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Connections between groups of people determine the speed at which a virus spreads

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How fast does a virus spread within the population? And what is it that makes a video go viral on internet? A new mathematical theory by researchers at TU/e reveals that the way people in groups are connected is a decisive factor. How fast something spreads is entirely dependent on the connections between these groups. They present their theory today in the *Scientific Reports* journal published by *Nature*.

Many networks, formed by humans or by nature, have a clear group structure: internet, biological networks, communication networks, the brain, social networks, and networks created by physical contacts among people. It is generally the case that group members – people, smartphones or neurons – have strong connections but that connections between groups are few and far between. If we are to understand networks, therefore, mathematical models that unravel these groups structures are essential.

Revelation

At the beginning of this year mathematicians Clara Stegehuis, Remco van der Hofstad and Johan van Leeuwaarden of TU Eindhoven revealed a sophisticated mathematical theory to examine networks, including the group structures. Today they demonstrate in *Scientific Reports* – published by *Nature* – which new phenomena this theory brings to light when the theory is used to calculate real networks.

Spread of viruses

A key insight is that it is not the groups in themselves that matter but the connections between these groups. This is what determines how fast something spreads over a network. "Look, for instance, at how a virus spreads," says Van der Hofstad. "You then see that it happens very quickly within a community, but what is decisive is whether there is contact with other communities. It can go one of two ways: the spread may be faster or slower compared with a network without groups."

Domino effect

The mathematical theory predicts whether the outcome is good or bad. "The actual composition of the groups seems less important here," says Van Leeuwaarden. "Information or a virus spreads from group to group. If that is with relative ease, then something can go viral fast." In combating viruses this can be a useful piece of information. "By isolating the group where the virus grows, you may condemn that group but other groups can be saved," Van Leeuwaarden adds.

Networks

The mathematical theory of networks is a relatively recent field. The societal relevance of complex networks is increasing all the time while the fundamentals of the underlying theory are not yet clear. TU Eindhoven is researching the fundamental aspects of complex networks within the NWO core program 'NETWORKS'.

More information: Clara Stegehuis et al., Epidemic spreading on complex networks with community structures, *Scientific Reports* (21 July 2016)

Provided by Eindhoven University of Technology