

# Cognition Enhancers – summary

**What if our brain power which evolves through our development and education, and which can also deteriorate with age or illness, could be improved by taking certain drugs? This is the promise of cognition enhancers. They could help alleviate the mental decline of increasing numbers of elderly people or people with disorders that affect cognition. But their use raises many issues, including medical and ethical concerns. Drugs with modest enhancing effects are already being used by some individuals with cognitive skills who are in the normal range. In the coming 20 years, our growing knowledge of brain functions could allow many more possible cognition enhancers to be developed.**

The Foresight project on Brain Science, Addiction and Drugs asked Dr Kelly Morris and Professor David Nutt of the University of Bristol and Professor Roy Jones of the Bath Research Institute for Care of the Elderly, to look at the future issues surrounding cognition enhancers.

They found that the term 'cognition enhancers' conceals a number of types of product with different intended effects. The development of such products is targeted at four main groups: people with dementia, people with definite cognitive impairment (whether due to early dementia or other reasons), those affected by 'normal' ageing processes, and those with no distinctive deficit who wish to use such drugs for non-therapeutic purposes. While learning and memory are the main focus of potential enhancers at present, beneficial forgetting and more general mood and empathy conditions are also being targeted for potential for enhancement.

Scientific developments have pointed to a number of ways that cognition enhancers could work. Some aim to reinforce or maintain particular pathways of neurons in the brain by strengthening the synapses that connect brain cells. The formation of these pathways becomes more difficult with age, which is why older people learn more slowly. Others aim to slow brain cell death, a particular issue in degenerative conditions such as Alzheimer's Disease. Most of the cognition enhancers now on the market aim to enhance activity of nerves containing specific types of chemicals called neurotransmitters. Some have been found to have positive though modest effects in various population groups, including dementia sufferers and people with normal cognitive function.

Common drugs in use as cognition enhancers range from caffeine and nicotine to amphetamines and drugs such as Modafinil, which are designed to maintain attention or keep people awake. Others include vasodilators, designed to increase blood flow in the brain, and drugs intended to protect the brain from damage by oxidation, free radicals or cell death. But while some putative cognition enhancers may have little beneficial effect, others can have adverse effects when taken in the wrong context or can have other unintended effects.

In addition to drugs developed by the pharmaceutical industry, many herbal remedies and food supplements such as vitamins are said to assist immediate and long-term brain function. A few have been shown to be effective in formal trials.

Drugs are not the only way to maintain or perhaps improve brain function. Physical and mental exercise, and good diet, are also recognised as being a positive influence, especially in slowing the mental decline linked with normal ageing.

## **The future**

Some possible interventions that might enhance or repair brain function would be surgical rather than pharmaceutical. These include the possible use of stem cells to encourage the growth of new brain cells to replace dead ones. Victims of strokes and of Parkinson's Disease have been early targets for experimental versions of this approach.

At the other extreme, physical and mental exercise and diet regimes, which might enhance mental performance are likely to be increasingly popular.

Many drug targets in the normal and diseased brain are certain to emerge from our growing knowledge of brain function. The sums of money involved may be large in view of the ageing population. Sales of drugs for Alzheimer's Disease could reach \$8 billion (£4.4 billion) by 2010, with 21 million people in seven major drug markets using them for dementia alone.

## **The issues**

Cognition enhancement could bring great social benefits. It may be especially welcome in the context of ageing populations, which bring with them a vast increase in both neurodegenerative disease and normal decline in cognitive function. Cognitive enhancers also seem to have positive results for selected groups, such as children with Attention Deficit Hyperactivity Disorder (ADHD).

But enhancement raises many ethical and social issues. When used by victims of neurodegenerative disease, they might lead to the prolongation of a low-quality life rather than improved life quality. Also, widespread treatment could be costly to individuals and society. Furthermore, the use of cognition enhancement in the normal population involves 'medicalising' conditions and people that have not previously been regarded as needing treatment.

There are also potential trade-offs in the use of the cognition enhancers that have so far been produced. For example, some drugs that speed up reaction times, might make some people more impulsive, or reduce the quality of the decisions they take.

In addition, it would be possible for a user to take a cognition enhancer regularly for many decades, and we do not know enough about their effects over long periods. This may be especially true if drugs were taken by children, or even by pregnant women in the hope of influencing their unborn child's mental powers.

Today's regulatory processes may not effectively manage the potential ready-availability of cognition enhancers. Some putative enhancers are already being sold informally, especially online. At present, availability is greater for such enhancers that are sold as herbal remedies or 'nutraceutical' food supplements rather than as mainstream pharmaceuticals. But with the likely growth of online availability of pharmaceuticals, this trend could change. If effective cognition enhancers become generally available, the issue would be how best to regulate such a change in access. In order to minimise the harms of these and other pharmaceuticals, whilst ensuring appropriate access to their benefits.

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