Addiction Article for CPS (PandA)

Most drugs that can be abused such as heroin, cocaine, alcohol and cannabis, even caffeine, boost the activity of the reward system in the brain, to get a feeling of euphoria. At least this is what happens at first. After being repeatedly exposed to any of these drugs, more is needed to get the same effect – this is tolerance. Then they need it just to feel normal - compulsive use kicks in, without a "fix" they feel depressed or even physically ill – they have become addicted! Getting hold of the drug becomes the priority. Food, relationships, their job - all are secondary to this overwhelming obsession.

The reward or pleasure system is a complex circuit of nerve cells (neurons). Sex and eating stimulate this region – not surprising – they are needed to live and for the survival of the species. Even worms have one.

However repeated use of drugs changes the structure and functioning of these cells for weeks or even years after cessation of use. The changes not only lessen the pleasure gained but also increase the craving for these drugs. It doesn't have to be drugs, compulsive gamblers also display these brain alterations.

An understanding of the process of addiction was obtained by experimenting on animals, starting as long as 40 years ago, and increasingly confirmed by using brain-imaging techniques in humans.

An essential part of the reward system is the Mesolimbic (a brain area) dopamine (a neurotransmitter, a chemical carrying messages between nerve cells) system. A set of neurons near the base of the brain (the VTA the Ventral Tegmental Area in the mid-brain) have connections with a structure in the front of the brain (NA Nucleus Acumbens beneath the cortex). Dopamine is discharged from the VTA to the NA receptor sites. In humans several other areas are involved, the Amygdala assesses the pleasurable or otherwise effects of the experience, the Hippocampus records the memories of it, including the place and company, and the frontal regions of the Cerebral Cortex coordinate and process all the information which sets the pattern of behaviour of the individual.

It seems contradictory that drugs with such opposite effects, e.g. cocaine a stimulant and heroin a pain reliever and depressant, should both influence dopamine production. Cocaine and other stimulants prevent dopamine from being re-absorbed back into the discharging neuron, and opiates like heroin disable neurons that normally suppress the dopamine-discharging ones, so the dopamine is left to function in the synapse (gap between nerve cells). Caffeine impairs the action of adenosine, an inhibitory neurotransmitter.

Tolerance occurs because frequent use actually suppresses some regions of the reward system. Increased levels of dopamine result in the production of 2 different proteins which regulate the expression or activity of genes. One of them (CREB) induces production of an opium-like substance (dynorphin) which inhibits the VTA neurons. Acting for only a matter of days, CREB cannot be responsible for the long-term hold that drugs have over their users, making them relapse even years after cessation of use. The other protein, Fos B, a much more stable compound, is responsible. It can remain active for weeks or months, maintaining any changes that have taken place in the cells. In animals the accumulation of Fos B induces hypersensitivity to drugs. Relapse was common when, long after the drug was withdrawn, it was again made available. (In mice, wheel-running and sugar consumption also increased Fos B production). Even the sight of drug paraphernalia can be enough to bring on these overpowering feelings, and many "clean" former addicts have relapsed months afterwards.

Eventually Fos B concentrations return to normal but with regular exposure to cocaine it has been found that additional neuronal branches are grown to connect with other neurons for several months after drug taking. It is speculated that these extra connections amplify signals

so the brain may over-react to drug-related clues. These extra connections may help to explain the intransigence of addiction.

The other involved brain regions, Amygdala, Hippocampus and Cerebral Cortex communicate with the VTA and NA by means of another neurotransmitter, glutamate. A rise in dopamine levels cause the sensitivity of these regions to glutamate to increase for days and strengthens the pathways that link the memory of drug-taking with pleasure, bolstering the desire to obtain the drug. From other studies it has been found that glutamate receptor sites can be moved around and released from storage or new ones can be made. These new sites are made for up to 60 days after stopping the drug. They are atypical and induce stronger stimulation of the NA.

Thus there is a common mechanism at work that causes a psychological addiction from different types of drugs.

Many drugs of abuse also cause physical dependence and withdrawal symptoms are seen on cessation of use. Fewer natural neurotransmitters are made in the brain in response to the presence of these drugs. Some drugs cause the depletion of several neurotransmitters. When the brain's ability to manufacture its natural neurotransmitters is completely suppressed, the empty receptor sites have to be filled with these 'foreign' chemicals. Failure to do this results in the uncomfortable, distressing and sometimes life-threatening experience of withdrawal. Any method whereby neurons can be encouraged to resume production of these neurotransmitters will help to alleviate withdrawal symptoms. The identification of these neurotransmitters is useful as a special diet can be prescribed with the relevant vitamins or amino acids needed. Some success has been achieved with smokers in this way. Some addicts have also been helped by NET (Neuro-Electric Therapy), where a low current electrical impulse is passed across the head to stimulate the resumption of neurotransmitter production.

In the particular case of cannabis, a Cannabinoid system in the brain was confirmed in the 1990s, with the discovery of receptor sites (CB1) and endogenous cannabinoid ligands (natural neurotransmitters mimicked by cannabinoids), mainly anandamide.

Reports of physical withdrawal symptoms have been documented for over 50 years. The amount of cannabis smoked positively correlates with the severity of the symptoms. The DSM IV (Drug and Statistical Manual of Mental Disorders 1994) says that cannabis withdrawal symptoms are not clinically significant. This may be due to the persistence of the fat-soluble THC in the cell membranes, delaying the onset of withdrawal and ameliorating these symptoms.
Drugs like heroin and cocaine are quickly eliminated from the body so withdrawal is more abrupt. More recently however evidence has been growing that cannabis-dependent users do indeed experience a clinically significant physical withdrawal syndrome after stopping. Symptoms include: nervousness, restlessness, irritability, headaches, depressed mood, sleep difficulties, increased anger and strange dreams.

In the late nineties, research in the USA showed that opiate receptors play a part in cocaine addiction as well. Scans of cocaine addicts demonstrated that they showed increased binding activity at opiate receptor sites in the brain during active cocaine addiction. Remove the cocaine and the brain has to deal with too many unfilled dopamine and endorphin receptors (natural neurotransmitter mimicked by heroin). Interestingly also, recent research has indicated that the cannabinoid system and opioid systems may be associated in terms of dependence. The two systems may have a reciprocal relationship in that an injection of an opioid (morphine) into mice completely blocked the cannabis withdrawal symptoms in a dose-dependent manner. Receptors for cannabinoids and opioids are both located in brain limbic areas associated with dependence.

Converging evidence from the USA, New Zealand and Australia support the estimate that one in six or seven adolescents and young adult cannabis users become dependent on cannabis by their early twenties.
This series of events that occurs with addiction can be moderated and explained to adults and in a much simplified form to children, especially with the use of simple diagrams. They can then understand exactly what may happen if they decide to follow this lifestyle. I know from feedback that this approach is appreciated, and in many cases, successful.

Unfortunately the Government's current policy in Drug Education is one of Harm Reduction, not Prevention, coupled with an alarming dearth of adequate, accurate and up-to-date drug information. This applies particularly to cannabis. So are our children being warned that cannabis is addictive?

FRANK, the official Government website for drug information for parents and children, says, "There are no physical withdrawal symptoms from cannabis use". This is echoed by the charity Drugscope, the Government's advisor on drugs. 'Understanding Drugs – Drug education pack for schools (key stage 3)' was published by the Government in 2006. Children are warned about the dangers of addiction to cocaine, heroin, alcohol and tobacco, but the word is not even mentioned in relation to cannabis.

Because our children are being allowed to have "informed choice", from the age of 7 about whether or not to take drugs (See Government Guidelines on Drug Education, QCA in 2003 and DfES in 2004), this means that in the case of addiction, and many other aspects, they are *not* being informed about all the facts. Since we don't let our offspring "choose" to break the laws in other ways, petty pilfering or spraying graffiti, letting them decide to embark on a drug-taking lifestyle, which could end in mental illness or even prove fatal is unbelievable and a complete abrogation of the duty of care we have as adults. Anyone under the age of twenty still has a brain that has not completely matured, and with the risk-taking parts developing before the parts holding us back from irresponsible actions, this advocating "choice" is not only unjustified and stupid, but extremely dangerous. Children are simply not capable of making a reasoned choice, nor should they have to.

Arguably, another aspect of the government's policy, which assumes that kids will take drugs anyway and so they must show them how to do it safely, is even more hazardous. There is no guaranteed safe way to take any drug, legal or illegal. You only have to look at the warnings on a packet of prescribed pills. And since physical addiction is officially denied in respect of cannabis, it is no wonder that the number of children now seeking treatment for problems with the drug is soaring. Lulled into a false sense of security, and given the green light that they are safe from addiction, among 11 to 17 year olds, the total is around 10,000 (British Psychological Annual Conference in Dublin, April 2008).

It simply isn't true that kids will use drugs anyway. They may *try* them once or twice but the number of children taking drugs regularly is in reality quite small. Only 9% of 11 to 15 year olds took drugs in the last month in the most recent survey available (Smoking, Drinking and Drug Use among Young people in England in 2006, Home Office) and only 4% of these indulged more than that. Most young people don't want to take drugs and are looking for excuses to refuse. They need and want the truth about drugs, proper guidance and sanctions from adults. Children feel safer and more secure when clear boundaries have been set.

Prevention is better than cure and always has been. Prevention is what parents want for their children. Prevention is common sense.

Mary Brett of the UK is the former spokesperson for EURAD- Europe Against Drugs.