

Support for the nicotine-dopamine link

Support for the link between nicotine and dopamine comes from the finding (Paterson and Markou, 2002) that an epilepsy drug (gamma-vinyl GABA – GVG) reduces the surge of dopamine in the NAc that occurs after taking nicotine. This reduces the addictive tendencies of nicotine and other drugs that boost the brain levels of dopamine. By counteracting any pleasurable experiences that may be gained by the increase in dopamine, this drug may offer an alternative way of treating nicotine addiction. The researchers claim that GVG would work better than other stop-smoking treatments as it is not addictive, is not based on nicotine and has fewer side effects.

Support for the role of glutamate and GABA

The role of glutamate and GABA in nicotine addiction is supported by a study of nicotine-dependent rats (D'Souza and Markou, 2013). The researchers blocked transmission of the neurotransmitter glutamate, which resulted in a decrease in nicotine intake and nicotine seeking in the animals. Nicotine seeking also decreased when GABA neurotransmitters, as was facilitated. This is consistent with explanations of the role of these two neurotransmitters, as glutamate enhances the dopamine-releasing effects of nicotine – so blocking it would decrease those effects, making nicotine less rewarding. Likewise, the inhibition of GABA by nicotine keeps the dopamine effect going for longer – therefore facilitation of GABA would overcome this inhibitory effect and also decrease the pleasurable effects of nicotine.

Nicotine and Parkinson's disease

Further support for the link between nicotine and dopamine comes from an unusual source – the treatment of patients with Parkinson's disease (PD). Parkinson's is a progressive neurodegenerative disorder, which is characterised by a gradual loss of dopamine-producing nerve cells, causing the symptoms of PD to appear. Research suggests that smokers are less likely to get PD than those who have never smoked, suggesting that nicotine may have a neuroprotective function against the development of PD and may also be beneficial in its treatment. For example, Fagerstrom *et al.* (1994) treated two elderly PD patients with nicotine gum and patches. They found significant changes in symptoms that were attributed to the increased levels of dopamine caused by the nicotine administration.

Implications: Nicotine addiction and depression

A Canadian study (Khaleel *et al.*, 2009) found that long-term smoking can have an adverse effect on mood because it alters brain neurochemistry. They found that the incidence of depression was highest in long-term smokers and lowest in those who had never smoked. This was also the case in a Chinese study where smoking was associated with a greater risk of depression in both males and females (Luk and Tsoh, 2010). However, in this study, female smokers were particularly at risk of developing depression. The researchers explain that female gender is considered a risk factor for depression in both Western and Chinese cultures, so therefore the greater prevalence of depression in Chinese female smokers could be understood in terms of the additive effects of altered brain chemistry due to smoking and female gender.

Nicotine affects men and women differently

► Research in China suggests that nicotine addiction was a risk factor for depression, particularly for females.



1. Outline the brain neurochemistry of nicotine addiction. (6 marks)
2. Outline the role of dopamine in nicotine addiction. (6 marks)
3. Explain one limitation of the brain neurochemistry explanation of nicotine addiction. (6 marks)
4. Outline and evaluate the brain neurochemistry explanation of nicotine addiction. (16 marks)

CAN YOU?

No. 11.4



Using your knowledge of the brain neurochemistry of nicotine addiction, explain Gerry's smoking behaviour.

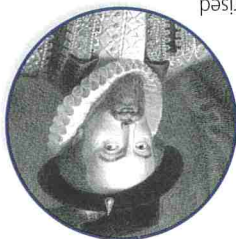
Gerry teaches psychology at a university in the south-west. He is a long-term smoker, usually smoking between 15 and 20 cigarettes a day. He finds it difficult to get going in the morning until he has had his first cigarette, and when he is teaching a two-hour seminar he often has to give his students something to do while he nips outside to have a quick cigarette. Smoking gives him a real buzz and energises him for the rest of the seminar. This works quite well for him because he can normally go for about 40 minutes before he needs another nicotine fix.

APPLY YOUR KNOWLEDGE



cigarettes and chips!

Raleigh, Raleigh popularised the use of tobacco in the court of Elizabeth I, and it is widely believed that his final request before his beheading in 1618 was a last puff of his pipe. Raleigh is also credited for introducing the potato into Britain, so we have a lot to thank him for –



MEET THE ADVENTURER

The introduction of tobacco into England is attributed to the adventurer Sir Walter Raleigh. Raleigh popularised