

## Editorial

### ***Toxoplasma Gondii: The Mind-Control Parasite***

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*Toxoplasma gondii* is an extremely widespread protozoan parasite, with a prevalence of 20-70% in USA. This high prevalence is attributable in part to the HIV pandemic: neurotoxoplasmosis is the most frequent opportunistic infection and the most common cause of brain focal injuries in AIDS patients. There are no effective vaccines for *T. gondii*, and the available drugs have significant adverse effects [1].

During its life cycle, *T. gondii* needs to be transmitted from an intermediate host to the definitive host, the feline predator, by predation. *Toxoplasma* is able to manipulate the behavior of its hosts to increase the probability of the intermediate host being captured by a predator [2]. In humans, the parasite can alter the host's mental state, and then change its behavior - the so called manipulation hypothesis.

Various microbial agents are able to establish persistent infections in the central nervous system. Park et al. [3] showed a strong correlation between schizophrenia and infectious agents, e.g. *Toxoplasma*, and these infections were able to alter the balance among cerebral neurotransmitter such as serotonin. The fact that some individuals with first-episode schizophrenia are positive to *Toxoplasma* strongly suggests that the parasite is a potential risk factor for schizophrenia [4]. However, nowadays it is more difficult to evaluate this correlation in patients, due to lower cooperativeness and conscientiousness of infected subjects [2].

In addition to epidemiological studies, animal behavior studies may provide more robust evidence for behavioral changes induced by *T. gondii*. It is widely acknowledged that behavioral changes in rodents infected with *T. gondii* are adapted for the parasite because they appear to increase predation of infected rodents by cats, thus ensuring transmission of the parasite to its definitive host.

Some of the processes affecting behaviors that

*Toxoplasma* is thought to induce in infected rodents are: motor coordination, learning, memory, locomotion, anxiety, response to novelty, and aversion to feline odor, the latter being the most publicized effect of *Toxoplasma*. Nevertheless, Worth [5] has suggested that some inconsistencies in behavioral studies involving *T. gondii* point to a need for better controls. Difference of host species, gender, measurement time, and sources of error should be considered prior to undertaking future behavioral studies. In addition, more sophisticated analytical techniques for behavioral studies are required.

Finally, despite the difficulties in the currently behavior studies, in animal or epidemiological approaches, the parasites' ability to manipulate intermediate host behavior may be indirectly responsible for high rates of mortality and morbidity from toxoplasmosis. Thus, more controlled approaches are needed for the better understanding of correlation between *T. gondii* infections and mind control.

## References

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