Brain parasite directly alters brain chemistry

Research shows infection by the brain parasite Toxoplasma gondii, found in 10-20 per cent of the UK’s population, directly affects the production of dopamine, a key chemical messenger in the brain.

Findings from the University of Leeds research group are the first to demonstrate that a parasite found in the brain of mammals can affect dopamine levels.

Whilst the work has been carried out with rodents, lead investigator Dr Glenn McConkey of the University's Faculty of Biological Sciences, believes that the findings could ultimately shed new light on treating human neurological disorders that are dopamine-related such as schizophrenia, attention deficit hyperactivity disorder, and Parkinson's disease.

This research may explain how these parasites, remarkably, manipulate rodents' behaviour for their own advantage.

Infected mice and rats lose their innate fear of cats, increasing the chances of being caught and eaten, which enables the parasite to return to its main host to complete its life cycle.

In this study, funded by the Stanley Medical Research Institute and Dunhill Medical Trust, the research team found that the parasite causes production and release of many times the normal amount of dopamine in infected brain cells.

Dopamine is a natural chemical which relays messages in the brain controlling aspects of movement, cognition and behaviour.

It helps control the brain's reward and pleasure centres and regulates emotional responses such as fear.

The presence of a certain kind of dopamine receptor is also associated with sensation-seeking, whereas dopamine deficiency in humans results in Parkinson's disease.

These findings build on earlier studies in which Dr McConkey's group found that the parasite actually encodes the enzyme for producing dopamine in its genome.

"Based on these analyses, it was clear that *T. gondii* can orchestrate a significant increase in dopamine production in neural cells," says Dr McConkey.

"Humans are accidental hosts to *T. gondii* and the parasite could end up anywhere in the brain, so human symptoms of toxoplasmosis infection may depend on where parasite ends up.

This may explain the observed statistical link between incidences of schizophrenia and toxoplasmosis infection."

Dr McConkey says his next experiments will investigate how the parasite enzyme triggers dopamine production and how this may change behaviour.

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**Notes for editors**

The paper, titled The neurotropic parasite Toxoplasma gondii increases dopamine metabolism is published on Plos ONE. <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0023866>

Toxoplasmosis, which is transmitted via cat faeces (found on unwashed vegetables) and raw or undercooked infected meat, is relatively common, with 10-20% of the UK population and 22% of the US population estimated to carry the parasite as cysts.  Most people with the parasite are healthy, but for those who are immune-suppressed - and particularly for pregnant women - there are significant health risks that can occasionally be fatal.

The parasite infects the brain by forming a cyst within its cells and produces an enzyme called tyrosine hydroxylase, which is needed to make dopamine.  Dopamine's role in mood, sociability, attention, motivation and sleep patterns are well documented and schizophrenia has long been associated with dopamine, which is the target of all current schizophrenia drugs on the market.

The enzyme tyrosine hydroxylase is a crucial step in making L-DOPA (prescribed as levodopa for Parkinson's Disease), a chemical that is readily converted to the neurotransmitter dopamine.

The US-based Stanley Medical Research Institute, which focuses on mental health conditions and has a particular emphasis on bipolar illnesses. Dunhill Medical Trust supports research on diseases of aging.