**eLife Digest Questions for article 'Modelling the emergence of whisker barrels'**

**1. What background information would someone who is completely unfamiliar with your field need to know to understand the findings in your paper? (Suggested word limit: 150 words)**

* Include something that most readers will be able to relate to in the first sentence. Get gradually more specific in the following sentences.
* Don’t try to explain the background to your entire field; instead consider which details a reader would need to know to understand the new findings, and then explain these facts as clearly and concisely as you can.
* Make sure to provide simple definitions or explanations for all technical terms and acronyms.

How does the brain wire itself up? One possibility is that brain development follows a very precise genetic blueprint, with every brain cell being told explicitly by the genes how it is to be connected to other cells. Another possibility is that complex patterns of connections between cells emerge from relatively simple interactions between growing cells, and that genetic instruction oversees this process much less rigidly.

One of the brain’s most distinctive patterns is the ‘barrel cortex’ of rats and mice. This consists of cylindrical clusters of cells (the barrels) which are arranged in a pattern that closely matches that of the whiskers on the face. The neurons within one barrel become active when its corresponding whisker is touched. This precise mapping between the individual whisker and its brain representation makes the whisker-barrel system ideal for studying brain wiring.

One wiring mechanism known to result from genetic instructions involves protein molecules that are found in varying concentrations across the brain. These are called guidance fields. Growing axons (the brain’s wires) can navigate towards regions of higher (or lower) concentration. A very large number of guidance fields could map out a set of locations (or ‘center-points’) for axons to grow towards, to ensure the correct barrel arrangement. However, there are too few known guidance fields to reconstruct the barrel cortex, so we tried to find a mechanism that would work with only two, which is just enough to form a coordinate system on the surface of the cortex.

**2. What exact research question did you set out to answer and why? (Suggested word limit: 75 words)**

* Provide context by making it clear if this question was asking something completely new, or if you wanted to test or build upon previous findings.
* Make sure that you explain why it was important to find an answer to this question (why should people care whether you can answer this question or not?).

To understand how complex neuronal wiring could arise in the presence of genetically specified, but relatively simple guidance fields, we asked the following question: 'Can the cortical barrel map reliably self-organize without a full genetic blueprint pre-specifying the barrel center-point locations in the cortex?'

**3. What are the most important findings of your paper? (Suggested word limit: 100 words)**

* Focus on findings highlighted in the title or abstract of your paper, and explain them clearly and completely.
* If possible, describe your methodology with a sentence or two.
* Always mention which species, type of organism or cells you have studied (for example, mutant mice, fruit flies, human kidney cells, or cancer cells).

We extended a mathematical model of a type first applied to biological theory by Alan Turing in 1952, and to axon growth by Jan Karbowski and Bard Ermentrout in 2004. We showed, using computer simulations of the model, that if axons originating from different whiskers compete strongly for space to make connections, causing them to concentrate into whisker-specific clusters, then only two guidance fields are required to reproduce the map. We demonstrated that center-points do not need to be specified in the target tissue (the cortex) if, instead, the axons’ response to the guidance fields is specified in the origin tissue. This model provides a simple account of how an organised structure in one part of the central nervous system can be ‘copied’ to another location.

**4. Who might eventually benefit from the findings of your study, and what would need to be done before we could achieve these benefits? (Suggested word limit: 75 words)**

* Think beyond your immediate field of research, and explain how your findings could lead to a benefit for wider society (patients, the environment, and so on).
* Avoid hype or exaggeration. For example, if your findings are about a fundamental process in living cells that could be relevant to understanding cancer, you should mention the link but be careful not to imply that the findings will imminently lead to new treatments.

The mechanisms of development in the barrel cortex are thought by many to be translatable across the rest of the cortex and may help inform future research into stroke recovery.

Models of these mechanisms can be used to explore how genetic changes affect cortical development in the context of neurodevelopmental disorders. Computational models also have the potential to reduce the amount of animal experimentation which is required to understand the wiring of the brain. By varying the parameters of the model, it is possible to ask questions about how developmental processes play out in species with brains of different size and overall complexity.