

**The Academy of Medical Sciences call for submissions
Brain Science, Addiction and Drugs**

Memorandum by the Royal Society of Chemistry

The Royal Society of Chemistry (RSC) welcomes the opportunity to comment on the Academy of Medical Sciences call for submissions on brain science, addiction and drugs.

The RSC is the largest organisation in Europe for advancing the chemical sciences. Supported by a network of 43,000 members worldwide and an internationally acclaimed publishing business, our activities span education and training, conferences and science policy, and the promotion of the chemical sciences to the public.

This document represents the views of the RSC. The RSC's Royal Charter obliges it to serve the public interest by acting in an independent advisory capacity, and the RSC is happy for this submission to be put into the public domain.

The evidence submitted was for the most part published in an RSC report entitled "The Science of Drug addiction and treatment"¹.

If you would like further information or need anything in this document clarified, please do not hesitate to contact me.

Yours Sincerely

Dr Philippa Bell
Bioscience Manager
Tel: 020 7440 3308
Email: bellp@rsc.org

¹ This document is available at <http://www.rsc.org/policy>

This communication (including any attachments) is intended for the use of the addressee only and may contain confidential, privileged or copyright material. It may not be relied upon or disclosed to any other person without the consent of the RSC. If you have received it in error, please contact us immediately. Any advice given by the RSC has been carefully formulated but is necessarily based on the information available, and the RSC cannot be held responsible for accuracy or completeness. In this respect, the RSC owes no duty of care and shall not be liable for any resulting damage or loss. The RSC acknowledges that a disclaimer cannot restrict liability at law for personal injury or death arising through a finding of negligence.

Background

The Royal Society of Chemistry (RSC) is the largest professional body in Europe for advancing the chemical sciences and can trace its origins back to the establishment of The Chemical Society in 1841, here in Burlington House.

In accordance with its first Royal Charter, granted in 1848, the RSC continues to pursue the aims of the advancement of chemistry as a science, the dissemination of chemical knowledge, and the development of chemical applications. The key role that the chemical sciences will play in the search for solutions to challenges which face humanity in the 21st Century, from finding cures for diseases to building a sustainable environment makes the need for such an advocate of beneficial scientific progress as strong as ever.

Over a century and a half on from its beginnings, the RSC has a global membership of over 43,000 and is actively involved in the spheres of education, qualifications and professional conduct. It runs conferences and meetings for chemical scientists, industrialists and policy makers at both national and local level. It is a major publisher of scientific books and journals, the majority of which are held in the Library and Information Centre in this building. In all its work, the RSC is objective and impartial, and it is recognised throughout the world as an authoritative voice of chemistry and chemists.

Drug addiction has become one of the most significant social problems of the last decade. With the recent news that class A drugs are now flooding into the UK as never before, the situation is becoming more acute. In November 2004, the RSC invited a panel of scientists to discuss the scientific basis of drug addiction and to survey the latest research on treating addiction. For the interests of the working group a copy of this report can be found at: <http://www.rsc.org/ScienceAndTechnology/Policy/Documents/TheScienceofDrugAddictionandTreatment.asp>

The RSC welcomes this opportunity to comment on this timely consultation. In making submissions the RSC restricts comments to those of a scientific nature.

General

In what areas is future research needed to improve understanding of addiction and the treatments for it; the development of new medicine for mental health; and new psychoactive substances that improve the performance of the healthy brain?

1. The RSC would like the Academy of Medical Sciences to note that the number of class A drug users (heroin and other opiates) in England and Wales was estimated to be between 1.7 and 3.5 million in a 2002 Home Office report². The same report stated that the total economic cost of drug use could be more than £3.5bn, with 88% of these costs being linked to drug-related crime. The RSC recommends that to address issues arising from drug addiction there needs to be a greater understanding of the chemical and biological mechanisms causing the phenomena and use this knowledge to develop more effective treatment strategies.
2. The key to studying addiction is to understand that the brain is a chemical factory, constantly releasing and detecting chemicals. When addictive drugs are taken into the body they will affect normal brain chemistry.

It is important that further research is supported and co-ordinated to improve understanding of (a) addiction and the treatments for it; (b). the development of new medicines for mental health problems (reversing or preventive progression of Alzheimer's) and (c) new psychoactive substances that improve the performance of the healthy brain (improved cognitive function). At such an early stage of our understanding of the human brain, collaborative research between the chemical and biological sciences is essential to enable further advances in brain research. Developments in the imaging technologies are significant areas of research in both the chemical sciences with application to biological systems.

3. Drug addiction has become a huge social and economic problem for the UK and receives considerable political attention, but in the end, little funding for new research is available. Both basic scientific research into new pharmacotherapies and comparative research into success rates of present treatments are poorly funded. The UK needs to provide more quality addiction treatment before we can even assess what really works. We need to wake up to the scale of this problem and consider the contribution that all scientific disciplines can offer.

'Recreational' psychoactive substances

How should new scientific understanding and technological advances be applied to the treatment of 'recreational' drug users?

4. The chemical and biological basis of addiction is becoming clearer but for successful treatment the RSC believes that drug dependence needs to be considered as both a physiological and a psychological phenomenon. Treatment of addicts is ultimately unlikely to succeed by purely chemical means. Research shows that a combination of psycho-social and pharmacotherapy is the most successful approach.
5. The development of technologies such as Positron Emission Tomography (PET) and advances in computer modelling are helping to develop improved models of addiction.

² D Morgan, K A Grant, H D Gage, R H Mach, J R Kaplan, O Pringle, S H Nader, N Buchheimer, R L Ehrenkauf & M A Nader. *Nature Neuroscience* (2002) 5, 2, 169.

This communication (including any attachments) is intended for the use of the addressee only and may contain confidential, privileged or copyright material. It may not be relied upon or disclosed to any other person without the consent of the RSC. If you have received it in error, please contact us immediately. Any advice given by the RSC has been carefully formulated but is necessarily based on the information available, and the RSC cannot be held responsible for accuracy or completeness. In this respect, the RSC owes no duty of care and shall not be liable for any resulting damage or loss. The RSC acknowledges that a disclaimer cannot restrict liability at law for personal injury or death arising through a finding of negligence.

PET scanning of the brain is establishing a new understanding of the complex chemical and biological pathways at play. Using this technique, the effects of drug of abuse on the brain can be seen. For example, the actual opioid binding sites which stimulate a response to opioids can be detected and when treatments that block such sites are administered the sites can be seen to be no longer available to the drug of abuse.

6. The study of pharmacokinetics - how the body absorbs a drug - is fundamental to understanding the addictiveness of drugs, and thus the treatment of drugs users. In determining the addictiveness of drugs we would argue that the speed at which a drug reaches the brain is more important than the nature of the drug itself. The speed at which a drug reaches the brain is controlled by the route of administration. Drugs that are injected, snorted or smoked have an immediate effect on the brain and are able to produce a very high initial concentration which will quickly peak and then decrease almost as fast. Oral routes will give a slower, steadier release with no high initial peak. The addictiveness of a drug seems to be related to its half-life within the brain, with crack-cocaine having one of the shortest half-lives of commonly abused drugs. The see-saw pattern of drug concentrations in the brain seems to exaggerate the need for the next fix. For this reason therapies are often of longer duration (slower kinetics).
7. Understanding this see-saw effect is key to the developments in drug addiction treatments. Current treatments include agonists or antagonists. Agonists such as methadone act by stimulating the same pathways as the addictive drug. Antagonists such as naltrexone, completely block the effect of the opiate so that the abused drug no longer gives the desired high. Such treatments are not always successful however, because the effect of blocking the pleasure experience will lead to severe withdrawal symptoms and cravings that often lead addicts to stop taking the treatment.
8. Partial agonists such as buprenorphine stimulate the brains opioid receptors, acting as a substitute for the abused drug, but unlike full agonists, buprenorphine only partially stimulates the receptors. A ceiling is reached which stimulates enough to prevent cravings and withdrawal symptoms, but reduces the high experienced after taking heroin. It does not allow the patient to overdose or become addicted to the substitute drug itself. The drug is also deposited in the body's fat tissues, which makes it long lasting.
9. The RSC believes that new drugs to treat addiction will work for a range of addictive drugs, and for a long period of time, allowing a greater interval between doses. Such a treatment would go some way in preventing the common re-abuse that occurs with addicts. Currently, combinations of buprenorphine or methadone together with an antagonist are being used. Ultra long lasting antagonists such as methoclocinnamox are being considered as possible alternative treatments.
10. As well as establishing what makes a drug addictive, the RSC believes that it is important to establish why some people are more susceptible to becoming addicts than others.
11. Experiments have shown that when two subjects are given the same stimulant they do not necessarily react in the same way. Some people seem to have fewer dopamine receptors than average and the intake of opiates or stimulants will compensate and stimulate a pleasurable response. This is known as reward deficiency syndrome and leaves the person susceptible to addiction. The syndrome can be caused by genetic factors but recent research suggests that vulnerability to addiction could also be related to environmental factors.
12. Animal studies have shown that deprivation, in the form of isolation during the first 4-8 hours of life, can lead to a 'dulling' of the dopamine receptors². This may be just one of

This communication (including any attachments) is intended for the use of the addressee only and may contain confidential, privileged or copyright material. It may not be relied upon or disclosed to any other person without the consent of the RSC. If you have received it in error, please contact us immediately. Any advice given by the RSC has been carefully formulated but is necessarily based on the information available, and the RSC cannot be held responsible for accuracy or completeness. In this respect, the RSC owes no duty of care and shall not be liable for any resulting damage or loss. The RSC acknowledges that a disclaimer cannot restrict liability at law for personal injury or death arising through a finding of negligence.

the possible answers in explaining increased rates of drug abuse in individuals from deprived background, if corresponding effects can be detected in humans.

13. Alternative strategies to treat addiction exist in the form of developing vaccines against cocaine and nicotine addiction. The vaccines cause the production of antibodies, which will capture and retain the addictive substance in the blood stream, stopping it from reaching the brain. Such a vaccine would have the potential to be used as a preventative treatment, however, the RSC would advise wider consultation on this issue as it asks many ethical issues that society would need to consider.

Medicines for mental health

Treatments for mental health are likely to be developed in a wide range of areas, in which of these (for example, depression, anxiety, schizophrenia) should drugs be developed and their use encouraged?

14. Treatments for mental health are likely to be developed in a wide range of areas. We would stress the need for new drug developments to provide therapies for depression, anxiety, bipolar disorder and schizophrenia. Even for depression, current therapies do not achieve remission for more than 30% of those treated, and at the cost of relevant side effects. In all of these conditions we should be seeking a cure rather than the current approach which is little more than palliation³.

Cognition Enhancers

15. Both caffeine and nicotine are cognition enhancers. Thus the RSC would recommend that issues raised over the potential benefits and dangers of substances to, for example, enhance short term memory or speed of thought, should be considered in greater detail.

Openness

16. The Royal Society of Chemistry are pleased for this response to be publicly available and will be shortly placing a version on www.rsc.org. Should the Academy of Medical Sciences have any queries regarding this response then they should address them to Dr Philippa Bell, Bioscience Manager, Royal Society of Chemistry, Burlington House, Piccadilly, London W1J 0BA. Email: bellp@rsc.org.

³ Evidence submitted by Dr I Waldron, Head of Strategy and Planning, Oncology and Infection Area, AstraZeneca.

This communication (including any attachments) is intended for the use of the addressee only and may contain confidential, privileged or copyright material. It may not be relied upon or disclosed to any other person without the consent of the RSC. If you have received it in error, please contact us immediately. Any advice given by the RSC has been carefully formulated but is necessarily based on the information available, and the RSC cannot be held responsible for accuracy or completeness. In this respect, the RSC owes no duty of care and shall not be liable for any resulting damage or loss. The RSC acknowledges that a disclaimer cannot restrict liability at law for personal injury or death arising through a finding of negligence.