

UC SANTA BARBARA

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## **Cat Parasite May Affect Cultural Traits in Human Populations**

A common parasite found in cats may be affecting human behavior on a mass scale, according to a scientist based at the University of California, Santa Barbara.

While little is known about the causes of cultural change, and biological explanations often stimulate social and scientific debate, a new study by the U.S. Geological Survey published in the August 2 issue of the Proceedings of the Royal Society, Biology, indicates that behavioral manipulation of a common brain parasite may be among factors that play a role.

"In populations where this parasite is very common, mass personality modification could result in cultural change," said study author Kevin Lafferty, a USGS scientist at UC Santa Barbara. "The geographic variation in the latent prevalence of *Toxoplasma gondii* may explain a substantial proportion of human population differences we see in cultural aspects that relate to ego, money, material possessions, work and rules."

Although this sounds like science fiction, it is a logical outcome of how natural selection leads to effective strategies for parasites to get from host to host, said Lafferty. *Toxoplasma gondii* is a parasite of cats, both domestic and wild. While modern humans are a dead-end host for the parasite, *Toxoplasma* appears to manipulate personality by the same adaptations that normally help it complete its life cycle. The typical journey of the parasite involves a cat and its prey, starting as eggs shed in an infected cat's feces, inadvertently eaten by a warm-blooded animal,

such as a rat. The infected rat's behavior alters so that it becomes more active, less cautious and more likely to be eaten by a cat, where the parasite completes its life cycle. Many other warm-blooded vertebrates may be infected by this pathogen. After producing usually mild flu-like symptoms in humans, the parasite tends to remain in a dormant state in the brain and other tissues.

Evidence for subtle long-term effects on an individual's personality, reported by researchers in the Czech Republic, inspired Lafferty to explore whether a shift in the average, or aggregate, personality of a population might occur where *Toxoplasma* has infected a higher proportion of individuals. Infection with *Toxoplasma* varies considerably from one population to another; in some countries it is very rare, while in others nearly all adults are infected. To test his hypothesis, Lafferty used published data on cultural dimension and aggregate personality for countries where there were also published data on the prevalence of *Toxoplasma* antibodies in women of childbearing age. Pregnant women are tested for antibodies because of the serious risk posed by toxoplasmosis to fetuses, which lack their own immune systems.

The results of previous work suggested that *Toxoplasma* could affect specific elements of human culture. *Toxoplasma* is associated with different, often opposite, behavioral changes in men and women, but both genders exhibit guilt proneness (a form of neuroticism). Lafferty's analysis found that countries with high *Toxoplasma* prevalence had a higher aggregate neuroticism score, and western nations with high prevalence also scored higher in the 'neurotic' cultural dimensions of 'masculine' sex roles and uncertainty avoidance.

"There could be a lot more to this story. Different responses to the parasite by men and women could lead to many additional cultural effects that are, as yet, difficult to analyze," said Lafferty.

Lafferty suggested that because climate affects the persistence of infectious states of *Toxoplasma* in the environment, it helps drive the geographic variation in the parasite's prevalence by increasing exposure risk. The parasite's eggs can live longer in humid, low-altitude regions, especially at mid latitudes that have infrequent freezing and thawing. Cultural practices of food preparation such as rare or undercooked meats, or poor hygiene, can increase exposure to infection, as can having cats as pets. Lafferty added, "Toxoplasmosis is one of many factors that may influence personality and culture, which may also include the effects of other

infectious diseases, genetics, environment and history. Efforts to control this infectious pathogen could bring about cultural changes."

"This is not to say that the cultural dimensions associated with *T. gondii* are necessarily undesirable," noted Lafferty. "After all, they add to our cultural diversity."

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