrawal symptoms. Thus, the discomfort of withdrawal symptoms comes to drive the decision to continue to take the drug.

Theory

Addiction involves the development of physiological or psychological needs, as a result of engaging in the addictive behaviour, which are then met by the addictive behaviour.

Evidence

- Addicts often experience aversive withdrawal symptoms and drive states which deter abstinence (West and Gossop, 1994).
- Medication that relieves these needs and drive states improves the chances of achieving and maintaining abstinence (Lingford-Hughes et al., 2004).

Limitations

- When addicts make serious attempts to cease the addictive behaviour permanently, relapse is frequent long after the acute withdrawal phase is over and there are no withdrawal symptoms present (Weiss et al., 2001).

- In many cases, there is no clearly identifiable withdrawal syndrome (Katz and Singh, 1986a,b).
- This theory cannot easily account for behavioural addictions. Although it is possible to construe as withdrawal symptoms the feelings that arise when, for example, compulsive gamblers are forced to abstain, this is stretching the concept of withdrawal symptoms beyond its usual boundaries (Rosenthal and Lesieur, 1992).

Examples

Drug withdrawal theory: This is probably the most commonly held theory of addiction. Under this theory, physiological adaptation occurs with the presence of a drug in the body so that, when the drug is no longer present, physiological rebound occurs, leading to unpleasant and sometimes life-threatening symptoms (Koob et al., 1992, 1998; De Vries and Shippenberg, 2002). This is often referred to as 'physical dependence'. In fact, there may be multiple physiological adaptations that lead to a range of unpleasant withdrawal symptoms and drive states that motivate activities that may have previously relieved the symptoms. Thus, under the most general form of this theory, the drive to use a drug (experienced as 'craving') could arise out of a process of physiological adaptation.

Opponent-process theory (Solomon and Corbit, 1973, 1974; Solomon, 1980)**:** This is a specific version of drug withdrawal theory. The human brain has a physiological propensity to adapt to and counter influences that disturb its homeostasis. Repeated administration of a pleasurable drug, or repeated experiences of euphoria, lead to physiological adaptive processes to restore equilibrium so that, in the absence of the drug or euphoriant activity, a negative state prevails. This state is aversive and motivates activities to mitigate it.

Implications for prevention and promoting recovery

One strategy is to treat the withdrawal symptoms with medication. Thus, nicotine replacement therapies, bupropion, cytisine and varenicline are effective in reducing the mood disturbance and craving for cigarettes that occur during attempts to stop smoking (Hughes et al., 2007; Stead et al., 2008; Cahill et al., 2011a). Benzodiazepines are used to reduce potentially dangerous alcohol withdrawal symptoms during 'detox' (Amato et al., 2010). Methadone and buprenorphine reduce the symptoms of heroin withdrawal (Mattick et al., 2009). Another strategy is

to provide counselling to help addicts cope with the withdrawal symptoms without relapsing (Lancaster and Stead, 2005).

4.3.3 Pre-existing need theories

A striking observation in those people who are addicted to illicit drugs is the proportion who suffered abuse as children (Simpson and Miller, 2002). There is also good evidence of a strong association between depression and anxiety in children and subsequent development of addiction to a range of drugs including alcohol and nicotine (Douglas et al., 2010). This, together with self-reports of addicts, has led to the view that an important motive for taking up and continuing with an addictive behaviour pattern is to meet pre-existing psychological needs. The need may involve numbing or improving adverse mood. In the case of smoking, it has been suggested that one reason that people with schizophrenia smoke is to help with gating of sensory inputs, which is an important factor underlying the symptoms of this condition (Adler et al., 1993, 1998). In all these cases, the presumption is that these needs contribute to the process of reflective choice, which may or may not be rational.

Theory

Addiction involves engaging in behaviours that meet important pre-existing needs.

Evidence

- Individuals with pre-existing psychological needs (e.g. depression, anxiety) met by addictive behaviours are more likely to become addicted and less likely to recover (Jane-Llopis and Matytsina, 2006).

Limitations

- Many addicts show no evidence of psychological needs prior to developing addiction.
- Psychological health often improves following a period of abstinence (Lembke et al., 2007).

Examples

Self-medication theory: Addicts have pre-existing psychological problems arising out of early life experiences, genetic endowment or an interaction between the two, and the addictive activity provides relief from the aversive experiences arising from these. This may be by way of numbing of affect, reduction in negative affect, distraction or countervailing positive affect (Khantzian, 1997).

Attachment theory: As applied to addiction, attachment theory proposes that addiction represents a 'misguided' attempt at 'self-repair' arising from maladaptive attachment styles, which in turn arise from developmental problems and environmental deprivation. Substance use exacerbates the problem because of the physical dependence and damage to psychological structures (Flores, 2004).

Affect regulation theory: In its general form, this theory proposes that addictive behaviours, and in particular substance use, arise out of defective affect regulation systems. This means that, on the one hand, individuals may be vulnerable to seeking out an addictive behaviour in the hope that it might help overcome this problem, but, on the other hand, they may be vulnerable to continuing with the addictive behaviour because the behaviour exacerbates the problem, leading to a vicious circle (Cooper et al., 1995).

Implications for prevention and promoting recovery

The main implication of pre-existing need theories is that it will not be sufficient to treat withdrawal symptoms or other consequences of the behaviour; the underlying need has to be addressed. This may be done through individual or group therapy, therapeutic communities and/or in some cases with medication with effects that are less damaging than those of what they are currently using (Caspers et al., 2006).

4.3.4 Identity theories

A different kind of theory from those above focuses on the importance of identity as a source of motivation. Under these theories, one's self-concept, often deriving from people with whom one identifies, shapes one's behaviour. There are important theories of behaviour that involve aspects of identity, most notably social cognitive theory (Bandura, 1977) and the theory of planned behaviour (Ajzen, 1991), in which one's perception of one's self-efficacy or ability to control one's behaviour

plays an important role. These are dealt with earlier in this publication. Theories in this section place identity at centre stage.

Theory

Addiction arises from, and is at least partly maintained, by aspects of one's self-identity (how one views oneself).

Evidence

- There is evidence of identity change in the development of and transition away from addictive behaviour patterns (Kearney and O'Sullivan, 2003).
- There is some evidence that interventions that attempt to promote new aspects of identity, for example as a person 'in recovery' in 12-step programmes, can have some effect in promoting recovery from addiction (Davis et al., 2002).

Limitations

- There is as yet no direct, unequivocal evidence linking identity and identity change causally with the development of or recovery from addiction.
- Clearly other factors are extremely important in the development of and recovery from addiction.

Examples

Identity theory: In this theory, identity involves a disposition to form particular kinds of mental representation of the self that have potentially strong emotions attached to them. Identity can be an important driver of addiction if it involves self-destructive or antisocial elements (Walters, 1996). A vulnerability to addiction can arise from a lack of a self-protective or pro-social identity. Identity change appears to play an important role in recovery from addiction. This change may be sudden or gradual (Kearney and O'Sullivan, 2003).

Prototype willingness model (Gibbons et al., 2003)**:** This model was developed to explain apparently irrational behaviour in adolescents. It has important features that go beyond identity, but identity and identification lie at its heart. First, it proposes that many behaviours that are volitional are neither rational nor intentional; they are

reactions to situations. Second, it proposes that health-risk behaviours are social behaviours for many adolescents. Third, because of this they have clear social images associated with them. These images have a significant impact on the decision to engage in the behaviour. This leads to the two key concepts of the theory: prototypes, which are social images that adolescents aspire to as part of their identity, and willingness, which is different from intention in that it involves the absence of a clear intention not to do something if a situation should arise which prompts the activity (Gibbons et al., 2003).

Self-affirmation theory: This theory argues that people are motivated to maintain a self-image of integrity, morality and competence. The theory has been particularly applied to enhancing the effects of persuasive communications seeking to change undesirable or unhealthy behaviours. Such messages threaten self-integrity and often provoke defensive reactions. Preceding such messages with interventions that boost feelings of self-worth has been found to mitigate this defensive reaction and enhance the effectiveness of the communication (Harris et al., 2007).

Implications for prevention and recovery promotion

Prevention of and recovery from addiction could involve the development of positive role models for people to aspire to and generally a fostering of positive self-images that do not involve the addictive behaviour. It could also involve fostering of an identity that is supportive of maintenance of abstinence.

4.4 Integrative theories

Most modern theories of addiction involve some degree of integration between components of the theories described thus far in this report. The components that are integrated vary and in most cases the integration involves the addition of new ideas that explain how these components interact. Among the theories is a strong theme of 'executive control' or reflective processing versus automatic processing. A metaphor that has been used to describe this is the 'rider and the elephant' (Haidt, 2007). The rider does not have direct control over where the elephant takes him but has to communicate as best he can with the elephant, and exert whatever influence he can with whatever means are at his disposal to achieve his goals. The risk that all these models run is invoking the age-old notion of the 'homunculus' — the little person inside our heads controlling things (Ryle, 1949). It is important, but often difficult, to avoid this because it simply transfers the burden of explanation of behaviour to another agent, which itself then has to be understood.

Addiction involves a combination of mechanisms in which environmental factors and internal states and traits interact to generate conscious and non-conscious motivations based on seeking pleasure or satisfaction or avoiding discomfort.

Prevention of addiction and promotion of recovery involves identifying and addressing key environmental and internal factors that need to be changed at the level of conscious choice and automatic processes.

4.4.1 Self-regulation theories

Self-regulation extends beyond impulse control or adequate functioning of mechanisms that underlie intentional inhibition of behaviour. It involves the capability to make plans about the future that can be remembered when needed and can generate sufficient motivational force to trigger a decision to inhibit actions. It also involves having a sufficient understanding of oneself and the factors that trigger behaviours to be able to arrange one's environment to minimise cues for unwanted behaviours and maximise cues for desired ones.

Theory

Addiction involves a failure of an individual's strategies, skills and capacity for self-control to counter the immediate impulses and desires underlying the addictive behaviour; this failure can in part be caused by 'ego depletion'.

Evidence

- Many addicts show every evidence of wanting to control or stop the addictive behaviour but experience a sense of being overwhelmed (Schober et al., 1991; Baumeister and Heatherton, 1996; Heatherton and Vohs, 1998; Hustad et al., 2009).
- Some measures of capacity for self-control are associated with the development of and recovery from addiction (Muraven and Baumeister, 2000; Tangney et al., 2004).
- Addicts often show signs of disordered lifestyles that may be indicative of difficulties in regulating their behaviour (Feichtinger et al., 1997; Schwartz, 1998; Smith and Marshall, 2007).

Limitations

- Much addictive behaviour appears to occur without any sense of conflict or desire for self-control (Becker and Murphy, 1988; Chaloupka, 1991; Olekalns and Bardsley, 1996).
- Addiction frequently occurs in individuals who show evidence of having a high degree of self-control in other areas of their life (Fehr and Zych, 1998; Schaler, 2000; Skog, 2000).

Examples

Cognitive control theory (Miller and Cohen, 2001): This theory proposes that cognitive control required for execution of preformed plans stems from active maintenance of patterns of activity in the prefrontal cortex that represent goals and the means to achieve them.

Executive dysfunction theory (Hester and Garavan, 2004; Fernandez-Serrano et al., 2010; Madoz-Gurpide et al., 2011): Elaborated in the context of cocaine addiction, this theory proposes that repeated cocaine use results in structural and metabolic abnormalities in brain structures important in the control of executive functions.

Self-regulation theory (Baumeister and Vohs, 2007): This model is wide ranging and contains many facets, but a core concept is that mental resources required for self-control are finite and are depleted by the mental effort required to exercise it. These authors use the term 'ego depletion' to refer to the extent to which mental energy required for self-control is reduced. Ego depletion can also result from stress, fatigue and the effects of disinhibiting drugs.

Self-determination theory (Deci et al., 1994; Ryan and Deci, 2000): This theory of motivation is actually a combination of five 'mini theories'. 'Cognitive evaluation theory' argues for the importance of intrinsic motivation in which behaviours are in themselves rewarding and people gain satisfaction out of competence and autonomy. 'Organismic integration theory' concerns the ways in which extrinsic motivation turns into intrinsic motivation and the factors that promote or prevent this. It stresses the importance of autonomy and 'relatedness' as critical to internalisation. 'Causality orientations theory' is concerned with individual differences, with three important categories being valuing autonomy, valuing rewards and experiencing anxiety about competence. The fourth mini theory is the 'basic psychological needs theory', which proposes that well-being is dependent on autonomy, relatedness and

competence. Finally, 'goal contents theory' differentiates between extrinsic goals of financial success, appearance, popularity and so on, on the one hand, and intrinsic goals of community, close relationships and personal growth, on the other. Pursuit of the former is regarded as likely to lead to lower well-being.

Implementation intentions (Gollwitzer, 1999): This is not presented by its proponents as a theory, but it makes important theoretical propositions about how to achieve self-regulation. The proposition is that people are more likely to achieve self-consciously determined behavioural goals (i.e. do things they previously intended to) if they state the intention in terms of very specific if–then rules rather than making only general plans.

Implications for prevention and promoting recovery

Self-regulatory theories suggest a number of approaches to combating addiction. Individuals who are vulnerable to developing addiction or already addicted could be given education and training to build their self-regulatory capacity and skills. In addition, addressing causes of ego depletion, such as stress and fatigue, may help with recovery from addiction.

4.4.2 Broader integrative theories

A number of theories have arisen recently that seek to encompass a much wider range of components of addiction than those described earlier. There is always going to be a trade-off between what might be considered 'reach' and 'grasp'. The broader one seeks to make one's reach, the greater the risk that one will fail to adequately capture or describe the processes in a way that is testable or comprehensible. So a key objective of a broad integrative theory of addiction is to find a relatively simple coherent structure or framework on which to 'hang' the complex ideas that need to be expressed.

Theory

Addiction involves a wide range of processes for different behaviours, populations, contexts and individuals. Social and environmental factors interact with different pre-existing dispositions to trigger initiation of the behaviour and this leads, through an interactive process, to changes in the personal environment and personal dispositions to increase the strength of motivation to engage in the behaviour relative to competing behaviours.

Evidence

- Evidence for this class of theory derives from the failure of more specific theories to account for the full range of important observations encountered. Evidence for specific theories within this class relates to specific features of the theories, as they are multifaceted. Ultimately, the value of such theories as a whole will be determined by how effectively they promote the development of successful interventions that would not have been generated by different approaches.

Limitations

- The main limitation of this kind of theory is that, in seeking to encapsulate so many features of addiction, it loses parsimony, testability and ease of comprehension and use.

Examples

The pathways model of pathological gambling: The 'pathways model' of pathological gambling (Blaszczynski and Nower, 2002) considers the multiple biological, psychological and ecological variables that contribute to the development of pathological gambling. It claims that advances in this area are hampered by imprecise definitions, failure to distinguish between gambling problems and problem gamblers, and a tendency to assume that pathological gamblers form a homogeneous population with similar psychological principles applying equally to all members of the class.

It proposes that pathological gambling involves three primary pathways: (1) behavioural conditioning, (2) manifestation of emotional vulnerability and (3) antisocial impulsive tendencies. The theory seeks to explain only problem gambling, not other addictions or the mechanisms that underlie these addictions, and does not directly address the process of recovery.

Externalising and internalising pathways to addiction: There are a number of models along these lines which focus on traits that are manifest in early childhood which set individuals along trajectories that lead to addictive disorders (e.g. Sher et al., 1991). The externalising pathway manifests itself as 'difficult' temperament in infancy, which involves low levels of inhibitory control, aggression and, subsequently, antisocial behaviour. It has also been proposed that, for at least some subgroups of addicts, an internalising pathway might be present that involves a tendency towards

a negative affect. The combination of externalising and internalising pathways could lead to what has been termed 'negative affect alcohol use disorder' (Hussong et al., 2011). These models may be considered integrative in that they chart the dialectic process in which these early traits interact with other characteristics and environmental factors to lead to psychopathologies including substance use disorder.

Excessive appetites theory: The excessive appetites model (Orford, 2001) is one of the most complete and integrative accounts of addiction available. It is worth considering it in somewhat more detail than has been afforded to other theories examined thus far.

The model notes that a range of objects and activities exist to which humans are at risk of developing a strong attachment, finding that their ability to moderate their behaviour is considerably reduced. It suggests that addiction can be explained in terms of an 'appetite' for certain experiences and that the initial pleasure experienced towards the addictive stimuli can transform into a lack of control if one experiences a certain degree of need for it and conflict about the extent to which one is seeking it. Consequently, 'addiction' is referred to as 'appetitive consumption'.

This model recognises that non-drug forms of addiction are possible, such as gambling, sex or exercise, as the initial delight, feelings of necessity and erosion of social control are applicable to these kinds of stimuli. The way that the mechanism of addiction operates is different from behaviour to behaviour and drug to drug.

With regard to cocaine, for example, the drug-induced euphoria becomes so pleasant that it becomes more important to individuals than their own health. Alcohol, it is argued, provides a means of coping with stress by increasing feelings of self-efficacy, deadening sensation, preventing coherent thought and releasing inhibition. Psychomotor stimulants such as amphetamines increase arousal, so it has been proposed that they improve performance on tasks requiring sustained attention in addition to producing euphoric effects.

The theory also proposes that the development of a strong appetite gives rise to new, acquired motivations for activity in the form of secondary emotional cycles, which add an important drive reduction element with the examples of chasing losses (gambling), neuroadaptation (some drugs) and maintaining secrecy (most activities).

The degree of a person's involvement in each of these appetitive activities has multiple interacting determinants. These include features of character or personality, but some of the strongest determinants are ecological, socio-economic or cultural,

including the availability of opportunities for activity and the normative influence of friends. The wide range of determinants includes those that operate to restrain activity or that offer disincentives, as well as those that operate to promote activity or that offer incentives. Each of these activities can serve numerous personal functions for different individuals, and even within the same person, which include forms of mood modification as well as enabling many different forms of self-expression and enhancing many different kinds of self-identity.

The theory proposes two ways in which casual consumption escalates to uncontrollable levels of consumption.

First, there is the 'law of proportionate effect', which suggests that appetitive consumption will escalate when the individual perceives the incentives of the appetitive activity to be relatively great and the restraints to be relatively weak. This is intended to capture the elements of choice and self-control.

Second, it is argued that learning theory explains the development of strong attachment. The development of increasing attachment is manifest in the form of increasingly generalised activity and the erosion of the discriminations that would ordinarily maintain moderate activity. Strong appetite development gives rise to a new acquired motivation for activity in the form of a secondary emotional cycle, which adds an important drive reduction component to the excessive appetites model. A strong attachment to an appetitive behaviour runs an increased risk of incurring costs, which may be physical or social, immediate or long term and affecting the self or others.

In this model, the consequences of conflict are an important part of addiction. They may be thought of as a set of tertiary processes and their effect can be to further amplify the addiction process. They include demoralisation, poor information processing and alterations of social role and social group.

In order to understand the development of appetitive consumption more fully, the theory argues that it is important to examine how appetitive behaviours are distributed within populations. Surveys of the consumption of alcohol within mainly western populations have been found to produce a frequency distribution curve skewed towards the highest levels of consumption. Therefore, the amount of alcohol consumption for the majority of the population is 'moderate' and mostly unproblematic. The minority consume in excess of this 'norm': the greater the deviation, the smaller the proportion that shows that pattern of behaviour. Norms

are not just statistical descriptions of population distributions; they are potentially one of the most important sources of influence on behaviour.

Orford (2001) refers to Hyman's idea of deterrence. He uses the analogy of barriers to the formation of a river: competition from other tributaries, insufficient rain or extreme heat. The evolution of appetitive behaviour to higher levels of consumption can be impeded by a range of deterrents including (with the example of alcohol) gastric distress, headaches, dizziness or a psychological make-up that regards intoxication as unpleasant. The idea is that our appetitive consumption would naturally escalate given the opportunity. It is environmental and physiological constraints and deterrents that prevent our consumption from escalating further than it does. This emphasis upon appetitive activity as a dynamic, changing process through time is an important departure from simple dispositional theories of excessive behaviour.

The theory incorporates classic conditioning mechanisms to explain the development of the strongest of attachments to appetitive behaviour. The combination of operant learning based on mood modification together with other positive rewards associated with the activity, negative reinforcement, 'coping' functions of the activity and the establishment of associations between multiple cues and the appetitive activity, plus the abundant opportunities that exist for the development of behaviour-enhancing expectations, attributions, images and fantasies, provides a powerful set of processes for the development of a strong attachment. Circumstances are favourable for the development of a strong appetite when the availability of the activity is high, inclination is strong and restraints are weak.

Orford (2001) argues that other theories are overly specific and fail to account for the diversity of emotional rewards associated with even one form of appetitive consumption, let alone the whole range. Neuropharmacological explanations based on a single reward system in the brain are viewed as simplistic. The social context in which these behaviours take place has also been largely overlooked. A single substance or activity may serve very different functions depending on an individual's social circumstances and needs. Theories that attempt to specify the exact nature of emotional changes are unlikely to be able to provide anything near to a comprehensive account of appetitive emotional reward.

Cognitive schemata are believed to operate within learning and memory processes. Following the multiple regulation model (Leventhal and Cleary, 1980), it is proposed

that excessive appetites result from a strong emotional memory and that it is the memory schema that is responsible for provoking desire or craving.

The excessive appetites theory introduces the concept of secondary processes that play an important role in amplifying an individual's level of consumption. The first of these is termed 'acquired emotion regulation cycles', which operate when the individual's appetite for the stimuli strengthens, providing further incentives for consumption by serving new emotional regulating functions.

The excessive appetites theory has a number of important implications. One is that the concept of addiction needs to be applied more broadly than has been proposed by some and should include any behaviour which shows the particular features set out in the theory. Second, it implies that prevention of addiction should involve intervention at social and psychological levels to prevent the development of excessive appetites. This may seem obvious, but it is a view that is often overlooked. Third, promoting recovery from addiction should involve fostering conflict and shaping the outcome of that conflict in the direction of intention to change. Unlike some theories that focus on psychological or social forces at work in addiction, this one recognises the potential benefit of pharmacological treatments but also their potential limitations. There is clearly much more to addiction than a simple 'brain disease' model would suggest, and there is more to treatment than medication or even medication plus therapy.

PRIME theory (West, 2006)**:** PRIME theory was developed as an attempt to bring together the top-level features of the existing models of addiction into a single coherent model. In doing so, it recognised that motivation lay at the heart of addiction and that any theory of addiction had to involve the development of a theory of motivation. It was heavily influenced by the excessive appetites theory but attempted to take those ideas and link them to basic motivational constructs in the simplest model that could capture the key phenomena.

According to PRIME theory, addiction can arise from many distortions in a motivational system that consists of five key levels involving moment-to-moment generation of plans, responses, impulses and inhibition, motives (wants and needs) and evaluations (beliefs about what is good and bad). In most cases, because of past associative learning, the addict repeatedly wants or needs to engage in the addictive behaviour more than he or she wants or needs not to.

Recovery involves changing this moment-to-moment balance of motivational forces. This can potentially be achieved by changing the environmental triggers and/or the

underlying physiological and psychological drivers, and/or fostering a new identity in which the addictive behaviour is 'not allowed or desired'.

The theory has been tested specifically in the domain of smoking. It successfully predicts the success of unplanned quit attempts (West and Sohal, 2006), the lower success rates associated with gradual reduction (Cheong et al., 2007), the differential role played by enjoyment of smoking and urges to smoke as barriers to quit attempts and success of quit attempts, respectively (Fidler and West, 2011). It also conforms with the fact that the behaviour change technique 'fostering an ex-smoker identity' is associated with successful quitting (West et al., 2011); and the advantage of physicians offering help to smokers over asking them if they are ready to stop before offering help (Pisinger et al., 2005).

PRIME theory has a number of strong implications for clinical and policy interventions to combat addiction. These stem from the proposition that interventions to prevent or mitigate addiction problems should begin with a focus on changing the moment-to-moment balance of wants and needs involving the addictive behaviour and that self-regulation arising from a strong, coherent identity with an emotional attachment to a set of personal rules is fundamental to deliberate behaviour change. The following are some specific examples of intervention guidance derived from this theory:

- Media campaigns to promote cessation of an addictive behaviour in a population where there is already a moderate to high level of dissonance about the behaviour should focus on triggering immediate action that cements a commitment to change (e.g. calling an advice line, going to a website); they should come in short, sharp bursts and make maximum use of emotion-generating imagery.

- Policy interventions aimed at promoting cessation of an addictive behaviour should involve multiple components that are implemented in synchrony (e.g. in the case of legal drugs, time price rises to coincide with mass media campaigns).

- Promoting a strong, coherent non-user identity should be an important target for therapy to achieve recovery.

- With addictions in which there is already a high prevalence of conflict, brief opportunistic advice from healthcare professionals should begin with the offer of help rather than with seeking to establish 'readiness to change'.

4.5 Biological theories

Biological theories of addiction as a 'brain disease' have been developed that describe mechanisms leading from initial experimentation with drugs for positive reward to craving as a result of increased 'incentive salience', together with damage to executive function, impairing the capacity of addicts to engage in reflective self-regulation. These theories focus on addictive drugs rather than behavioural addictions and, in fact, they were originally formulated primarily in the context of stimulants.

Theorising in this field is not generally characterised by specific named theories; instead, there are accounts emerging that draw together some key observations and build them into coherent narratives. Two of these are presented below.

Neural circuitry in addiction: One of the most coherent descriptions of the neural circuitry involved in addiction is given by Brewer and Potenza (2008), as follows (with text adapted from the original). The amygdala is important in the assignment of emotional significance and learned associations between motivationally relevant and otherwise neutral stimuli; the orbitofrontal cortex (OFC) encodes outcome expectancies and, via its strong anatomical connections with the basolateral amygdala (BLA), may facilitate associative learning in the amygdala; and the anterior cingulate cortex (ACC) is implicated in discriminative learning and cognitive control. Additional structures that are important in this process include the hippocampus, which provides contextual memory relevant to motivational stimuli, and the hypothalamic and septal nuclei, which provide information relevant to primitive motivational behaviours such as sexual drives and nutrient ingestion. As motivated behaviours become increasingly subordinated to the addictive behaviours as addiction progresses, changes in the structure and function of these brain regions contribute to the excessive engagement in behaviours. The nucleus accumbens (NAcc) also plays an important role. The NAcc shell is proposed as important in modulating incentive salience, while the core is involved with the expression of learned behaviours in response to stimuli that predict motivationally relevant events experienced as pleasurable. The ventral tegmental area (VTA), which projects the amygdala, NAcc and prefrontal cortex (PFC, which includes the OFC and ACC), facilitates learned associations with motivationally salient events using bursts of dopamine release. Dopaminergic neurons are inhibited, probably through the dorsal medial thalamus (habenula), when expected rewards do not occur.

It has been proposed that, during the latter stages of addiction, the predominant motivational influence moves from corticostriatal circuits involving the ventral striatum to circuits that involve the dorsal striatum, a structure that has long been implicated in habit formation.

Using the striatum as a focus, a speculative model is generated in which appetitive conditioning begins in the NAcc shell by means of inputs from the hippocampus, VTA (which also receives input from the central nucleus of the amygdala) and PFC. It 'transitions' to conditioned reinforcement in the NAcc core through inputs from the BLA and PFC and, finally, evolves to habit formation in the dorsal striatum by input from the sensorimotor cortices and other regions such as the septal hypothalamus. These transitions involve limbic, associative and sensorimotor regions of the striatum, respectively. The dorsal striatum and globus pallidus (by input from the NAcc core) act on the thalamus, which then feeds back to cortical structures.

Individual differences in neural circuitry: A challenge for many of the brain disease model of addiction is how to explain why some people become addicted, given exposure to addictive behaviours or drugs, whereas others do not. There is any number of possible ways in which genetic and environmental factors may lead to variation in vulnerability to addiction in general, and addiction to specific drugs or behaviours in particular, in the 'brain disease' model. Genetics must play an important role given that the heritability of addictive disorders has been estimated at around 30–50 % (Brewer and Potenza, 2008). In terms of dispositions that predispose to addiction impulsivity, depressive tendencies, stress responsiveness and trait anxiety are also clearly important (Covey et al., 1990; Sinha, 2008; Uhart and Wand, 2009; Breese et al., 2011). Reward sensitivity and reduced capacity to learn from punishment also appear to be important (de Ruiter et al., 2008; Lyvers et al., 2009; Dong et al., 2011). All of these have neural substrates that can be identified with and linked to addiction.

Theory

Addiction is primarily a 'brain disease' in which neural pathways of executive function become disordered and particular motivational processes become amplified as a result of an interaction between behaviours and their effects in the brain, particularly ingestion of certain drugs.

Evidence

- There is a considerable body of evidence about the importance of the midbrain dopamine pathway in natural and pharmacological reward (Cummings, 2000; Di Chiara, 2002; Goldstein and Volkow, 2002; Volkow et al., 2002; Di Chiara et al., 2004; Ahmed, 2005; Franken et al., 2005; Kovacic, 2005; Kim et al., 2011).
- There is mounting evidence from imaging studies on the involvement of the prefrontal cortex in regulation of behaviour and differences between addicts and non-addicts in activity in that structure (Goldstein et al., 2004; Peters et al., 2009).

Limitations

- The exclusive focus on brain reward pathways and executive control functions omits consideration of other psychological processes that have so far been described only at a more abstract level.
- Most of the research supporting the theory has been undertaken using somewhat simplistic models of addictive behaviours in non-human species of doubtful relevance to humans.
- To date, no useful interventions have emerged from this line of research, with the exception of varenicline, which is based on a partial-agonist model focusing on a particular nicotinic receptor subtype (Cahill et al., 2010).

Examples

There are many different theoretical accounts within this class, often not named as theories and with very subtle differences between them. Below is one prominent example.

Expectancy–reward theory ([4]): Drugs of dependence stimulate the midbrain dopamine system, which projects to the PFC, the ACC and the basal ganglia. These neurons send information about rewarding events so that bursts and dips in dopamine neuron activity occur when experiences following actions are better or worse than 'expected', respectively Baker et al., 2011). This leads to learning of associations between predictive cues, behaviour and the reward or punishment,

([4]) This label is one applied for the purposes of the report.

which leads to wanting of rewards that goes beyond the expected enjoyment from them. Addictive drugs lead to excessive wanting by pharmacologically amplifying the dopamine signal, even when the experiences are expected, allowing the motivational significance of drug cues to grow to abnormal levels. This has knock-on effects, which means that the addictive behaviour takes over the cognitive control system. Individual differences in susceptibility to addiction involve innate and environmentally determined differences in the functioning of the neural substrates underlying motivation.

Implications for prevention and promoting recovery

Biological theories primarily serve as the basis for the development of new drugs to treat addictive behaviours, although they can also, in principle, be a basis for electrophysiological and surgical treatment.

4.6 Process-of-change theories

The theories described up to this point have focused on the development and maintenance of addiction. There is also a body of theory that focuses on the life cycle of addiction, from initial enactment of the behaviour, through development of addiction, to attempts at recovery and success or failure of those attempts. Some of these theories focus on stages or steps in the change process, whereas others focus on mechanisms involved in changing motivations and beliefs.

Theory

Initial enactment of the addictive behaviour, development of addiction, attempts at recovery and success or failure of those attempts involve different processes that can be delineated and influenced by different interventions.

Evidence

- There is a large body of evidence on the effectiveness of particular cognitive and emotional processes, particularly cognitive dissonance (see below), in changing attitudes and behaviour (Condiotte and Lichtenstein, 1981; Prochaska and DiClemente, 1983, 1984; Dickerson et al., 1992; Sobell et al., 1993; Matthew, 1994; Koski-jännes, 1998; Pollak et al., 1998; Hyde et al., 2008).

- More proximal stages in stage theories show stronger temporal associations with each other (Dijkstra et al., 1998). For example, 'contemplation' (intending to change within the next 6 months but not the next month) is more likely at follow-up to have turned into 'preparation' (intending to stop within the next month) than, say, 'action' (having started to make the change).

- Different change processes have been identified at different stage transitions (DiClemente et al., 1991; Remme et al., 2008; Lippke et al., 2010).

- In some populations, and with some addictive behaviours at least, different factors have been found to predict different phases in the addiction life cycle; thus, development of dependence and failure of recovery appear to have a higher heritability than initiation (Rhee et al., 2003; Vink et al., 2005, but see Heath et al., 2002); experience of positive affect appears to play a greater role in deterring attempts at recovery than success of those attempts (Fidler and West, 2011); and population-level interventions in some populations with some addictions appear to have differential effects on different phases of transition (DeCicca et al., 2008).

Limitations

- Interventions based on the transtheoretical model have not proved more effective than non-stage-based ones (Quinlan and McCaul, 2000; Adams and White, 2005; Dijkstra, 2005; de Vet et al., 2008; Cahill et al., 2011b).

- Stage definitions used by the transtheoretical model are arbitrary and simplistic in terms of both timescales and intention (Povey et al., 1999; Sutton, 2000, 2001, 2005).

- Stages as measured according to in the transtheoretical model show a high degree of fluidity, and orderly progression through stages is not required, which undermines the use of the 'stage' concept (West and Sohal, 2006; Guo et al., 2008, 2009a,b).

- Some population-level interventions, such as increasing the financial cost of the addictive behaviour or limiting access to supply, can in some circumstances have an impact on more than one phase of transition (Topp et al., 2003; Jha et al., 2006).

Examples

Cognitive dissonance theory (Festinger, 1957)**:** This is a very powerful theory and forms the basis for most persuasive communication. In its most general form, it states that we find it aversive when we hold beliefs that conflict with each other. We are motivated to reduce this 'dissonance' and can do so in a number of ways. One is to change one of the beliefs to bring it in line with the other. Another is to avoid thinking about the issue. A third is to add a new belief that allows the situation to make sense. For example, the knowledge that one's alcohol use is harming one's marriage is incompatible with a belief that the marriage is good and should be cherished. One way of reducing the dissonance is to reduce one's alcohol consumption, another is to deny that the alcohol use is harming the marriage, a third is to avoid thinking about the issue and a fourth is to label oneself as 'addicted', which takes the matter out of one's hands.

The capacity for addicts to resolve dissonance by denying the extent of the problems associated with their behaviour, framing them in positive rather than negative terms or self-labelling themselves as 'hopeless addicts', and thereby abrogating responsibility for addressing the problem, are likely to be important factors in maintaining addictive behaviours (Blume and Schmaling, 1996).

Much of the art of persuasion is creating dissonance and then channelling the manner in which it is reduced to achieve the attitude change required. Communication campaigns that seek to motivate addicts to try to address their problem typically seek to raise the level of discomfort by drawing attention to the harms caused and then setting out the first steps that would be needed to overcome the addiction.

Elaboration likelihood theory (Cacioppo and Petty, 1984)**:** The premise of this theory is that attitude change will be more deeply entrenched if it identifies with a coherent set of beliefs that support it, involving greater depth of processing. Therefore, communications that allow the recipient to think up his or her own arguments in favour of the new position will be more effective than ones that merely state them. Thus, an intervention aimed at preventing uptake of cannabis use in adolescence would invite the youngster to think up as many reasons as he or she can that using cannabis would be a bad idea (Petty et al., 1991).

Transtheoretical model (TTM; Prochaska et al., 1992)**:** The TTM is one of the most widely used models underpinning psychological treatment or counselling for

addictive behaviours. It states that individuals can be classified as being in one of five stages in relation to a given change in behaviour: pre-contemplation (not considering changing within the next 6 months), contemplation (considering changing in between 1 and 6 months), preparation (planning to change within the next month and taking some preparatory actions), action (actively trying to change but within 6 months of having done so) and maintenance (having succeeded in changing for at least 6 months). Different processes are involved in transition between these stages. For example, consciousness-raising is regarded as important in moving someone from precontemplation to contemplation, whereas helping relationships is important in moving from action to maintenance (DiClemente et al., 1991).

Acceptance and commitment theory (Hayes et al., 1999)**:** Promoting and assisting with recovery from addiction involves a set of six processes: cognitive defusion (learning to perceive thoughts, images, memories and emotions as they are and not what they say they are); psychological acceptance (learning to respond to previously avoided drug cues with acceptance rather than avoidance); contact with the present moment (focus on the here and now and experiencing it with openness, interest and receptiveness); observing the self (achieving an experience of a transcendent self which is unchanging); clarifying values (discovering what one truly values in life); and committed action (forgoing short-term negative reinforcement of substance use in service of the more valued longer-term positive reinforcement of cessation of substance use). An important element of this theory is the notion of continued recommitment. There is recognition that actively recommitting is often an important part of maintenance of recovery.

Relapse prevention (RP) model (Marlatt and George, 1984; Larimer et al., 1999; Hendershot et al., 2011)**:** The RP model, based on social cognitive theory, describes how both immediate determinants (e.g. high-risk situations, coping skills, outcome expectancies and the 'abstinence violation effect') and what may be termed 'covert antecedents' (e.g. cravings) can contribute to relapse. The model describes intervention strategies to combat each step of the relapse process. These include identifying high-risk situations and enhancing skills for coping with those situations, increasing self-efficacy, combating unhelpful beliefs and managing the cognitive and emotional response to lapses. More global strategies include changing lifestyle and fostering substitute activities, using stimulus control techniques and 'urge management' techniques, and developing 'road maps' to give a sense of purpose

and direction. A central component of the model covers how lapses turn into relapse and includes the notion of the 'abstinence violation effect' (AVE; Larimer et al., 1999). AVE occurs when the person attributes the cause of the initial lapse to 'internal', 'stable' and 'global' factors (e.g. lack of will power or the underlying addiction or disease). This undermines self-efficacy and motivation to remain abstinent. Under this model, it is imperative to avoid lapses because they have a high likelihood of becoming a full-blown relapse. If a lapse does occur, steps must be taken to minimise AVE. This model has been very influential and has considerable face validity but, surprisingly, there is only limited evidence to support its core propositions (Hajek et al., 2005, 2009; Lancaster et al., 2006).

Implications for prevention and promoting recovery

Interventions to prevent uptake or promote recovery should focus on promoting particular change processes, which should be tailored to the stage of change and/or the specific relapse processes operating within the individual or his or her environment.



Chapter 5: Modelling populations

5.1 Social network theories 80

5.2 Economic models 82

5.3 Communication/marketing models 83

5.4 Organisational systems models 85

Chapter 5: Modelling populations

Addiction can be understood in terms of the interplay between population-level parameters. In many cases these can be modelled quantitatively as functions.

Within population- or group-focused theories there are those that focus on (i) social networks, (ii) behavioural economics, (iii) communication and marketing and (iv) populations as systems.

5.1 Social network theories

Social network theories use variables that measure connectedness between different types of 'node'. They treat the strength and type of those connections as inputs and the prevalence of addictive behaviours in populations, subpopulations and groups as outputs.

Theory

The rates of transition into and out of addiction on the part of individuals within a group or population are a function of the social connections between individuals who are and are not promoters of addiction or non-addiction, and the nature of those connections.

Evidence

- Addictive behaviours occur in clusters at multiple levels, from families, through local area groups, to subcultures and ultimately whole populations (Valente et al., 2003; Rosenquist et al., 2010).
- Changes in prevalence of addictive behaviours appear to show patterns similar to contagion in infectious diseases (Christakis and Fowler, 2008).

Limitations

- This approach deals with only one aspect, albeit an important one: the aetiology of addiction and recovery.

- As currently formulated, this analysis does not address specific issues with addictive behaviours as opposed to other kinds of behaviour.

Examples

Diffusion theory: This theory describes how 'innovations' spread through social networks; in the case of addiction, this may mean the use of an addictive product or method (e.g. a new medication) to help overcome the addiction (Ferrence, 1996, 2001). A five-step process is proposed, which involves knowledge, persuasion, decision, implementation and confirmation. The process is fluid and depends on communication channels and a complex set of potentially competing forces.

Social contagion theory: This model focuses specifically on the social connections between individuals and groups to chart uptake and cessation of behaviours, including addictive behaviours such as smoking (Einstein and Epstein, 1980; Rende et al., 2005).

Actor–network theory (ANT): ANT describes the process whereby individuals come together to form groups that act as agents apparently possessing their own intelligence. It proposes that the process begins with identification of a problem that needs to be solved and identification of the relevant actors. Then the primary actor needs to convince others of their roles and the group as a whole needs to mobilise allies. This model has been used to describe the development of tobacco control activities (Young et al., 2011). As with many such models, it may seem quite commonsensical, but it can be helpful in providing a structure for understanding these social processes.

Implications for prevention and promotion of recovery

Social network theories imply that interventions to combat uptake of addictive behaviours should focus on weakening social connections that promote such uptake or develop effective connections to counter that uptake. They provide clues to how and where ideas to combat addiction should be 'seeded'. They also provide potentially useful information on the mobilisation of agencies to develop and implement effective interventions to counter addiction.

5.2 Economic models

Behavioural economic models ([5]) take principles of classic economics to arrive at equations relating economic parameters such as price to aggregate measures of addictive behaviours in populations (e.g. prevalence, consumption). Economic models can be applied at the level of individuals, but their most common application is at the level of populations (i.e. estimating changes in population-level measures of behaviours as a function of population-level interventions). These models are primarily descriptive, modelling observed functions without necessarily seeking to explain them. In such cases, explanations are often assumed to derive from a simplified version of one of the models described earlier or are left indeterminate. Economic models have strong predictive value in the field of addiction and form the basis for highly effective intervention strategies.

Theory

The prevalence, incidence and/or rate of addictive behaviours in populations can be predicted by functions from economic theory, including current and future financial and other costs relating to the behaviour and/or competing/alternative behaviours.

Evidence

- There are numerous well-established models linking financial cost and availability of addictive behaviours and rate of engagement in populations (Ornstein, 1980; Pekurinen and Valtonen, 1987; Townsend, 1996; Zhang et al., 2000; Gallus et al., 2003; Heeb et al., 2003; Fernandez et al., 2004).

Limitations

- The models do not address a large number of key issues within addiction that are addressed by other theories.
- Non-economic factors are needed to take account of the complexity of possible responses, for example with smokers reacting to increased financial cost by

([5]) Behavioural economics is a term that has come to be almost synonymous with psychology. This report uses the term in the stricter sense of those parts of economic theory in which the behaviours of human populations are modelled as a function of financial cost of engaging in those or facilitatory or competing behaviours.

reducing the number of cigarettes they smoke but inhaling more from each cigarette, and environmental factors potentially influencing price changes and the effect on heroin purchasing (Roddy et al., 2011).

Examples

Price elasticity: Price elasticity refers to the extent to which demand for a product is reduced by an increase in the financial cost. An elasticity of 1 means that demand falls in direct proportion to the increase in cost. If a product is completely inelastic the demand is not affected by price. Most addictive 'products' have an elasticity of in the region of 0.5 (Oriordan, 1969; Gallet and List, 2003; French et al., 2006; John, 2008). This means that price is potentially an effective method of reducing addictive behaviours at a population level. This is true for both illicit and licit drugs (van Ours, 1995; Liu et al., 1999).

Cross-elasticity models: Cross-elasticity refers to the extent to which the financial cost of one product affects demand for another. Thus, for example, it has been suggested that raising the price of alcohol may lead to consumers switching to another product, such as cannabis, that achieves similar goals (Mytton et al., 2007).

Implications for prevention and promoting recovery

Economic models lead to an emphasis on the use of financial cost as a key deterrent to addictive behaviours. This may be the financial cost not only of the target behaviour, but also of other behaviours that may be supportive of it or compete with it. Thus, for example, one may wish to reduce the cost of a less harmful alternative behaviour.

5.3 Communication/marketing models

There is a large body of theory around the effectiveness of persuasive communications and marketing. Such models view addicts as 'consumers'. Many of these are framed at the individual level (Hirschman, 1992), but it is also possible to construe them at a population level. They are relevant to the development, as well as the prevention and promotion, of recovery from addiction. In the case of licit addictive products, the role of marketing is clear and it is essential that any strategy to combat these addictions take this into account. The resources at the disposal of tobacco and alcohol manufacturers to promote their products and the absence of

effective regulation of this in many parts of the world no doubt contribute to the prevalence of addiction to these products. The promotion of gambling products, both on site and in mass media, is also well resourced and adopts powerful motivational messaging. Even illicit drugs are marketed in ways that conventional marketers would recognise from their textbooks with cut-price promotions and use of relationship marketing techniques.

Theory

The development of and recovery from addiction is influenced by the persuasive communications and marketing activities of those promoting or seeking to combat the behaviours concerned.

Evidence

- Marketing campaigns by the alcohol and tobacco industry are effective in promoting sales of their products (Gordon et al., 2011).
- Social marketing campaigns have in some cases been found to reduce sales of addictive products (DeJong et al., 2006; Gordon et al., 2006; Stead et al., 2007).

Limitations

- There are numerous examples of the failure of social marketing campaigns to influence addictive behaviours (Clapp et al., 2003; Wechsler et al., 2003, 2004; Russell et al., 2005; DeJong et al., 2009).

Examples

Contemporary marketing theory: Key concepts within modern marketing theory are (1) establishing a relationship with the 'customer' and building customer loyalty; (2) tailoring the product to the wants and needs of the customer; (3) use of 'branding' to create a well-established product or supplier image with strong positive associations; (4) market segmentation so that products and services are tailored to the needs of particular groups; (5) exploiting 'herd behaviour' in which the perceived popularity of a product increases the liking for it; and (6) diffusion of innovation, which involves processes by which people adopt new services, products and ideas.

Implications for prevention and promoting recovery

Preventing harmful industries from using marketing tactics may reduce the prevalence of addictive behaviours while in certain circumstances social marketing campaigns can reduce uptake and promote cessation or reduction.

5.4 Organisational systems models

'Systems theory' (Emshoff et al., 1975; Ahn et al., 2006; Chambers et al., 2007; Borland et al., 2010) is emerging as an important theme in addiction research. At its core is the recognition that understanding a complex phenomenon of this kind requires a specification of the elements involved and how they interact, and to model this iteratively, as in weather forecasting, to predict medium- and long-term developments.

Theory

Addictive behaviours can be understood in terms of systems of mutually interacting components at a societal level (e.g. government, tobacco industry, public). The effects of innovation introduced into the system can be nullified by compensatory changes in another or can propagate through the system or even be amplified.

Evidence

- Systems theories at a general level are difficult to test using experiments because they contain many interconnected propositions but they have proved successful in explaining phenomena that would be difficult to explain without such approaches (Ahn et al., 2006).

Limitations

- The strength of systems theories is also potentially a weakness in that they can explain a great deal but in real-life situations may lack predictive power.

Examples

Tobacco use management system: This model approaches the problem of tobacco control from a systems perspective and identifies systemic barriers to progress (Borland et al., 2010). This leads to recommendations regarding the regulation of

the tobacco industry per se, in addition to the usual countermeasures that affect price, availability, dependence and motivation to smoke.

Systems approach to healthcare delivery: The World Health Organization has recently published a report detailing ways in which a systems approach can help to improve healthcare delivery that can be applied as successfully to treatment for addiction problems as to any other area of health care (de Savigny and Adam, 2009).

Implications for prevention and promoting recovery

The most important implication of the organisational systems approach is that interventions need to consider how the organisational system as a whole will adapt to the introduction of the innovation. It may be that there will be compensatory adaptation in another part of the system nullifying the effect or it could be that the innovation will set off a chain reaction that will lead to a much greater effect than was anticipated. Merely being sensitive to these possibilities may be helpful when designing interventions.

Chapter 6: Towards a comprehensive theory of addiction

6.1 Identification of key constructs in theories and models of addiction 88

6.2 Linking the constructs into a coherent model 94

6.3 Motivation and capability 97

6.4 Process of change 98

6.5 Conclusions 103

Chapter 6: Towards a comprehensive theory of addiction

The preceding chapters indicate that numerous important insights have been gleaned about the development of and recovery from addiction at many different levels of analysis. Each approach has particular implications for the policy response and there is good evidence that there are numerous ways of influencing addictive behaviours, ranging from social marketing campaigns and interventions that raise the financial cost, to behavioural support and medicines. It is also apparent from the literature, however, that different contexts and different addictive behaviours require different blends of policies at different times in different cultures. This suggests that there may be merit in attempting to bring together the insights contained in these models at a general level to help establish strategies for combating addiction. A comprehensive theory of addiction would ideally encompass all the relevant concepts and link them together in a way that accords with the evidence and provides a coherent account that can be used to develop effective interventions. The first step in this process is gathering together the relevant concepts. Such a theory would be framed at a general level and provide a pegboard into which more specific theories can be located. Thus, for example, the theory would include the concept of 'psychological need', but the specifics of how a particular psychoactive drug generates and then meets such a need would require a more detailed theory.

6.1 Identification of key constructs in theories and models of addiction

From the preceding review it is apparent that a wide range of concepts have been applied to understanding addiction. The definitions in Table 6.1 represent an attempt to capture the essence of the constructs as used by researchers in the field, not a choice between different explicit formulations. The list is not intended to be comprehensive (that would constitute a dictionary of addiction), but it conveys the variety of concepts involved. Arguably, all of these are potentially significant and could usefully be incorporated into an overarching model.

It should be remembered that this report does not address the details of biological models underpinning the major mechanisms that can be observed or inferred at a behavioural level. However, as already noted, these can lead to the development of

highly effective interventions that address one or more of the mechanisms of addiction. For example, a theory that nicotine's actions at the alpha-4 beta-2 nicotinic acetylcholine receptor play a central role in the 'drive' to smoke (craving) and pharmacological 'reward' from smoking led to the development of a partial agonist targeting that receptor, which has proved successful in helping smokers to overcome their addiction to tobacco (Cahill et al., 2011a). However, such accounts are generally speculative. Even if one accepts the generalisations from particular animal models to humans, they account for only part of the nexus of causation that underlies addictions.

Table 6.1: Key concepts as used in models of addiction

Abstinence violation effect (AVE)	A psychological process whereby a lapse leads to relapse. It involves a loss of motivation and self-efficacy
Actions	Discrete, coordinated responses involving voluntary muscles
Analysis	Thought processes involving calculation, inference and comparison
Anxiety	An aversive and also motivational trait or state involving worry about adverse future events. Addictive behaviours may reduce it acutely but increase it chronically
Associative learning	A process whereby patterns of brain activity representing perceptions, emotions or response organisation become linked so that when a particular pattern occurs another is more likely to occur. In addiction, associative learning plays a pivotal role, with drug cues coming to generate feelings of desire or impulses
Attentional bias	A non-conscious tendency to focus attention on particular types of object or features of objects; a form of cognitive bias
Automatic processes	Events in the brain that do not involve self-conscious reflection and analysis; and mental states arising from these, including feelings
Autonomy	Part of identity — a belief in one's independence or freedom
Behaviour	Action sequences and the manner in which these are enacted
Beliefs	Mental representations of objects, events or situations in the form of propositions held to be true
Choice	A process whereby alternative courses of action are imagined, one of which is selected through a process of reflective analysis
Cognition	Strictly, the process of creating and modifying mental representations, but often specifically limited to beliefs

Table 6.1 (continued)	
Cognitive bias	A non-conscious tendency to preferentially process information or form mental representations of particular types of object or features of objects in the environment
Cognitive control	Influence of reflective thought on responses
Compulsion	Experience of a strong, sometimes irresistible, impulse to perform an act
Consciousness	The content of subjective experience when awake; includes feelings, perceptions, memories, beliefs and abstract ideas; distinguished from self-consciousness
Cost	Negative consequence or consequences of performing an act
Craving	Strong desire or feeling of a powerful urge to do something
Decision	The process involved in determining a course of action following reflective analysis; also the outcome of that process
Decision framing	A way of representing a decision problem and the possible outcomes from each option
Depression	Feeling of gloom often accompanied by belief in own inadequacy and worthlessness; can involve physical symptoms of tiredness and motor retardation
Desire	Feeling of want or need for some imagined state of affairs
Dissonance	A feeling of discomfort attached to conflict between beliefs
Dopamine	A neurotransmitter which, when it attaches to receptors in the nucleus accumbens, is believed to lead to experience of pleasure (in the shell of the accumbens) or increased incentive salience (in the core of the accumbens)
Ego depletion	Lowered mental energy needed for the exercise of self-control
Emotion (generalised)	Experience of generalised feelings of happiness, anger, anxiety, etc.
Emotion (targeted)	Experience of feeling about something such as liking, hating, enjoying
Environmental stress	Events or conditions that can lead to anxiety or depression
Evaluations	Beliefs about the degree to which something is good or bad in some way, e.g. harmful vs. beneficial, morally right or wrong

Table 6.1 (continued)	
Executive dysfunction	Impaired ability for reflective control over behaviour
Expectancy	Expected outcome from an action and the expected utility of that outcome
Feelings	Experiences of emotions, desires and urges
Habit	A process whereby, as a result of learning, stimuli influence responses without the requirement for reflective thought
Habituation	Reduced responsiveness as a result of repeated or continuing exposure to a stimulus
Hyperbolic discounting	A tendency to discount (attach reduced utility to) costs and benefits to a greater degree early in the imagined future
Goal	An imagined state of affairs that is the object of desire
Identity	Mental representations of the self as one is or aspires to be and emotions associated with these
Imitation	A process whereby an individual copies all or some of the features of another person; the process may not be intentional
Impulse	A coordinate action schema which, if unopposed, will result in an action
Impulsivity	A tendency to react to stimuli without, or despite, reflection
Incentive salience	An attribute of 'wanting' attached to reward-predicting stimuli
Inhibition	A process by which a response is suppressed
Intention	A self-conscious decision to undertake an act
Lapse	An instance in which a personal rule is violated but the rule is still considered to be in operation
Liking	A feeling of anticipated pleasure or enjoyment associated with an object or event
Modelling	A process whereby a behaviour occurs and all or some of its features are copied by another
Motivation	Processes within the brain that energise and direct behaviour; not limited to reasoned choice
Motivational bias	A tendency to favour a given course of action or value a given outcome as a result of factors that lie outside conscious awareness

Table 6.1 (continued)	
Motive	A feeling of desire (i.e. want or need) to attain an imagined state of affairs
Need	A kind of desire involving anticipated relief from mental or physical discomfort
Negative reinforcement	A process whereby a behaviour is induced or maintained in anticipation (not necessarily conscious) of avoidance of or escape from an aversive stimulus
Norms	Behaviour patterns or beliefs that are widely enacted or held within a population, subpopulation or group
Norms (descriptive)	Beliefs about how widespread a behaviour pattern or belief is in a population, subpopulation or group
Norms (prescriptive)	Beliefs about what a population, subpopulation or group considers to be good or bad
Norms (subjective)	Beliefs about what significant others consider to be good or bad weighted by the importance one attaches to such views
Observational learning	Acquisition of information or skills through observation of the behaviour of others and the outcomes of those behaviours
Opportunity	A set of environmental factors that make a behaviour possible
Perceived control	The extent to which people believe they can enact a given behaviour (similar to self-efficacy)
Physical dependence	In relation to a drug, a condition of the central nervous system such that reduced concentrations or absence of the drug results in an adverse physiological reaction
Plan	A self-conscious intention to perform an act in the future
Pleasure	An enjoyable experience gained by addicts as a result of their addictive behaviour that leads them to seek them to repeat the experience
Positive reinforcement	A process whereby a behaviour is induced or maintained in anticipation (not necessarily conscious) of experience of a positive stimulus
Price	The amount of money needing to be paid to acquire something or benefit from a service

Table 6.1 (continued)	
Reflective thought	Self-conscious analysis of information in the form of propositions, and thoughts arising from these
Relapse	Abandonment of a personal rule governing behaviour
Relief	A positive feeling that follows removal of mental or physical discomfort
Response	Reaction to a stimulus in the form of feeling, thought or behaviour
Reward	An event that increases the probability of a behaviour that it follows, often involving pleasure, satisfaction or relief
Risk taking	Behaviours as a result of which there is a significant probability of harm or failure to mitigate harm
Rule	A plan that is applicable beyond just one occurrence
Self-consciousness	Experience of the self, necessary for reflective, executive control of thoughts and actions
Self-control	A process whereby intentions are enacted in the face of desires or impulses arising from other sources; part of self-regulation
Self-determination	A belief in one's power to control one's own behaviour and experience
Self-efficacy	A belief in one's capability to enact a behaviour or achieve a particular outcome
Self-regulation	A process in which plans and reflective choices govern behaviour
Sensitisation	An increase in magnitude of a response as a result of continued or repeated exposure to the stimulus
Social influence	A process whereby thoughts, feelings and behaviour are influenced by other people. This can be through a variety of mechanisms including actual or anticipated reinforcement and modelling
Stress	A negative feeling arising from adverse environmental conditions or events, or expectation of these
Subjective expected utility	The expected perceived value of an outcome from choosing an option that takes into account the likelihood that it will occur if that option is chosen
System	A set of interacting elements

Table 6.1 (continued)	
Temporal discounting	A tendency to attribute lower utility to outcomes of similar objective value as a function of how far in the future they are expected to occur
Urges	Feelings of impulse to engage in an action
Utility (also subjective utility)	Perceived personal value attaching to an outcome
Value	Objectively specified worth of something
Values	Beliefs about what is morally or ethically right or wrong
Want	A feeling of anticipated pleasure or satisfaction attaching to an imagined future
Well-being	A feeling of being content and happy
Willingness	An absence of an intention not to engage in an act
Withdrawal symptoms	Temporary adverse reportable changes to physical or mental functioning resulting from reduction or termination of a drug to which the body has become adapted

The constructs are diverse and many of them overlap, but it should be apparent that they are all to some degree important and should be included, or at least accommodated, within any overarching model. The next section attempts to do this.

6.2 Linking the constructs into a coherent model

Addiction involves behaviour, so behaviour could usefully lie at the heart of any model. The causes of behaviour lie in the interaction between the individual and his or her environment.

When it comes to the individual, one can distinguish between two kinds of attribute that contribute to the disposition to act in a given way in a given set of circumstances: capability and motivation. Then it is important to consider factors that lie outside the individual that promote or constrain behaviour. We can refer to this as opportunity. Capability, motivation and opportunity must be present for any behaviour to occur. The components are described in more detail below. Together they are the COM-B system, which allows us to analyse behaviour (Michie et al., 2011a). Figure 6.1 shows the components of the COM-B system and how they are interrelated.

Capability refers to the physical or psychological capacity to engage in the behaviour in question. This capacity resides within the individual. It includes knowledge and understanding as well as physical and mental skills and facilities. It also includes the capability to resist impulses to engage in an action as well as the ability to engage in an action.

- **Physical**
  Having the motor skills and anatomy required to enact the behaviour.
  Example: Skill at self-injection.

- **Psychological**
  Having the knowledge and intellectual and self-regulatory capacity to enact the behaviour.
  Example: Ability to understand health messages.

Opportunity refers to the environmental factors that permit a behaviour to occur or promote it. This may involve the physical environment, including, for example, availability of a given drug or cues that prompt people to consider taking the drug as an option. It may also involve the social environment, including social mores that make it possible to entertain the idea of using a drug.

- **Physical**
  Environmental factors that enable or prompt the behaviour to occur.
  Example: Presence of alcohol sales outlets in a neighbourhood.

- **Social**
  Social factors that enable or prompt the behaviour.
  Example: Peer group mores that promote cannabis use.

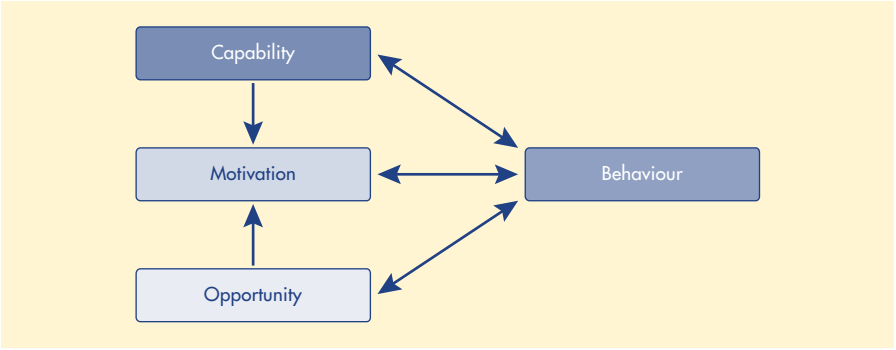
Motivation refers to mental processes that energise and direct behaviour. It extends beyond the narrow confines of self-conscious, reflective reasoning and choice and into processes that have been labelled 'automatic'. Thus, it includes impulses and desires that we are not necessarily reflecting on, or able to reflect on, at any given moment.

- **Reflective**
  Self-conscious analysis leading to a decision or intention to perform an action.
  Example: Belief that cannabis is non-addictive and relatively harmless.

- **Automatic**
  Learned and unlearned associative processes leading to feelings, impulses or counter-impulses.
  Example: Feelings of euphoria immediately after ingesting cocaine.

Behaviour develops through the interaction of these components, as Figure 6.1 describes. Arrows represent the potential for major causal influences between components. Behaviour in this particular model refers to sequences of actions which arise from impulses and inhibitory processes. Inhibition plays a crucial role in the flow of behaviour by preventing some actions and thereby enabling others. Therefore, it is useful to refer to behaviour in terms of absence or cessation of actions (e.g. ceasing injecting heroin) as well as occurrence.

Figure 6.1: The COM-B system for analysing behaviour in context



Source: Michie et al., 2011a.

The COM-B system provides one potentially helpful way of generating a high-level analysis of an ongoing behaviour pattern as well as a way of deducing the changes required in order to alter that pattern. It can be applied at the level of populations, subpopulations, social groups or individuals. Therefore, in principle, it could form the basis for an individual assessment of an addict or a generalisation about a population. It is not a psychological, sociological or environmental model. It seeks to treat the individual or population as part of a system with interacting components.

The systems approach represented by the COM-B model is reflected in arrows denoting potential influence between the components as well as patterns of influence within each component. Thus, it is clear that capability to engage in a behaviour

influences motivation to engage in it, as does opportunity. Engaging in the behaviour then clearly influences motivation, capability and opportunity.

With regard to addictions, powerful motivation lies at the heart of the problem, but there may be different contributions in terms of capability and opportunity for different individuals in different circumstances. Thus, one individual may experience a chronic overwhelming desire to drink alcohol and will seek out opportunities to do so, whereas another may experience those desires only when opportunities present themselves. Similarly, for one user, the need for heroin may be a near-constant feature of his or her waking experience, whereas another may experience an equally powerful desire but more narrowly linked to specific occasions.

6.3 Motivation and capability

Focusing our attention on intra-individual components of the model, there are two factors that may be conceptualised as interacting to contribute to the behaviour: motivation and capability. Capability sets boundaries around what we are able to do. Motivation determines what we do and how we do it within those boundaries. Most of the theories described in this report consider motivation but some deal with psychological capability — particularly capacity for self-regulation — and some deal with both.

All the theories can be thought of as characterising individuals in terms of 'dispositions' to react in particular ways, mentally or physically, to particular stimuli or circumstances. These dispositions may be short or long term. Ultimately, they must involve structural features of the central nervous system in terms of both connectivity between neurons and the characteristics of those neurons. However, it is often more useful to think of these dispositions in terms of higher-level 'traits' and 'states'.

Thus, vulnerability to addiction may be thought of as arising from a number of long-term dispositions (traits), such as tendency towards anxiety or depression, impulsivity, failure to adopt conventional social norms, low self-esteem, tendency towards risk-seeking, sensitivity to the reward potential of a particular drug and tendency towards steep hyperbolic discounting. Addictive behaviour patterns may be maintained by both long- and short-term dispositions (states) including a range of emotional states and what may be termed 'mental sets'. The latter are cognitive dispositions that may include short-term cognitive biases as well as ways of construing.

The PRIME theory of motivation was developed to bring together key elements of the other theories described in this report, so may provide a potentially useful framework for describing how motivational dispositions interact with the immediate environment to generate behaviour (West, 2006). It aims to capture all of the constructs set out in Table 6.1 and to link them together in a coherent fashion. The next section describes it in more detail. It is important to stress that all models are perceptions and each may have value for different purposes. PRIME theory addresses concepts only within the areas of motivation and psychological capability as it relates to motivation. Its focus is on providing a basis from which to develop interventions to change behaviour. It is not a replacement for other models but only an attempt to integrate their key constructs into a single framework.

6.4 Process of change

PRIME theory aims to be as parsimonious as possible and to identify core constructs that are pivotal and those that are variants on the theme. Table 6.2 shows key tenets of PRIME theory as they relate to ongoing behaviour and deliberate behaviour change. The core constructs appear in bold. It should be possible to link all the other intra-individual constructs in Table 6.1 to these core concepts.

Table 6.2: Key propositions within PRIME theory as they relate to ongoing behaviour and deliberate behaviour change

1. At every moment we act in pursuit of what we most desire ('want' or 'need') at that moment
2. Wants and needs involve imagined futures and associated feelings of anticipated pleasure/satisfaction (wants) or relief from mental or physical discomfort (needs). They form part of our conscious experience but we are not necessarily conscious *of* them
3. Beliefs (propositions that we hold to be true) influence actions only if they generate desires that are strong enough to overwhelm those arising from other sources (e.g. drives and emotions) or impulses and inhibitions arising automatically out of learned or unlearned associations; imagery plays a key role in this
4. Plans (self-conscious intentions to undertake actions in the future) provide overarching structure to our actions, but in order to direct our behaviour they need to be recalled and generate desires at relevant moments that are sufficiently powerful to overcome desires and impulses arising from other sources

Table 6.2 (continued)

5. The motivational system can be characterised in terms of dispositions for its components to respond in particular ways to internal and external inputs. Processes that lead to changes in dispositions include associative learning, habituation, sensitisation, direct imitation, analysis and inference. A wide variety of patterns of change can occur with sudden large changes resulting from apparently small triggers
6. Identity (our mental representations of ourselves and the feelings attached to these) is an important source of desires and provides a degree of stability to our behaviour by virtue of the labels we apply (e.g. ex-addict) and the rules that govern our behaviour (e.g. no longer using drugs)
7. Identity change is a starting point for deliberate behaviour change (in terms of a new label and a new set of rules governing our behaviour) and can be regarded as an 'act' that occurs when the desire to make the change is momentarily greater than the desire not to
8. Deliberate behaviour change is sustained when the desires arising from the new identity are stronger at each relevant moment than the desires arising from other sources to revert to the previous behaviour pattern or are able to overwhelm habitual or instinctive impulses
9. When identity change results from self-conscious beliefs about what is good and bad, maintaining behaviour change requires 'self-control': the effortful generation of desire to adhere to a rule that is sufficiently powerful to overcome desires arising from other sources
10. Personal rules that have clear boundaries and a strong connection with components of identity that involve strong emotional attachments will generate more powerful desires when required and better suppress countervailing desires and so have a stronger lasting impact on behaviour

The model recognises the importance of distinguishing between automatic and reflective processes. It differs from classic dual-process models (Strack and Deutsch, 2004) in (1) positing that there is a multi level hierarchy of influence so that beliefs have to work through desires (wants and needs) and these have to work through impulses and counter-impulses (inhibition); and (2) recognising a fundamental distinction between automatic processes that involve affective goals (wants and needs) and those that involve stimulus–impulse associations (see Figure 6.2).

Figure 6.2: The structure of human motivation

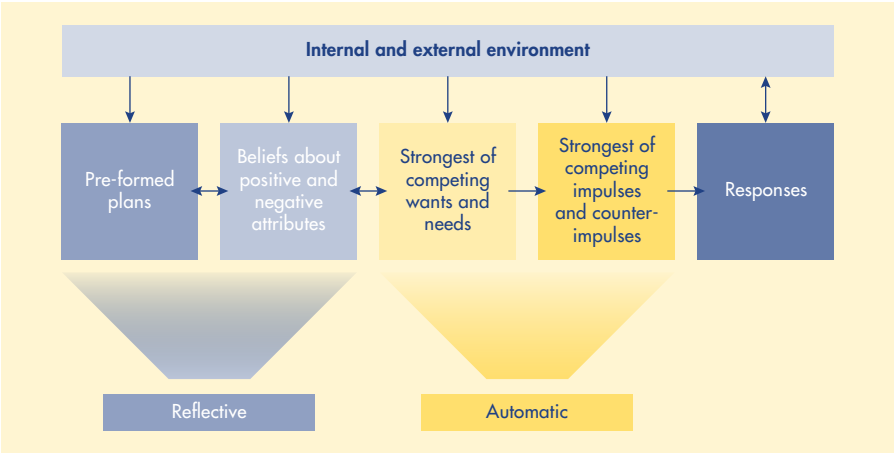
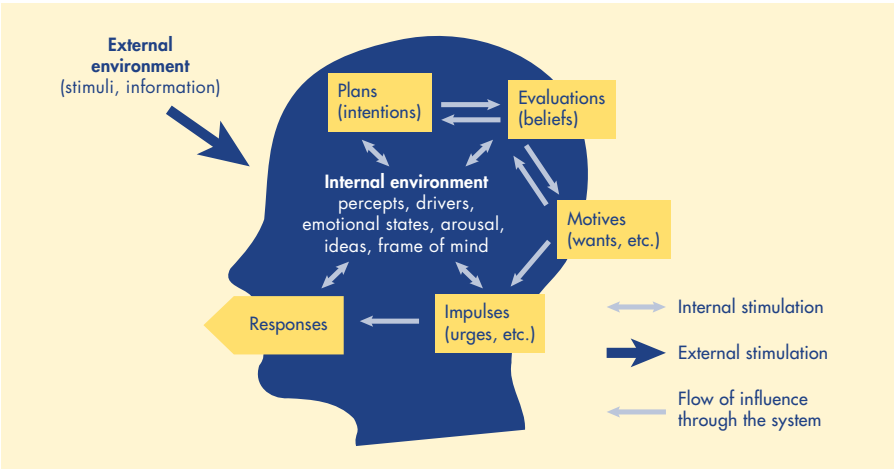


Figure 6.3 shows the structure of the human motivational system in a slightly different form, which makes explicit that all external input needs to be sensed and interpreted at some level in order to feed into the system and internal states such as drives and emotions are important in that process. It also shows how the acronym PRIME is derived: plans, responses, impulses, motives and evaluations.

Figure 6.3: The structure of human motivation — a different view



Probably the most important single proposition within PRIME theory is that the strongest of momentary wants and needs drive purposeful behaviour and that plans and evaluations are an important source of wants and needs. This embodies the concepts within the reflective choice models (in terms of resolution of competing evaluations) and the learning theory and drive models (in the generation of wants and needs through associative learning and processes of habituation and sensitisation). Self-regulation and biological executive control theories are captured by the relative strength of plans, evaluations and non-reflective processes to influence wants and needs in the moment and for wants and needs to generate impulses versus inhibition. Identity theory is encompassed by the proposition that identity is potentially a very important source of wants and needs that can work in favour of or against developing an addictive disorder, as well as in favour of or against recovery.

Individual differences in vulnerability to addiction can arise from any of a number of dispositions, such as the following:

Impaired plan formation and enactment

- Impaired capacity to formulate coherent plans that provide structure to daily life and protect against the motivations arising from ready rewards.
- Impaired connectivity between plans and lower-level motivational structures, reducing their capacity to form motives that can counter impulses and motives to engage in addictive behaviours.

Maladaptive evaluations

- Lack of protective beliefs about the harmfulness of the addictive behaviour, including low self-esteem or acceptance of social mores.
- Beliefs that actively promote the addictive behaviour, including those relating to self-harm or the benefits of the addictive behaviour.

Maladaptive motives

- Low capacity to form imagery from beliefs that would be needed to create the necessary desires to avoid the addictive behaviour, leading to temporal discounting amongst other phenomena.
- Predisposition to adverse emotional states that are relieved by the addiction (leading to greater 'need').

- Heightened sensitivity to the propensity of the addictive behaviour to create acquired drive states (leading to greater 'want' and 'need').
- Heightened sensitivity to the propensity of the addictive behaviour to generate withdrawal symptoms (leading to greater 'need').
- Heightened sensitivity to the pleasurable effect of the addictive behaviour or propensity for this to become sensitised (leading to greater 'want').

Maladaptive impulse formation and control

- Heightened sensitivity to the effect of the addictive behaviour in generating cue–impulse associations (leading to strong cue-driven impulses).
- Reduced capacity to inhibit impulses (leading to predominance of impulses over inhibitions).

PRIME theory recognises that there are many elementary processes that lead to changes in dispositions. These are listed in Table 6.3. It is important to note that a number of change processes are included that are not covered by the models described earlier (e.g. maturation), but for which there is considerable evidence of their importance. It is also important to note that there are change processes included for completeness (e.g. physical insult) that may only rarely impact upon addictive behaviours. Thus, for example, injury to the prefrontal cortex may generate disinhibited behaviour patterns.

The observation that the development of, and recovery from, addictive disorders can follow many different trajectories, from steady gradual change to sudden change without any obvious driving factor, is encompassed in PRIME theory by the recognition that the processes of change follow a highly non-linear course and in important respects appear to be 'chaotic' — in the sense characterised by chaos theory (Gleick, 2011). In chaos theory, a simple, single underlying equation that is applied iteratively to its own outputs can result, at one point in time, in an apparently stable pattern of behaviour and then, without any apparent external cause, change to chaotic switching from one pattern to another before returning to the original pattern or switching to a new stable pattern. Then the new stable pattern can revert without any obvious warning to either the chaotic switching or the original pattern. The major lesson from this approach, as distinct from a linear stage type of approach, is that it makes sense to establish the conditions in which a

fundamental switch is more likely (but may occur unpredictably) and persist with these conditions, even when there is no obvious evidence of movement.

Table 6.3: Elementary processes of changes to dispositions

Automatic	
Maturation	Changes associated with growing older
Habituation	Decrease in response with exposure
Sensitisation	Increase in response with exposure
Chemical 'insult'	Pharmacological responses
Physical 'insult'	Brain lesions
Associative learning	Operant and classic conditioning
Imitation	Direct copying
Perception	Acquiring information from the senses
Identification	Forming one's own identity from perceptions of others
Consistency disposition	Generation of motives and ideas from similar ones
Dissonance avoidance	Negating or blocking uncomfortable thoughts
Objectification	Generating evaluations from likes and dislikes
Reflective	
Assimilation	Acquiring information through communication
Inference	Induction and deduction
Analysis	Formal and informal calculation

In addiction, these dispositions can be expected to interact with each other and with elements of the COM-B system outside the individual to create a pattern of behaviour that escalates over a period of months or years and then stabilises. Changing this pattern of behaviour requires structural changes to dispositions or opportunities or both.

6.5 Conclusions

Understanding behaviour can usefully involve identifying the capabilities, opportunities and motivations that underpin it, and how these interact. Understanding addictive behaviours would then require consideration of all these aspects.

Motivation lies at the heart of this. In one overarching model, PRIME theory, behaviour can be understood in terms of five interacting levels of the motivational system: self-conscious plans provide a means of enacting future orientation and give structure to our behaviour; evaluations (beliefs about what is good or bad) provide input to plans and are subject to reflection and analysis; motives/desires are feelings of want and need arising from expected pleasure or satisfaction (wants) or relief from mental or physical discomfort (needs) associated with imagined futures; and impulses and counter-impulses/inhibition are action schemas that directly drive/inhibit behaviour.

It is possible that plans and evaluations can influence behaviour only to the extent that they influence motives/desires, which in turn have to act through impulses and counter-impulses. At any moment, there are multiple inputs to these processes at all levels so that, for example, desires arising from plans come into conflict with powerful sources of desire arising from anticipated pleasure or relief.

Addiction generally involves powerful wants and needs arising at critical moments, which undermine or overwhelm any that are derived from plans based on other goals such as self-preservation. Addressing addiction involves reducing exposure to the environmental and internal factors which generate desires to engage in the addictive behaviour, bolstering countervailing desires and maximising the efficiency of the process of formulation of plans and how plans come to generate desires. The next two chapters examine the implications of this for assessment and intervention.



Chapter 7: Implications of theory for assessment and measurement of addiction and related constructs

7.1 How should addiction be 'diagnosed'? 106

7.2 How should the 'degree' of addiction be measured? 107

7.3 How should one measure constructs that contribute to or protect against addiction? 110

7.4 Summary 113

Chapter 7: Implications of theory for assessment and measurement of addiction and related constructs

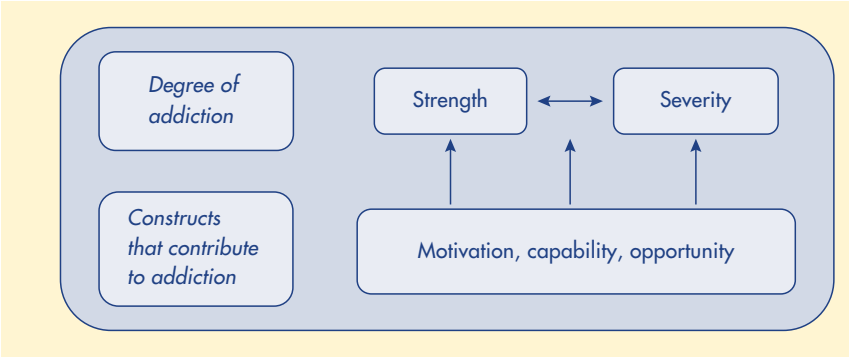
The models reviewed in this report contain a wide range of constructs that can be assessed and measured. This assessment and measurement is fundamental to the practical application of the models and to their testing and development. This chapter examines the options, beginning with the issue of 'diagnosis': whether or not addiction is present. Before continuing, it is important to say that the discussion that follows is intended not to detract from the very large amount of high-quality research that has been undertaken in the field of measurement relating to addiction (Bush et al., 1987; Meyers et al., 1995; Morgan et al., 1999; Friedmann et al., 2000; Savage, 2002; Knight et al., 2003; Webster and Webster, 2005), but to raise questions that arise from the analysis of the models presented earlier and to attempt to answer them.

7.1 How should addiction be 'diagnosed'?

In particular, the present chapter highlights a number of important aspects that need to be taken into consideration when attempting to assess and/or monitor drug addiction at the individual and/or population level. First, any meaningful assessment or monitoring of addiction, for example for service planning purposes, cannot merely rely on a dichotomous approach (presence of addiction or not). Any meaningful monitoring of addiction has to therefore determine, primarily, the degree of addiction. Thus, being able to determine the proportions of the population that show different degrees of addiction allows, for example, more efficient and targeted allocation of resources. To date, 'one size fits all' seems to remain the most prevalent approach in service planning. Therefore, the present chapter shows how degrees of addiction can be determined by assessing the strength and the severity of addiction. Although these are two distinct aspects, they often overlap, influence each other and form the framework within which the assessment and monitoring of addiction can take place. Finally, as described in the COM-B model of addiction, there are three main components that promote addiction and the maintenance of addictive behaviours, namely motivation, opportunity and capability. As presented here, these individual and contextual components act directly upon the strength and the severity

of addiction. Therefore, as these components appear to play a crucial role in promoting addiction, it is important that well-constructed assessment tools are developed to capture these components in order to inform effective treatment or prevention interventions.

Figure 7.1: Addiction and related constructs



7.2 How should the 'degree' of addiction be measured?

Each of the models of addiction reviewed recognises that addiction is a matter of degree. However, there are two key factors fundamental to the definition that may vary in degree: the strength of the motivational forces in operation and the extent of harm that is involved or could be involved. In practice, the two are highly correlated: the stronger the motivation to engage in the behaviour, the greater the harm that often ensues. Equally, the greater the harm, the stronger the motivation often has to be to sustain the behaviour in the face of it. However, the fact that they are correlated in practice does not mean they should be combined. There will be occasions when combining them leads to confusion and a failure to address important issues.

This is illustrated by the example of countries with a more traditional approach to cannabis drug policy, where a substantial amount of the harm to individuals and cost to society arises from the fact that cannabis use is illegal. Thus, for a given strength of motivation to engage in this activity, the harm arising from it is strongly related to the societal response. If one conflates strength of motivation to engage in the activity and harm arising from it, one loses sight of an important dimension in formation of policy.

The above analysis suggests a separation of what might be termed 'strength' from 'severity' of addiction. Strength itself is multifaceted because of the different aspects of motivation and self-regulatory capacity involved, but the principle of parsimony dictates that one should not construct more complex measures than are needed for one's purposes.

7.2.1 Strength of addiction

Before considering what may constitute a good measure of strength of addiction, it is important to consider how one would assess the value of such a measure. The most important criterion is how well it predicts continuation of the behaviour in the face of attempts to change it (Miller et al., 1996; McKay, 1999; McKay et al., 1999). For addicts with a clear goal of ceasing the addictive behaviour, a better measure of addiction will be one that, other things being equal, predicts success at achieving that goal. Other measures are also plausible, but if the target of interventions is to promote recovery from addiction or prevent behaviour patterns from becoming addictive this seems to be the logical choice.

The measurement of strength of addiction involves an inference from observable behaviour. Physiological variables such as activation of particular brain regions and density of particular receptors in certain brain regions may be used as measures of specific factors that may contribute to addiction, but they cannot be considered measures of the degree of addiction because they do not take account of factors that lie outside the individual that may contribute to the problem (as per the COM-B system analysis). It is important to avoid the tendency to equate addiction with neurological 'abnormalities' without regard to context, as this will lead to a focus on interventions (such as pharmacological treatments) that address only a part of the problem.

The observable 'behaviour' used to measure addiction may involve any of a number of different types of indicator. However, the observation will usually involve self-report because of the practical difficulty in observing the behaviour or motivational construct directly. Table 7.1 summarises the options for measuring the strength of addiction.

First, measurement may involve self-report of degree of motivation to engage in the behaviour or some specific facet of that motivation. This may focus on 'urge' in the case of addictions that are driven largely at the level of impulses. 'Need' and related labels (e.g. feelings of distress or anxiety) apply when addiction is driven largely by

Table 7.1: Options for measuring the strength of addiction

Measures of motivation
Strength of urges
Frequency of urges
Strength of need
Strength of drive
Beliefs about the importance of the addictive behaviour in one's life
Measures of behavioural tendencies
Frequency of engaging in the behaviour
Patterns of the behaviour that reveal powerful motivation
Objective markers of intensity of engagement with the behaviour
Response to interventions

anticipated relief from mental or physical discomfort and 'want' and related labels (e.g. enjoyment, satisfaction, pleasure) are appropriate when the addiction is driven largely by anticipated positive feelings.

Second, it may involve self-report of behaviours that can be considered as markers of some specific facet of motivation. It may involve statements of the priority attached to the addictive behaviour relative to other behaviours that are valued. Even after many decades of research in addiction, there is still a paucity of studies comparing different measures of this kind as predictors of success of attempts to cease an addictive behaviour.

7.2.2 Severity of addiction

The same strength of motivation to engage in a behaviour pattern may be more or less harmful depending on the context. One may term this the 'severity' of the addiction. Thus, a heroin addict who is experiencing significant health problems as a result of injecting may be regarded as having a more severe problem than someone who is mitigating the harm through hygienic injection practices. Some people who continue to smoke in the face of severe chronic obstructive pulmonary disease may be considered to be more severely addicted to tobacco than someone who smokes but is showing no evidence of harm. A gambler with a low disposable income whose life and whose family's lives are severely harmed by the money spent on gambling may be considered to have a more severe problem than someone who

spends more money and time gambling but who is much wealthier and so for whom it is less of a problem.

Severity could be a relevant concept in both individual cases and populations so as to determine how much resource to devote to addressing the problem. It is not clear whether this can be done in a global way for addictions in general. It is more likely that severity will have to be assessed for particular addictive behaviours in particular contexts for particular purposes.

A measure very commonly used in people with alcohol and illicit drug problems is the Addiction Severity Index (McLellan et al., 1980). This identifies a number of problem domains arising from addiction: psychological, social adjustment, legal, health and employment. This measure has shown good reliability and correlates well with other measures of the problem domains assessed. It can be administered within about 30 minutes using a structured interview. For the reasons outlined earlier, caution should be exercised in interpreting scores from this test across individuals and populations.

7.3 How should one measure constructs that contribute to or protect against addiction?

The range of constructs that relate to addiction that can help with understanding what underlies addiction in individual cases and in populations is vast, and for each such construct there is a plethora of variables. These include urges, wants, needs, capacity for impulse control, withdrawal symptoms, ego depletion, aspects of identity, measures of environmental cues promoting the addictive behaviour, beliefs regarding the benefits and harms associated with the behaviour, the nature of any personal rules applying to the behaviour or attempts to control it and environmental factors that promote or protect against formation of the intra-individual variables. The COM-B analysis can provide a helpful framework for the assessment of variables promoting addiction. Table 7.2 shows the main headings that such an analysis would require. Note that this kind of analysis can be undertaken with individuals, groups or populations, but in the last two cases the features need to be summarised in terms of statistical distributions.

As with measures of the strength of the addiction, it will be necessary to rely heavily on self-report. Traditionally, self-report measures involve 'scales' that use multiple items to assess a single construct (Furr and Bacharach, 2008). This is based on an

assumption from psychometrics that error of measurement would be reduced. However, this assumption often has not been borne out in those areas where it has been tested. For example, where comparisons have been made, single-item measures of craving have been found to have at least as good predictive validity and reliability as multi-item measures. Similar findings have emerged for measures of anxiety and depression and other withdrawal symptoms (DiFranza et al., 2002; West et al., 2006; Davey et al., 2007; West and Ussher, 2010; Lefèvre et al., 2011). An important lesson from this is that researchers should not assume that multi-item measurement is better than single-item measurement; rather, every additional item should show a clear benefit in terms of the purpose of the measure, such as its predictive validity.

Measures based on physiological functioning are important with regard to models at that level of analysis, but it is important not to imagine that they measure psychological constructs unless it can be demonstrated that they correlate highly with those constructs. Thus, at present, it is not realistic to talk about physiological measures of craving or impaired impulse control. Failure to understand this can lead to an inappropriate reification of measures as central to addiction, and therefore these measures become inappropriate targets for interventions.

Table 7.2: A COM-B analysis of an addictive behaviour in context

Capability	**What aspects of psychological capability, or lack of it, are contributing to the behaviour?**
Knowledge of and ability to understand consequences	What is the extent, nature and salience of knowledge about the addictive behaviour and its consequences? Is the information fully understood?
Self-regulatory capacity and skills	What are the capabilities for exerting inhibitory control generally and specifically in relation to the addictive behaviour in the presence of triggers or cues? What organisational and other cognitive skills are available to minimise exposure to temptations or cope with the temptations, e.g. through substitute activities?
Knowledge of and ability to understand how to change	What understanding is there about appropriate pathways to change including available sources of support and optimal methods of achieving change?
Opportunity	**What aspects of the physical and social environment are promoting the behaviour or inhibiting change?**
Access to the addictive behaviour	How easy is it to gain access to the behaviour? How affordable is it? What are the opportunity costs?

Table 7.2 (continued)	
Cues in the physical and social environment that prompt or remind about the addictive behaviour	What are the events and features of the social and physical environment that provoke desires or impulses to engage in the addictive behaviour, e.g. exposure to advertising? Note the importance of evaluating these cues as the addict experiences them and not merely as they are delivered
Cues in the social environment that would permit or prompt change	What are the events and features of the social and physical environment that provoke desires or impulses to change the behaviour pattern, e.g. social marketing campaigns?
Motivation	**What are the motivational forces that promote the behaviour in competition with other more adaptive behaviours?**
Beliefs about the positive and negative features of the addictive behaviour	What are the beliefs about the positive functions and negative aspects of the behaviour? How salient are they? Note this is different from beliefs about the consequences (see above) – this concerns the *evaluation* of the consequences as good or bad
Pleasure and satisfaction derived from the addictive behaviour	What is the extent, nature and time course of positive feelings associated with the behaviour? These may include direct pharmacological effects, effects on social standing and functions served by the behaviour such as achieving a desirable body image
Mental and physical discomfort arising from the addictive behaviour	What is the extent and nature of the feelings of mental and physical discomfort caused directly or indirectly by the behaviour? This would include worry about future health and punishment from the criminal justice system, as well as the aversion to any physical discomfort of engaging in the behaviour
Needs met by the addictive behaviour	What needs are met by the addictive behaviour, whether they be ones that did not derive from that behaviour (e.g. anxiety, depression, boredom, loneliness) or that arose because of the addictive behaviour (e.g. cravings, withdrawal symptoms)?
Pleasure and satisfaction derived from, and needs met by, other activities	What is the extent and nature of the enjoyment and satisfaction experienced from other activities? How does this conflict with the addictive behaviour?
General aspects of identity	What are the labels, characteristics and personal rules that the person applies to him- or herself generally and what feelings are attached to these?
Aspects of identity relating to the addictive behaviour	What are the labels, characteristics and personal rules that the person applies to him- or herself in relation to the behaviour and what feelings are attached to these?

7.4 Summary

Adopting a broad-based model of addiction highlights the problems with trying to define the presence or absence of addiction based on a set of 'diagnostic criteria' of the kind adopted in the *Diagnostic and Statistical Manual of Mental Disorders* 4th edition (DSM-IV) and the International Classification of Diseases (ICD). Such a diagnostic process can lead to spurious estimates of prevalence and can provide inappropriate decisions with respect to the provision of beneficial help for addicts.

One possible solution to the problem is to say that, in addition to the diagnosis of addiction, it should be assessed whether the person engages in a behaviour that has known addictive potential and whether it results in a significant harm or risk of harm. In the case of behaviours such as injecting illicit drugs and tobacco use, this would apply to all users. In the case of alcohol use, it would apply to use above known safe limits in terms of amount or pattern.

The issue of assessment of the degree of addiction is separate and it is necessary to distinguish strength (based on the strength of motivation to engage in the behaviour) from severity (the harm resulting from the behaviour).

Assessment of factors underlying the addictive behaviour could perhaps be structured around the COM-B model. Within each of these categories there is a need to assess how far different components are contributing to the problem. Problems with capacity may include failure to understand the consequences of the behaviour, low capacity to learn from harmful consequences, weak capacity for inhibitory control or poor self-regulatory skills. Opportunity may involve ready access to the addictive behaviour or prevalence of cues that provoke a desire to engage in the behaviour. Motivation may involve strong desires arising from anticipated pleasure, satisfaction or relief, or weak countervailing desires. Identity is a pervasive and powerful source of desires, so it is appropriate to measure aspects of this, including self-labels, self-attributes and personal rules, separately.

Chapter 8: Implications of the comprehensive theory for intervention strategies

8.1 How should intervention strategies be developed? 116

8.2 The behavioural analysis 117

8.3 Identification of intervention functions 118

8.4 Implementing intervention functions 124

8.5 Evaluation 126

8.6 Summary 126

Chapter 8: Implications of the comprehensive theory for intervention strategies

The analysis in Chapter 6 suggests that there should be a wide range of interventions to tackle addiction and these should address the contributing individual and environmental factors. The particular blend of interventions in the case of different individuals, groups, subpopulations or populations will depend on an analysis of the current drivers of the behaviour and a further analysis of what would be needed to achieve the necessary change.

8.1 How should intervention strategies be developed?

In practice, the development of intervention strategies tends to be rather haphazard and based on an intuitive analysis of the problem domain or on a favourite theory (Michie et al., 2008). Sometimes frameworks are developed to help guide the process but these generally do not provide a comprehensive coverage of the options or clear linkage with models of behaviour change (Michie et al., 2011a). The COM-B system described earlier has been used as a starting point for a more systematic and theoretically driven approach to developing an intervention strategy for behaviour change that is applicable to addictive behaviours. This is only one possible approach, but it could help to structure the process of policy development. Table 8.1 shows the steps that might be involved. These steps would lead one to only the process of designing the intervention strategy, which would then need to be implemented in some form, evaluated and, if necessary, adapted in an iterative process until the behavioural target is achieved. The following section describes the process in more detail.

Table 8.1: Steps involved in designing an intervention strategy	
Behavioural analysis	1. Define the behavioural target
	2. Undertake an analysis of the current behaviour in context, assessing what aspects of capability, opportunity and motivation are driving the behaviour
	3. Undertake an analysis of what would be needed to achieve the behavioural target
Identification of intervention functions	4. Use appropriate theory to map requirements onto a set of candidate intervention functions
	5. Use available evidence to refine the list of intervention functions and decide on the kinds of interventions that might be appropriate within those
	6. Further refine the list in the light of judgements and evidence on affordability, practicability and acceptability
Implementing intervention functions	7. Use available evidence and analysis to identify behaviour change techniques likely to be most effective in achieving the intervention functions
	8. Use available evidence to determine what mixture of policies (e.g. regulation, service provision, fiscal policies) can best deliver the intervention functions and behaviour change techniques
Evaluation of functions and policies chosen	9. Check if behavioural target is achieved

8.2 The behavioural analysis

A first step in intervention design is specifying the behavioural target. This step is often left implicit, but it could be helpful to be precise because everything else follows from this. In the case of addiction, the behavioural target for a population might be a reduction in the prevalence of a given addictive behaviour or engagement in an addictive behaviour at a certain level of harm. One might, for example, seek to reduce the number of injecting heroin users by half, or the cost of drug-related crime by a given amount; for example, the English tobacco control strategy in 1998 set a target of reducing prevalence from 28% to 21% by 2010 (Department of Health, 2010). From the previous theoretical analysis it would appear that, in any area of behaviour change, targets can play a very important role. However, unrealistic targets that are

not policed or which do not precisely conform to one's desired goals can be counterproductive. Other critical points include the availability of necessary means to reach the target (e.g. treatment slots, number of therapists available), the choice of outcome indicators and the use of objective, stable parameters for their assessment.

For a given individual seeking treatment, setting an appropriate behavioural target is equally important. Different individuals will often have different goals or differ in the extent to which they have reflected on those goals. The simple question of 'What do you want from this treatment?' is an obvious starting point. This may not be the goal that is eventually set, but it is important to ensure that, ultimately, there is a clear goal in mind and to know the basis for it.

For individuals or groups with multi-addiction problems, it is important to be clear about which of them are to be targeted. In this regard, it is worth noting that changing one addictive behaviour can affect others. Thus, there is some evidence that addressing alcohol addiction increases the chances of stopping tobacco smoking even if that behaviour is not targeted (Karam-Hage et al., 2005) and that smoking cessation may improve abstinence from alcohol and illicit drugs (Prochaska et al., 2004). This highlights the importance of taking a systems approach to understanding behaviour and behaviour change.

The next step is to use whatever evidence is available to determine how the current problem arises from different aspects of capability, opportunity and motivation. This can involve an assessment of the kind described in Table 7.2. The focus is to assess what the momentary drivers of wants and needs are for that individual, given the opportunities and capabilities afforded by their personal characteristics and circumstances. This can provide a basis, alongside other evidence available, and further theoretical inference for a COM-B analysis of what would be needed to achieve the behavioural target. This involves assessing what might be thought of as deficits in capability and opportunity, and how motivation (primarily momentary wants and needs) to enact and sustain the change can be bolstered relative to continuing with the addictive behaviour.

8.3 Identification of intervention functions

The next step is to develop a broad intervention strategy by selecting a type of intervention. There are many potential behaviour change intervention frameworks that can guide this. A recent systematic review found that, as with the models of addiction reviewed earlier, each framework included some but not all of the

intervention functions available (Michie et al., 2011a). This review proposed a system that combined all the intervention functions into a single framework that was also closely linked to the COM-B system as a broad-brush system for analysing the behaviour in question. This framework (originally labelled as the 'Behaviour Change Wheel' by the authors) included nine intervention functions and seven types of policy that could be used to implement these interventions.

Figure 8.1 provides information on combinations of sources of behaviour, intervention functions and policy approaches based on the models described above.

All nine intervention functions are potentially relevant for different individuals, populations and circumstances. In each case a clear specification of the behavioural target and an analysis of the changes (in terms of capability, opportunity and motivation) needed to achieve that target are required. This leads to a selection of intervention functions needed to make those changes. Of course, this can only set out the broad strategy and there is still considerable work required to develop and implement effective behaviour change techniques within each intervention.

This concept makes a distinction between intervention functions and policies needed to enact these. For example, it may be decided that an important aspect of prevention of cannabis use was education concerning specific short-term harms about which there was low awareness. This does not necessarily mean that a mass media campaign should be mounted. It may be more effective or cost-effective to educate through targeted provision of an advisory service.

PRIME theory suggests possible mappings from the COM-B analysis to the intervention functions. For example, deficits in reflective motivation can be addressed through education, persuasion, incentivisation and coercion. Where there is a problem in automatic motivation the appropriate intervention functions can include persuasion, incentivisation, coercion, environmental restructuring, modelling and enablement. The initial choice of specific intervention functions depends on reviewing the best available evidence specifically related to the issue, failing which, evidence relating more generally to this kind of behaviour and context.

The following are further examples of how behaviour can be influenced through changing opportunity, capacity or motivation:

- Physical capability can be achieved through physical skill development, which is the focus of training, or potentially through enabling interventions such as medication, surgery or prostheses.

Figure 8.1: Relationships between intervention functions, policies for implementing these and sources of behaviour

		INTERVENTION FUNCTIONS								
		Restriction	Environ-mental re-structuring	Modelling	Persuasion	Incentivisa-tion	Coercion	Education	Training	Enablement
SOURCES OF BEHAVIOUR	Opportunity – Physical									
	– Social									
	Motivation – Automatic									
	– Reflective									
	Capability – Physical									
	– Psychological									
POLICY CATEGORIES	Communication/ marketing									
	Guidelines									
	Fiscal									
	Regulation									
	Legislation									
	Environmental/ social planning									
	Service provision									

Based on Michie et al. (2011a).

- Psychological capability can be achieved through imparting knowledge or understanding, training emotional, cognitive and/or behavioural skills or through enabling interventions such as medication.
- Reflective motivation can be achieved through increasing knowledge and understanding, eliciting positive (or negative) feelings about behavioural target.
- Automatic motivation can be achieved through associative learning that elicit positive (or negative) feelings and impulses and counter-impulses relating to the behavioural target, imitative learning, habit formation or direct influences on automatic motivational processes (e.g. through the use of medication).
- Physical and social opportunity can be achieved through environmental change.

If one starts from a specific intervention function one also can deduce which sources of behaviour might be targeted. So, 'restriction' only has a relationship with 'opportunity' and therefore can target this, while 'training' can target only 'physical' and 'psychological capability' in this concept.

Table 8.2 describes interventions and policies in more detail and provides definitions and examples to better explain these items.

Table 8.2: Definitions of intervention functions and policy categories

	Definition	Example
Interventions		
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	Controlling the supply of opiate medications
Environmental restructuring	Changing the physical or social context	Limiting the number of alcohol outlets in a district
Modelling	Providing an example for people to aspire to or imitate	Showing a popular media personality successfully battle against alcohol addiction

Table 8.2 (continued)

	Definition	Example
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery to create a feeling of disgust at the effects of smoking
Incentivisation	Creating expectation of reward	Using financial incentives to promote abstinence from cocaine
Coercion	Creating expectation of punishment or cost	Raising the price of alcohol
Education	Increasing knowledge or understanding	Informing smokers about optimal methods of quitting
Training	Imparting skills	Training bar staff in skills to refuse to serve intoxicated patrons
Enablement	Increasing means/reducing barriers to increase capability or opportunity ([1])	Provision of buprenorphine or methadone to help addict limit heroin use
Policies		
Communication/ marketing	Using print, electronic, telephonic or broadcast media	Conducting mass media campaigns
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision	Producing and disseminating treatment protocols
Fiscal	Using the tax system to reduce or increase the financial cost	Increasing duty or increasing anti smuggling activities
Regulation	Establishing rules or principles of behaviour or practice	Establishing voluntary agreements on advertising
Legislation	Making or changing laws	Prohibiting sale or use
Environmental/ social planning	Designing and/or controlling the physical or social environment	Street-lighting and enclosure schemes to limit opportunities for injecting
Service provision	Delivering a service	Establishing support services in workplaces and communities

([1]) Increasing capability beyond education and training, and opportunity beyond environmental restructuring.

Source: Michie et al. (2011a).

Having arrived at a set of possible intervention functions that evidence suggests would probably be effective in achieving the behavioural target, the question remains whether these meet other important criteria of affordability, practicability and acceptability. An intervention strategy has to meet all of these criteria to be implemented.

Affordability is a concept that is very much in the minds of policymakers but which is not well addressed by researchers and organisations that make recommendations on interventions. The latter tend to focus on cost-effectiveness, but this is not the same as affordability. An intervention might be highly effective and cost-effective but not judged to be affordable by whoever is bearing the cost.

Practicability is a criterion that requires systematic evaluation. It is possible for an intervention (e.g. complex counselling) to be highly effective when delivered by very skilled and motivated staff but ineffective otherwise. Another intervention (e.g. a text messaging intervention) may have less potential in terms of effectiveness but might actually be more effective because of the difficulties in achieving the skill level required to benefit from the counselling intervention.

Acceptability is a criterion that has a number of potential dimensions, one of which is ethicality. For example, in China there have been studies examining surgical ablation of the nucleus accumbens as a way of treating opiate addiction (Gao et al., 2003) and alcohol dependence (Wu et al., 2010). Many societies would consider this unethical, however effective it might or might not be. In general, the more restrictive and coercive an intervention, and the more it results in adverse side-effects, the greater the ethical problems it poses (Nuffield Council on Bioethics, 2007).

Ethicality is culturally determined and changes over time. It also has a political dimension. This is linked to the question of public acceptability (Science and Technology Select Committee, 2010–11). It is often assumed that the public will not accept restrictive and coercive interventions when it comes to behaviours that harm only themselves. However, this is not the case. Like Ulysses ordering his crew to tie him to the mast of his ship as it passed the island of the sirens, the public will often recognise that it needs to be protected from temptations that would be impossible to resist. Thus, there is widespread acceptance in the UK for using tax increases to promote cessation and deter uptake (Gardner and West, 2010). Supporters of the legal addiction industries cite public acceptability as reasons not to engage with more coercive and restrictive policies, but this is an assumption.

One advantage of the approach described in this section is that it ensures that the process of strategy development includes all possible options. Without it there may be a tendency for potentially useful interventions to be overlooked. Moreover, it provides a rational basis for intervention selection. However, it is only a starting point. The next step is to develop the specific 'behaviour change techniques' that will make up the intervention.

8.4 Implementing intervention functions

Behaviour change techniques (BCTs) are irreducible components of an intervention aimed at changing behaviour (Abraham and Michie, 2008). The idea for these arose out of the observation that interventions to achieve behaviour change were poorly defined and described. This limits the extent to which one can develop an incremental technology of behaviour change. For example, intervention bundles such as 'motivational interviewing', '12-step therapy' and 'cognitive behavioural therapy' may have the same label but be very different in terms of content, but those with different labels can actually share many components (Babor and Del Boca, 2002). A common system for describing the components of behaviour change interventions could allow comparisons among them and provide a basis for identifying active ingredients and determining how these are linked to underlying theory and effectiveness.

Work on this began in the domain of promoting dietary change and physical activity (Michie et al., 2011b). It has recently been extended to face-to-face behavioural support for smoking cessation (Michie et al., 2011c) and brief physician advice to reduce excessive alcohol consumption (Michie et al., 2012). For example, BCTs that have been identified in individual face-to-face behavioural support for smoking cessation in the English Stop Smoking Services, and their associations with short-term success rates, can be used to choose the most adequate interventions. Based on the odds ratios (ORs) in self-reports, 'advice on changing routines' (OR 1.14) and 'measurement of CO' (OR 1.06) might be selected from the list of possible approaches.

This kind of analysis could be undertaken for behavioural support/counselling for other addictive disorders, which could provide a sufficiently robust basis for comparing interventions and identifying active components. This in turn could provide a basis for incremental improvements, but this can be achieved only if detailed treatment protocols or manuals are routinely made available in published reports (some journals now require this) (Craig et al., 2008).

Behaviour change techniques extend beyond counselling or behavioural support to include different forms of pharmacotherapy, approaches to incentivisation, types of coercive intervention, and so on. The process of mapping BCTs onto intervention functions has recently begun (Michie et al., 2011a). As it develops, it will be important to keep it aligned with underlying theory and developments in theory. Work to establish a similar taxonomy of types of BCTs in domains outside behavioural support/counselling is under way but is still in its early stages (Free et al., 2011). Ultimately, the goal is to be able to map types of BCTs onto each of the nine intervention functions.

Having identified potential intervention functions and behaviour change techniques to deliver those functions, one needs to determine what policies would be most appropriate to enable the interventions to be put into effect. As already noted, there may be several options in each case. It is important to canvass all the options, and issues of effectiveness, practicability, ethicality and affordability will all come into play as criteria.

8.5 Evaluation

After formulating the behavioural target, identifying which intervention function to use and selecting the most appropriate BCT, the mix of policies had been decided upon. In many cases, the first approach might not reach the behavioural target on the first attempt. For this reason, there should be a final step in the process: an evaluation, which should compare outcome with target and analyse whether changes in BCTs or policies would improve results. In cases where these adaptations do not lead to adequate outcomes, one might also discuss the possibility of using intervention functions that might be more appropriate or promising.

8.6 Summary

The model of addiction presented in this report implies broad-based intervention strategies for combating the problem. A starting point for this would be a precise specification of the 'behavioural target', whether it be for an individual or for particular populations. This could be followed by analysis of the current behaviour in context and what would be needed to achieve the behavioural target in terms of changes in capabilities, opportunity and motivation. This would then lead to preliminary identification of intervention functions that could lead to the required changes.

A recent systematic review of behaviour change frameworks identified nine intervention functions: education, training, persuasion, incentivisation, coercion, restriction, environmental restructuring, modelling and enablement. Evidence relating to these functions would need to be reviewed and linked to a theoretical analysis to arrive at a preliminary intervention strategy. The intervention functions would then need to be considered in the light of criteria of practicability, affordability and acceptability.

The resulting intervention strategy could then form the basis for determining specific BCTs to deliver those functions. The final stage in this phase of intervention design would be to decide on the most appropriate policies for enacting these BCTs.

Once an intervention strategy has been designed, a new iterative process of trial, evaluation and development begins, which, in principle, continues until the behavioural target has been met (MOST, 2011). It would be commonplace after that to define a new, more challenging target.

Chapter 9: Implications for policy and practice

9.1 A common core concept 128

9.2 Modelling the individual addict 128

9.3 Modelling populations 130

9.4 Using models of addiction to develop interventions 131

Chapter 9: Implications for policy and practice

Addiction is one of the key concepts in the scientific and policy debate around drugs, drug use and intervention. This discussion, however, does not stop at substance-based problems and includes phenomena such as gambling or compulsive use of the Internet. This report has collected models and theories of addiction developed by different disciplines to reflect different scientific approaches with the aim of an improved and deepened common understanding of the concept. The term 'addiction' lies at the very heart of the responsibilities of the European Monitoring Centre for Drugs and Drug Addiction. Hence, a discussion of this term against a background of recent debates in the scientific community and its possible consequences for assessment, monitoring and intervention are core to the work of the centre.

9.1 A common core concept

Although there are numerous definitions of addiction, they share commonalities which permit a broad-based definition: a repeated powerful motivation to engage in a particular behaviour, acquired through enacting the behaviour with a potential risk of significant harm.

There are numerous overlapping models that attempt to specify how addiction develops, how it is maintained and how people recover from it. Although none of the theories today is accepted as an integrative single model of addiction, in conjunction the existing different models provide us with a wide understanding of the concept. The following paragraphs draw together the summary statements of all the different main approaches.

Commonalities and overlaps in definition and concept are mirrored by positive correlations found between, for example, alcohol and nicotine addiction or heroin and cocaine addiction, as well as similarities in aetiology, risk and protective factors. All this leads to the open question of the extent to which interventions and policies for illicit substances require a more general approach that covers other aspects of addiction in this broader sense.

9.2 Modelling the individual addict

In this model, addiction arises out of either pre-existing characteristics of individuals or the acquisition of characteristics that, together with a given set of environmental

circumstances, result in powerful motivations to engage in harmful behaviour patterns. Prevention involves protecting individuals from factors that promote addiction. Recovery involves changing individuals or their circumstances to redress the motivational imbalance.

Automatic processing theories

Addicts acquire addictive behaviours through mechanisms that shape our behaviours without the need for conscious decisions or intentions and/or influence our capacity for self-regulation. Prevention and promotion of recovery involves changing the environment to alter exposure to cues and/or reinforcers, cueing and reinforcing competing behaviours and/or improving the efficiency of inhibitory mechanisms.

Reflective choice theories

Addicts choose to engage in the addictive behaviour and recovery involves choosing not to engage in it. The choice may be rational or biased but it always involves a comparison of the costs and benefits. Prevention and promotion of recovery involves altering the actual or perceived costs and benefits and/or improving the decision-making process.

Goal-focused theories

Addiction arises out of pleasure seeking or avoidance of distress or discomfort, or, at least in part, out of identification with others who engage in the addictive behaviour. Prevention and promotion of recovery involves restricting access to the sources of these goals, reducing their reward value, meeting the needs in other ways or boosting the impact of conflicting goals.

Integrative theories

Addiction involves a combination of mechanisms in which environmental factors and internal states and traits interact to generate conscious and non-conscious motivations based on seeking pleasure or satisfaction or avoiding discomfort. Prevention of addiction and promotion of recovery involves identifying and addressing key environmental and internal factors that need to be changed at the level of conscious choice and automatic processes.

Process-of-change theories

Development of, and recovery from, addiction involves a set of processes that can be delineated and influenced. Different stages may be involved and different processes may be used to move between these stages.

Neurobiological theories

Addiction is primarily a 'brain disease' in which neural pathways of executive function become disordered and particular motivational processes become amplified as a result of an interaction between behaviours and their effects on the brain, particularly ingestion of some drugs.

9.3 Modelling populations

Addiction can also be understood in terms of the interplay among population-level parameters. In many cases these can be modelled quantitatively as functions.

Social network theories

The rates of transition into and out of addiction on the part of individuals within a group or population are a function of the social connections between individuals who are or are not promoters of addiction or non-addiction, and the nature of those connections.

Economic models

The prevalence, incidence and/or rate of addictive behaviours in populations can be predicted by functions from economic theory, including current and future financial and other costs and availability of the behaviour and competing/alternative behaviours.

Communication/marketing models

The development of and recovery from addiction are influenced by the persuasive communications and marketing activities of those promoting or seeking to combat the behaviours concerned.

Organisational systems models

Addictive behaviours can be understood in terms of systems of mutually interacting components at a societal level (e.g. government, tobacco industry, public). The effects of innovation introduced into the system can be nullified by compensatory changes in another or can propagate through the system or even be amplified.

9.4 Using models of addiction to develop interventions

This report has extracted the main concepts in these models and identified a possible overarching model into which each can potentially be located. One advantage of this approach is that it directs attention to the full range of potential interventions that can be effective in combating addiction and provides the beginnings of a way of mapping different intervention functions onto an analysis of causes of the behaviour and what is needed to change the behaviour. Specific interventions can then be developed by determining which specific BCTs are applicable.

Different domains to intervene: strengths and weaknesses

The overarching model involves specification of the capabilities, opportunities and motivations, and their interactions, that drive or permit the addictive behaviour. Motivation lies at the heart of the model and this can be considered to involve multiple interacting levels of self-conscious plans, evaluations (beliefs about what is good and bad), motives (feelings of want and need), impulses and counter-impulses, and responses. An important general feature of this account is that self-conscious plans and evaluations can influence behaviour only through momentary desires. The conflict between momentary desires arising from plans and those arising from drive states and emotions is fundamental to the concept of control and self-control, and thus to addiction. Under this model, at each moment we act in pursuit of what we most want or need at that moment. Addiction involves powerful wants and needs and potentially weakened capacity to form wants and needs from plans.

Identity (our disposition to form mental representations of ourselves and the feelings attached to these) plays a pervasive and powerful role in generating wants and needs. It is the basis for self-control and the generation and enactment of plans. Deliberate behaviour change requires a change in at least one aspect of identity — the formation of new personal rules. In the case of addiction, this may involve not engaging in the behaviour, reducing engagement or many other permutations.

Setting a clear target, inspecting a pool of interventions and selecting the most appropriate

This analysis can provide the basis for a more comprehensive and structured approach to intervention development than is typically undertaken. It begins with a clear specification of the behavioural target, followed by a COM-B analysis of what is driving the current behaviour and what would need to be in place for the target to be achieved. This leads to a preliminary selection from the full range of intervention functions available: education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring and enablement. This selection then needs to be considered in the light of the affordability, practicability and acceptability of the proposed interventions in this particular case.

Once an intervention strategy has been arrived at, the next step is to determine the specific BCTs that will best deliver those functions and, finally, the policies that will be needed to bring them into effect.

Factors influencing the initial enactment of an addictive behaviour, development of addiction, attempts at recovery and avoiding relapse can be understood in terms of the different but overlapping capabilities, opportunities and motivation operating in the different phases. To the extent that there is overlap across the phases, interventions (e.g. restricting access to the behaviour, raising its financial cost) can affect all of them.

Thus, the main conclusion to come from this report is that it is both possible and essential to undertake a broader analysis of addictive behaviours than is usually undertaken. Such a broad-based approach can be applied in a focused and structured way using a coherent model of behaviour as it applies to addiction. This should enable the development of more effective intervention strategies. This approach does not replace the continued search for more effective interventions (e.g. better pharmacotherapies, better behavioural support and treatment, more effective pricing policies), but it does highlight the need to consider how these work together to achieve the desired goals. It also gives cause for reflection on the resources currently devoted to particular kinds of research and interventions. Funding priorities need to consider the payoffs relative to the full spectrum of approaches that could be taken.

References

Abraham, C. and Michie, S. (2008), 'A taxonomy of behavior change techniques used in interventions', *Health Psychology* 27, pp. 379–387.

Adams, J. and White, M. (2005), 'Why don't stage-based activity promotion interventions work?', *Health Education Research* 20, pp. 237–243.

Adler, L. E., Hoffer, L. D., Wiser. A. and Freedman, R. (1993), 'Normalization of auditory physiology by cigarette smoking in schizophrenic patients', *American Journal of Psychiatry* 150, pp. 1856–1861.

Adler, L. E., Olincy, A., Waldo, M., Harris, J. G., Griffith, J., Stevens, K., et al. (1998), 'Schizophrenia, sensory gating, and nicotinic receptors', *Schizophrenia Bulletin* 24, pp. 189–202.

Ahmed, S. H. (2005), 'Dopamine and addiction: a couple between the reason and irrationality', *Biofutur* 261, pp. 39–42.

Ahmed, S. H. (2011), 'The science of making drug-addicted animals', *Neuroscience* 211, pp. 107–125.

Ahn, A. C., Tewari, M., Poon, C. -S. and Phillips, R. S. (2006), 'The clinical applications of a systems approach', *PLoS Medicine* 3, p. e209.

Ainslie, G. and Monterosso, J. (2003), 'Hyperbolic discounting as a factor in addiction: a critical analysis', in Vuchinich, R.E. and Heather, N., eds., *Choice, behavioural economics and addiction*, Pergamon, Amsterdam, pp. 35–48.

Ajzen, I. (1991), 'The theory of planned behaviour', *Organizational Behavior and Human Decision Processes* 50, pp. 179–211.

ALICE RAP Project (2011), 'Addiction and lifestyles in contemporary Europe reframing addictions project', online at: https://sites.google.com/site/alicerapproject/home (accessed 8 November 2011).

Amato, L., Minozzi, S., Vecchi, S. and Davoli, M. (2010), 'Benzodiazepines for alcohol withdrawal', *Cochrane Database of Systematic Reviews,* Issue 3: CD005063.

Anderson, P., de Bruijn, A., Angus, K., Gordon, R. and Hastings, G. (2009), 'Impact of alcohol advertising and media exposure on adolescent alcohol use: a systematic review of longitudinal studies', *Alcohol and Alcoholism* 44, pp. 229–243.

Andreou, C. (2008), 'Making a clean break: addiction and Ulysses Contracts', *Bioethics* 22, pp. 25–31.

Babor, T. F. and Del Boca, K. (2002), *Treatment matching in alcoholism*, Cambridge University Press, Cambridge.

Baker, T. E., Stockwell, T., Barnes, G. and Holroyd, C. B. (2011), 'Individual differences in substance dependence: at the intersection of brain, behaviour and cognition', *Addiction Biology* 16, pp. 458–466.

Balfour, D. J. (2004), 'The neurobiology of tobacco dependence: a preclinical perspective on the role of the dopamine projections to the nucleus accumbens [corrected]', *Nicotine and Tobacco Research* 6, pp. 899–912.

Bandura, A. (1977), 'Self-efficacy: toward a unifying theory of behavioral change', *Psychological Review* 84, pp. 191–215.

Bar-Anan, Y., De Houwer, J. and Nosek, B. A. (2010), 'Evaluative conditioning and conscious knowledge of contingencies: a correlational investigation with large samples', *Quarterly Journal of Experimental Psychology (Colchester)* 63, pp. 2313–2335.

Baumeister, R. F. and Heatherton, T. F. (1996), 'Self-regulation failure: an overview', *Psychological Inquiry 7*, pp. 1–15.

Baumeister, R. F. and Vohs, K. D. (2007), 'Self-regulation, ego depletion, and motivation', *Social and Personality Psychology Compass* 1, pp. 115–128.

Becker, G. S. and Murphy, K. M. (1988), 'A theory of rational addiction', *Journal of Political Economy* 96, pp. 675–700.

Beenstock, M. and Rahav, G. (2002), 'Testing gateway theory: do cigarette prices affect illicit drug use?' *Journal of Health Economics* 21, pp. 679–698.

Berrendero, F., Robledo, P., Trigo, J. M., Martin-Garcia, E. and Maldonado, R. (2010), 'Neurobiological mechanisms involved in nicotine dependence and reward: participation of the endogenous opioid system', *Neuroscience and Biobehavioral Review* 35, pp. 220–231.

Berridge, K. C., Robinson, T. E. and Aldridge, J. W. (2009), 'Dissecting components of reward: "liking", "wanting", and learning', *Current Opinion in Pharmacology* 9, pp. 65–73.

Blaszczynski, A. and Nower, L. (2002), 'A pathways model of problem and pathological gambling', *Addiction* 97, pp. 487–499.

Blume, A. W. and Schmaling, K. B. (1996), 'Loss and readiness to change substance abuse', *Addictive Behaviors* 21, pp. 527–530.

Borland, R., Young, D., Coghill, K. and Zhang, J. Y. (2010), 'The tobacco use management system: analyzing tobacco control from a systems perspective', *American Journal of Public Health* 100, pp. 1229–1236.

Breese, G. R., Sinha, R. and Heilig, M. (2011), 'Chronic alcohol neuroadaptation and stress contribute to susceptibility for alcohol craving and relapse', *Pharmacology & Therapeutics* 129, pp. 149–171.

Brewer, J. A. and Potenza, M. N. (2008), 'The neurobiology and genetics of impulse control disorders: relationships to drug addictions', *Biochemical Pharmacology 75*, pp. 63–75.

Bush, B., Shaw, S., Cleary, P., Delbanco, T. L. and Aronson, M. D. (1987), 'Screening for alcohol abuse using the CAGE questionnaire', *American Journal of Medicine* 82, pp. 231–235.

Cacioppo, J. T. and Petty, R. E. (1984), 'The elaboration likelihood model of persuasion', *Advances in Consumer Research* 11, pp. 673–675.

Cahill, K., Stead, L. F. and Lancaster, T (2010), 'Nicotine receptor partial agonists for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 2: CD006103.

Cahill, K., Stead, L. F. and Lancaster, T. (2011a), 'Nicotine receptor partial agonists for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 2: CD006103 (update).

Cahill, K., Lancaster, T. and Green, N. (2011b), 'Stage-based interventions for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 11: CD004492.

Caspers, K. M., Yucuis, R., Troutman, B. and Spinks, R. (2006), 'Attachment as an organizer of behavior: implications for substance abuse problems and willingness to seek treatment', *Substance Abuse Treatment, Prevention, and Policy* 1, p. 32.

Cawley, J., Markowitz, S. and Tauras, J. (2004), 'Lighting up and slimming down: the effects of body weight and cigarette prices on adolescent smoking initiation', *Journal of Health Economics* 23, pp. 293–311.

Chaloupka, F. (1991), 'Rational addictive behavior and cigarette smoking', *Journal of Political Economy* 99, pp. 722–742.

Chambers, R. A., Bickel, W. K. and Potenza, M. N. (2007), 'A scale-free systems theory of motivation and addiction', *Neuroscience & Biobehavioral Reviews* 31, pp. 1017–1045.

Cheong, Y., Yong, H. H. and Borland, R. (2007), 'Does how you quit affect success? A comparison between abrupt and gradual methods using data from the International Tobacco Control Policy Evaluation Study', *Nicotine & Tobacco Research* 9, pp. 801–810.

Christakis, N. and Fowler, J. (2008), 'The collective dynamics of smoking in a large social network', *New England Journal of Medicine* 358, pp. 2249–2258.

Claes, L. and Vandereycken, W. (2007), 'Self-injurious behavior: differential diagnosis and functional differentiation', *Comprehensive Psychiatry* 48, pp. 137–144.

Clapp, J. D., Lange, J. E., Russell, C., Shillington, A. and Voas, R. B. (2003), 'A failed norms social marketing campaign', *Journal of Studies on Alcohol* 64, pp. 409–414.

Condiotte, M. M. and Lichtenstein, E. (1981), 'Self-efficacy and relapse in smoking cessation programs', *Journal of Consulting and Clinical Psychology* 49, pp. 648–658.

Conklin, C. A. and Tiffany, S. T. (2002), 'Applying extinction research and theory to cue-exposure addiction treatments', *Addiction* 97, pp. 155–167.

Cooper, M. L., Frone, M. R., Russell, M. and Mudar, P. (1995), 'Drinking to regulate positive and negative emotions: a motivational model of alcohol use', *Journal of Personality and Social Psychology* 69, pp. 990–1005.

Covey, L. S., Glassman, A. H. and Stetner, F. (1990), 'Depression and depressive symptoms in smoking cessation', *Comprehensive Psychiatry* 31, pp. 350–354.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., Petticrew, M. (2008), 'Developing and evaluating complex interventions: the new Medical Research Council guidance', *BMJ* 337, p. a1655.

Crews, F. T. and Boettiger, C. A. (2009), 'Impulsivity, frontal lobes and risk for addiction', *Pharmacology Biochemistry and Behavior* 93, pp. 237–247.

Cummings, J. L. (2000), 'A window on the role of dopamine in addiction disorders', *Journal of Neurology Neurosurgery and Psychiatry* 68, p. 404.

Davey, H. M., Barratt, A. L., Butow, P. N. and Deeks, J. J. (2007), 'A one-item question with a Likert or Visual Analog Scale adequately measured current anxiety', *Journal of Clinical Epidemiology* 60, pp. 356–360.

Davies, J. B. (1997), *The myth of addiction*, 2nd edition, Harwood Academic, Amsterdam.

Davis, C. and Carter, J. C. (2009), 'Compulsive overeating as an addiction disorder. A review of theory and evidence', *Appetite* 53, pp. 1–8.

Davis, W. T., Campbell, L., Tax, J. and Lieber, C. S. (2002), 'A trial of "standard" outpatient alcoholism treatment vs. a minimal treatment control', *Journal of Substance Abuse Treatment* 23, pp. 9–19.

De Vries, T. J. and Shippenberg, T. S. (2002), 'Neural systems underlying opiate addiction', *Journal of Neuroscience* 22, pp. 3321–3325.

Deci, E. L., Eghrari, H., Patrick, B. C. and Leone, D. R. (1994), 'Facilitating internalization: the self-determination theory perspective', *Journal of Personality* 62, pp. 119–142.

DeCicca, P., Kenkel, D. and Mathios, A. (2008), 'Cigarette taxes and the transition from youth to adult smoking: smoking initiation, cessation, and participation', *Journal of Health Economics* 27, pp. 904–917.

Degenhardt, L., Dierker, L., Chiu, W. T., Medina-Mora, M. E., Neumark, Y., Sampson, N., et al. (2011), 'Evaluating the drug use "gateway" theory using cross-national data: consistency and associations of the order of initiation of drug use among participants in the WHO World Mental Health Surveys', *Drug and Alcohol Dependence* 108, pp. 84–97.

DeJong, W., Schneider, S. K., Towvim, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., et al. (2006), 'A multisite randomized trial of social norms marketing campaigns to reduce college student drinking', *Journal of Studies on Alcohol* 67, pp. 868–879.

DeJong, W., Schneider, S. K., Towvim, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., et al. (2009), 'A multisite randomized trial of social norms marketing campaigns to reduce college student drinking: a replication failure', *Substance Abuse* 30, pp. 127–140.

Denson, T. F., Capper, M. M., Oaten, M., Friese, M., Schofield, T. P. (2011), 'Self-control training decreases aggression in response to provocation in aggressive individuals', *Journal of Research in Personality* 45, pp. 252–256.

Department of Health (2010), *A smokefree future*, Department of Health, London.

Di Chiara, G. (2002), 'Nucleus accumbens shell and core dopamine: differential role in behavior and addiction', *Behavioural Brain Research* 137, pp. 75–114.

Di Chiara, G., Bassareo, V., Fenu, S., De Luca, M. A., Spina, L., Cadoni, C., et al. (2004), 'Dopamine and drug addiction: the nucleus accumbens shell connection', *Neuropharmacology* 47, pp. 227–241.

Dickerson, C. A., Thibodeau, R., Aronson, E., Miller, D. (1992), 'Using cognitive dissonance to encourage water conservation', *Journal of Applied Social Psychology* 22, pp. 841–854.

DiClemente, C. C., Fairhurst, S. K., Velasquez, M. M., Prochaska, J. O., Velicer, W. F. and Rossi, J. S. (1991), 'The process of smoking cessation: an analysis of precontemplation, contemplation, and preparation stages of change', *Journal of Consulting and Clinical Psychology* 59, pp. 295–304.

DiFranza, J. R., Savageau, J. A., Fletcher, K., Ockene, J.K., Rigotti, N. A., McNeill, A. D., et al. (2002), 'Measuring the loss of autonomy over nicotine use in adolescents: the DANDY (Development and Assessment of Nicotine Dependence in Youths) study', *Archives of Pediatrics & Adolescent Medicine* 156, pp. 397–403.

Dijkstra, A. (2005), 'The validity of the stages of change model in the adoption of the self-management approach in chronic pain', *Clinical Journal of Pain* 21, pp. 27–37.

Dijkstra, A., De Vries, H., Roijackers, J., van Breukelen, G. (1998), 'Tailored interventions to communicate stage-matched information to smokers in different motivational stages', *Journal of Consulting and Clinical Psychology* 66, pp. 549–557.

Dong, G., Huang, J. and Du, X. (2011), 'Enhanced reward sensitivity and decreased loss sensitivity in Internet addicts: an fMRI study during a guessing task', *Journal of Psychiatric Research* 45, pp. 1525–1529.

Douglas, K. R., Chan, G., Gelernter, J., Arias, A. J., Anton, R. F., Weiss, R. D., et al. (2010), 'Adverse childhood events as risk factors for substance dependence: partial mediation by mood and anxiety disorders', *Addictive Behaviors* 35, pp. 7–13.

Edwards, W. (1961), 'Behavioral decision theory', *Annual Review of Psychology* 12, pp. 473–498.

Einstein, S. and Epstein, A. (1980), 'Cigarette smoking contagion', *International Journal of Addictions* 15, pp. 107–114.

Emshoff, J. R., Cuskey, W. R. and Cort, R. W. (1975), 'Environmental interaction theory — systems approach to prevention and control of drug addiction', *Contemporary Drug Problems* 4, pp. 57–81.

Fadardi, J. S. and Cox, W. M. (2009), 'Reversing the sequence: reducing alcohol consumption by overcoming alcohol attentional bias', *Drug and Alcohol Dependence* 101, pp. 137–145.

Fehr, E. and Zych, P. K. (1998), 'Do addicts behave rationally?', *Scandinavian Journal of Economics* 100, pp. 643–661.

Feichtinger, G., Hommes, C. and Milik, A. (1997), 'Chaotic consumption patterns in a simple 2-D addiction model', *Economic Theory* 10, pp. 147–173.

Ferguson, S. G. and Shiffman, S. (2009), 'The relevance and treatment of cue-induced cravings in tobacco dependence', *Journal of Substance Abuse Treatment* 36, pp. 235–243.

Fernandez, E., Gallus, S., Schiaffino, A., Lopez-Nicolas, A., La Vecchia, C., Barros, H., et al. (2004), 'Price and consumption of tobacco in Spain over the period 1965–2000', *European Journal of Cancer Prevention* 13, pp. 207–211.

Fernandez-Serrano, M. J., Perez-Garcia, M., Perales, J. C., Verdejo-Garcia, A. (2010), 'Prevalence of executive dysfunction in cocaine, heroin and alcohol users enrolled in therapeutic communities', *European Journal of Pharmacology* 626, pp. 104–112.

Ferrence, R. (1996), 'Using diffusion theory in health promotion: the case of tobacco', *Canadian Journal of Public Health* 87 (Suppl. 2), pp. S24–S27.

Ferrence, R. (2001), 'Diffusion theory and drug use', *Addiction* 96, pp. 165–173.

Festinger, L. (1957), *A theory of cognitive dissonance*, Stanford University Press, Stanford, CA.

Fidler, J. A. and West, R. (2011), 'Enjoyment of smoking and urges to smoke as predictors of attempts and success of attempts to stop smoking: a longitudinal study', *Drug and Alcohol Dependence* 115, pp. 30–34.

Field, M. and Cox, W. M. (2008), 'Attentional bias in addictive behaviors: a review of its development, causes, and consequences', *Drug and Alcohol Dependence* 97, pp. 1–20.

Field, M., Duka, T., Tyler, E. and Schoenmakers, T. (2009), 'Attentional bias modification in tobacco smokers', *Nicotine & Tobacco Research* 11, pp. 812–822.

Fishbein, M. and Ajzen, I. (1975), *Belief, attitude, intention and behavior,* Wiley, New York.

Flay, B. R. (2009), 'The promise of long-term effectiveness of school-based smoking prevention programs: a critical review of reviews', *Tobacco Induced Diseases* 5, p. 7.

Flores, P. J. (2004), *Addiction as an attachment disorder*, Jason Aronson, Lanham, MD.

Franken, I. H. A., Booij, J. and van den Brink, W. (2005), 'The role of dopamine in human addiction: from reward to motivated attention', *European Journal of Pharmacology* 526, pp. 199–206.

Free, C., Knight, R., Robertson, S., Whittaker, R., Edwards, P., Zhou, W., et al. (2011), 'Smoking cessation support delivered via mobile phone text messaging (txt2stop): a single-blind, randomised trial', *Lancet* 378, pp. 49–55.

French, M. T., BrownTaylor, D. and Bluthenthal, R. N. (2006), 'Price elasticity of demand for malt liquor beer: findings from a US pilot study', *Social Science & Medicine* 62, pp. 2101–2111.

Friedmann, P. D., McCullough, D., Chin, M. H. and Saitz, R. (2000), 'Screening and intervention for alcohol problems', *Journal of General Internal Medicine* 15, pp. 84–91.

Furr, R. M. and Bacharach, V. R. (2008), *Psychometrics: an introduction*, Sage Publications, Thousand Oaks, CA.

Gallet, C. A. and List, J. A. (2003), 'Cigarette demand: a meta-analysis of elasticities', *Health Economics* 12, pp. 821–835.

Gallus, S., Fernandez, E., Townsend, J., Schiaffino, A. and La Vecchia, C. (2003), 'Price and consumption of tobacco in Italy over the last three decades', *European Journal of Cancer Prevention* 12, pp. 333–337.

Gao, G., Wang, X., He, S., Li, W., Wang, Q., Liang, Q., et al. (2003), 'Clinical study for alleviating opiate drug psychological dependence by a method of ablating the nucleus accumbens with stereotactic surgery', *Stereotactic and Functional Neurosurgery* 81, pp. 96–104.

Gardner, B. and West, R. (2010), 'Public support in England for raising the price of cigarettes to fund tobacco control activities', *Tobacco Control* 19, pp. 331–333.

Gelkopf, M., Levitt, S. and Bleich, A. (2002), 'An integration of three approaches to addiction and methadone maintenance treatment: the self-medication hypothesis, the disease model and social criticism', *Israel Journal of Psychiatry and Related Sciences* 39, pp. 140–151.

Gibbons, F. X., Gerrard, M. and Lane, D. J. (2003), 'A social-reaction model of adolescent health risk', in Suls, J. M. and Wallston, K. A., eds., *Social psychological foundations of health and illness*, Blackwell, Oxford, pp. 107–136.

Gleick, J. (2011), *Chaos: making a new science*, Open Road, New York.

Goldstein, R. Z. and Volkow, N. D. (2002), 'Drug addiction and its underlying neurobiological basis: neuroimaging evidence for the involvement of the frontal cortex', *American Journal of Psychiatry* 159, pp. 1642–1652.

Goldstein, R. Z., Volkow, N. D., Wang, G. J., Fowler, J. S. and Rajaram, S. (2001), 'Addiction changes orbitofrontal gyrus function: involvement in response inhibition', *Neuroreport* 12, pp. 2595–2599.

Goldstein, R. Z., Leskovjan, A. C., Hoff, A. L., Hitzemann, R., Bashan, F., Khalsa, S. S., et al. (2004), 'Severity of neuropsychological impairment in cocaine and alcohol addiction: association with metabolism in the prefrontal cortex', *Neuropsychologia* 42, pp. 1447–1458.

Goldstein, R. Z., Woicik, P. A., Maloney, T., Tomasi, D., Alia-Klein, N., Shan, J., et al. (2011), 'Oral methylphenidate normalizes cingulate activity in cocaine addiction during a salient cognitive task', *Proceedings of the National Academy of Sciences of the United States of America* 107, pp. 16667–16672.

Gollwitzer, P. M. (1999), 'Implementation intentions: strong effects of simple plans', *American Psychologist* 54, pp. 493–503.

Gordon, R., McDermott, L., Stead, M., Angus, K. (2006), 'The effectiveness of social marketing interventions for health improvement: what's the evidence?', *Public Health* 120, pp. 1133–1139.

Gordon, R., MacKintosh, A. M. and Moodie, C. (2011), 'The impact of alcohol marketing on youth drinking behaviour: a two-stage cohort study', *Alcohol and Alcoholism* 45, pp. 470–480.

Guo, B., Aveyard, P., Fielding, A. and Sutton, S. (2008), 'Testing the convergent and discriminant validity of the Decisional Balance Scale of the Transtheoretical Model using the Multi-Trait Multi-Method approach', *Psychology of Addictive Behaviors* 22, pp. 288–294.

Guo, B., Aveyard, P., Fielding, A. and Sutton, S. (2009a), 'Using latent class and latent transition analysis to examine the transtheoretical model staging algorithm and sequential stage transition in adolescent smoking', *Substance Use & Misuse* 44, pp. 2028–2042.

Guo, B., Aveyard, P., Fielding, A. and Sutton, S. (2009b), 'Do the Transtheoretical Model processes of change, decisional balance and temptation predict stage movement? Evidence from smoking cessation in adolescents', *Addiction* 104, pp. 828–838.

Gwaltney, C. J., Shiffman, S., Balabanis, M. H., Paty, J. A. (2005), 'Dynamic self-efficacy and outcome expectancies: prediction of smoking lapse and relapse', *Journal of Abnormal Psychology* 114, pp. 661–675.

Haidt, J. (2007), *The happiness hypothesis: putting ancient wisdom to the test of modern science*, Random House Australia.

Hajek, P., Stead, L. F., West, R. and Jarvis, M. (2005), 'Relapse prevention interventions for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 1: CD003999.

Hajek, P., Stead, L. F., West, R., Jarvis, M. and Lancaster, T. (2009), 'Relapse prevention interventions for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 1: CD003999 (update).

Harris, P. R., Mayle, K., Mabbott, L. and Napper, L. (2007), 'Self-affirmation reduces smokers' defensiveness to graphic on-pack cigarette warning labels', *Health Psychology* 26, pp. 437–446.

Haw, J. (2008), 'Random-ratio schedules of reinforcement: the role of early wins and unreinforced trials', *Journal of Gambling Issues* 21, pp. 56–67.

Hayes, S. C., Strosahl, K. D., Wilson, K. G. (1999), *Acceptance and commitment therapy: an experiential approach to behavior change*, Guilford Press, New York.

Heath, A. C., Martin, N. G., Lynskey, M. T., Todorov, A. A. and Madden, P. A. (2002), 'Estimating two-stage models for genetic influences on alcohol, tobacco or drug use initiation and dependence vulnerability in twin and family data', *Twin Research* 5, pp. 113–124.

Heatherton, T. F. and Vohs, K. D. (1998), 'Why is it so difficult to inhibit behavior?', *Psychological Inquiry* 9, pp. 212–216.

Heeb, J. L., Gmel, G., Zurbrugg, C., Kuo, M. and Rehm, J. (2003), 'Changes in alcohol consumption following a reduction in the price of spirits: a natural experiment in Switzerland', *Addiction* 98, pp. 1433–1446.

Hendershot, C. S., Witkiewitz, K., George, W. H. and Marlatt, G. A. (2011), 'Relapse prevention for addictive behaviors', *Substance Abuse Treatment, Prevention, and Policy* 6, p. 17.

Herd, N., Borland, R. and Hyland, A. (2009), 'Predictors of smoking relapse by duration of abstinence: findings from the International Tobacco Control (ITC) Four Country Survey', *Addiction* 104, pp. 2088–2099.

Hester, R. and Garavan, H. (2004), 'Executive dysfunction in cocaine addiction: evidence for discordant frontal, cingulate, and cerebellar activity', *Journal of Neuroscience* 24, pp. 11017–11022.

Heyes, C. (2011), 'Automatic imitation', *Psychological Bulletin* 137, pp. 463–483.

Hirschman, E. (1992), 'The consciousness of addiction: towards a general theory of compulsive consumption', *Journal of Consumer Research* 19, pp. 155–179.

Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F. and Crombez, G. (2010), 'Evaluative conditioning in humans: a meta-analysis', *Psychological Bulletin* 136, pp. 390–421.

Hughes, J. R. (2007), 'Effects of abstinence from tobacco: etiology, animal models, epidemiology, and significance: a subjective review', *Nicotine & Tobacco Research* 9, pp. 329–339.

Hughes, J. R., Stead, L. F. and Lancaster, T. (2007), 'Antidepressants for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 1: CD000031.

Hussong, A. M., Jones, D. J., Stein, G. L., Baucom, D. H. and Boeding, S. (2011), 'An internalizing pathway to alcohol use and disorder', *Psychology of Addictive Behaviors* 25, pp. 390–404.

Hustad, J. T., Carey, K. B., Carey, M. P. and Maisto, S. A. (2009), 'Self-regulation, alcohol consumption, and consequences in college student heavy drinkers: a simultaneous latent growth analysis', *Journal of Studies on Alcohol and Drugs* 70, pp. 373–382.

Hyde, J., Hankins, M., Deale, A. and Marteau, T. M. (2008), 'Interventions to increase self-efficacy in the context of addiction behaviours', *Journal of Health Psychology* 13, pp. 607–623.

Hyman, S. E., Malenka, R. C. and Nestler, E. J. (2006), 'Neural mechanisms of addiction: the role of reward-related learning and memory', *Annual Review of Neuroscience* 29, pp. 565–598.

Jane-Llopis, E. and Matytsina, I. (2006), 'Mental health and alcohol, drugs and tobacco: a review of the comorbidity between mental disorders and the use of alcohol, tobacco and illicit drugs', *Drug and Alcohol Review* 25, pp. 515–536.

Janis, I. L. and Mann, L. (1977), *Decision making, a psychological analysis of conflict, choice and commitment*, The Free Press, New York.

Jellinek, E. M. (1960), *The disease concept of alcoholism*, Hillhouse Press, New Brunswick, NJ.

Jha, P., Chaloupka, F. J., Moore, J., Gajalakshmi, V., Gupta, P. C., Peck, R., et al. (2006), 'Tobacco addiction', in Jamison D.T., Breman, G. J., Measham, A. R., et al, *Disease control priorities in developing countries*, World Bank, Washington, DC.

Jimenez-Gomez, C. and Shahan, T. A. (2007), 'Resistance to change of alcohol self-administration: effects of alcohol-delivery rate on disruption by extinction and naltrexone', *Behavioural Pharmacology* 18, pp. 161–169.

John, R. M. (2008), 'Price elasticity estimates for tobacco products in India', *Health Policy and Planning* 23, pp. 200–209.

Jones, B. T., Corbin, W. and Fromme, K. (2001), 'A review of expectancy theory and alcohol consumption', *Addiction* 96, pp. 57–72.

Kahneman, D. and Tversky, A. (1979), 'Prospect theory: an analysis of decision under risk', *Econometrica* 47, pp. 263–292.

Kanayama, G., Brower, K. J., Wood, R. I., Hudson, J. I., Pope, H. G., Jr. (2009), 'Anabolic-androgenic steroid dependence: an emerging disorder', *Addiction* 104, pp. 1966–1978.

Kandel, D. B. and Andrews, K. (1987), 'Processes of adolescent socialization by parents and peers', *International Journal of the Addictions* 22, pp. 319–342.

Kandel, D. B., Yamaguchi, K. and Chen, K. (1992), 'Stages of progression in drug involvement from adolescence to adulthood: further evidence for the gateway theory', *Journal of Studies on Alcohol* 53, pp. 447–457.

Kaplan, G. B., Heinrichs, S. C. and Carey, R. J. (2011), 'Treatment of addiction and anxiety using extinction approaches: neural mechanisms and their treatment implications', *Pharmacology, Biochemistry, and Behavior* 97, pp. 619–625.

Karam-Hage, M., Pomerleau, C. S., Pomerleau, O. F. and Brower, K. J. (2005), 'Unaided smoking cessation among smokers in treatment for alcohol dependence', *Addictive Behaviors* 30, pp. 1247–1253.

Katz, R. C. and Singh, N. (1986a), 'A comparison of current smokers and self-cured quitters on Rosenbaum self-control schedule', *Addictive Behaviors* 11, pp. 63–65.

Katz, R. C. and Singh, N. N. (1986b), 'Reflections on the ex-smoker — some findings on successful quitters', *Journal of Behavioral Medicine* 9, pp. 191–202.

Kearney, M. H. and O'Sullivan, J. (2003), 'Identity shifts as turning points in health behavior change,' *Western Journal of Nursing Research* 25, pp. 134–152.

Keeney, R. L. and Raiffa, H. (1976), *Decisions with multiple objectives: preferences and value tradeoffs*, Wiley, New York.

Kelley, A. E. and Berridge, K. C. (2002), 'The neuroscience of natural rewards: relevance to addictive drugs', *Journal of Neuroscience* 22, pp. 3306–3311.

Khantzian, E. J. (1997), 'The self-medication hypothesis of substance use disorders: a reconsideration and recent applications', *Harvard Review of Psychiatry* 4, pp. 231–244.

Kim, S. H., Baik, S. H., Park, C. S., Kim, S. J., Choi, S. W. and Kim, S. E. (2011), 'Reduced striatal dopamine D2 receptors in people with Internet addiction', *Neuroreport* 22, pp. 407–411.

Knight, J. R., Sherritt, L., Harris, S. K., Gates, E. C. and Chang, G. (2003), 'Validity of brief alcohol screening tests among adolescents: a comparison of the AUDIT, POSIT, CAGE, and CRAFFT', *Alcoholism: Clinical and Experimental Research* 27, pp. 67–73.

Kokavec, A. (2008), 'Is decreased appetite for food a physiological consequence of alcohol consumption?', *Appetite* 51, pp. 233–243.

Kollins, S. H., MacDonald, E. K. and Rush, C. R. (2001), 'Assessing the abuse potential of methylphenidate in nonhuman and human subjects: a review', *Pharmacology, Biochemistry, and Behavior* 68, pp. 611–627.

Koob, G. F. (2008), 'Hedonic homeostatic dysregulation as a driver of drug-seeking behavior', *Drug Discovery Today: Disease Models* 5, pp. 207–215.

Koob, G. F. and Le Moal, M. (2001), 'Drug addiction, dysregulation of reward, and allostasis', *Neuropsychopharmacology* 24, pp. 97–129.

Koob, G. F. and Le Moal, M. (2005), 'Plasticity of reward neurocircuitry and the "dark side" of drug addiction', *Nature Neuroscience* 8, pp. 1442–1444.

Koob, G. F. and Le Moal, M. (2008), 'Addiction and the brain antireward system', *Annual Review of Psychology* 59, pp. 29–53.

Koob, G. F., Maldonado, R. and Stinus, L. (1992), 'Neural substrates of opiate withdrawal', *Trends in Neurosciences* 15, pp. 186–191.

Koob, G. F., Sanna, P. P. and Bloom, F. E. (1998), 'Neuroscience of addiction', *Neuron* 21, pp. 467–476.

Koski-jännes, A. (1998), 'Turning points in addiction careers: five case studies', *Journal of Substance Use* 3, pp. 226–233.

Kostowski, W. (2002), 'Drug addiction as drive satisfaction ("antidrive") dysfunction', *Acta Neurobiologiae Experimentalis (Warsaw)* 62, pp. 111–117.

Kovacic, P. (2005), 'Unifying mechanism for addiction and toxicity of abused drugs with application to dopamine and glutamate mediators: electron transfer and reactive oxygen species', *Medical Hypotheses* 65, pp. 90–96.

Lancaster, T. and Stead, L. F. (2005), 'Individual behavioural counselling for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 2: CD001292.

Lancaster, T., Hajek, P., Stead, L. F., West, R. and Jarvis, M. J. (2006), 'Prevention of relapse after quitting smoking — a systematic review of trials', *Archives of Internal Medicine* 166, pp. 828–835.

Larimer, M. E., Palmer, R. S. and Marlatt, G. A. (1999), 'Relapse prevention — an overview of Marlatt's cognitive–behavioral model', *Alcohol Research & Health* 23, pp. 151–160.

Leeman, R. F., O'Malley, S. S., White, M. A. and McKee, S. A. (2010), 'Nicotine and food deprivation decrease the ability to resist smoking', *Psychopharmacology (Berlin)* 212, pp. 25–32.

Lefèvre, T., Singh-Manoux, A., Stringhini, S., Dugravot, A., Lemogne, C., Consoli, S. M., et al. (2011), 'Usefulness of a single-item measure of depression to predict mortality: the GAZEL prospective cohort study', *European Journal of Public Health*, 22, pp. 643–647.

Lembke, A., Johnson, K. and DeBattista, C. (2007), 'Depression and smoking cessation: does the evidence support psychiatric practice?', *Neuropsychiatric Disease and Treatment,* 3, pp. 487–493.

Leshner A. I. (1997) 'Addiction is a brain disease, and it matters', *Science* 278, pp. 45–47.

Leventhal, H. and Cleary, P. D. (1980), 'The smoking problem: a review of the research and theory in behavioral risk modification', *Psychological Bulletin* 88, pp. 370–405.

Lingford-Hughes, A. R., Welch, S. and Nutt, D. J. (2004), 'Evidence-based guidelines for the pharmacological management of substance misuse, addiction and comorbidity: recommendations from the British Association for Psychopharmacology', *Journal of Psychopharmacology* 18, pp. 293–335.

Lippke, S., Schwarzer, R., Ziegelmann, J. P., Scholz, U. and Schuz, B. (2010), 'Testing stage-specific effects of a stage-matched intervention: a randomized controlled trial targeting physical exercise and its predictors', *Health Education & Behavior* 37, pp. 533–546.

Liu, J. -L., Liu, J. -T., Hammitt, J. K. and Chou, S. -Y. (1999), 'The price elasticity of opium in Taiwan, 1914–1942', *Journal of Health Economics* 18, pp. 795–810.

Lovato, C., Watts, A. and Stead, L. F. (2011), 'Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours', *Cochrane Database of Systematic Reviews*, Issue 10: CD003439.

Lubman, D. I., Yucel, M. and Pantelis, C. (2004), 'Addiction, a condition of compulsive behaviour? Neuroimaging and neuropsychological evidence of inhibitory dysregulation', *Addiction* 99, pp. 1491–1502.

Lussier, J. P., Heil, S. H., Mongeon, J. A., Badger, G. J. and Higgins, S. T. (2006), 'A meta-analysis of voucher-based reinforcement therapy for substance use disorders', *Addiction* 101, pp. 192–203.

Lyvers, M., Czerczyk, C., Follent, A. and Lodge, P. (2009), 'Disinhibition and reward sensitivity in relation to alcohol consumption by university undergraduates', *Addiction Research and Theory* 17, pp. 668–677.

McCusker, C. G. (2001), 'Cognitive biases and addiction: an evolution in theory and method', *Addiction* 96, pp. 47–56.

McKay, J. R. (1999), 'Studies of factors in relapse to alcohol, drug and nicotine use: a critical review of methodologies and findings', *Journal of Studies on Alcohol* 60, pp. 566–576.

McKay, J. R., Alterman, A. I., Mulvaney, F. D. and Koppenhaver, J. M. (1999), 'Predicting proximal factors in cocaine relapse and near miss episodes: clinical and theoretical implications', *Drug and Alcohol Dependence* 56, pp. 67–78.

McLellan, A. T., Luborsky, L., Woody, G. E. and O'Brien, C. P. (1980), 'An improved diagnostic evaluation instrument for substance abuse patients. The Addiction Severity Index', *Journal of Nervous and Mental Disease* 168, pp. 26–33.

Madoz-Gurpide, A., Blasco-Fontecilla, H., Baca-Garcia, E. and Ochoa-Mangado, E. (2011), 'Executive dysfunction in chronic cocaine users: an exploratory study', *Drug and Alcohol Dependence* 117, pp. 55–58.

Marlatt, G. A. and George, W. H. (1984), 'Relapse prevention — introduction and overview of the model', *British Journal of Addiction* 79, pp. 261–273.

Matthew, R. (1994), 'Cognitive dissonance and social change', *Journal of Economic Behavior and Organization* 23, pp. 177–194.

Mattick, R. P., Breen, C., Kimber, J. and Davoli, M. (2009), 'Methadone maintenance therapy versus no opioid replacement therapy for opioid dependence', *Cochrane Database of Systematic Reviews*, Issue 3: CD002209.

Meyers, K., Thomas McLellan, A., Jaeger, J. L. and Pettinati, H. M. (1995), The development of the comprehensive addiction severity index for adolescents (CASI-A): an interview for assessing multiple problems of adolescents', *Journal of Substance Abuse Treatment* 12, pp. 181–193.

Michie, S., Johnston, M., Francis, J. J., Hardeman, W. and Eccles, M. P. (2008), 'From theory to interventions: mapping theoretically derived behavioural determinants to behaviour change techniques', *Applied Psychology: An International Review* 57, pp. 660–680.

Michie, S., van Stralen, M. M. and West, R. (2011a), 'The behaviour change wheel: a new method for characterising and designing behaviour change interventions', *Implementation Science* 6, p. 42.

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A. and French, D. P. (2011b), 'A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy', *Psychology & Health* 26, pp. 1479–1498.

Michie, S., Hyder, N., Walia, A. and West, R. (2011c), 'Development of a taxonomy of behaviour change techniques used in individual behavioural support for smoking cessation', *Addictive Behaviors* 36, pp. 315–319.

Michie, S., Whittington, C., Hamoudi, Z., Zarnani, F., Tobert, G. and West, R. (2012), 'Behaviour change techniques to reduce excessive alcohol use and their associations with outcome', *Addiction* 107, pp. 1431–1440.

Miller, E. K. and Cohen, J. D. (2001), 'An integrative theory of prefrontal cortex function', *Annual Review of Neuroscience* 24, pp. 167–202.

Miller, W. R., Westerberg, V. S., Harris, R. J. and Tonigan, J. S. (1996), 'What predicts relapse? Prospective testing of antecedent models', *Addiction* 91, pp. 155–172.

Modell, J. G., Glaser, F. B., Mountz, J. M., Schmaltz, S. and Cyr, L. (1992), 'Obsessive and compulsive characteristics of alcohol abuse and dependence: quantification by a newly developed questionnaire', *Alcoholism: Clinical Experimental Research* 16, pp. 266–271.

Mook, D. (1995), *Motivation: the organization of action*, Norton, London.

Mooney, D. K., Fromme, K., Kivlahan, D. R. and Marlatt, G. A. (1987), 'Correlates of alcohol consumption: sex, age, and expectancies relate differentially to quantity and frequency', *Addictive Behaviors* 12, pp. 235–240.

Morgan, J. F., Reid, F. and Lacey, J. H. (1999), 'The SCOFF questionnaire: assessment of a new screening tool for eating disorders', *BMJ* 319, pp. 1467–1468.

MOST (2011), 'About the MOST programme', online at: http://www.unesco.org/new/en/social-and-human-sciences/themes/social-transformations/most-programme/about-most/ (accessed 8 November 2011).

Muraven, M. and Baumeister, R. F. (2000), 'Self-regulation and depletion of limited resources: does self-control resemble a muscle?', *Psychological Bulletin* 126, pp. 247–259.

Mytton, O., Gray, A., Rayner, M. and Rutter, H. (2007), 'Could targeted food taxes improve health?', *Journal of Epidemiology and Community Health* 61, pp. 689–694.

National Institute on Drug Abuse (2011), *Understanding drug abuse and addiction,* online at: http://www.drugabuse.gov/publications/drugfacts/understanding-drug-abuse-addiction

Nevin, J. A. and Grace, R. C. (2000), 'Behavioral momentum and the law of effect', *Behavioral and Brain Sciences* 23, pp. 73–90.

Nuffield Council on Bioethics (2007), *Public health: ethical issues*, Nuffield Council on Bioethics, London.

O'Brien, C. (2011), 'Addiction and dependence in DSM-V', *Addiction* 106, pp. 866–867.

Olekalns, N. and Bardsley, P. (1996), 'Rational addiction to caffeine: an analysis of coffee consumption', *Journal of Political Economy* 104, pp. 1100–1104.

Olsen, M. A. and Fazio, R. H. (2002), 'Implicit acquisition and manifestation of classically conditioned attitudes', *Social Cognition* 20, pp. 89–103.

Orford, J. (2001), 'Addiction as excessive appetite', *Addiction* 96, pp. 15–31.

Oriordan, W. K. (1969), 'Price elasticity of demand for tobacco in Ireland', *Economic and Social Review* 1, pp. 109–115.

Ornstein, S. I. (1980), 'Control of alcohol consumption through price increase', *Journal of Studies on Alcohol* 41, pp. 807–818.

van Ours, J. C. (1995), 'The price elasticity of hard drugs: the case of opium in the Dutch East Indies, 1923–1938', *Journal of Political Economy* 103, pp. 261–279.

Padwa, H. and Cunningham, J. (2010), *Addiction: a reference encyclopedia*, Greenwood Publishing Group, Santa Barbara, CA.

Pekurinen, M. and Valtonen, H. (1987), 'Price, policy and consumption of tobacco: the Finnish experience', *Social Science and Medicine* 25, pp. 875–881.

Perry, J. L. and Carroll, M. E. (2008), 'The role of impulsive behavior in drug abuse', *Psychopharmacology (Berlin)* 200, pp. 1–26.

Peters, J., Kalivas, P. W. and Quirk, G. J. (2009), 'Extinction circuits for fear and addiction overlap in prefrontal cortex', *Learning & Memory* 16, pp. 279–288.

Petty, R. E., Baker, S. M. and Gleicher, F. (1991), 'Attitudes and drug-abuse prevention — implications of the elaboration likelihood model of persuasion', in L.

Donohew, H. Sypher, W. Buksoski (eds.) *Persuasive communication and drug abuse prevention* Erlbaum Hillsdale, NJ, pp. 71–90.

Pfister, H. R. and Bohm, G. (2008), 'The multiplicity of emotions: a framework of emotional functions in decision making', *Judgment and Decision Making Journal* 3, pp. 5–17.

Pisinger, C., Vestbo, J., Borch-Johnsen, K. and Jorgensen, T. (2005), 'It is possible to help smokers in early motivational stages to quit. The Inter99 study', *Preventive Medicine* 40, pp. 278–284.

Pleyers, G., Corneille, O., Luminet, O. and Yzerbyt, V. (2007), 'Aware and (dis) liking: item-based analyses reveal that valence acquisition via evaluative conditioning emerges only when there is contingency awareness', *Journal of Experimental Psychology Learning Memory and Cognition* 33, pp. 130–144.

Pollak, K. I., Carbonari, J. P., DiClemente, C. C., Niemann, Y. F. and Mullen, P. D. (1998), 'Causal relationships of processes of change and decisional balance: stage-specific models for smoking', *Addictive Behaviors* 23, pp. 437–448.

Poulos, C. X., Parker, J. L. and Le, D. A. (1998), 'Increased impulsivity after injected alcohol predicts later alcohol consumption in rats: evidence for "loss-of-control drinking" and marked individual differences', *Behavioral Neuroscience* 112, pp. 1247–1257.

Povey, R., Conner, M., Sparks, P., James, R. and Shepherd, R. (1999), 'A critical examination of the application of the Transtheoretical Model's stages of change to dietary behaviours', *Health Education Research* 14, pp. 641–651.

Prochaska, J. O. and DiClemente, C. C. (1983), 'Stages and processes of self-change of smoking: toward an integrative model of change', *Journal of Consulting and Clinical Psychology* 51, pp. 390–395.

Prochaska, J. O. and DiClemente, C. C. (1984), 'Self change processes, self efficacy and decisional balance across five stages of smoking cessation', *Progress in Clinical and Biological Research* 156, pp. 131–140.

Prochaska, J. O., DiClemente, C. C. and Norcross, J. C. (1992), 'In search of how people change — applications to addictive behaviors', *American Psychologist* 47, pp. 1102–1114.

Prochaska, J. J., Delucchi, K. and Hall, S. M. (2004), 'A meta-analysis of smoking cessation interventions with individuals in substance abuse treatment or recovery', *Journal of Consulting and Clinical Psychology* 72, pp. 1144–1156.

Quick, S. L. and Shahan, T. A. (2009), 'Behavioral momentum of cocaine self-administration: effects of frequency of reinforcement on resistance to extinction', *Behavioural Pharmacology* 20, pp. 337–345.

Quinlan, K. B. and McCaul, K. D. (2000), 'Matched and mismatched interventions with young adult smokers: testing a stage theory', *Health Psychology* 19, pp. 165–171.

Remme, L., Lippke, S., Wiedemann, A., Ziegelmann, J. and Reuter, T. (2008), 'Promoting physical activity at work: how effective are stage-matched interventions?', *Psychology & Health* 23, pp. 221–222.

Rende, R., Slomkowski, C., Lloyd-Richardson, E. and Niaura, R. (2005), 'Sibling effects on substance use in adolescence: social contagion and genetic relatedness', *Journal of Family Psychology* 19, pp. 611–618.

Rhee, S. H., Hewitt, J. K., Young, S. E., Corley, R. P., Crowley, T. J. and Stallings, M. C. (2003), 'Genetic and environmental influences on substance initiation, use, and problem use in adolescents', *Archives of General Psychiatry* 60, pp. 1256–1264.

Riley, W., Rivera, D., Atienza, A., Nilsen, W., Allison, S. and Mermelstein, R. (2011), 'Health behavior models in the age of mobile interventions: are our theories up to the task?', *Translational Behavioral Medicine* 1, pp. 53–71.

Robinson, T. E. and Berridge, K. C. (2001), 'Incentive-sensitization and addiction', *Addiction* 96, pp. 103–114.

Roddy, J., Steinmiller, C. L. and Greenwald, M. K. (2011), 'Heroin purchasing is income and price sensitive', *Psychology of Addictive Behaviors* 25, pp. 358–364.

Rogers, R. W. (1975), 'A protection motivation theory of fear appeals and attitude change', *Journal of Psychology* 91, pp. 93–114.

Rosenquist, J. N., Murabito, J., Fowler, J. H. and Christakis, N. A. (2010), 'The spread of alcohol consumption behavior in a large social network', *Annals of Internal Medicine* 152, pp. 426–433.

Rosenthal, R. J. and Lesieur, H. R. (1992), 'Self-reported withdrawal symptoms and pathological gambling', *American Journal on Addictions* 1, pp. 150–154.

de Ruiter, M. B., Veltman, D. J., Goudriaan, A. E., Oosterlaan, J., Sjoerds, Z. and van den Brink, W. (2008), 'Response perseveration and ventral prefrontal sensitivity to reward and punishment in male problem gamblers and smokers', *Neuropsychopharmacology* 34, pp. 1027–1038.

Russell, C. A., Clapp, J. D. and Dejong, W. (2005), 'Done 4: analysis of a failed social norms marketing campaign', *Health Communication* 17, pp. 57–65.

Ryan, R. M. and Deci, E. L. (2000), 'Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being', *The American Psychologist* 55, pp. 68–78.

Ryle, G. (1949), *The concept of mind*, University of Chicago Press, Chicago.

Savage, S. R. (2002), 'Assessment for addiction in pain-treatment settings', *Clinical Journal of Pain* 18, pp. S28–S38.

de Savigny, D. and Adam, T. (2009), *Systems thinking for health systems*, World Health Organization, Geneva.

Schaler, J. A. (2000), *Addiction is a choice*, Open Court Publishers, Chicago and LaSalle, Illinois.

Schober, S., Schade, C.; National Institute on Drug Abuse (1991), *The epidemiology of cocaine use and abuse*, U.S. Department of Health and Human Services, Public Health Service, Alcohol, Drug Abuse, and Mental Health Administration, National Institute on Drug Abuse, Washington, DC.

Schwartz, R. H. (1998), 'Adolescent heroin use: a review', *Pediatrics* 102, pp. 1461–1466.

Science and Technology Select Committee (2010–12), 'Behaviour change', House of Lords paper 179, 2011.

Self, D. W. and Nestler, E. J. (1995), 'Molecular mechanisms of drug reinforcement and addiction', *Annual Review of Neuroscience* 18, pp. 463–495.

Seligman, M. E. (1972), 'Learned helplessness', *Annual Review of Medicine* 23, pp. 407–412.

Sher, K. J., Walitzer, K. S., Wood, P. K. and Brent, E. E. (1991), 'Characteristics of children of alcoholics: putative risk factors, substance use and abuse, and psychopathology', *Journal of Abnormal Psychology* 100, pp. 427–448.

Shiffman, S. (2000), 'Comments on craving', *Addiction* 95 (Suppl 2), pp. S171–S175.

Simpson, T. L. and Miller, W. R. (2002), 'Concomitance between childhood sexual and physical abuse and substance use problems. A review', *Clinical Psychology Review* 22, pp. 27–77.

Sinha, R. (2008), 'Chronic stress, drug use, and vulnerability to addiction', *Annals of the New York Academy of Sciences* 1141, pp. 105–130.

Skog, O. -J. (2000), 'Addicts' choice', *Addiction* 95, pp. 1309–1314.

Skog, O. -J. (2003), 'Addiction: definitions and mechanisms', in Vuchinich, R. E. and Heather, N., eds., *Choice, behavioural economics and addiction*, Pergamon, Amsterdam, pp. 157–175.

Slovic, P., Finucane, M., Peters, E. and MacGregor, D. G. (2002), 'The affect heuristic', in Gilovich, T., Griffin, D. and Kahneman, D., eds, *Intuitive judgement: heuristics and biases*, Cambridge University Press, New York, pp. 397–420.

Smith, F. M. and Marshall, L. A. (2007), 'Barriers to effective drug addiction treatment for women involved in street-level prostitution: a qualitative investigation', *Criminal Behaviour and Mental Health* 17, pp. 163–170.

Sobell, L. C., Sobell, M. B., Toneatto, T. and Leo, G. I. (1993), 'What triggers the resolution of alcohol problems without treatment?', *Alcoholism: Clinical and Experimental Research* 17, pp. 217–224.

Solomon, R. L. (1980), 'The opponent-process theory of acquired motivation: the costs of pleasure and the benefits of pain', *The American Psychologist* 35, pp. 691–712.

Solomon, R. L. and Corbit, J. D. (1973), 'An opponent-process theory of motivation. II. Cigarette addiction', *Journal of Abnormal Psychology* 81, pp. 158–171.

Solomon, R. L. and Corbit, J. D. (1974), 'An opponent-process theory of motivation. I. Temporal dynamics of affect', *Psychol Rev* 81, pp. 119–145.

Speranza, M., Revah-Levy, A., Giquel, L., Loas, G., Venisse, J. L., Jeammet, P., et al. (2012), 'An investigation of Goodman's addictive disorder criteria in eating disorders', *European Eating Disorders Review* 20, pp. 182–189.

Stead, L. F., Perera, R., Bullen, C., Mant, D. and Lancaster, T. (2008), 'Nicotine replacement therapy for smoking cessation', *Cochrane Database of Systematic Reviews*, Issue 1: CD000146.

Stead, M., Gordon, R., Angus, K. and McDermott, L. (2007), 'A systematic review of social marketing effectiveness', *Health Education* 107, pp. 126–191.

Strack, F. and Deutsch, R. (2004), 'Reflective and impulsive determinants of social behavior', *Personality and Social Psychology Review* 8, pp. 220–247.

Sutton, S. (2000), 'Interpreting cross-sectional data on stages of change', *Psychology & Health* 15, pp. 163–171.

Sutton, S. (2001), 'Back to the drawing board? A review of applications of the transtheoretical model to substance use', *Addiction* 96, pp. 175–186.

Sutton, S. (2005), 'Another nail in the coffin of the transtheoretical model? A comment on West (2005)', *Addiction* 100, pp. 1043–1046; author reply pp. 8–50.

Tangney, J. P., Baumeister, R. F. and Boone, A. L. (2004), 'High self-control predicts good adjustment, less pathology, better grades, and interpersonal success', *Journal of Personality* 72, pp. 271–324.

Thaler, R. H. and Sunstein, C. R. (2008), *Nudge: improving decisions about health, wealth and happiness*, Yale University Press, New Haven, CT.

Tiffany, S. T. (1990), 'A cognitive model of drug urges and drug-use behavior: role of automatic and nonautomatic processes', *Psychological Review* 97, pp. 147–168.

Topp, L., Day, C. and Degenhardt, L. (2003), 'Changes in patterns of drug injection concurrent with a sustained reduction in the availability of heroin in Australia', *Drug and Alcohol Dependence* 70, pp. 275–286.

Townsend, J. (1996), 'Price and consumption of tobacco', *British Medical Bulletin* 52, pp. 132–142.

Tversky, A. and Kahneman, D. (1986), 'Rational choice and the framing of decisions', *Journal of Business* 59, S251–S278.

Tversky, A. and Kahneman, D. (1991), 'Loss aversion in riskless choice: a reference-dependent model', *Quarterly Journal of Economics* 106, pp. 1039–1061.

Uhart, M. and Wand, G. S. (2009), 'Review: stress, alcohol and drug interaction: an update of human research', *Addiction Biology* 14, pp. 43–64.

Valente, T. W., Hoffman, B. R., Ritt-Olson, A., Lichtman, K. and Johnson, C. A. (2003), 'Effects of a social-network method for group assignment strategies on peer-led tobacco prevention programs in schools', *American Journal of Public Health* 93, pp. 1837–1843.

Verkooijen, K. T., de Vries, N. K. and Nielsen, G. A. (2007), 'Youth crowds and substance use: the impact of perceived group norm and multiple group identification', *Psychology of Addictive Behaviors* 21, pp. 55–61.

de Vet, E., de Nooijer, J., de Vries, N. K. and Brug, J. (2008), 'Testing the transtheoretical model for fruit intake: comparing web-based tailored stage-matched and stage-mismatched feedback', *Health Education Research* 23, pp. 218–227.

Vink, J. M., Willemsen, G. and Boomsma, D. I. (2005), 'Heritability of smoking initiation and nicotine dependence', *Behavior Genetics* 35, pp. 397–406.

Volkow, N. D., Fowler, J. S. and Wang, G. -J. (1999), 'Imaging studies on the role of dopamine in cocaine reinforcement and addiction in humans', *Journal of Psychopharmacology* 13, pp. 337–345.

Volkow, N. D., Fowler, J. S., Wang, G. J. (2002), 'Role of dopamine in drug reinforcement and addiction in humans: results from imaging studies', *Behavioural Pharmacology* 13, pp. 355–366.

Vuchinich, R. E. and Heather, N. (2003), *Choice, behavioral economics and addiction,* Pergamon, Cambridge.

Walters, G. D. (1996), 'Addiction and identity: exploring the possibility of a relationship', *Psychology of Addictive Behaviors* 10, pp. 9–17.

Webster, L. R. and Webster, R. M. (2005), 'Predicting aberrant behaviors in opioid-treated patients: preliminary validation of the opioid risk tool', *Pain Medicine* 6, pp. 432–442.

Wechsler, H., Nelson, T. E., Lee, J. E., Seibring, M., Lewis, C. and Keeling, R. P. (2003), 'Perception and reality: a national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use', *Journal of Studies on Alcohol* 64, pp. 484–494.

Wechsler, H., Seibring, M., Liu, I. C. and Ahl, M. (2004), 'Colleges respond to student binge drinking: reducing student demand or limiting access', *Journal of American College Health* 52, pp. 159–168.

Weiss, F., Ciccocioppo, R., Parsons, L. H., Katner, S., Liu, X., Zorrilla, E. P., et al. (2001), 'Compulsive drug-seeking behavior and relapse. Neuroadaptation, stress, and conditioning factors', *Annals of the New York Academy of Sciences* 937, pp. 1–26.

West, R. (2006), *Theory of addiction*, Wiley-Blackwell, Oxford.

West, R. (2009), 'The multiple facets of cigarette addiction and what they mean for encouraging and helping smokers to stop', *COPD* 6, pp. 277–283.

West, R. and Gossop, M. (1994), 'Overview: a comparison of withdrawal symptoms from different drug classes', *Addiction* 89, pp. 1483–1489.

West, R. and Sohal, T. (2006), '"Catastrophic" pathways to smoking cessation: findings from national survey', *BMJ* 332, pp. 458–460.

West, R. and Ussher, M. (2010), 'Is the ten-item Questionnaire of Smoking Urges (QSU-brief) more sensitive to abstinence than shorter craving measures?', *Psychopharmacology (Berlin)* 208, pp. 427–432.

West, R., Courts, S., Beharry, S. and Hajek, P. (1999), 'Acute effect of glucose tablets on desire to smoke', *Psychopharmacology* 147, pp. 319–321.

West, R., Ussher, M., Evans, M. and Rashid, M. (2006), 'Assessing DSM-IV nicotine withdrawal symptoms: a comparison and evaluation of five different scales', *Psychopharmacology* 184, pp. 619–627.

West, R., Walia, A., Hyder, N., Shahab, L. and Michie, S. (2011), 'Behavior change techniques used by the English Stop Smoking Services and their associations with short-term quit outcomes', *Nicotine & Tobacco Research* 12, pp. 742–747.

Wiers, R. W., Rinck, M., Kordts, R., Houben, K., Strack, F. (2010), 'Retraining automatic action-tendencies to approach alcohol in hazardous drinkers', *Addiction* 105, pp. 279–287.

Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S. and Lindenmeyer, J. (2011), 'Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome', *Psychological Science* 22, pp. 490–497.

Wise, R. A. and Bozarth, M. A. (1987), 'A psychomotor stimulant theory of addiction', *Psychological Review* 94, pp. 469–492.

World Health Organization (2002), *The world health report 2002*, World Health Organization, Geneva.

Wu, H. M., Wang, X. L., Chang, C. W., Li, N., Gao, L., Geng, N., et al. (2010), 'Preliminary findings in ablating the nucleus accumbens using stereotactic surgery for alleviating psychological dependence on alcohol', *Neuroscience Letters* 473, pp. 77–81.

Yeomans, M. R. (2010), 'Alcohol, appetite and energy balance: is alcohol intake a risk factor for obesity?', *Physiology & Behavior* 100, pp. 82–89.

Young, D., Borland, R. and Coghill, K. (2011), 'An actor–network theory analysis of policy innovation for smoke-free places: understanding change in complex systems', *American Journal of Public Health* 100, pp. 1208–1217.

Zhang, P., Husten, C., Giovino, G. (2000), 'Effect of the tobacco price support program on cigarette consumption in the United States: an updated model', *American Journal of Public Health* 90, pp. 746–750.

European Monitoring Centre for Drugs and Drug Addiction

EMCDDA Insights Series No 14

Models of addiction

Luxembourg: Publications Office of the European Union, 2013

2013 – 161 pp. – 14.8 x 21 cm

ISBN: 978-92-9168-652-0
doi: 10.2810/99994

Price (excluding VAT) in Luxembourg: EUR 15

How to obtain EU publications

Free publications:

- via EU Bookshop (http://bookshop.europa.eu);
- at the European Union's representations or delegations. You can obtain their contact details on the Internet (http://ec.europa.eu) or by sending a fax to +352 2929-42758.

Priced publications:

- via EU Bookshop (http://www.bookshop.europa.eu).

Priced subscriptions (e.g. annual series of the *Official Journal of the European Union* and reports of cases before the Court of Justice of the European Union):

- via one of the sales agents of the Publications Office of the European Union (http://publications.europa.eu/others/agents/index_en.htm).

About the EMCDDA

The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is one of the European Union's decentralised agencies. Established in 1993 and based in Lisbon, it is the central source of comprehensive information on drugs and drug addiction in Europe.

The EMCDDA collects, analyses and disseminates factual, objective, reliable and comparable information on drugs and drug addiction. In doing so, it provides its audiences with an evidence-based picture of the drug phenomenon at European level.

The EMCDDA's Insights are volumes conveying the findings of study and research on topical issues in the drugs field.

TD-XD-13-014-EN-N

Price (excluding VAT) in Luxembourg: EUR 15

Publications Office

ISBN 978-92-9168-652-0