

The Link Between a Common Parasite and Mental Illness

The jury is still out on whether this brain parasite associated with certain household pets is causing mental illness in humans, but there does seem to be a link between the infection and schizophrenia. It's known to change the behavior of rodents, and now wolves at Yellowstone.

Analysis by Dr. Karen Shaw Becker

STORY AT-A-GLANCE

- A study of Yellowstone National Park's wolves shows that those infected with the common parasite *Toxoplasma gondii* (*T. gondii*) are much more likely to become pack leaders than their uninfected counterparts
- The downside is the infection causes the wolves to "make more daring decisions" and engage in "enhanced risk-taking," which can have negative consequences
- *T. gondii* is a brain parasite, and earlier research has shown that infected rodents lose their fear of the odor of cat urine and have been observed walking right into the mouths of waiting cats
- Multiple studies have yet to conclude toxoplasmosis is a cause of mental illness in humans, though there seems to be a link between the infection and schizophrenia

A fascinating new study has found that **wolves** in Yellowstone National Park infected with the common parasite *Toxoplasma gondii* (*T. gondii*) are much more likely to become pack leaders.

The *T. gondii* parasite is found in a wide variety of birds and mammals, but it can only reproduce inside felines (wild and domestic), which are the primary host. Once inside a cat's intestines, *T. gondii* produces millions of oocysts that complete their life cycle in the gastrointestinal (GI) tract and re-enter the environment in the cat's feces.

According to ScienceNews, wolves with toxoplasmosis "make more daring decisions than their uninfected counterparts," and their "enhanced risk-taking" means they are more likely to leave their pack or become leaders of their own pack.¹

*"Those are two decisions that can really benefit wolves, or could cause wolves to die," said lead study author Connor Meyer, a field biologist at the University of Montana in Missoula. The findings reveal a parasite's potent ability to influence a wolf's social fate.*²

The research was published in the journal *Communications Biology* in November 2022, and is the result of an analysis of studies of wolves in the park over a 26-year period.³

Toxoplasmosis May Make Male Wolves Bolder, Braver

For the study, the researchers set out to determine the impact, if any, of *T. gondii* infections on Yellowstone's wild wolf population. They analyzed data from blood samples of over 200 wolves living in the park during 1995 through 2020, looking for evidence of toxoplasmosis. They also looked at the notes of research observers for evidence of any

behavior changes in the wolves. What they learned:

- Young, infected male wolves tended to leave their packs earlier than young, uninfected males; those infected were 50% more likely to leave their pack as early as six months after birth, whereas young males normally stay for up to 21 months
- Infected females were 25% more likely to leave their pack at 30 months, rather than the normal 48
- Infected males were more than 46 times more likely to become pack leaders than uninfected males
- Infection rates were higher in wolves who mingled with cougars

In the video below, Yellowstone's Junction Butte wolf pack passes by a trail camera. The researchers were able to observe slight differences in wolf behavior between individuals:

As Meyer observes, diseases in wildlife are an important area of study, primarily in the context of their potential to be fatal, but "We have evidence now that just being infected with a certain parasite — *Toxoplasma* — can have pretty major implications for wolf behavior."

The wolves' *T. gondii*-driven boldness may have wider ranging consequences, since infected pack leaders may be more likely to introduce pack members to riskier situations, such as venturing into cougar territories, which makes additional infections among the pack more likely.

"I think people are just starting to really appreciate that personality differences in animals are a major consideration in behavior," study coauthor Kira Cassidy, a wildlife biologist at the Yellowstone Wolf Project in Bozeman, MT told ScienceNews. "Now we add a parasite-impacting behavior to the list."

Toxoplasmosis Also Causes Brain Alterations in Rodents

Since *T. gondii* is a brain parasite, scientists have long wondered if it plays a role in human mental illness, especially schizophrenia. According to Science Magazine, while over 100 studies⁴ have found a link between toxoplasmosis and schizophrenia, not one has concluded the parasite is the definitive cause.⁵

Scientists suspect toxoplasmosis may cause mental illness based on the effect it has on rodents, who seem to lose their fear of the odor of cat urine and have been observed walking right into the mouths of waiting cats.

The scientists' theory is that the parasite alters brain function by forming cysts in regions that process fear and decision-making and may also influence behavior by increasing levels of the neurotransmitter dopamine, which is involved in reward-seeking and risk-taking.

Scientists also suspect the infection may cause permanent alterations in the brain, since affected rodents remain without fear of cats long after the parasite has been cleared from their bodies. The parasite also forms cysts inside human neurons. From Science Magazine's Emily Underwood:

"In people with HIV or other immune-weakening conditions, the cysts can grow and replicate, causing deadly brain inflammation, dementia, and psychosis. Although scientists have long assumed the cysts are benign in healthy people, a growing body of data suggests T. gondii infection can alter personality and increase the chance of developing schizophrenia and other mental illness.

*"Even without directly infecting the brain, a chronic T. gondii infection can ramp up inflammation, and inflammation has been linked to mental disorders such as schizophrenia, autism, and Alzheimer's disease."*⁶

Does T. Gondii Exposure Cause Mental Illness in Humans?

While studies seem to show that toxoplasmosis causes "mental illness" in rodents, testing the hypothesis in humans is extremely difficult according to Duke University geneticist Karen Sugden.

In a 2016 study, Sugden looked at 200 New Zealanders in their late 30s infected with T. gondii and concluded that, "On the whole, there was little evidence that T. gondii was related to increased risk of psychiatric disorder, poor impulse control, personality aberrations or neurocognitive impairment."⁷

However, she doesn't dismiss the idea that the parasite may cause schizophrenia. She says to test the theory, researchers would need to know if study participants were exposed to the parasite as children or teens, before the typical age of onset of schizophrenia (late teens/early 20s).

Sugden's study, like others, used small sample sizes. Schizophrenia only occurs in about 1% of the population, so to obtain realistic statistical results, researchers would need to follow tens or even hundreds of thousands of people over long periods, testing for T. gondii exposure and mental illness at regular intervals to determine which came first.

A recent large-scale Danish study looked at 80,000 blood donors.⁸ The number of donors with schizophrenia was quite small (151), however, the researchers found that people exposed to T. gondii had a 47% increased risk of being diagnosed with schizophrenia.

Of the 151 donors with schizophrenia, 28 were determined to have tested positive for T. gondii before being diagnosed with schizophrenia. The researchers found that these individuals were 2.5 times more likely to develop the disease post-exposure.

The Danish study results are similar to the results of other large studies that have also uncovered about a 2.5-fold increase in the chance that people with a toxoplasmosis infection will be diagnosed with schizophrenia. However, because the incidence of schizophrenia in the general population is so small, T. gondii exposure increases the odds only slightly.

Robert Yolken, a virologist at the Johns Hopkins University School of Medicine in Baltimore, Maryland, and one of the authors of the Danish study, and other researchers suspect that toxoplasmosis alone may not cause mental illness, but that the parasite "interacts with genetic variants that make some people more susceptible."

Sources and References

^{1,2} [ScienceNews, December 6, 2022](#)

³ [Meyer, C.J. et al. Communications Biology, Volume 5, Article number: 1180 \(2022\).](#)

^{5,6} [Science Magazine, February 15, 2019](#)

⁷ [PLOS ONE, February 17, 2016](#)

⁸ [Brain, Behavior, and Immunity, January 29, 2019](#)
