Physicists shed light on mysterious tongue condition

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Oblate lesions on the dorsum of the tongue are shown. The tiny "hairs" covering the unaffected regions in are the filiform papillae. Credit: *New Journal of Physics*, 2015. Reproduced by permission of IOP Publishing.

Physicists from Israel have shed light on the intricate dynamics underpinning a mysterious tongue condition that has been puzzling the medical community for decades.

Known as geographic tongue (GT), the condition affects around two per

cent of the population and is characterised by evolving red patches on the surface of the tongue that— as the name suggests—can have a map-like resemblance.

The red patches appear due to the loss of one of four types of tiny hair-like protrusions, called papillae, which cover the surface of the tongue. Despite extensive research, the exact cause of GT remains unknown.

In their study published today, 1 April, in the Institute of Physics and German Physical Society's *New Journal of Physics*, the researchers performed a number of numerical simulations to closely examine and visualise the development of the condition, and have devised a new way of identifying the severity of individual cases.

It is hoped the research will lead to a practical assessment that doctors can use to diagnose GT, as well as inspire further research to ultimately find out what causes the condition.

The researchers, from the Weizmann Institute of Science in Israel, approached the problem of GT as if it were an "excitable medium"—a system through which a wave of some description can pass across, and which cannot support the passing of another wave until a certain amount of time has passed.

A forest fire is a classic example of an "excitable medium"—a fire can spread through a forest, but it cannot return to a burnt spot until the vegetation has regrown over time.

The researchers' investigation showed that GT can spread across the tongue in two different ways, each of which has distinguishing characteristics that could be used to diagnose the severity of each case.

They discovered that the condition, which typically starts as small spots

on the tongue, can continue to gradually expand in circular patterns until the whole tongue becomes affected. Once affected the whole tongue then heals itself.

Alternatively, the condition can develop through the formation of spiral patterns. The researchers' simulations showed that these spirals evolve into regions of the tongue that are still recovering, causing that particular region to be excited again.

Lead author of the study Dr Gabriel Seiden, currently at the Max Planck Institute for the Physics of Complex Systems, said: "While the propagation of small, circular lesions results in the whole tongue being gradually affected and subsequently healed, the propagation of spiral patterns involves a continuous, self-sustaining excitation of recovering regions, implying a more acute condition that will linger for a relatively long period of time."

"We hope these results can be used by physicians as practical way of assessing the severity of the condition based on the characteristic patterns observed."

Just as the development of forest fires can be strongly affected by external conditions, such as the strength of the wind, the researchers note that conditions surrounding the tongue may also have important consequences on the dynamics of GT.

In their study, they note how GT was observed in a one-year-old boy who developed the characteristic lesions on multiple occasions along the tongue's edge adjacent to growing teeth, implying that the continuous rubbing of the tongue against the gum may trigger the condition.

"Going forward, we intend to collaborate with physicians and dentists who treat GT patients to obtain valuable—and often scarce—empirical

data regarding the dynamic evolution of the condition," Dr Seiden continued. "This will allow for further, more quantitative explorations of GT, and may eventually lead to a firmer understanding of what causes the condition."

More information: 'The tongue as an excitable medium' Seiden G and Curland S 2015 *New J. Phys.* 17 033049. iopscience.iop.org/1367-2630/17/3/033049

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