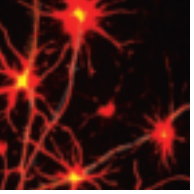

Experimental Psychology and Research into Brain Science, Addiction and Drugs – summary

Experimental psychology is the science that illuminates the mental and cognitive effects of psychoactive substances, and the link between these effects and addiction. New science such as the sequencing of the human genome, and new technology such as neuroimaging, are increasing experimental psychology's ability to explain the effects of psychoactive substances on the brain.

The Foresight project on Brain Science, Addiction and Drugs asked Professor Theodora Duka of the University of Sussex and Dr Danielle Turner and Professor Barbara Sahakian of the University of Cambridge to review what experimental psychology might tell us about addiction over the next 20 years.

Brain processes involve a range of neural pathways and chemical neurotransmitters. Psychoactive substances alter the efficiency of these pathways and transmitters on a long-term basis. The result is that stimuli associated with addiction come to be especially visible and important to an individual who has experienced them before. This confirms the behavioural observation that the presence of drug-related stimuli, such as places where drugs are consumed or the equipment involved in consuming them, can bring with them the danger of a relapse into drug use even after a long period of abstinence.

Stronger stimuli

These changes are accompanied by reduced interest in other stimuli including money and sex. Research using imaging and other methods also shows that drugs can be far more powerful reinforcers of behaviour than other types of stimulus.

It is also known that drug addicts are poor at decision making and at choosing delayed, worthwhile rewards over more immediate, less beneficial rewards. Changes in brain structure, as seen with imaging techniques, may accompany these changes, particularly in a part of the brain called the prefrontal cortex. These effects are apparent in drug addicts and especially so during active drug use. This may help explain the poor decision making of binge drinkers. In addition, regular drug users develop tolerance, which means that increasingly larger amounts of drug are needed to achieve similarly reinforcing effects.

Persistent drug use is associated with a variety of harms, such as the reduced memory power of alcoholics and of ecstasy users. The latter are also more likely to suffer depression than the population at large. Users of marijuana and amphetamines suffer a higher level of psychotic behaviour. Reduced reflective abilities in general may be the result of drug use and may also contribute to its continuation.

Recreational drug users often take more than one drug at a time. It may be possible to find out more about how drugs interact when such 'polydrug' use occurs.

Varying susceptibility

Experimental psychology is also revealing why some people are much less likely to become addicts than others. People who are most likely to become addicts may have brain circuits that are more sensitive to drugs or drug-related cues while also having cognitive control circuits that are less effective. Parts of the brain responsible for memory, motivation and control are strongly affected by frequent drug use. In addition, certain internal factors such as personality type, and external ones such as environmental stress, are associated with an increased risk of drug use and addiction. It may be possible to predict at-risk individuals, such as potential alcoholics, through particular behaviours such as poor or risky decision-making, or through brain differences such as a smaller-than-expected amygdala (part of the brain associated with emotional decision-making).

The role of drug-related cues in encouraging drug use is established. This means that experimental psychology may be able to suggest ways of weakening such cueing that might help reduce addiction. In addition, it may be possible to strengthen the cognitive skills that make addiction less likely, either by psychological methods or by pharmacological intervention.

The future

Experimental methods will be needed to determine the long-term effects of drugs now entering use, such as cognitive enhancers and new lifestyle drugs. We are starting to find out more about the connection between genetic variation and drug effects. The different effects of amphetamines on memory and brain activity in groups of varying genotypes has already been shown, as has a genetic variation in predisposition to tobacco addiction. The same is likely to be true of cognitive enhancers designed to improve particular brain pathways.

Our knowledge of how drugs work in the brain may also allow valid pharmaceutical treatment strategies to be developed against addiction to drugs or their reuse.

Much of the knowledge we gain from experimental psychology applies to non-chemical addictions such as gambling as well as to drug use. It also provides insights into future possibilities of direct intervention in the brain, such as transcranial magnetic stimulation (TMS) and the use of neural prosthetics to repair brain damage.

In addition, experimental psychology methods will allow the increasing promise of drugs that relieve cognitive impairment, especially neurodegeneration, to be developed in a fully scientific manner to maximise their effect. This is particularly important because cognitive enhancers for both impaired and normal users may be taken over decades.

The full version of this review is on www.foresight.gov.uk

URN 05/1192