

ISSUE 12 JUNE 2010

Big Picture

BRINGING CUTTING-EDGE SCIENCE INTO THE CLASSROOM

ADDICTION

Getting hooked?

Exploring the science
behind addiction

What is addiction?

How is the brain involved
in addiction?

How is addiction treated?

What might the future
of addiction hold?

A resource for teachers and learners
FREE

wellcome trust

Big Picture

Big Picture is a free resource for teachers, school and college students, and learners of any age. Published twice a year, each issue comes as a printed magazine with accompanying online articles and other content. Here's how to get the most from your issue.

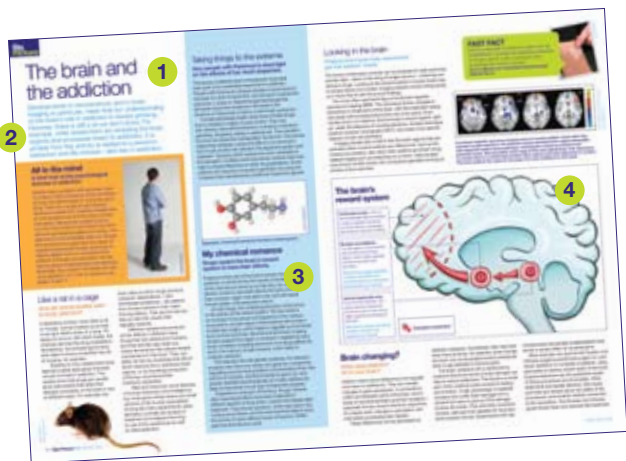
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How to use *Big Picture* magazine

Each issue of *Big Picture* focuses on a topic that is current, relevant to the biology curriculum, rooted in science, and that has debate-provoking aspects. The issues are divided into double-page spreads, each dealing with a different aspect of the topic.

The spreads are a jigsaw of articles, images, diagrams and 'Fast Facts', allowing you to dip into each issue, and each spread, as you need. Every issue contains a series of 'real voices' – interviews with people whose lives are affected and shaped by the topic in question. Whether you want to stimulate debate, to provide up-to-date, scientifically accurate examples around particular issues, or to get across complex ideas to your students, *Big Picture* helps you to bring cutting-edge science into your classroom.

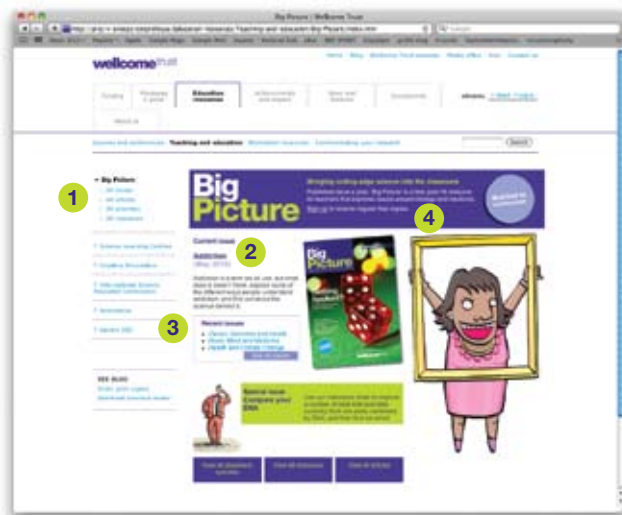


- 1 Title** – Each spread deals with a particular aspect of the title topic.
- 2 Intro** – This sets the scene for the spread within the issue, and the wider world.
- 3 Article** – Each article can be used alongside others from the same spread or the rest of the issue, or as a standalone component for a lesson.
- 4 Image/diagram** – Illustrations and diagrams help you express complex ideas in a visual way, as well as helping to place the issues in question into a real-life context.

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As well as twice-yearly magazines, there's loads of other useful material on the *Big Picture* website (www.wellcome.ac.uk/bigpicture). The exclusive online content is created for each issue, and includes articles, videos, games, image galleries, animations, lesson plans, activities and more. Our selected links help you and your students to get the most out of the web for each topic.

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Introducing addiction

Addiction is a term we all use, but what do we mean?

Do something pleasurable, and the chances are that you want to do it again. Do it a lot – whether it is eating a chocolate bar or watching a band on YouTube – and you have a habit. Most habits are pretty harmless. The worst thing likely to happen is that you waste time on them or people make fun of them. A few, though, turn into a problem. Sometimes that problem is so serious we call it an addiction.

The addictions with the tightest grip tend to involve drugs, sometimes illegal ones. But

take a look in the papers: people who can't get enough of sunbeds, shopping or sex are all addicts, journalists say. Are they really? What about those unable to control how much they gamble or surf the web? Deciding whether these really are addictions means having a clear definition of what addiction is. That is difficult, because addicts do not just feel one thing. Most definitions amount to a list of features, and people then discuss whether a particular behaviour can count as an addiction.

All the definitions agree that addiction involves psychological need: you really feel you cannot do without it. Then there is

physical need: cutting off supply makes you ill. Tolerance is common: where you need more and more of the thing you are addicted to for the same effect. So is persistence: the fact that you'll continue with a particular behaviour in spite of its harmful effects.

Some addictions, especially to certain drugs, tick all of these boxes. Other things that may be addictive, such as gambling, do not. In those cases, there is more of an overlap with obsessive or compulsive behaviour of other kinds.

So addiction is complex, involving aspects of brain and body that are not well understood, along with social influences and personal history. That leaves plenty of room for disagreement among researchers and health workers about its diagnosis, causes, effects, treatment and prevention.

Old habits? A history of drink, drugs and addiction.

7000 BCE
Oldest known alcoholic drink, identified from traces left on pottery excavated from a site in China. Some archaeologists believe cultivating fermentable crops was a key factor in the origins of agriculture, and so is as old as human settlement.



4000 BCE
Opium poppies domesticated in the western Mediterranean. Opium, which can be harvested from the wild, is probably the oldest narcotic.



4000 BCE
Cannabis in use as a narcotic in Eurasia.

1200 CE
The Incas in South America adopt the traditional Andean habit of chewing coca leaves (which contain cocaine), and declare coca a sacred plant.



1839
The British force China to allow continued importation of opium, mainly from their territories in India. This helps finance the new trend among the English at home, tea-drinking.



1599
Shakespeare uses the word "addiction" in *Henry V*. At that time, it meant to be bound to someone as a slave, or by excessive devotion, hence "His addiction was to causes vain..."

1860
First pure cocaine extracted from coca leaves. Coca extracts in wide use in tonics and patent medicines in Europe and the USA.



1729
Faced with a gin craze, especially among the poor in London, Parliament passes the first of a series of laws trying to control gin drinking.



1614
First shipment of Virginia tobacco auctioned in London. It breaks a Spanish monopoly on the weed, and creates a demand for labour that is to be met by the slave trade.

1875
San Francisco city ordinance bans use of opium, the earliest US prohibition.



1890
Popular fictional detective Sherlock Holmes is described in *The Sign of Four* injecting cocaine. Holmes, also a user of morphine, describes cocaine to an anxious Dr Watson as "transcendently stimulating and clarifying to the mind".



1956
American Medical Association declares alcoholism a disease.

1997
Alan Leshner, Director of US National Institute on Drug Abuse, publishes review paper in *Science* concluding that "addiction is a brain disease".

2008
Premiere of US series *Celebrity Rehab* with Dr Drew. In this reality show celebrities undergo 21 days' treatment for drug or alcohol addiction, and are filmed 24/7.

What is addiction?

Ask ten people what they think addiction is, and you'll have ten different answers. Even key health bodies can't agree. What most people do accept, though, is that the basis of addiction is very complex: a combination of biological, genetic, psychological and social factors. We all have pleasurable experiences, but we don't all become addicted to everything. So what makes something addictive? And what makes someone become addicted?

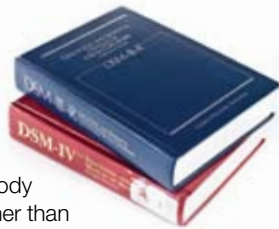


Defining addiction

How do key health bodies define addiction?

World Health Organization

The World Health Organization (WHO), the UN-backed body based in Geneva, prefers to talk about 'dependence' rather than addiction. For drugs, it uses this word to cover both addiction and habituation (drug-taking becoming a habit psychologically). Back in 1964, a WHO expert committee offered a definition of dependence that brought in aspects of behaviour, cognition and physiology. The latest WHO International Classification of Diseases says that dependence includes strong desire, problems controlling use, withdrawal symptoms, tolerance for increasing doses, ignoring alternatives, and continuing to use a drug in spite of the harm it causes.



American Psychiatric Association

Dependence and addiction are seen differently by the American Psychiatric Association (APA), which is revising its official manual of mental disorders (above). In the latest draft, the 'substance-related disorders' category has been expanded to include, for the first time, a non-substance addiction: gambling. The APA will consider others, including internet addiction, when more research has been carried out.

The revision group is proposing to use 'addiction and related disorders' as a new name for the 'substance-related disorders' category. It thinks that 'dependence' should be used only to describe a precise physiological response to particular substances, saying that using it to describe out-of-control drug use has been confusing for doctors.

Life's a drag

What makes smoking so attractive to so many?

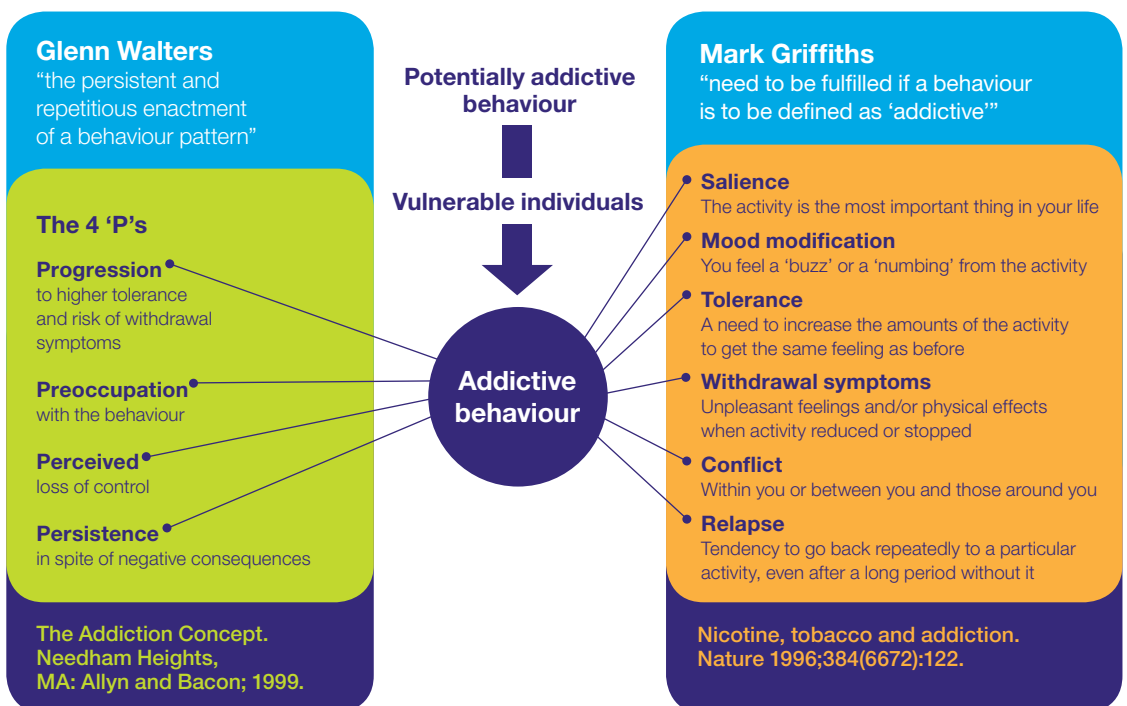
Smoking cigarettes is the most widespread addiction worldwide because it delivers a powerful chemical, nicotine, very effectively. Take a puff and the nicotine level in the brain peaks around ten seconds later. The effect wears off quickly, so the smoker quickly has another go. For many people, it is not long before the habit is hard to break. This, added to the ritual of lighting up (often in company), the unpleasant effects of nicotine withdrawal, and – although there are now tight controls in the UK – a history of heavy advertising of tobacco products, gives you a foolproof recipe for mass addiction.

But not everyone tries it. And not everyone who tries it keeps on smoking. You have to learn how to do it – the smoke can be off-putting at first. And plenty of other factors, such as the price of a packet of cigarettes, and whether friends think it is cool, help decide whether anyone becomes a wheezing 60-a-day smoker, a lifelong abstainer or something in between.

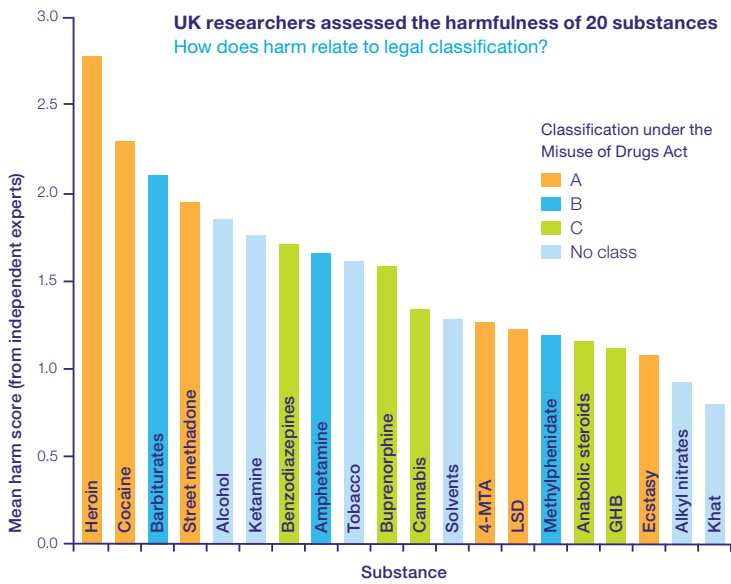
What is addictive behaviour?

For many, the concept of addiction has typically involved drugs. In the 1990s, two researchers proposed wider models that included other behaviours.

Which do you think is most comprehensive? Do you see any overlap between the two? What would you add to or take away from these, bearing in mind other definitions of addictions you have come across?



Graph: Adapted from Nutt et al. Lancel 2007;369(9566):1047-53.



Addicted to mobiles?

Is everything potentially addictive?

Addiction isn't just associated with drugs. If you have a mobile phone, do the bills shock you? Do people in your family complain that you use it too much? Does keeping up with friends on the phone get in the way of other things, such as school? Is your use still creeping up? Do you keep upgrading to a sexier model?



Do you get really upset if you cannot get a signal for more than a few minutes? If so, says, Mariano Cholz of the University of Valencia in Spain, your relationship with your mobile has the marks of an addiction.

The point is that these are similar to the tests being applied by experts trying to decide whether to include gambling and uncontrollable internet use in official manuals of diseases. If these can be diagnosed as addictions, could any compulsive behaviour be?

The route to this kind of behavioural fixation is different from the path to substance dependence – as any effects on the brain are indirect. Calling them addictions is controversial. Some argue such compulsions usually stem from some other underlying cause, such as depression or anxiety.

Who's vulnerable?

A person's experiences, genes and environment are all factors.

A person's chances of developing an addiction depend on what they are like, and what happens to them. Where you live matters a lot, too – for example, is gambling widespread there? Are drugs available? Early exposure to stress or trauma, especially child abuse, is strongly linked with later drug use. Parental drug addiction is also a big risk as it can combine a disrupted childhood, genetic risk factors and access to drugs. Less dramatically, teenagers may be influenced by their friends, and be drawn to places where drug use is seen as 'normal'.

There are also strong and complex links between addiction and mental illness. People with bipolar disorder are more than three times as likely to be smokers as those with no mental illness, for



example. But do mental disorders put people at risk for addiction, or the other way round? Both might be true. Or maybe other predisposing factors – such as child abuse, or genetic variations – leave some people more vulnerable to both mood or anxiety disorders and addictions of various kinds. What is certain is that there is a high incidence of 'comorbidity', where the same person has both, and each affects the other.

Just like a drug

Some things are more addictive than others.

Drugs top the bill of addictive substances. Efforts to rank them generally take into account the good feelings – or intoxication – from taking a drug, whether users develop tolerance to its effects, how bad withdrawal symptoms can be, and how hard it is to stay off if you stop. With all these things in mind, heroin is generally considered more addictive than cocaine, but less so than nicotine – and crack cocaine even more so than cocaine alone. Alcohol, coffee and marijuana (cannabis) come lower down the list.

Other drugs are not physically addictive. Ecstasy (MDMA), for instance, does not lead to the uncontrollable craving (intense desire) for more seen with some other drugs. In fact, repeated use of MDMA seems to go along with reduction in the amount of the neurotransmitter serotonin in the brain, which may limit some of MDMA's pleasurable effects.

Some American soldiers in Vietnam in the early 1970s smoked heroin, encouraged by easy access, the stresses of service in a strange land or by boredom. When they came back home, two-thirds of them lost the habit within a year or two. Those who had seen combat, and often been traumatised, were more likely to remain addicts when back in the USA. Others abandoned heroin but took up barbiturates or amphetamines instead.



Craig DeBourbon/Stockphoto

Rowan McOregan

Runs in the family

What role do your genes play in predisposing you to becoming addicted?

Sometimes the chances of addiction are strongly influenced by a person's genetic make-up. The most-used method of studying this is to compare the lives of pairs of identical twins (who share the same variations in DNA sequence) and non-identical pairs. Traits that show a closer resemblance in the identical pairs are typically under stronger genetic influence.

On this basis, there are genetic factors involved in susceptibility to alcoholism, and in the use of other drugs such as cocaine, heroin and nicotine. We can inherit different versions of certain genes that produce variation in the ways particular substances such as nicotine are processed (metabolised) in cells. They can alter levels of one of the chemicals that act as neurotransmitters, helping brain cells to signal to each other. Finally, there are genes that influence general aspects of behaviour, such as desire for new experiences, or risk-taking.

The inherited influences on anyone's vulnerability to addiction are normally a result of complex combinations of such genes, working out in ways that are affected by their life and environment. Some may be more susceptible to particular substances because of their biochemistry. Others may show broader behaviour patterns, such as impulsiveness, which sometimes lead to addiction. This may mean there is something in the idea often discussed by psychologists that there is an 'addictive personality', although the existence of well-defined trait that justifies that term remains controversial.



VisualCommunications/Stockphoto

The brain and the addiction

Developments in neuroscience, and in brain imaging in particular, mean that our understanding of the brain's role in addiction is always growing. However, there is still a lot we don't know. For example, while researchers are revealing the brain regions and processes linked to addiction, it is unclear how this activity is related to a person's behaviour and life choices – also key in addiction.

All in the mind

A brief look at the psychological theories of addiction.

Addicts have a problem with decisions. Even if, in theory, there is always a choice of what to do next, the addict keeps on doing the same thing. There are a range of psychological theories to explain this. Cognitive models look at what people know and how they process information. Behavioural models focus on how the mind reacts to information and other stimuli to generate set patterns of choice. The distinction is not completely clear-cut, though. Some treatment programmes are based on cognitive behavioural models, and focus on helping addicts to try to understand their patterns of thought and perception so they have a chance of altering their own behaviour. Essentially, they 'unlearn' the habits that add up to addiction. For more on treatment see pages 10 and 11.



4x6/stockphoto

Like a rat in a cage

How are animal studies used to study addiction?

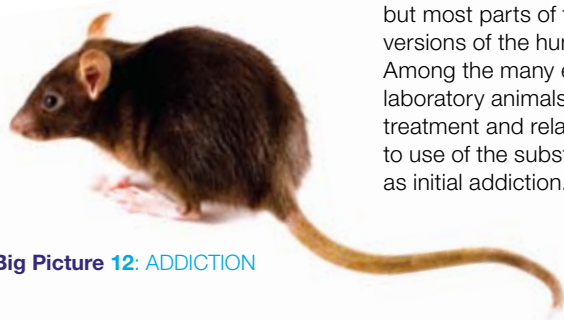
A laboratory animal, most often a rat or mouse, can be hooked up so that it can give itself a dose of a drug. If it keeps on and on with fresh doses, the chances are that the drug is addictive. Sometimes, the animals ignore food and water in favour of another tiny hit of cocaine, for example.

Building on this, researchers have learned a great deal about the brain circuits involved in addiction. The results show that drugs are usually blunt instruments that affect the delicate complexity of the brain in lots of different ways. For example, the

brain sites at which drugs produce 'physical' dependence – and withdrawal symptoms – are distinct from those involved in their habit-forming effects. That second set are tied up with the circuits that regulate rewards.

Different substances produce similar effects in different ways. Drugs that are addictive to humans, and that animals also seek out, nearly all enhance the natural reward mechanisms in the brain. They can either do this by increasing the rate at which neurons fire in particular brain regions, or by boosting production of the key neurotransmitter chemical, dopamine.

Rats and mice lack some features of human behaviour and intelligence, but most parts of their brains are small versions of the human equivalents. Among the many experiments using laboratory animals are studies of treatment and relapse (returning to use of the substance) as well as initial addiction.



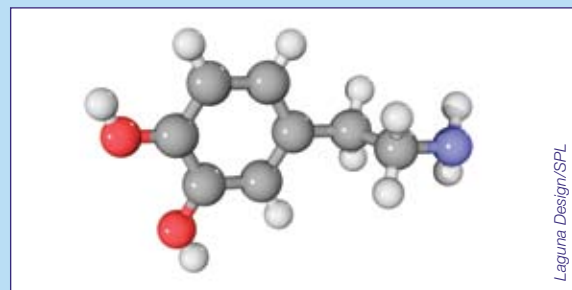
Digital Vision
Photography/Veer

Taking things to the extreme

How people with Parkinson's shed light on the effects of too much dopamine.

One group of patients given a therapeutic drug have been part of an unintended experiment in addiction. People with Parkinson's disease develop muscle tremors because of a lack of dopamine, and are given a dopamine precursor, L-dopa, or dopamine agonists (drugs that stimulate dopamine receptors in the brain in the absence of dopamine) to help to control their symptoms.

A small percentage begin using more of these drugs than is needed to regain muscle control. They may also develop disordered behaviour, including compulsive gambling, shopping, eating or seeking sex. This condition is known as dopamine dysregulation syndrome. The precise relationship between cause and effect is not yet known, but it is yet another link between the dopamine system and addiction. Studying which people are more vulnerable to this iatrogenic condition (one induced by medical care) may help to unravel influences on other drug addictions. Some patients who became compulsive gamblers are suing the company that manufactures a particular dopamine agonist.



Laguna Design/SPL

Dopamine, a chemical involved in the brain's reward system.

My chemical romance

Drugs exploit the brain's reward system to have their effects.

Evidence of the role of the brain's reward circuitry in addiction is reinforced by the results of studies in which animals are wired up so that they can use an electric current to stimulate directly the parts of the brain involved. Again, they like it a lot, and will repeat the stimulation until exhaustion sets in.

As with drugs, the underlying attraction is the boost in the activity of the reward system. The key result is an increase in the amount of dopamine in the nucleus accumbens, a small region in the forebrain with ancient evolutionary origins, which helps to regulate survival drives such as food and thirst. Biochemical and brain-imaging studies suggest this region is involved in registering many kinds of reward, including some from non-drug addictions, and in the memory of past rewards, which helps to maintain addiction.

This idea also fits with genetic evidence. For instance, smokers who have one version of a gene for a dopamine-regulating enzyme have problems concentrating when they are low on nicotine, and find it harder to give it up. And people classified psychologically as novelty seekers are likely to have fewer of one type of dopamine receptor.

Dopamine is only part of the story, though. Several other neurotransmitters have been implicated in different aspects of drug action, reward and relapse after treatment. They include serotonin, which also acts in the nucleus accumbens, and the chemical that helps to tune the activity of many different types of neurons, GABA (gamma-aminobutyric acid).

Looking in the brain

Imaging techniques help researchers get into addicts' heads.

The brains of laboratory animals can be analysed to yield extremely precise data – down to the firing of single neurons – while they are taking in drugs. Looking at the reward system in human brains has to be less direct, but modern imaging wizardry shows things going on in there that fit with the animal findings.

The most often-used technique is functional magnetic resonance imaging (fMRI). This technique shows changes in blood flow in small parts of the brain, with the implication being that areas with increased blood flow are more active. Such studies show, for instance, that the brain's reward regions 'light up' under the influence of cocaine injections. Another technique, positron emission tomography (PET), can probe more specific aspects of brain biochemistry.

Imaging studies also confirm that the brain regions that are activated when cocaine addicts are offered a hit, such as the nucleus accumbens, also react when addicts are shown drug-related images such as white lines on a mirror. Other studies have shown similar results with compulsive gamblers looking at photos of slot machines.

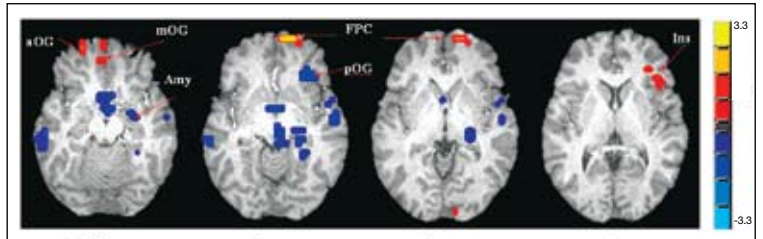
FAST FACT

Some constituents of tobacco smoke, such as acetaldehyde, increase the rewarding properties of nicotine, which is why smoking is more rewarding than nicotine patches.

Source: Belluzzi et al. *Neuropsychopharmacology* 2005;30:705–12.



Libby Welch



From Kurlah et al. *Neuroimage* 2005;28(4):904–14.

Functional magnetic resonance imaging scans of cocaine addicts' brains after they received cocaine injections. The injected cocaine activated brain regions associated with dopamine-based reward pathways, including the nucleus accumbens and prefrontal cortex. Red and yellow show regions that were significantly more responsive to cocaine than to a control (salt solution). Blue regions were less responsive to cocaine. The more extreme the colour on the scale, the more confidence in the result.

The brain's reward system

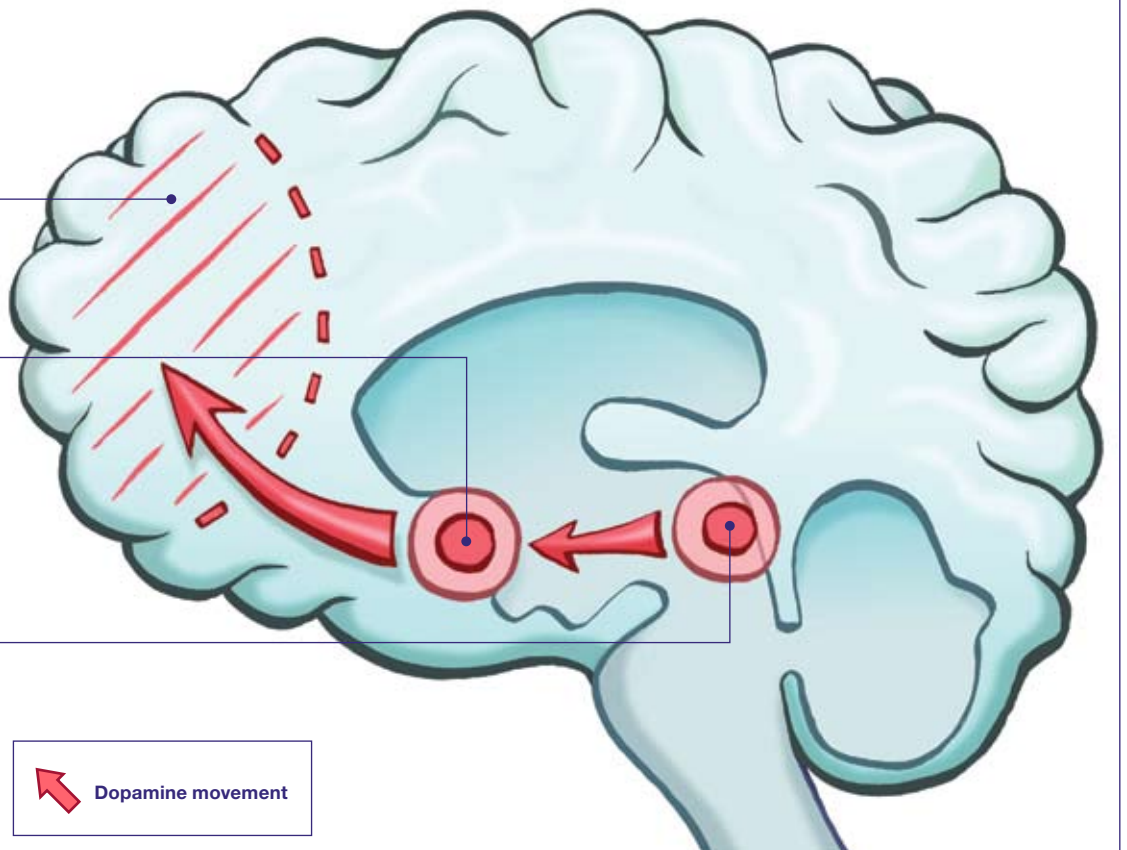
Prefrontal cortex – Part of the frontal lobe that is involved in many cognitive functions, including memory, language, planning and decision making.

Nucleus accumbens – A small region in the forebrain with ancient evolutionary origins, which helps regulate survival drives like food and thirst.

Affected by drugs including cocaine, amphetamine, cannabinoids (e.g. cannabis) and opioids (e.g. heroin).

Ventral tegmental area – Found in the midbrain, this area produces dopamine and forms part of one of four major dopamine pathways in the brain.

Affected by drugs including nicotine, alcohol and opioids (e.g. heroin).



 Dopamine movement

Brain changing?

What does addiction do to your brain?

Addicts' brains show differences from people who have no addictions. They can include changes in gene expression, in connections within and between parts of the brain, and in levels of neurotransmitters and their receptors – especially the key reward chemical, dopamine. At a higher level, changes in perception and information processing also happen.

These differences can be generated as

addiction develops. Sometimes, they may have been there all along. So addiction does change the brain, but some people's brains predispose them to get addicted in the first place.

The brain-addiction link is reinforced by evidence that some kinds of brain damage can help to reduce addictions. The insula is a small part of the cerebral cortex involved in feeling and emotion. A high percentage of cigarette smokers who suffer brain damage from a stroke find it easy to give up if the damage involves the insula. They lose their craving for nicotine, although their appetite for food and drink remains normal. Experiments with rats

whose brains are partially anaesthetised have shown a similar effect for amphetamine.

More dramatic are reports that Russian and Chinese surgeons performed surgery to 'cure' heroin addiction in hundreds of patients, using electrodes to destroy certain parts of the brain. Experts elsewhere say the published results of these procedures are incomplete. Other treatments are equally effective, they argue, and there are doubts about the safety of the procedures, and whether addicts consented to the operations. The Russian and Chinese governments have now banned this treatment.

Online, all the time?

Some people count compulsive use of the internet – usually for social networking or game playing – as an addiction. There is not yet much research on who is affected. Many studies in the news come from clinics promoting ‘treatment’ for the condition. However, what is known indicates, as usual, that some people are more at risk than others.

The incidence of ‘internet addiction’ is unclear. In terms of ‘normal use’, it is reported that 99 per cent of UK children aged eight to 17 have access to the internet. Playing video games is one of the top online activities. Almost half of boys aged seven to ten play games online, but this proportion seems to fall with age. However, just over a third of boys aged 11–16 have access to the internet via a games console. There is evidence of heavy use of some online games, especially multiplayer role-playing games, that take place in complex ‘virtual worlds’, e.g. *World of Warcraft*. Even average players devote 22 hours a week to the game.

A University of Leeds study in 2010 suggested that 1.2 per cent of people were ‘internet addicts’, and many of those were depressed. However, critics noted that recruitment to this study was via social networking sites, so it did not register non-internet users. Others suggested that the results showed that the problem is depression, not internet use.

Cognitive risk factors

Young people spending much of their time online are more likely to report being unhappy. Research in Taiwan (several Asian countries including China report high levels of internet addiction) suggested that 11-year-olds who showed signs of depression, attention deficit hyperactivity disorder, social phobia or hostility were more likely to develop an internet fixation when they became adolescents.

Genetic risk factors

There are no clear genetic factors, although the problem appears more common in males than females.

Demographic risk factors

Some studies suggest that a university-level education combined with a poor financial situation increases the risk.

Why are online gaming and social networking addictive?

Games can be addictive, in the loose sense of the word, because of their constantly repeated challenges and rewards, often moving through skill levels that reinforce the player’s interest. The immersion in a fictional world may reduce interest in dealing with people in the ‘real’ world outside, though this may only affect people already seeking escape.

What harm does it cause?

Compulsive internet use can lead to neglect of family, friends and other interests, sleep deprivation and problems with schoolwork. Those affected may be bored, anxious or irritable when they cannot get online. Then again, some people feel the same way when they cannot get to the gym or watch their favourite soap.

Any similarities to substance dependency?

Some studies claim that internet use can resemble substance addiction for some people, who show a preoccupation with their compulsion: they are always replaying the last game session or thinking about the next one. There may also be signs of tolerance, inability to cut back on use and withdrawal symptoms, but no physical dependency.



Double or quits?

Gambling is an ancient pastime that exists in new forms today. Some problem gamblers have difficulties controlling their gambling and run up crippling debts. Compulsive gambling has been studied more extensively than other non-drug addictions.

Statistics for gambling, including problem gambling, are not always reliable, and are hard to compare between countries and studies. There is good evidence that more than three-quarters of the UK population gamble, if only by joining in the National Lottery.

Gambling – including betting on horses, internet gambling, poker, playing slot machines and the Lottery – does not appear to be increasing, according to the latest British Gambling Prevalence Survey from the Gambling Commission, which did not show any increase between 2000 and 2007. The survey suggested around 0.6 per cent of the population aged over 16 are 'problem gamblers' (some 284 000 people). However, a number of studies suggest that more young people (under 18) are problem gamblers, as many as 5–7 per cent. The next round of the survey is due in late 2010.

Genetic risk factors

A twin study in the USA published in 2010 suggested that genetic factors account for around 70 per cent of the variance in gambling. However, in line with some other studies, there were significant differences between men and women. For males there was 85 per cent genetic influence on gambling. For females, no genetic influence was measured – the differences between those in this group were all due to environmental factors.

Cognitive risk factors

Registering high on tests for novelty seeking and impulsiveness is an indicator of high risk for taking to gambling, perhaps to excess.

Explaining gambling

Professor Mark Griffiths of Nottingham Trent University suggests that problem gamblers suffer a bias in perception, reading losses as 'near misses'. This is especially powerful when using slot machines, where the player can go again in seconds, and see if they can convert the near miss into a win. Nowadays, internet gambling can have the same effect. Slot machines – fruit machines are the most common example – are also made so that the player feels they are using some skill, and problem gamblers are prone to exaggerate the influence they can have on the results. Online games may use music and visual effects that encourage faster playing.

Demographic risk factors

Being male, single and living alone, having poor educational qualifications, low income and having parents who gambled makes it more likely that you will.

Social factors

Many of the forms of gambling are socially acceptable in regular use, and highly available. The National Lottery and TV game shows suggest gambling is fun. Fruit machines abound in pubs and arcades. Online gaming is now available 24/7 from the comfort of your home, often paid for on a credit card. Anyone susceptible to a gambling fixation will have plenty of opportunity to develop it.

Who gambles?

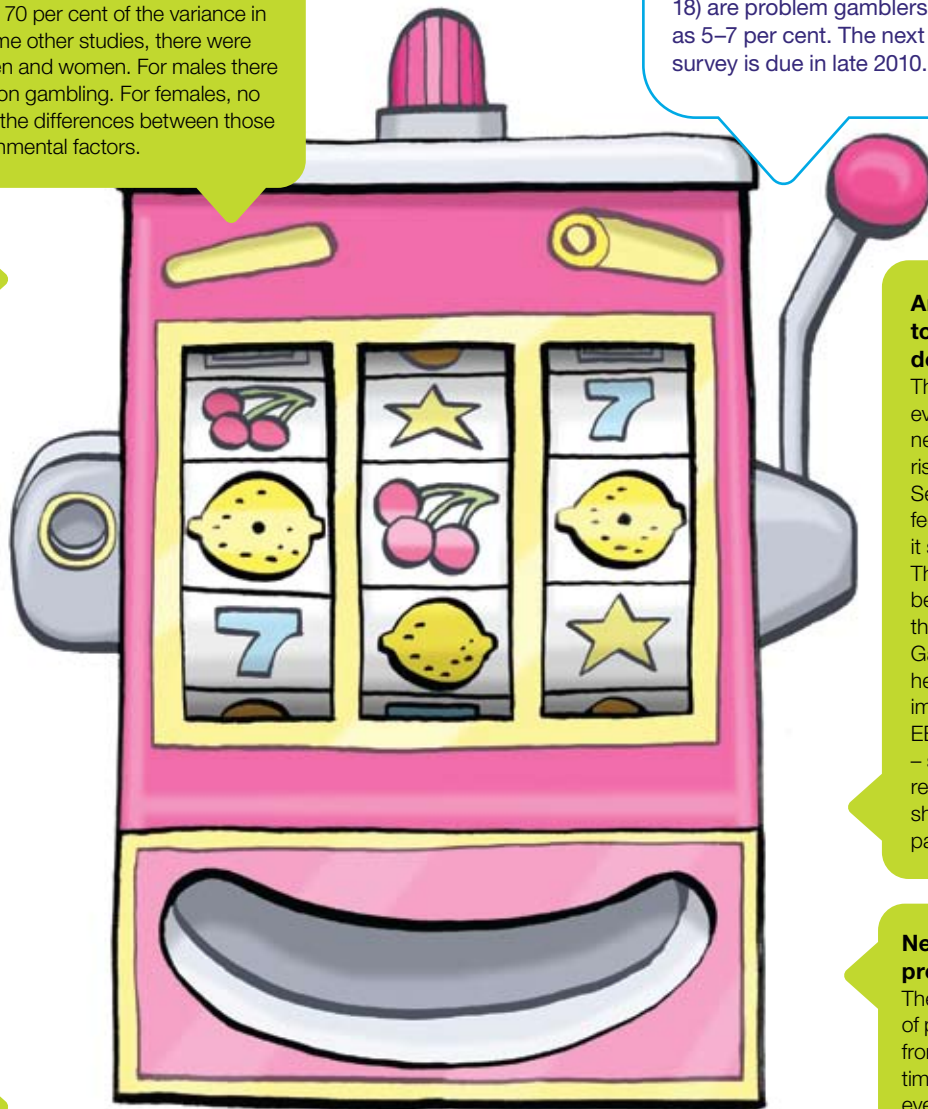
Most surveys show gambling is mainly for men – whether it is slot machines in pubs or visiting the betting shop to put money on a horse. However, there is evidence that online gambling sites are attracting more female users. Some are designed to be 'female-friendly' with pink colour schemes, gambling horoscopes and male pin-ups.

Any similarities to substance dependency?

There is experimental evidence of tolerance – new gamblers' pulse rates rise when they are playing. Seasoned gamblers also feel a rise in heart rate, but it soon slows down again. They may place bigger bets or play faster to get the same effect as before. Gamblers may also show heightened responses to images of gambling, on EEG scans of brainwaves – similar to the enhanced response drug addicts show to images of drug paraphernalia.

Negative effects of problem gambling

The main negative effects of problem gambling come from the sheer amount of time it takes up – all day, every day in the worst cases. This undermines family relationships and social life, and causes trouble with employers. There is a high risk of running up big debts, which are often hidden from others. Gamblers often experience mood swings, and may be prone to depression.



Dealing with addiction

Addiction is a costly thing – the financial shockwaves spread beyond the considerable medical costs of managing and treating addicts, from work hours lost and taxes unpaid by those unable to work, to the costs of crime committed by addicts. It's costly in emotional terms too – often, addicts' lives and those of the people around them are seriously disturbed by addiction.

Psychological therapies

Many different psychological therapies are available to treat addiction.

Psychological therapies for addiction include a range of talking-based treatments, such as cognitive behavioural therapy (CBT), which tries to make addicts aware of their patterns of thought and improve their decision-making, and motivational therapies, which try to increase addicts' awareness of their problem and their motivation to change their behaviour.

Other therapies are designed to help people 'relearn' behaviour through negative or positive reinforcement. For example, aversion therapy can be used to try and condition ('train') an addict to have a negative response to alcohol or drugs, and reduce their desire for them. Stimuli related to the substance (e.g. the sight or smell of alcohol) are presented along with unpleasant experiences (e.g. a small electric shock, or a drug that causes nausea when a person drinks).

Different behavioural approaches produce similar results, but they vary a good deal between patients. Believing in the treatment, and in the person giving it, is a vital ingredient. Otherwise, results may be little better than for addicts who decide to manage their own withdrawal.



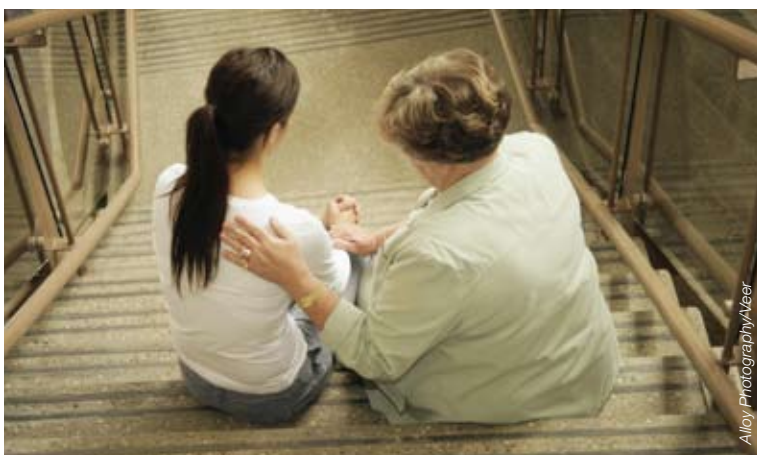
Corbis/Veer

Dependency

Addictions encompass psychological and physical needs.

Tackling an addiction may mean dealing with a physical dependency – as with a drug like heroin, which produces highly unpleasant withdrawal symptoms. Some aspects of an addict's behaviour attempt to avoid the negative states associated with withdrawal.

The heroin addict will also be psychologically dependent, relying on the drug high to get them through the day. Addictions vary in the balance between physical and psychological dependency. Some, such as gambling, are almost entirely psychological.



Alley Photography/Veer

Treatment

What are the options for treating addictions?

If an addiction causes such severe problems that it needs treatment, what can be done? The answer is almost always a combination of things, depending on the individual. At the moment, though, no treatment programme produces particularly

good results. Most drug users relapse, at least some of the time, which has led some in the field to argue that addiction is a chronic, recurring disease, that should be managed, rather than cured.

Comparison of results needs long, expensive studies, but the evidence overall suggests that combining medication with behavioural therapy is the best approach to controlling or stopping drug use.

Alejandro Rivera/Stockphoto



"To cease smoking is the easiest thing I ever did. I ought to know because I've done it a thousand times."

Mark Twain

A high-tech solution?

Will we one day be vaccinating against drugs and alcohol?

For some addictions, trials are underway with vaccines that block the actions of drugs. Most experiments have focused on cocaine, and use larger molecules with portions that resemble the structure of cocaine. The idea is that these would make the patient's immune system generate antibodies that would stick to these and the small cocaine molecules too, and slow or even prevent their entry into

the brain. But if a vaccine worked, would it still need supporting by therapy exploring why an addiction arose in the first place?

Vaccines to help people quit smoking are nearer to becoming available for use. Three anti-nicotine vaccines are currently in clinical trials.



Stefan Klein/Stockphoto

Pharmacological treatment

Chemical addictions are often treated with chemicals, as medication.

The most basic pharmacological approach, which is maintenance rather than treatment, is to prescribe the drug the patient depends on, as used to happen for heroin addicts in the UK. An addict may be given an alternative, less harmful drug, such as methadone (below) for heroin addiction. Nicotine patches to help people quit smoking are another example of this tactic. Other devices, such as the nicotine inhaler, combine the chemical craved for by the smoker with some key behaviours linked to the addiction (i.e. raising a cigarette to the mouth and inhaling). This aims to help the individual to cope with and reduce the habitual behaviours that have been associated with the addiction.

If an addict comes off their drug, they may need short-term medication to deal with withdrawal. Then there is the longer-term need to prevent relapse. That can involve other medications, which dampen craving for the drug, along with intensive counselling to try to understand how the addiction arose and how best to move on. The brain changes induced by addiction are probably reversible, but to change your brain, you must first change your mind.



Some drug addicts manage to maintain a normal working routine.

Should we treat?

Is it always right to try and offer treatment to addicts?

Addiction, especially drug addiction, is usually defined as a problem. It may not always seem so to the addict. There is evidence that some heroin users, for example, if they have a safe and secure supply, lead very routine, well-regulated lives – their daily habits are organised around their drug habit. This can fit in with a nine-to-five existence for some people.

Other addictions may be seen as harmless only for views to change later on. Cigarette smoking is the clearest example. It does not disrupt everyday life, it is often seen as rather cool, and it used to be widely accepted socially. Nowadays we know it is medically very risky over the long term, so we try to persuade people to stop, ban it from public places and offer smokers treatment to help them to give it up.

Picking up the tab

Treating drug and alcohol addictions is expensive.

Health services in the UK spend large amounts dealing with the effects of smoking and excessive drinking.

A big factor in justifying spending on treatment for some actual addictions in England, however, is another cost – crime. The National Treatment Agency for Substance Misuse is part of the National Health Service but mainly funded by the Home Office. It concentrates on illegal drugs, and estimates that for every £1 spent on treatment, at least £9.50 is saved on crime and health costs. That justifies a budget of just under £400 million in 2007/08.

Local Health Service Trusts and social service departments in England spend around another £200m a year. This money is targeted at 330 000 problem drug misusers in England, on Home Office estimates.

Private treatment for addiction is beyond the reach of most potential users. Some residential drug treatment centres charge thousands of pounds a week for round-the-clock care.

What about smoking? The National Institute for Health and Clinical Excellence (NICE), the public body that vets the costs and benefits of health treatments, put out guidance on smoking in 2006. It recommended that support for smokers trying to quit should be available from GPs, clinics and hospitals. This can include prescribing nicotine replacement patches, gum or nasal sprays, some of which are widely available from shops. There is also a prescription-only pill, Champix (varenicline), that reduces nicotine cravings.

The NHS Stop Smoking service costs £65m a year in England. It helps around 260 000 people give up each year – around half of the total number who had set a date to quit smoking. That works out at roughly £250 per person who stopped. Young people are less likely to use these services than adults, however.



Drugs also cause harm to the victims of the crime that some addicts use to fund their habits.

Who should pay? Some people argue that smokers already contribute to health costs through the tax on tobacco, and have to pay higher health and life insurance premiums.



Before you turn over, think about 25 years from now. Will addiction still be an issue? Can you think of one way in which the field of addiction might have changed, and perhaps be having an effect on your life?

The future of addiction?

Will addiction still be an issue in 25 years' time? How about 100? Could there ever be such a thing as 'harmless' recreational drugs? Will we all be popping pills to enhance our personality, mood and brainpower? Look at the articles, ads and discussions and see what you think about the implications of these imagined – and not so imagined – scenarios.

WORLD EXCLUSIVE

ANTI-DRUG JAB ROW GROWS

Angry crowds gather at drug company

Health reporter **Jemima Hack**

Ugly scenes greeted workers yesterday as they arrived at the HQ of Cerebetter, the pharmaceutical company behind the world's first anti-addiction munisition Addictagone. The company has courted controversy since the drug's launch in 2035. Its latest move, to offer jobs free of charge to all five-year-olds identified as 'at-risk' of future addiction, has angered many parents. "I don't want my child to be treated like an addict before he's even grown up," said one mum, who didn't want to be identified. When Addictagone first came on to the market it was licensed for use only in recovering drug addicts who chose the treatment. Since then, Cerebetter has wasted no time in expanding the uses of its blockbuster brand. Indeed, a recent change in health policy means that clinics can now inject addicts under their care without needing their consent.

Some commentators think that the authorities were too quick to license the drug, which – in some cases – has led to addicts seeking different and more dangerous means to 'get high'.

Patient groups are calling for more investigation into how Addictagone interacts with prescription drugs. "My father was involved in a road accident, but when he got to A&E the doctors found that all the painkillers they had couldn't help him," one woman told The Slurp. "A doctor said it may be because these drugs work in the same way in the brain as Addictagone, which Dad received last year."



twitter

Hey there! plainbrain is using Witter. Witter is a free service that lets you keep in touch with people through the exchange of quick, frequent answers to one simple question: 'What's happening?' Join today to start receiving plainbrain's bleats.

Plainbrain

Argh! More cospharm popups everywhere! I'm so fed up with all these drugs people are using to boost their brains! What's wrong with what we were born with?

pillsforyrits @plainbrain maybe you just need to take something to level your mood! There's lots out there.

Madforit @plainbrain cos I was born stupid! But really, no harm if we're all free to take 'em surely? I can't even remember what I was like before the brainboosters!

Sarahbeeeee @plainbrain @Madforit I'm drugfree and proud!

Dave101 @plainbrain yeah mate! Old school! I'll always need a pint of coffee to wake up in the morning but I don't like the idea of messing with my brain with this cosmetic pharm stuff.

FreeThinkers @plainbrain Check out the best selection of cosmetic pharmaceuticals on the web! For alertness, memory, libido, stress!

Name Pete
Location Leeds
Web http://www.plainbr.
Bio Sport-loving student. I love computer games, football and films. I hate exams, Man City, and drugs of any kind, even the legal ones!

101 following 2,188 followers 259 listed

Bleats: 1,977 Favorites



The names used in these scenarios are fictional and any likeness to existing companies or natural persons is purely coincidental.

BetterBabyTalk forum

Welcome to BetterBabyTalk. Whether you're newly pregnant or you're nearly due, you're in the right place. Ask a question, make friends and enjoy your pregnancy!

FORUM

Welcome to BetterBabyTalk >> Pre-birth >> Genetic modifications

HELP! Addicted dad-to-be

Name: wannabemum537 Posts: 1

Hi everyone. My husband and I are planning to have a baby, but because of my husband's history as a (now recovered) heroin addict, I'm terrified about our child growing up to have similar problems. My mother-in-law told me about private clinics that offer pre-birth testing for addiction. I think she and my husband want me to go for this but I'm really unsure. Are they safe? Do they work? Help!

Name: yumymummy3 Posts: 63

Save your money and spend it on something to make baby's first months really special. Addiction wouldn't even be a possible problem until later in life, and upbringing will have a lot to do with how your baby turns out.

Name: grinupnorth Posts: 34

@yumymummy3 Sorry but I don't agree. What parent wouldn't want the best for their child? I'll do whatever I can (finances allowing) to make sure my baby has the best start in life - especially if its dad had a history of addiction. Do it if you can afford it wannabemum!

Name: Madscimummy Posts: 3

It's hard but I think that these tests are still very early in development. They only look at genes that would give someone a minor risk of getting addicted, and environment plays a big role too. Personally, I wouldn't risk taking this test now.

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You wear make-up to enhance your face and choose clothes to flatter your shape, so why not make the most of your brain? Developed in conjunction with the world's foremost cosmetic neurologists and psychiatrists, our range of products will suit whoever you need to be.

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 - Struggling to remember everything? Need to sharpen your attention span? MoreMemory could be the answer!
- Employers, buy in bulk for a discount! Happier, more efficient staff and greater productivity!
- Parents, check out our new 'Superkids' range!

NIGHTLIFE!

Here at Hi there! magazine, we're partial to a cheeky glass of bubbly - just on special occasions, of course! One such occasion arose just last night at Bar Bara, where an innovative new drink was launched. This fab new fizz is guaranteed to help your night out go like a dream, without making the morning after a nightmare. So we helped ourselves to more than a couple of glasses of ClearHead with a clear conscience!

You can hang out without the hangover

Head boffin behind this clever concoction is Dr Beverley Ridge, who explained: "We've slaved over the test-tubes to produce ClearHead - the alcohol alternative that has none of the nasty health problems associated with traditional booze. Now you can hang out without the hangover!"

Hi there! didn't totally follow the 'science bit' (should've listened more in chemistry, instead of flirting with hottie lab partner Stuart over the Bunnie burner), but we're told that this is one of many products under development by More Fun Industries. The company, which "takes the pain out of drink and drugs", made a splash last year with "Crack On", its legal, non-addictive cocaine substitute. Now, if only they could make tasty, low-calorie cupcakes!

INTERVIEW: DEE TEES
PHOTOS: JAMES SNITCH

Do you, a female friend or relative have issues with addiction?

Make a free, confidential appointment at one of our modern, private clinics to discuss your contraceptive needs.

We will give you a monetary reward for committing to sterilisation or another permanent method to prevent future pregnancies.



See www.wellcome.ac.uk/bigpicture/addiction for downloadable versions of these materials and a lesson plan to use with them.

Real voices

We talk to three people for whom addiction has had, and continues to have, a huge impact on their lives. Meet a doctor who specialises in treating those with addiction-related problems, a young man who's fighting his own drug addiction and a young woman whose relationship with her father has suffered because of his addictive behaviour.

James*
Student



What were you addicted to?

Cannabis. I started smoking it when I was 11. It used to be a thing that I would do with my friends on the weekend. But then I found that I used to buy it for myself quite a lot, probably at least two or three times a week.

When did you know you were addicted?

I got to 12-13 and thought, yeah, I'm addicted. But I didn't really want to admit it. But now that I'm 16 I do admit that I'm addicted.

Just four months ago I talked to my mum and she agreed to support me. So I got a youth worker called Jenavi at Addaction [a UK-based drug and alcohol treatment charity]. When I first met him he told me about Addaction and what they do, and different ways he can help me. He also asked me stuff about what I like doing. I like to do music, so he takes some time out to go with me to the studio once a week. Addaction also helps me with homework and coursework – I take it there once a week. I found that's helped me to cut the cannabis down a lot.

So you haven't stopped taking it?

Not totally, not yet. It was out of control. The aim at first was to keep it under control, but I do intend to stop completely.

What impact did cannabis have on your life/school work?

A really large impact. I wasn't able to concentrate properly in school, so I couldn't really get a lot of work done. My friends noticed that I'd stopped really interacting with them that much. It affected my family too – I wouldn't have time to look after my little brother, who's three, because I was in my room, smoking and feeling lazy.

And you look after him now?

Yes. It seems like I've got a lot more time to spend with him. It makes things better with my mother too, because she has more time to relax. It was always hard on her, and my dad's not around.

How long will you stay with Addaction?

I'll stay with them till I feel I don't need their assistance anymore and that I can do it by myself.

For more information on Addaction, see www.addaction.org.uk

* Name has been changed.

Khaldoon Ahmed
Psychiatrist



What do you do?

I'm a psychiatrist at University College Hospital, London. I did a medical degree, then trained in psychiatry. As a doctor working in addiction, I have the opportunity to make a big impact on someone's life.

What is the hardest thing about treating addictions?

Working with people who don't realise that it is an addiction. The main psychological mechanism behind this is denial. Very often addictions build up over time; a person doesn't know the precise moment when they went from being a recreational user to somebody who's dependent – when the addiction is interfering with their life so much that they can't do their jobs, or maintain a relationship. And because the addiction itself is so powerful, they can't imagine life without the dependency, so they prefer not to see it as a problem.

What's the most rewarding part of your job?

People with addictions get taken over by something and very out of control and helpless. It's very rewarding to provide the mechanisms, advice and practical strategies that can help people get over this and see their lives change for the better.

Do people relapse after treatment often?

There is a strong likelihood of relapse, and that possibility is always there. But a lot of people completely overcome their addiction. Many factors help: a good family network, strong social support and access to services.

Are some people more prone to addiction than others?

Biologically, yes – you can give the same drug to lots of different people and only some of them will become addicted. Each drug has its own impact. Heroin is very dangerous in overdose, but in small amounts is not particularly damaging, either to the brain or body – it's used in hospitals to treat pain. It's the injecting and social chaos associated with heroin that are so damaging.

You have to put addiction in its social setting. People might be taking drugs because of the subgroup or subculture they belong to. Addiction is very closely connected to economics too. The price of alcohol and cocaine has come down over the past ten years, and that's why we're into an explosion of drug-related problems.



Catherine Student



How has addiction affected you?

Both my parents were addicted to alcohol, but my mum's been in recovery for 18 years. I'm 15 now, so I never saw her drink. My dad was also addicted to gambling and sex, and he was a bulimic.

What was it like growing up?

My parents were divorced when I was two. I saw my dad every other weekend, but he usually dropped me at the childminder's so he could drink.

He drank all the time, early in the morning and late at night, but he thought I only noticed him having one drink. There would be an unopened bottle, then it would be by the bin, empty, an hour later. There were empty bottles everywhere. I thought he was choosing not to stop. I was always worrying about him, about where he was.

What was the impact on you?

I threw myself into my school work more so as not to end up like him. It also affected my confidence in school, and I was bullied. I did whatever anyone else wanted me to do. I didn't know what I wanted to do. When I was nine, my mum took me to an Alateen meeting [for teenage relatives and friends of alcoholics]. That was when I realised that dad had a proper problem. After that, it was harder to watch him do it.

What happened next?

When I was ten dad moved to Spain without telling me, and that spurred me on to go to more Alateen meetings. I saw him a couple more times at a restaurant near mum's house. I felt a lot of anger and disappointment. I wanted what other children had with their dads – to have him there. Now he sends birthday and Christmas cards with messages that he knows will get to me, like "your nan wants to see you", or saying that he'll give me presents when he sees me. But I don't believe him anymore.

Could you have a relationship with him again?

If he went to Alcoholics Anonymous and got better, I could have a relationship with him. But I'd have to have a lot of proof. I'd have to see him working on his own programme.

Where is he now?

We don't know.

For more information on Alateen, see www.al-anonuk.org.uk/alateen

Extra online resources



Get online for even more addiction-related material from the *Big Picture* team.

Go to www.wellcome.ac.uk/bigpicture/addiction to find more articles, videos, image galleries and lesson plans around addiction. This issue's resources include:

- all you need to know about neurotransmitters
- a lesson plan on the media reporting of drug harms
- addiction in books and film
- the lowdown on gambling research with Prof. Mark Griffiths
- videos exploring the devastating effects of heroin addiction on one family, a personal account of problem gambling, and talking about addiction with a therapist and students.

Free science videos and films

The Wellcome Trust, the charity behind *Big Picture*, has a YouTube channel packed with videos on the research it supports. Free to use and share, the videos cover many different areas of biomedical science, from appetite to MRI, Parkinson's disease to chronic pain. Many include interviews with people researching and living with these issues.

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ADDICTION

- What is addiction?
- How is the brain involved in addiction?
- How is addiction treated?
- What might the future of addiction hold?

Addiction – what does it make you think about? People taking heroin? Uncontrollable habits you can't break? Addiction is a tricky term to pin down, as professionals working in the field agree. In this issue of *Big Picture* we explore what different people understand by addiction and examine the effects of addiction on the minds, bodies and lives of those affected. How are addictions treated, and what might the future hold? Forget your preconceptions and join us as we explore this fascinating field, in which there's still much to understand.



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