# Are neurological disorders the result of brain evolution mistakes?

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A team of researchers affiliated with several institutions in Australia has proposed that some neurological disorders might have their roots in evolutionary mistakes. In their paper published in the journal *Nature Neuroscience*, the group describes their ideas and possible paths of research moving forward.

As scientists delve ever deeper into our brains as part of an effort to understand how they work, they are proposing new ideas to explain their observations. One big area of research involves neurological disorders such as schizophrenia. How do they come about, what happens, and are there ways to treat them? In this new effort, the researchers have proposed a new idea—that some neurological disorders might result from natural evolution. They note that evolution of the brain is a balancing act due to its physical nature. We only have so much wiring, because our skulls are of a certain size. Thus, as our brains evolve, costs of anatomical wiring are weighed against computational gains as measured by an increase in complexity. They further suggest that due to a limited means for increasing the amount of wiring, nature is forced to deal with how to increase complexity. They propose that such a balancing act is likely to result sometimes in evolutionary changes that do not pan out—in other words, errors. And some of these errors are likely to take the form of neurological disorders such as schizophrenia.

As part of their idea, they note that current theory suggests that the brain has connectomes—regions of the brain that are connected in certain ways for certain purposes. As evolutionary changes arise due to environmental or other factors, causing mutations, connectomes can change or become disrupted. Such changes, they note, are likely to be seen by modern testing devices as changes to grey matter—this is because of the role gray matter plays in routing communications in the brain.

To better understand what sort of changes we might see in grey matter due to evolutionary mutations, the group created a mathematical model to simulate such changes. They found changes in grey matter that were sometimes consistent with similar changes that have been reported in schizophrenia patients.

The researchers suggest their ideas open the door to two new lines of research. The first would involve study of communication hubs in the brain and the way they evolve. The second would be focused on using what is learned in such research efforts to treat those with neurological disorders.

**More information:** Leonardo L. Gollo et al. Fragility and volatility of structural hubs in the human connectome, *Nature Neuroscience* (2018). DOI: 10.1038/s41593-018-0188-z

**Abstract**
Brain structure reflects the influence of evolutionary processes that pit the costs of its anatomical wiring against the computational advantages conferred by its complexity. We show that cost-neutral 'mutations' of the human connectome almost inevitably degrade its complexity and disconnect high-strength connections to prefrontal network hubs. Conversely, restoring the peripheral location and strong connectivity of empirically observed hubs confers a wiring cost that the brain appears to minimize. Progressive cost-neutral randomization yields daughter networks that differ substantially from one another and results in a topologically unstable phenomenon consistent with a phase transition in complex systems. The fragility of hubs to disconnection shows a significant association with the acceleration of gray matter loss in schizophrenia. Together with effects on wiring cost, we suggest that fragile prefrontal hub connections and topological volatility act as evolutionary influences on brain networks whose optimal set point may be perturbed in neuropsychiatric disorders.