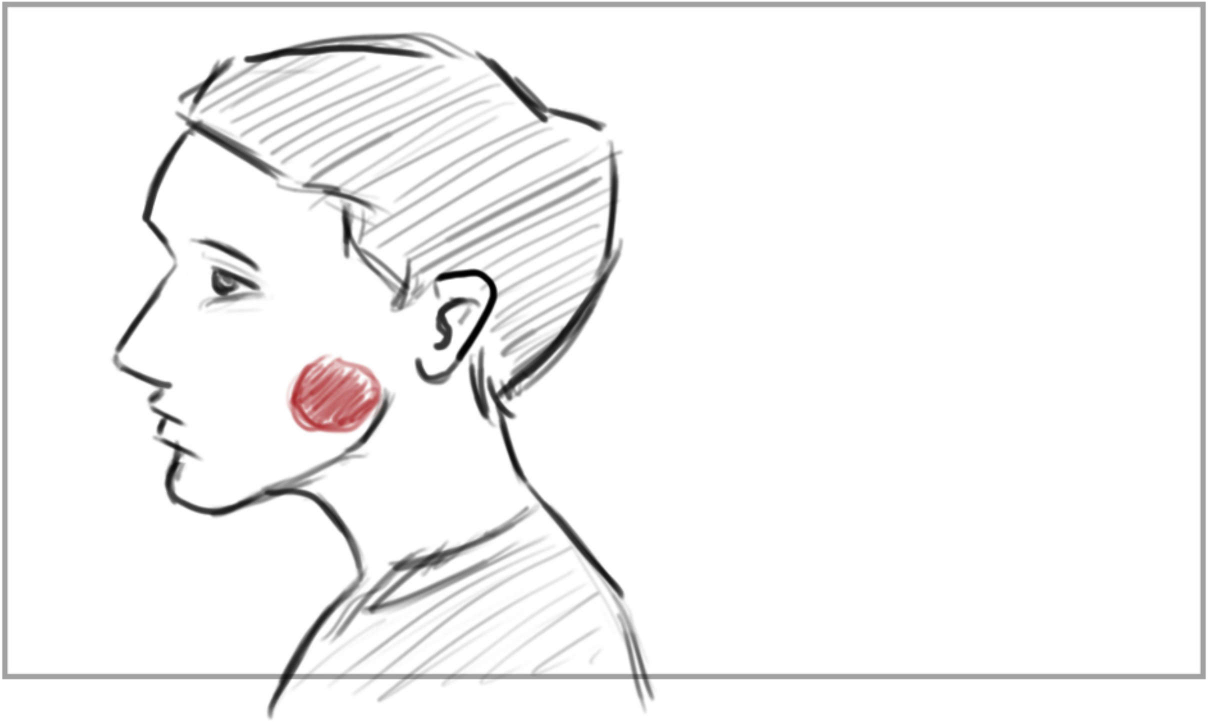
MRP Storyboard Presentation

October 29th, 2015

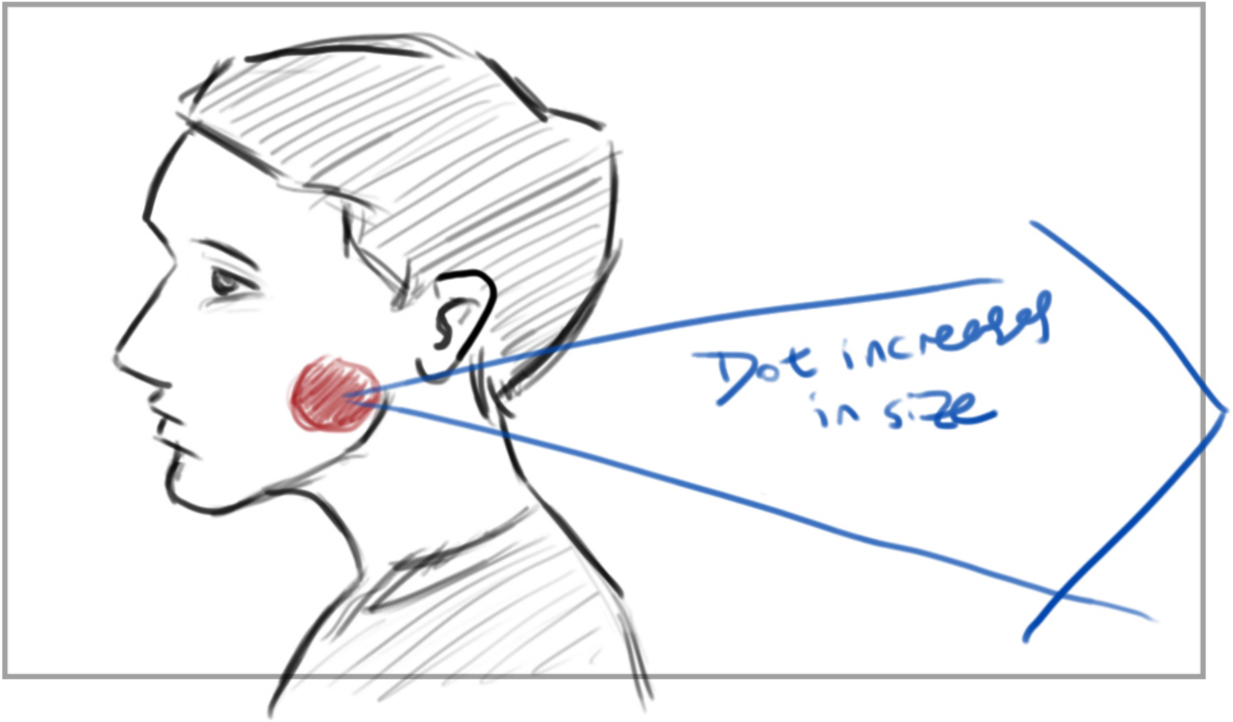
Audience: educated lay audience

Patients & family, undergraduates, non-brain imaging scientists

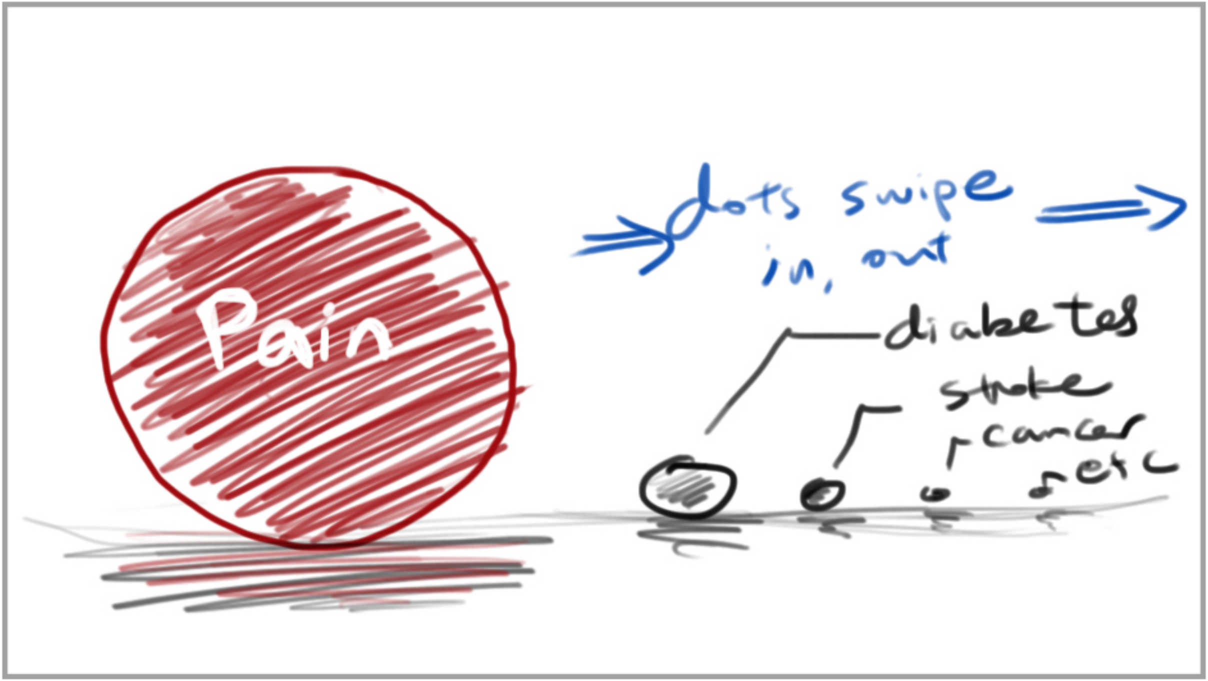
Pain can be a chronic, debilitating disorder



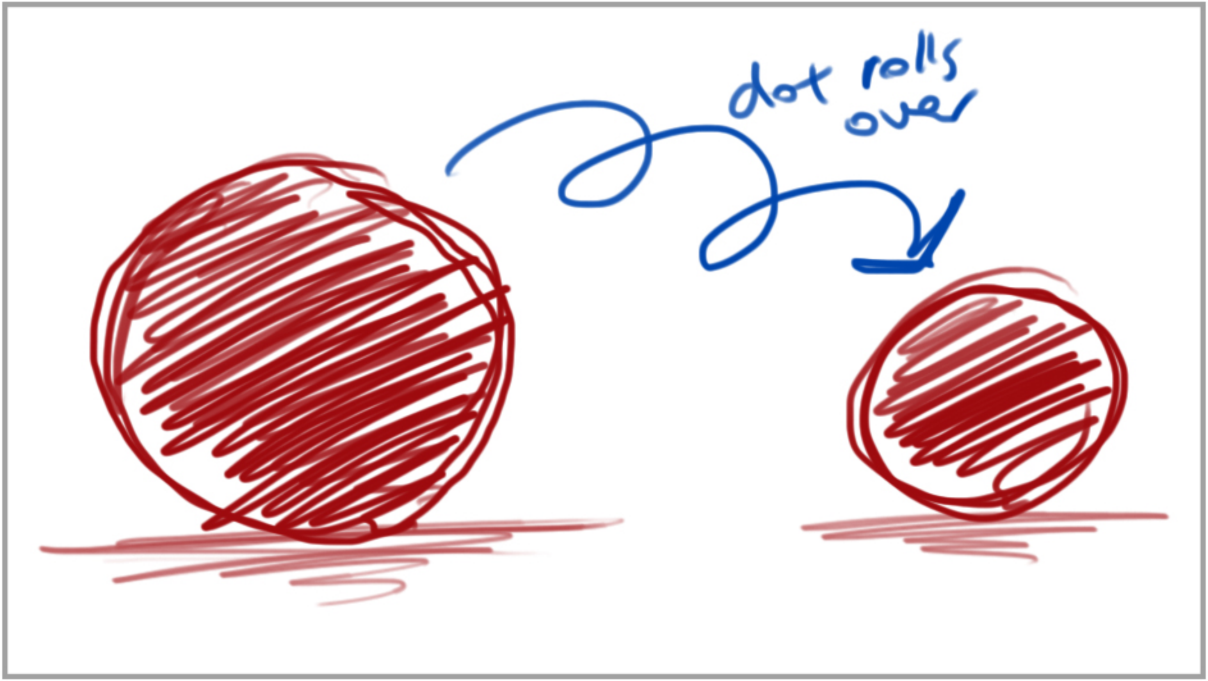
affecting hundreds of millions of North Americans



each year.

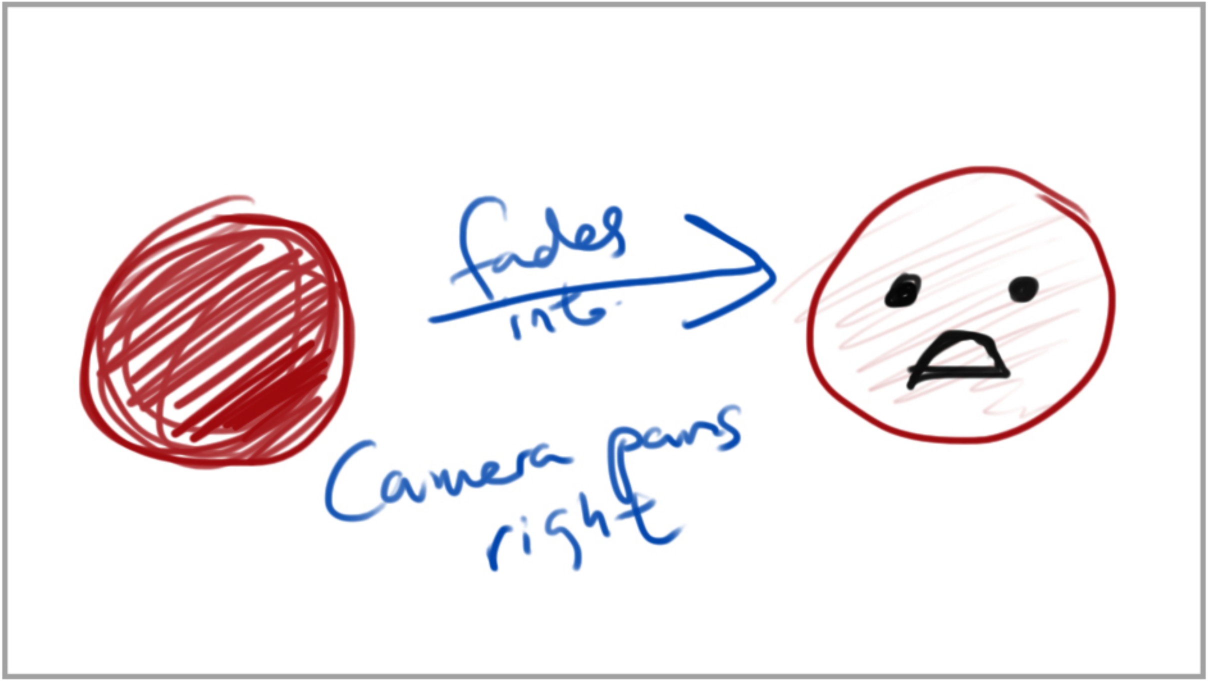


Pain affects more people than diabetes, coronary heart disease, stroke, and cancer combined.

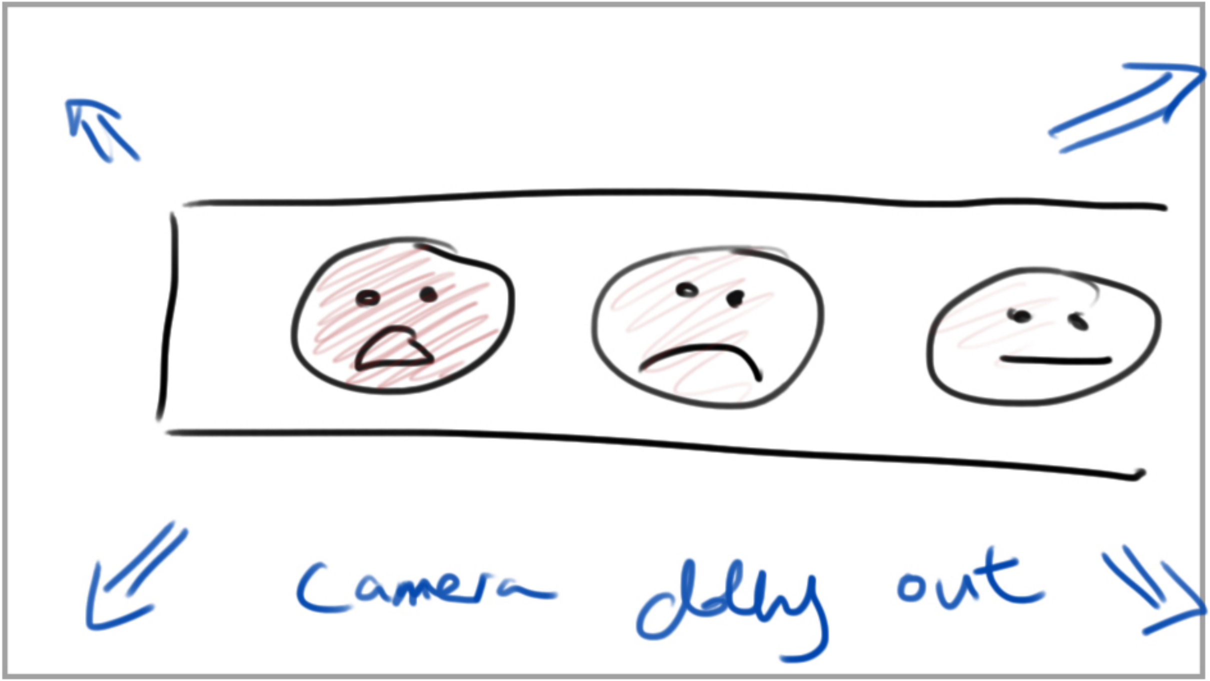


However, unlike many other diseases,

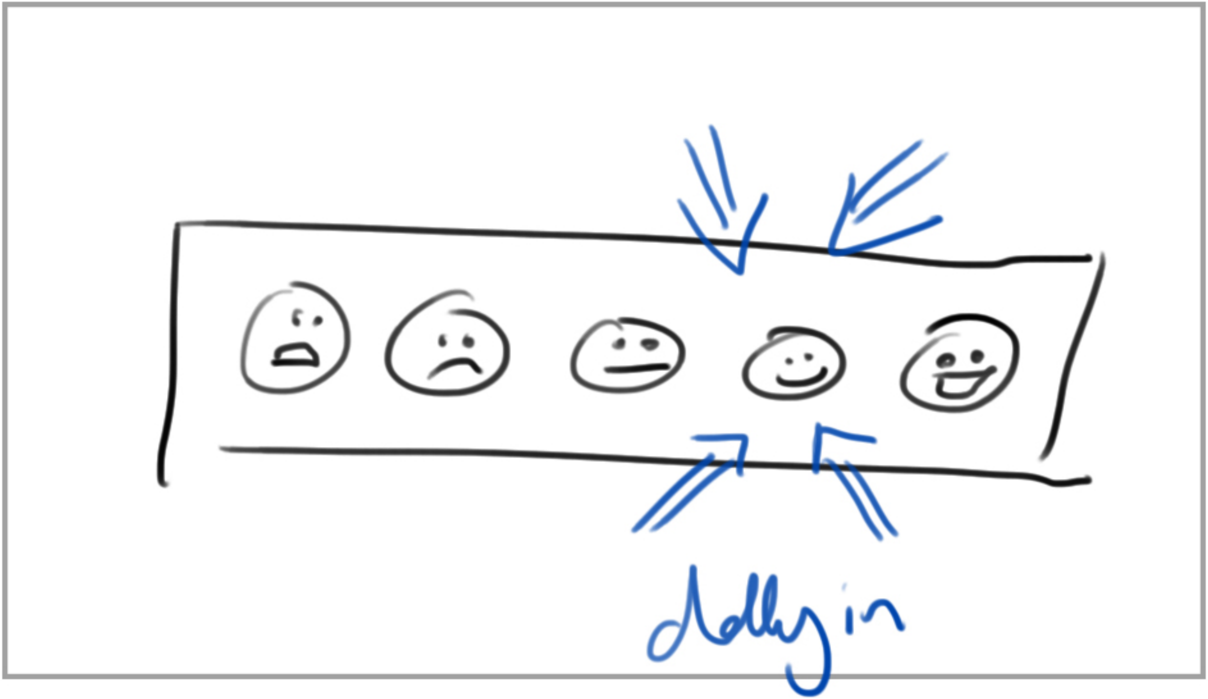
there are no objective tests for pain



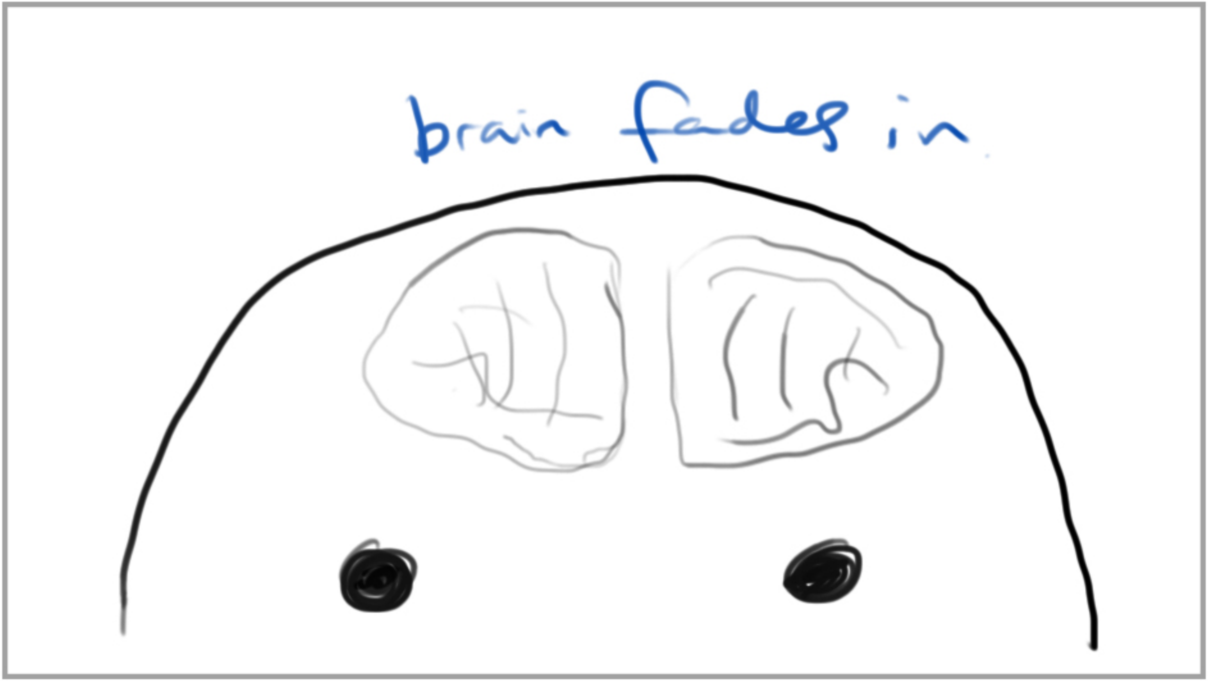
Major healthcare decisions,



Such as deciding to have invasive surgery,

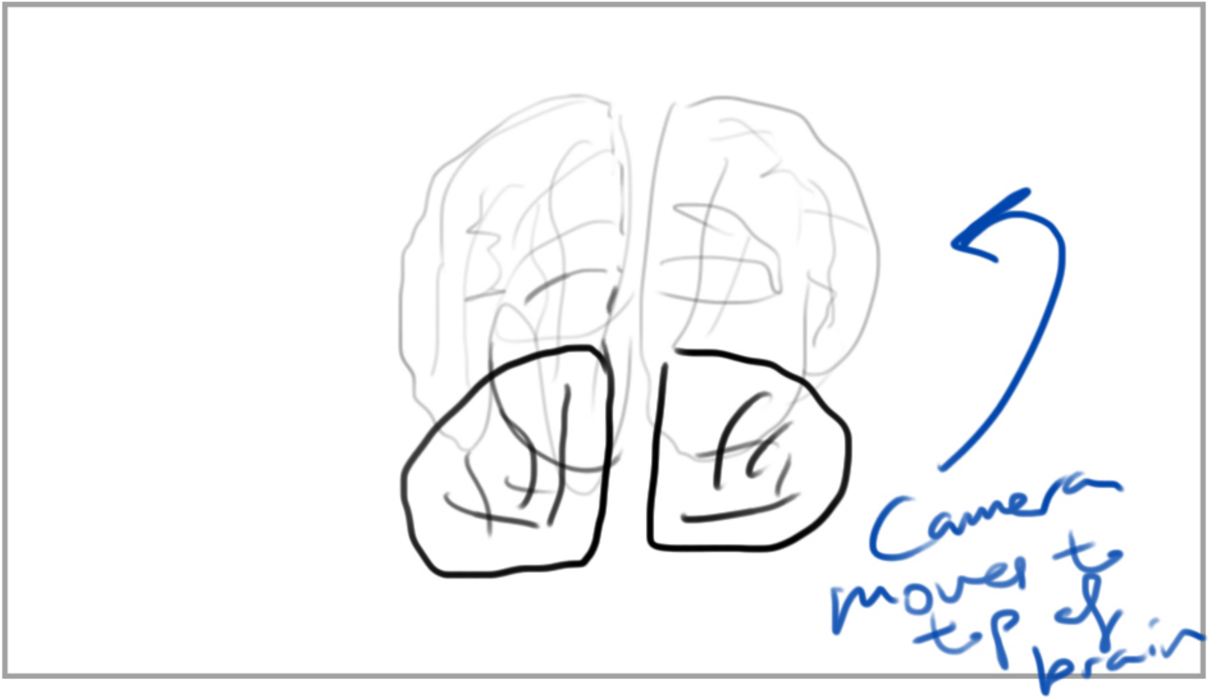


are often decided through subjective self-reporting methods

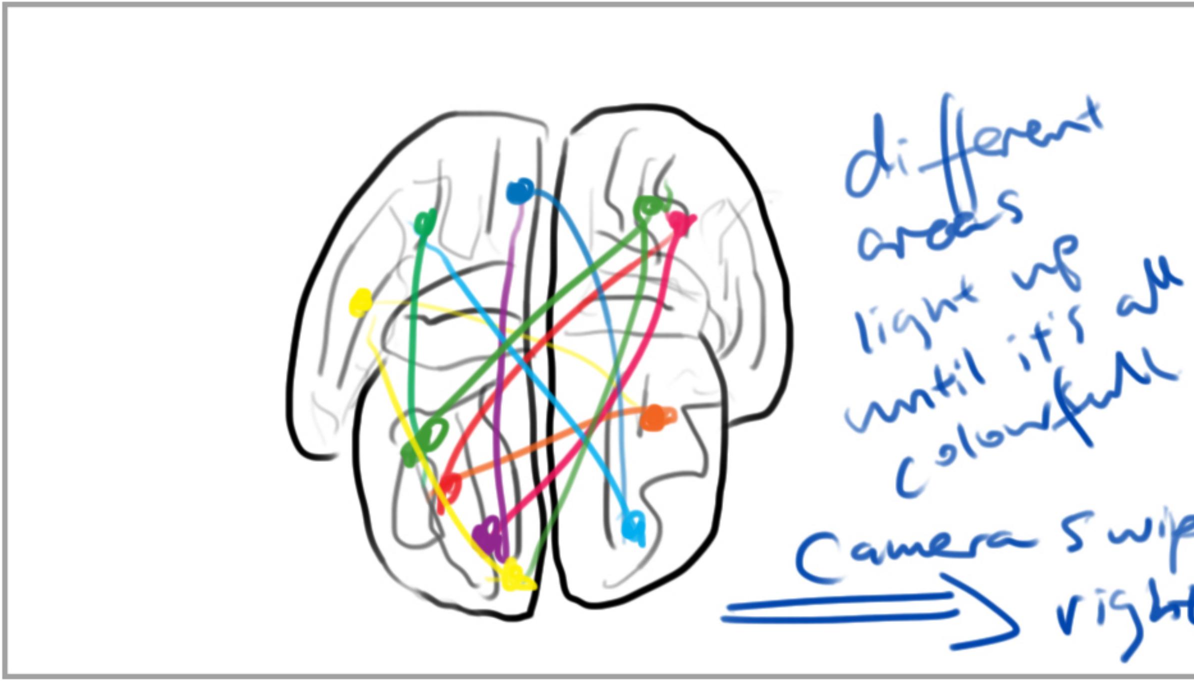


Clinical research scientists,

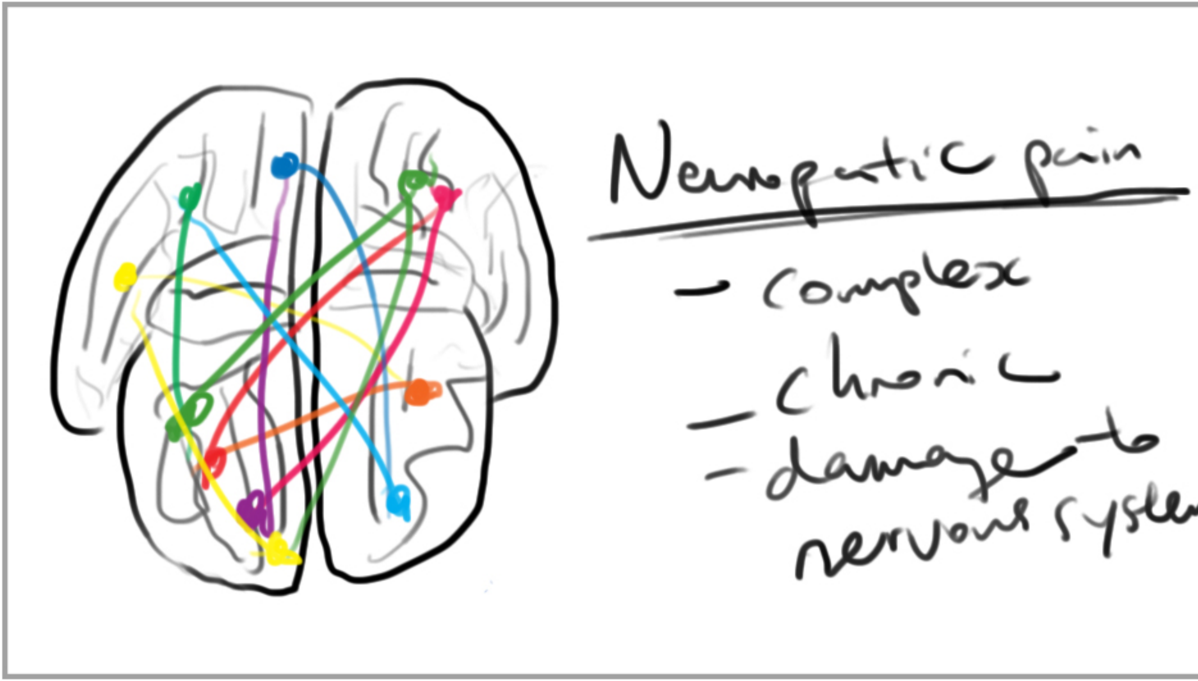
such as those a The Hodaie Lab at Toronto Western Hospital



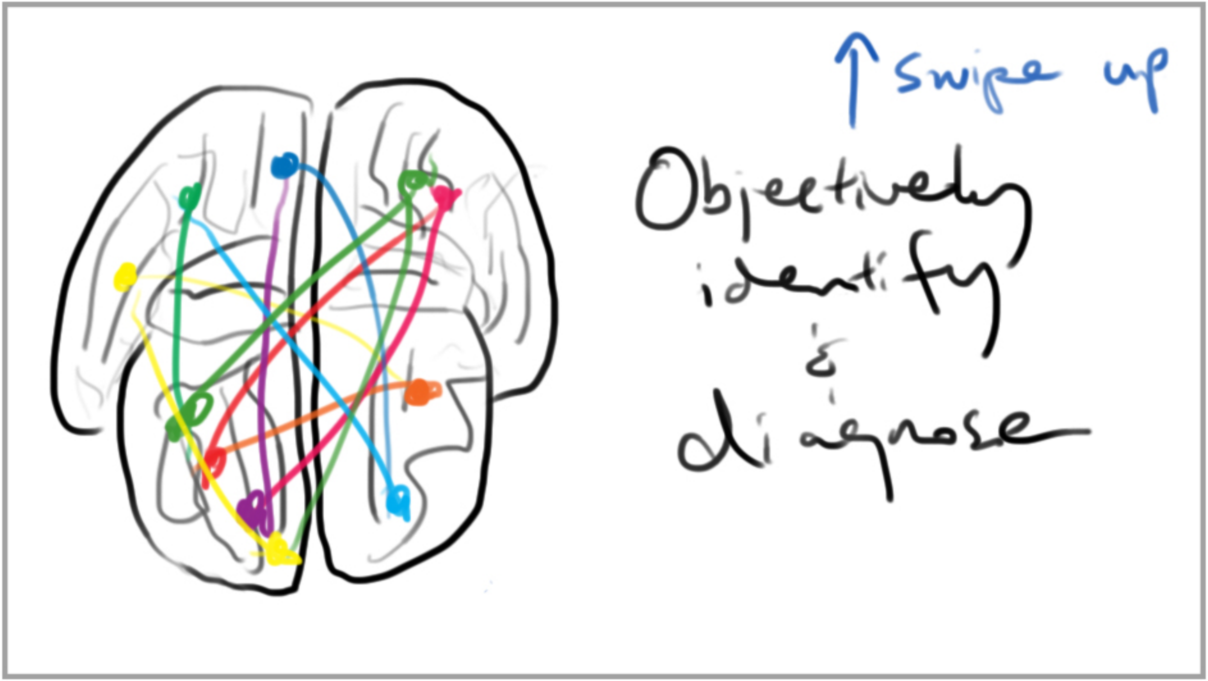
are working towards a solution.



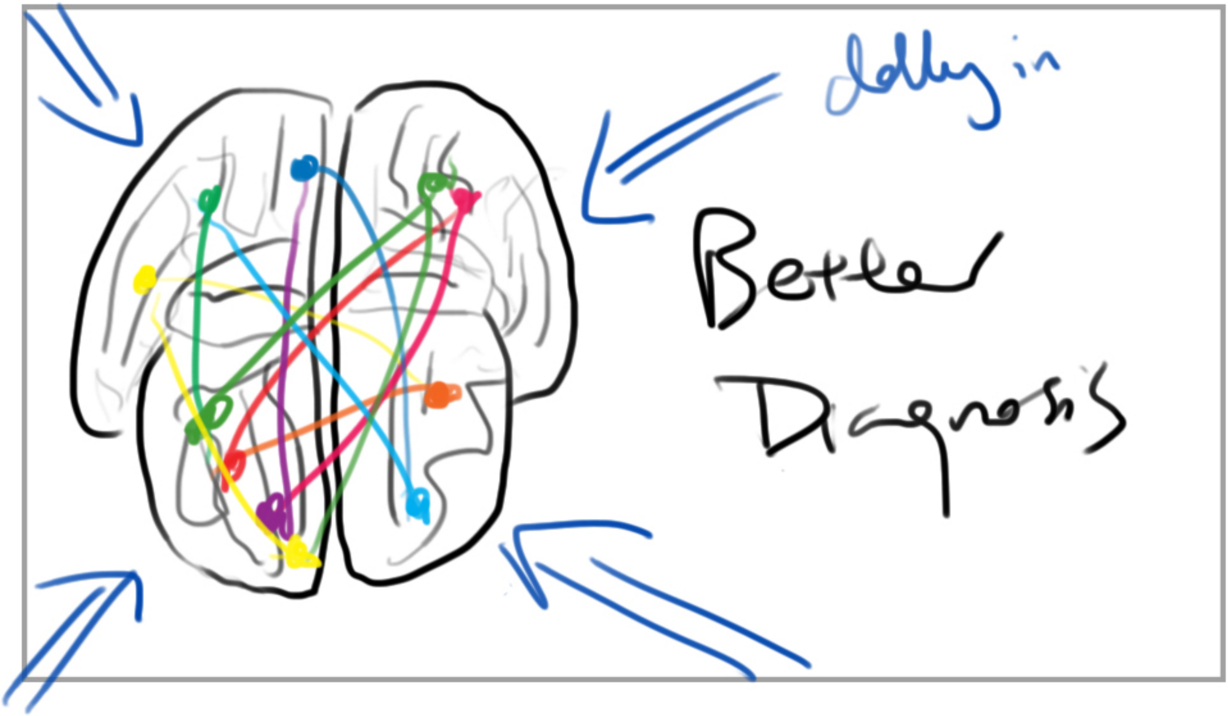
We seek to find the specific footprints of neuropathic pain;



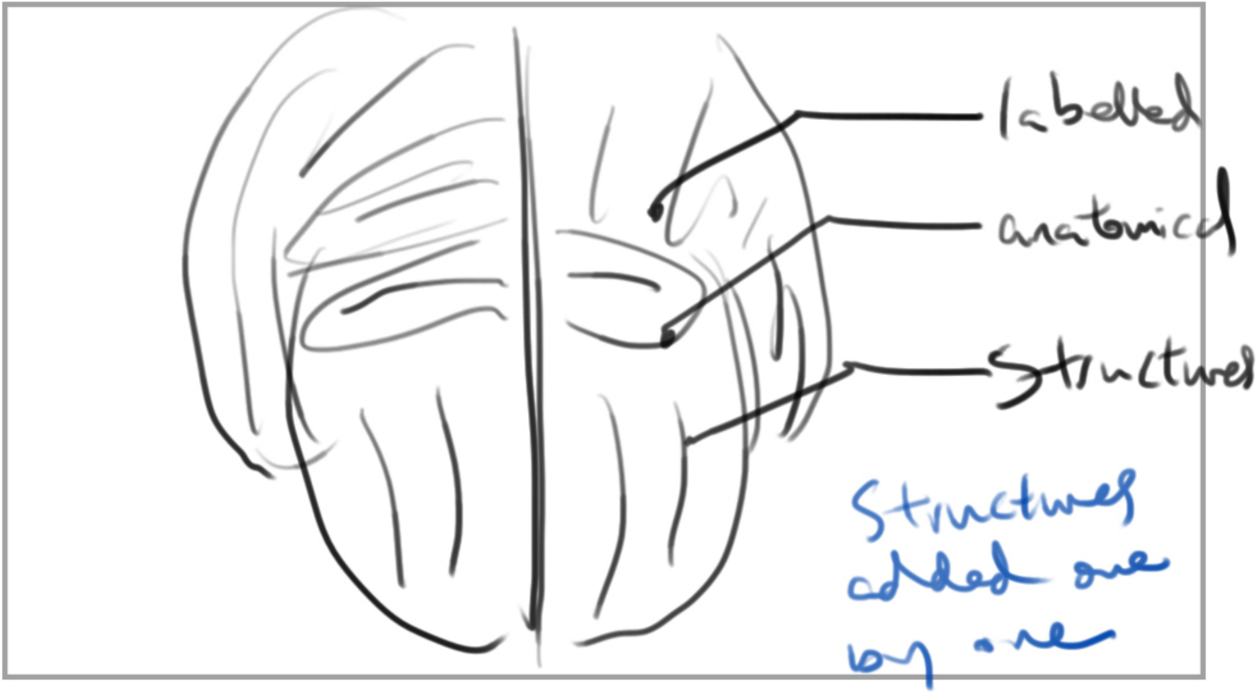
a complex, chronic pain caused by damage of disease to the body's nervous system.



It is important to be able to objectively identify ad diagnose neuropathic pain,

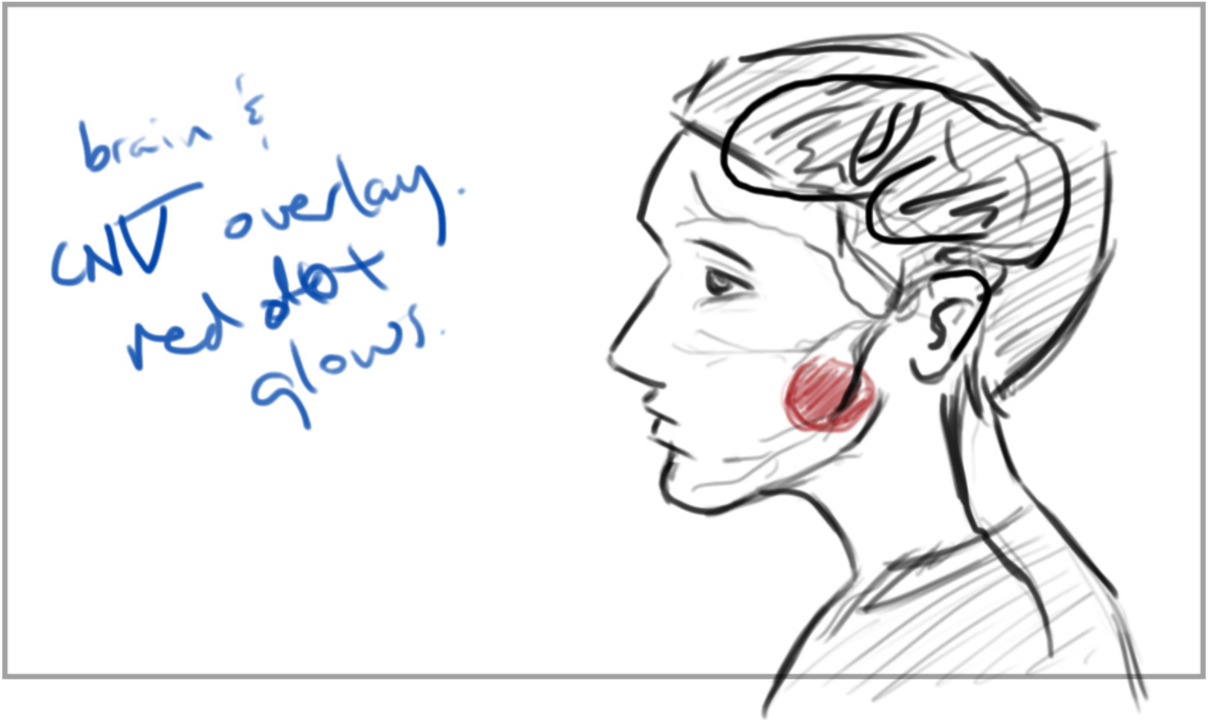


since some types can be alleviated through surgical treatment.



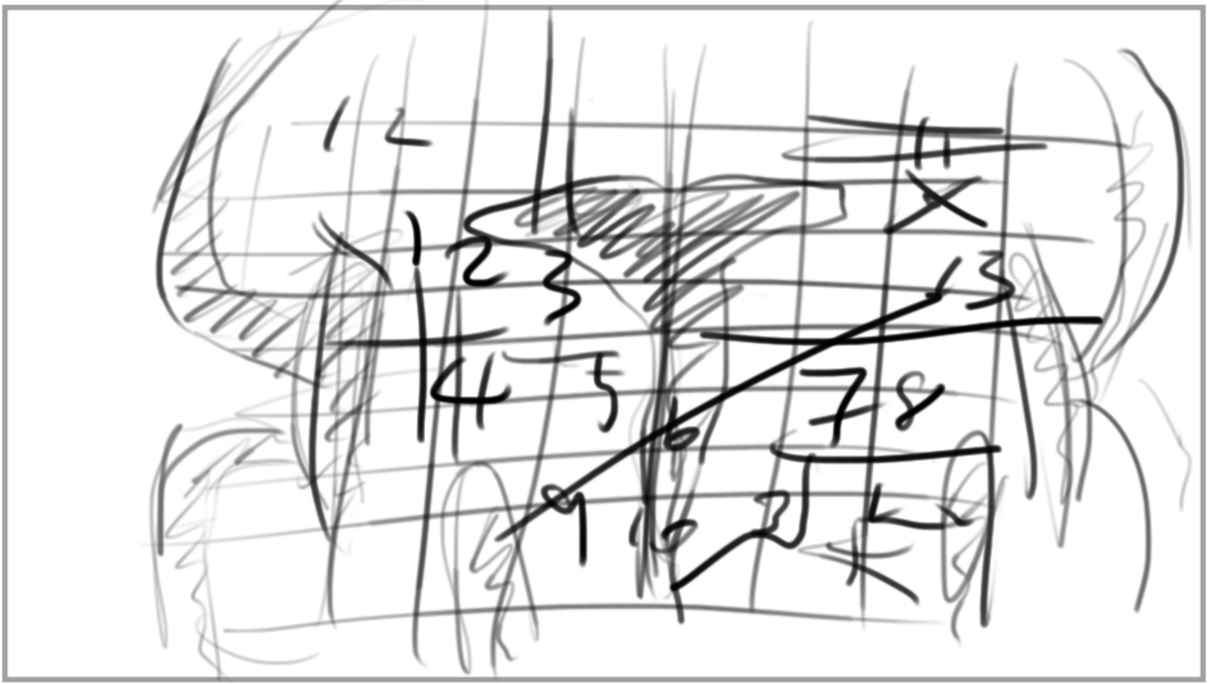
To find these footprints, we study the brain at the conventional anatomical scale,

and at the microscopic scale. This involves the study of structures such as nerve fibers and dendritic spines; things more than 5 times smaller than what we can see.

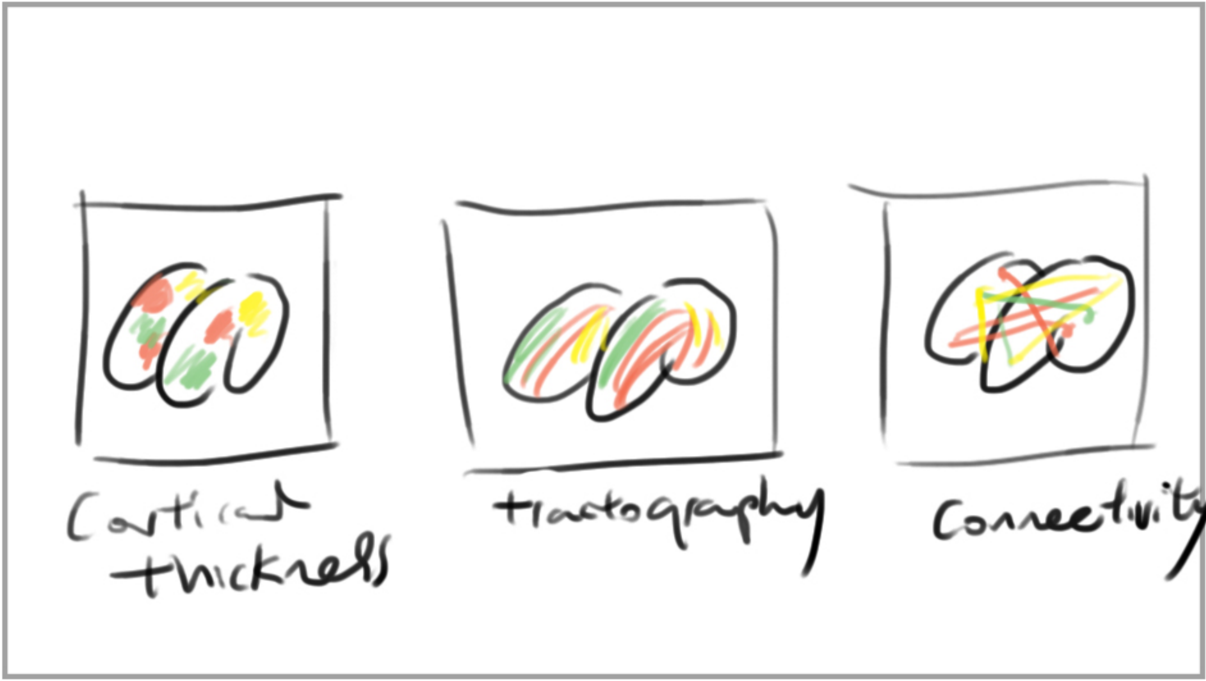


So how does a clinical examination lead to the better understanding of pain, structures, and mechanisms invisible to the naked eye?

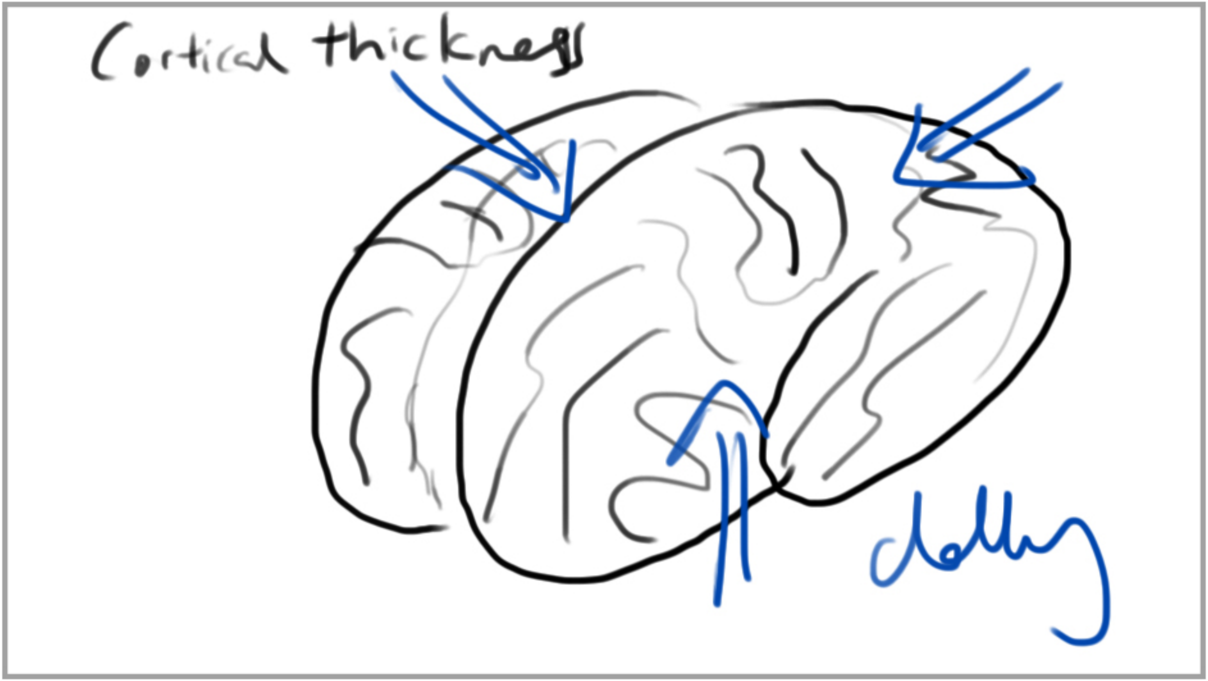
Patients suffering from chronic, neuropathic pain undergo MRI and fMRI imaging.



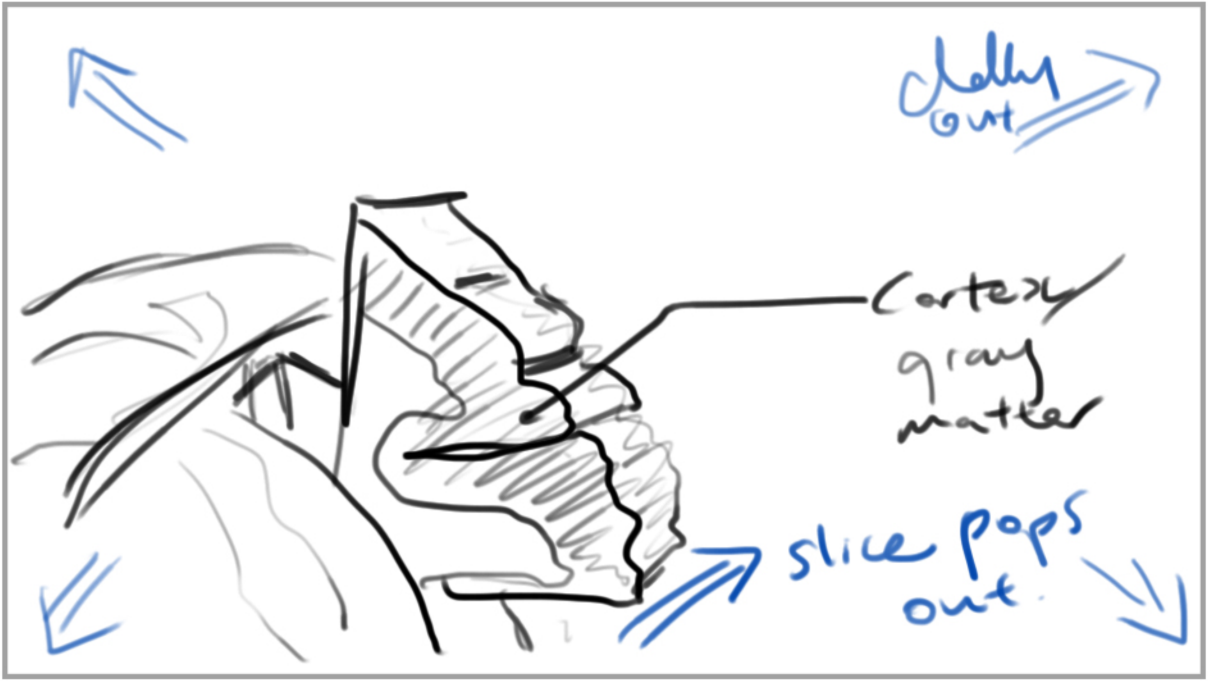
Data collected through imaging builds a 3D profile of the brain.



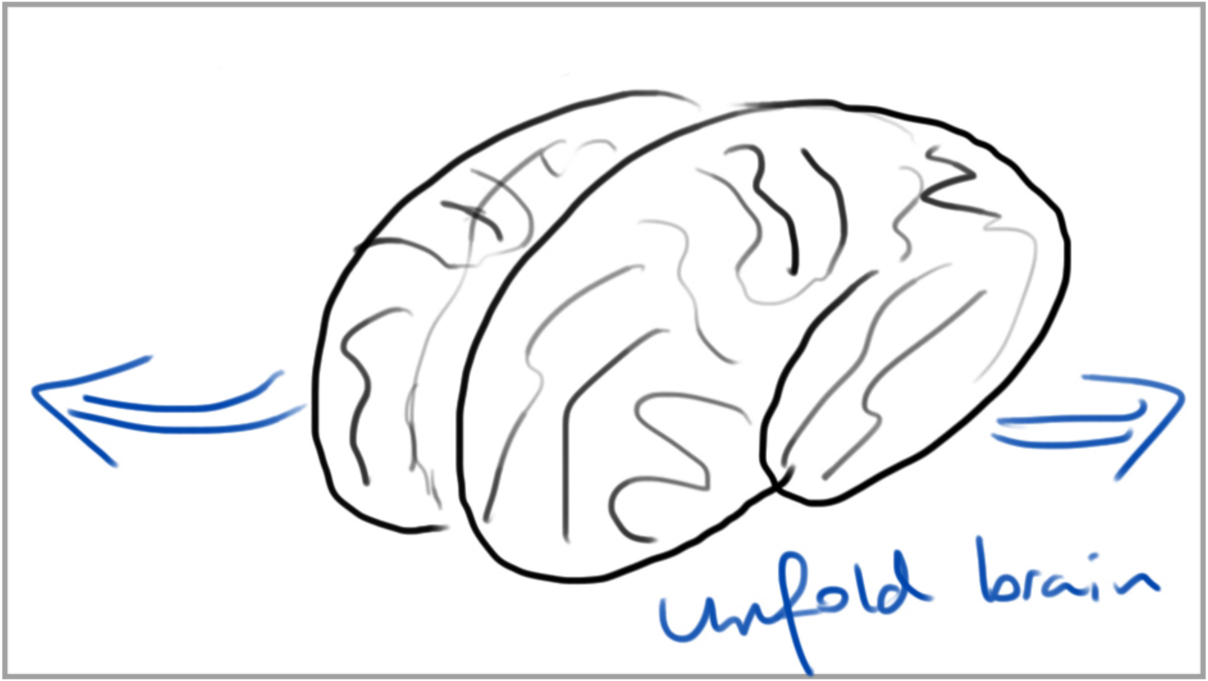
This profile can be used in 3 ways: in cortical thickness studies, tractography studies, and connectivity studies.



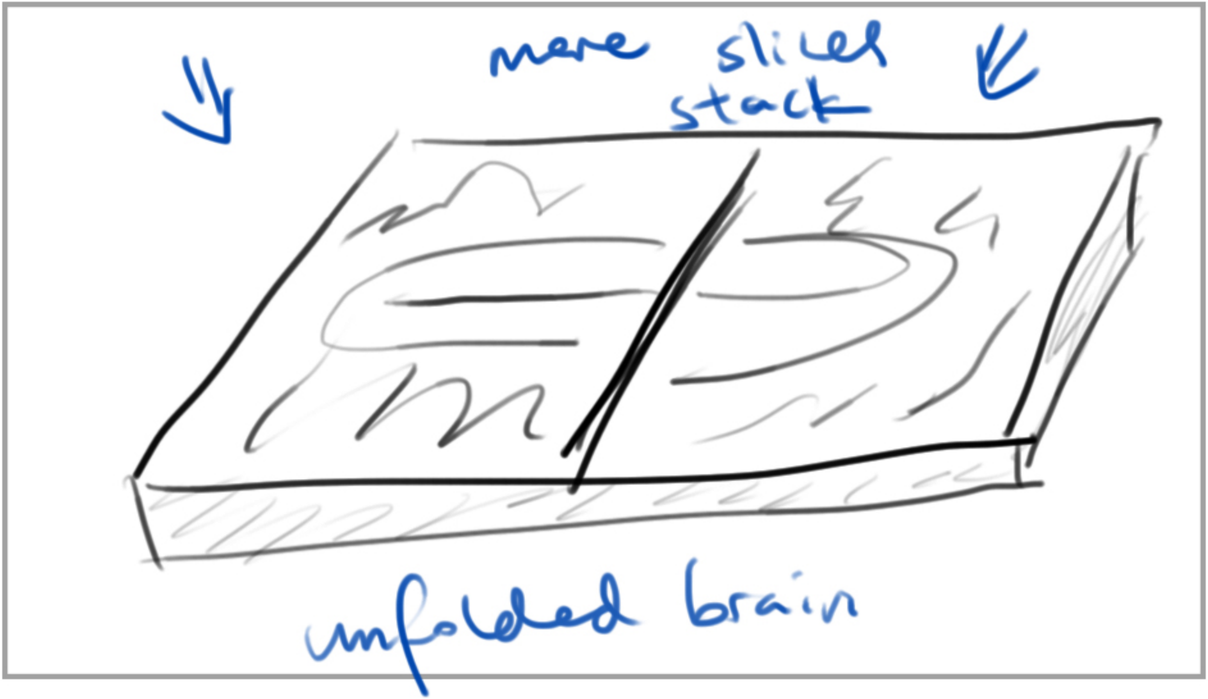
In cortical thickness studies, the mathematical data describing



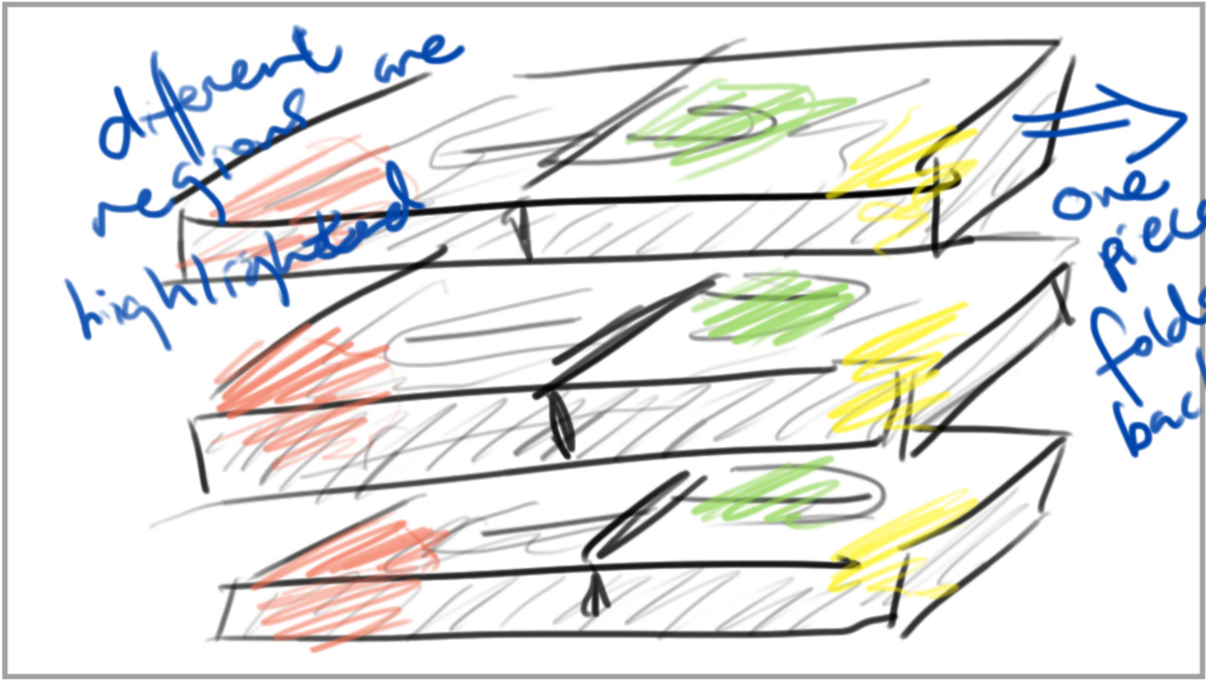
the cortex, also known as the outer layer or gray matter of the brain



is unfolded



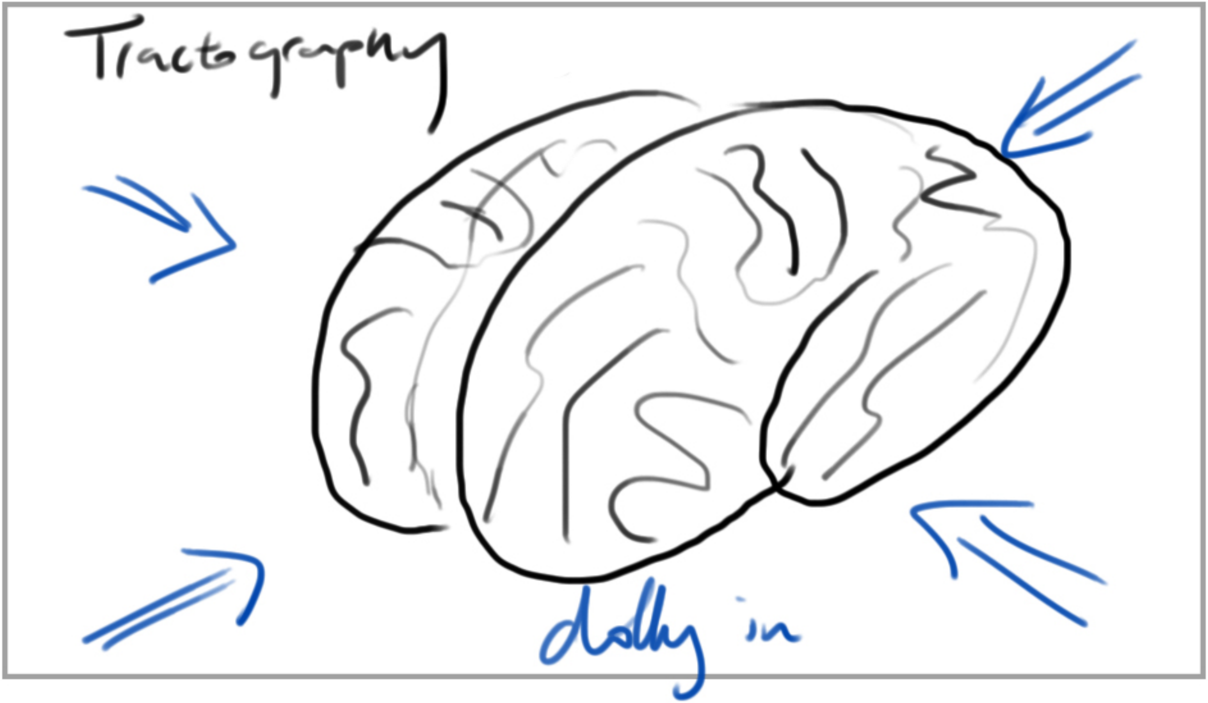
into a 3-dimensional slab.



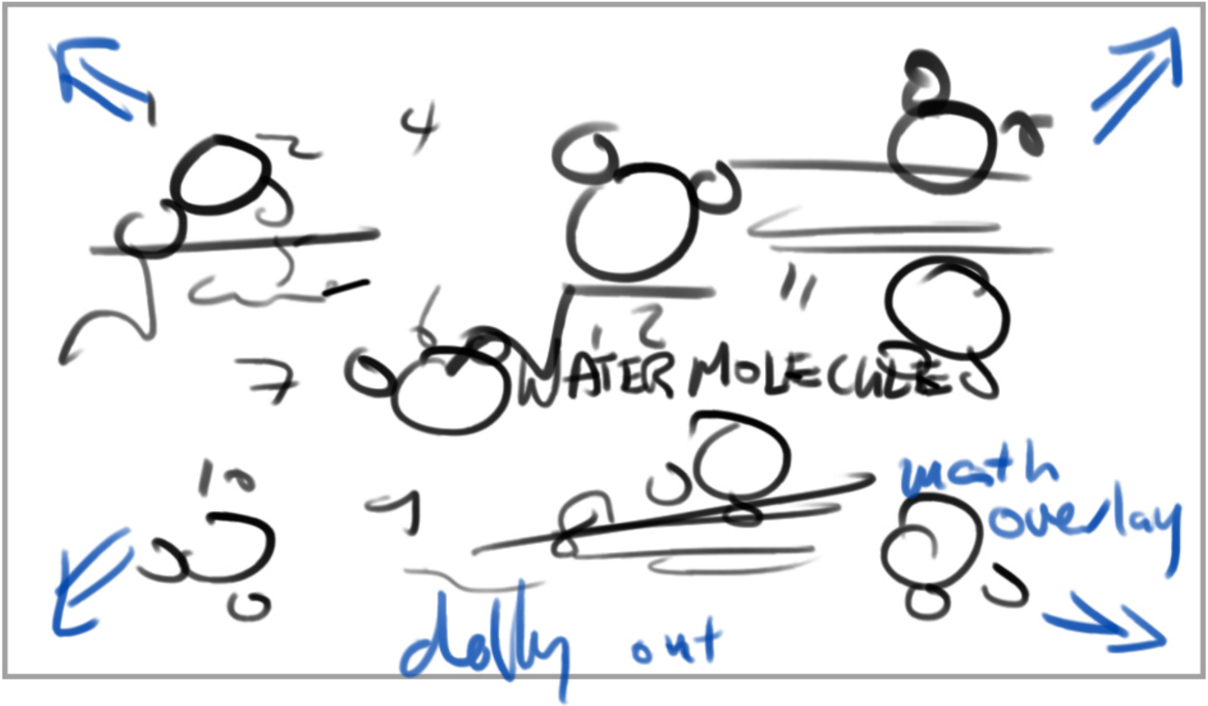
Data from previous scans can be compared to present data, and minute differences in cortical thickness can be seen.

These changes in the cortex can be correlated to specific signs and symptoms in chronic pain,

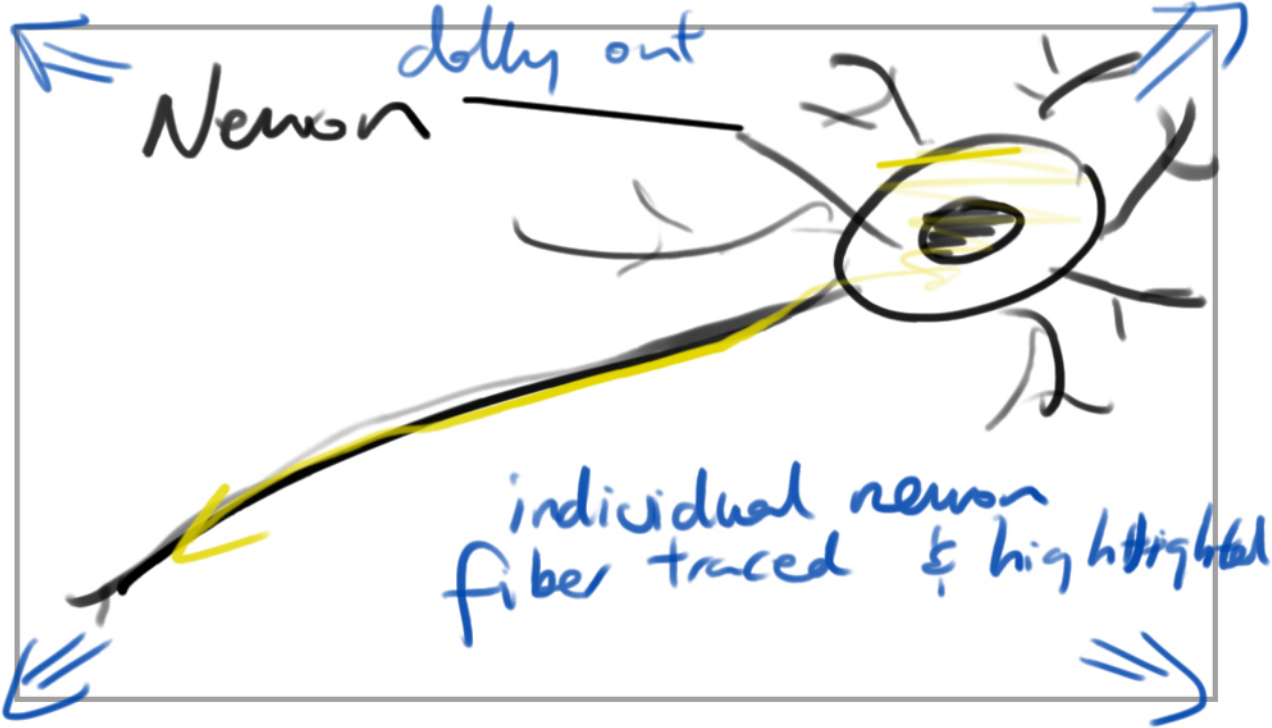
leading to more accurate diagnostics and treatments.



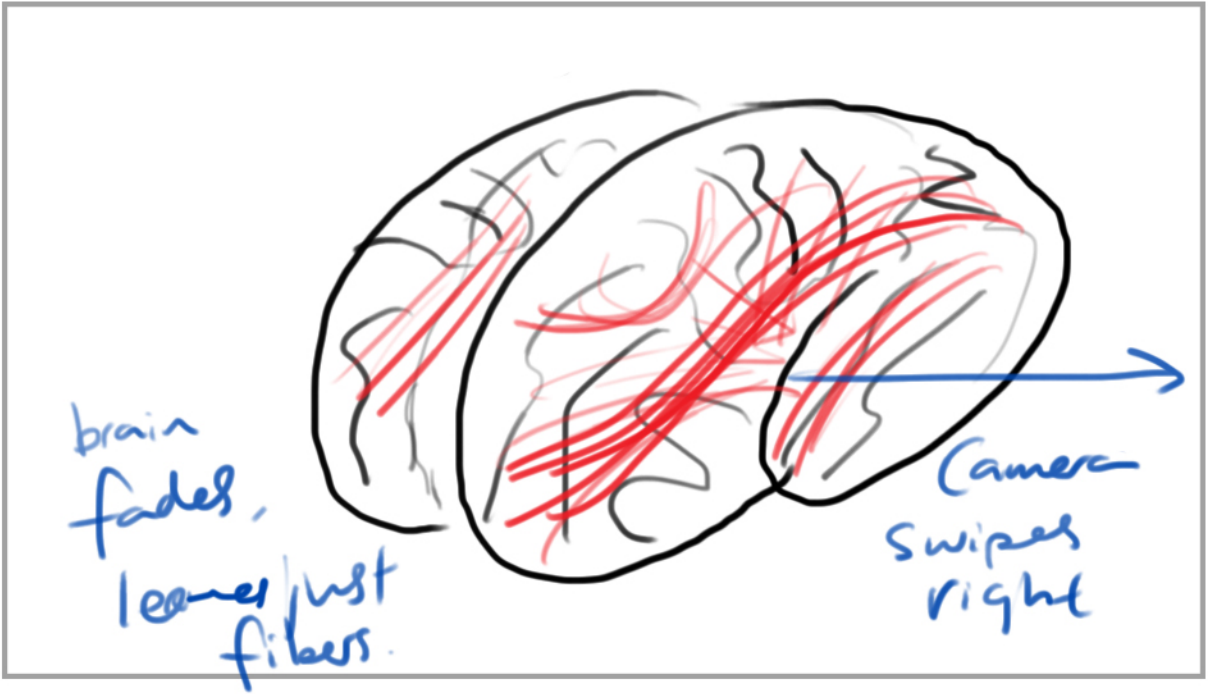
Tractography studies explore the brain's microscopic structures



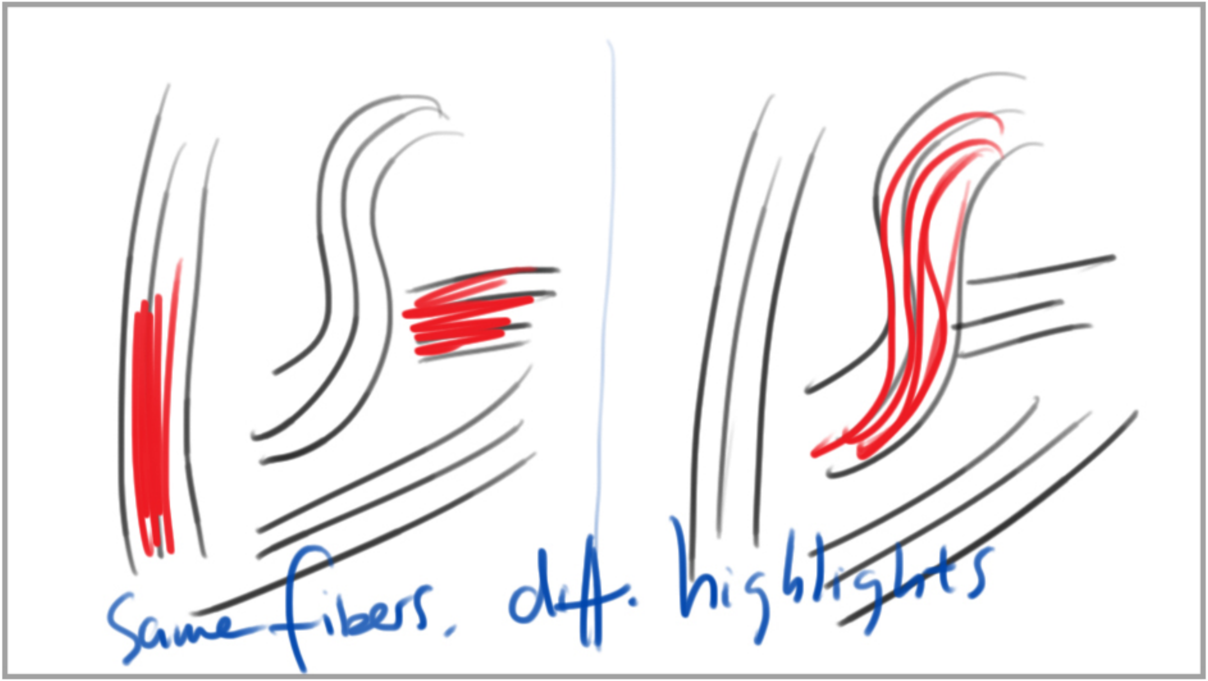
by measuring and analyzing the directional diffusion of water molecules. Through complex calculations,



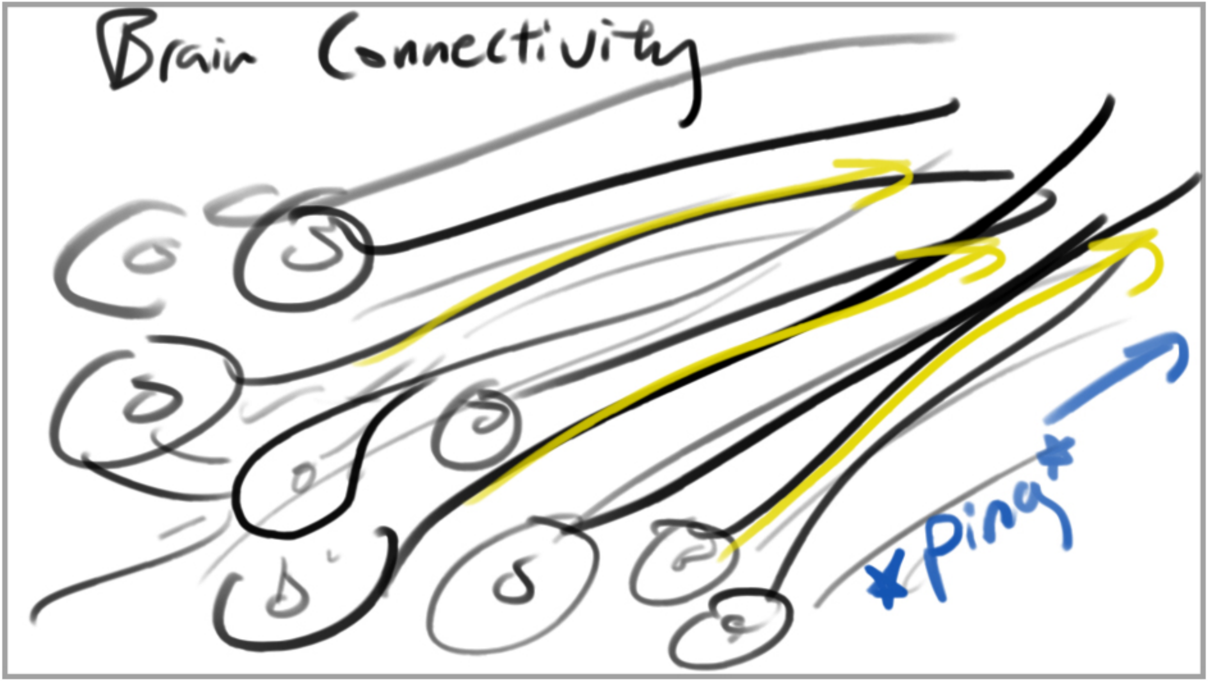
individual neural fibers - the telephone lines between individual brain cells - can be traced.



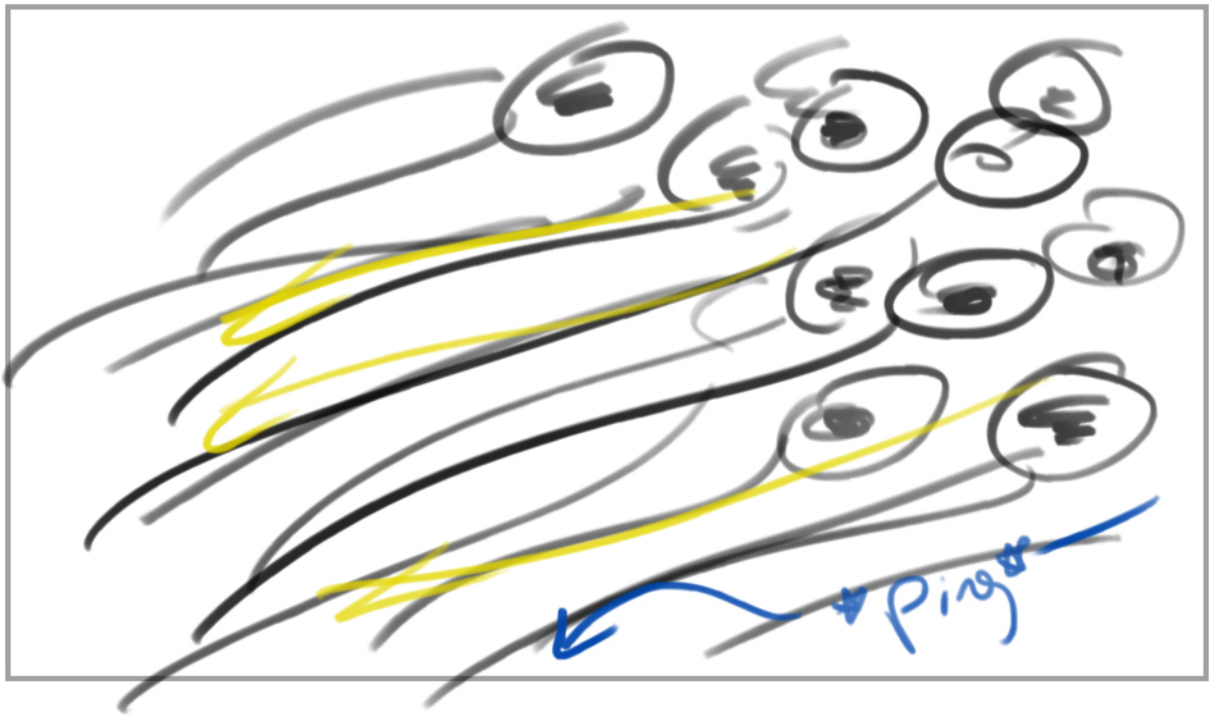
This enables physicians to study neural fibre bundles, also known as white matter tracts, in isolation.



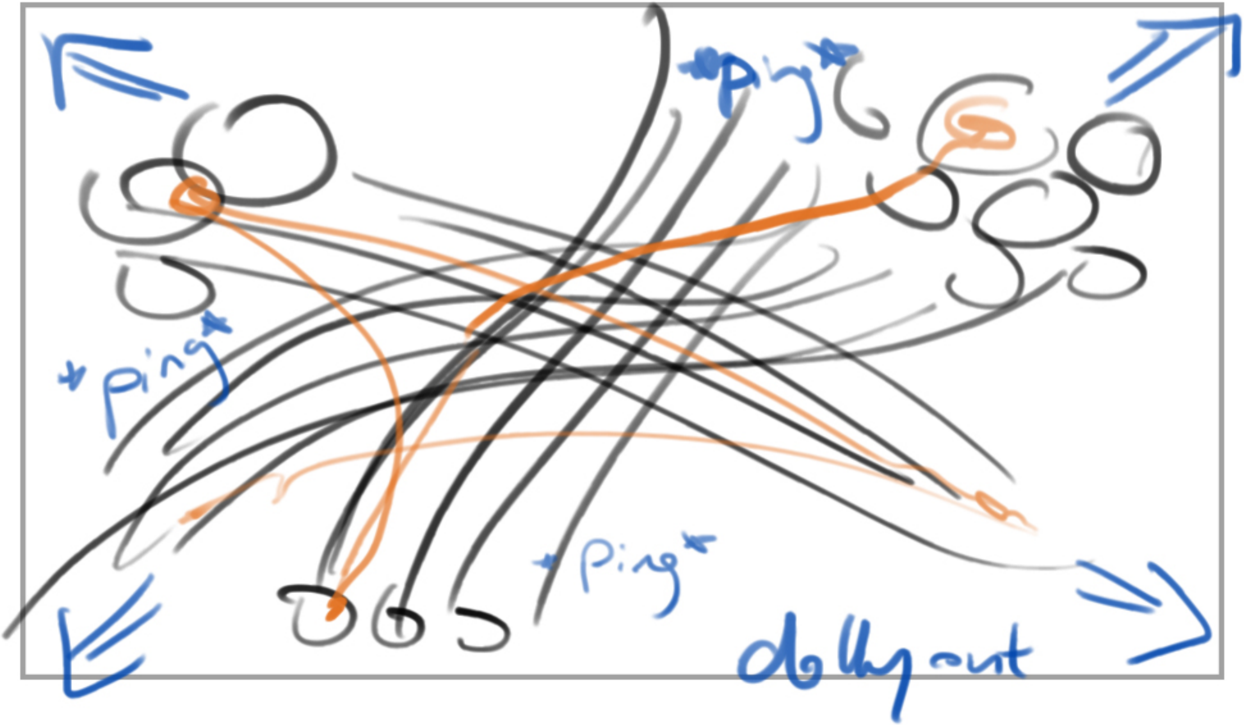
By comparing targeted regions of white matter between patients and healthy controls, changes such as degradation due to disease can be associated with particular symptoms.



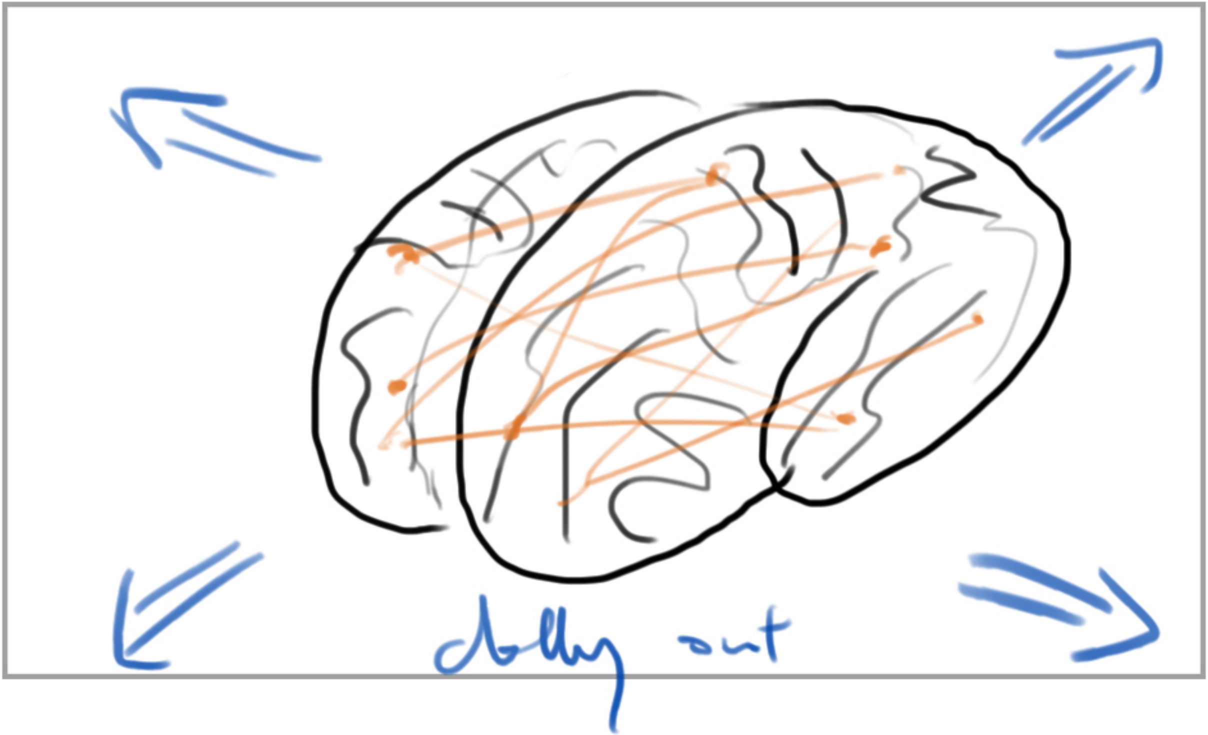
A 3rd method, brain connectivity studies, allows us to observe the activation of specific brain regions.



Connections are made throughout the brain through its white matter tracts,

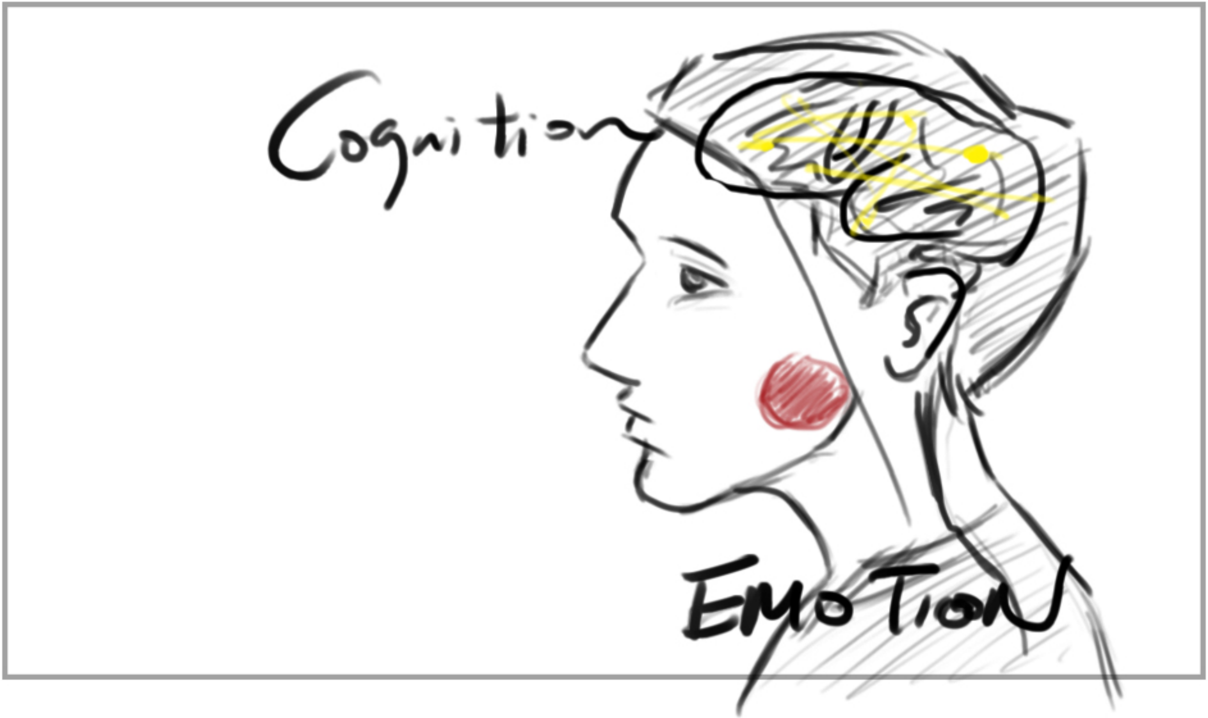


creating massive and complex structural and functional networks.

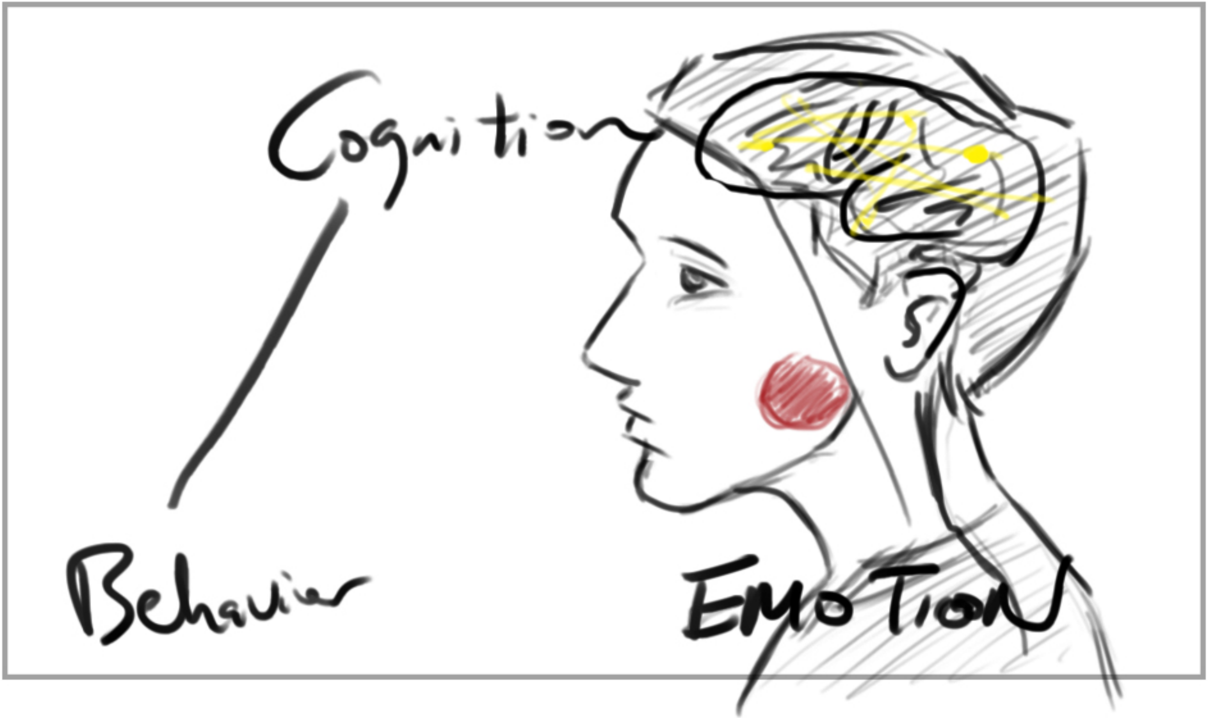


These networks connect areas of the brain involved in all aspects of our personal experiences,

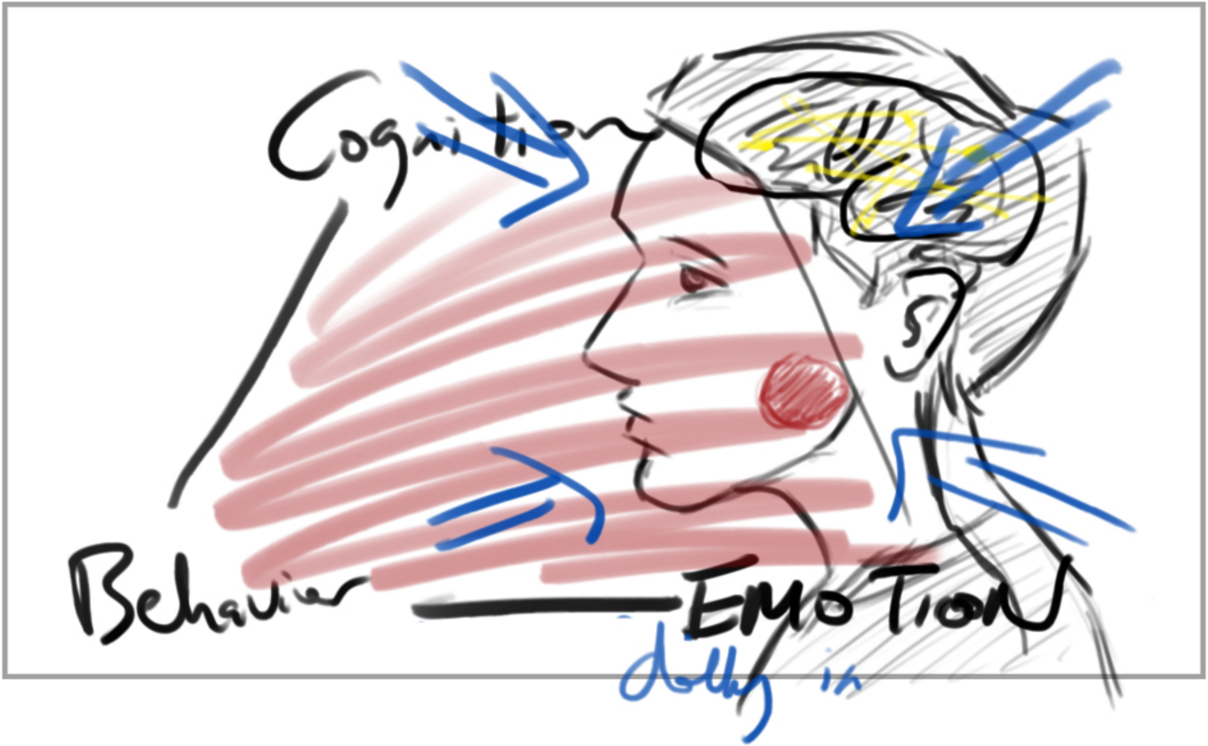
from emotions



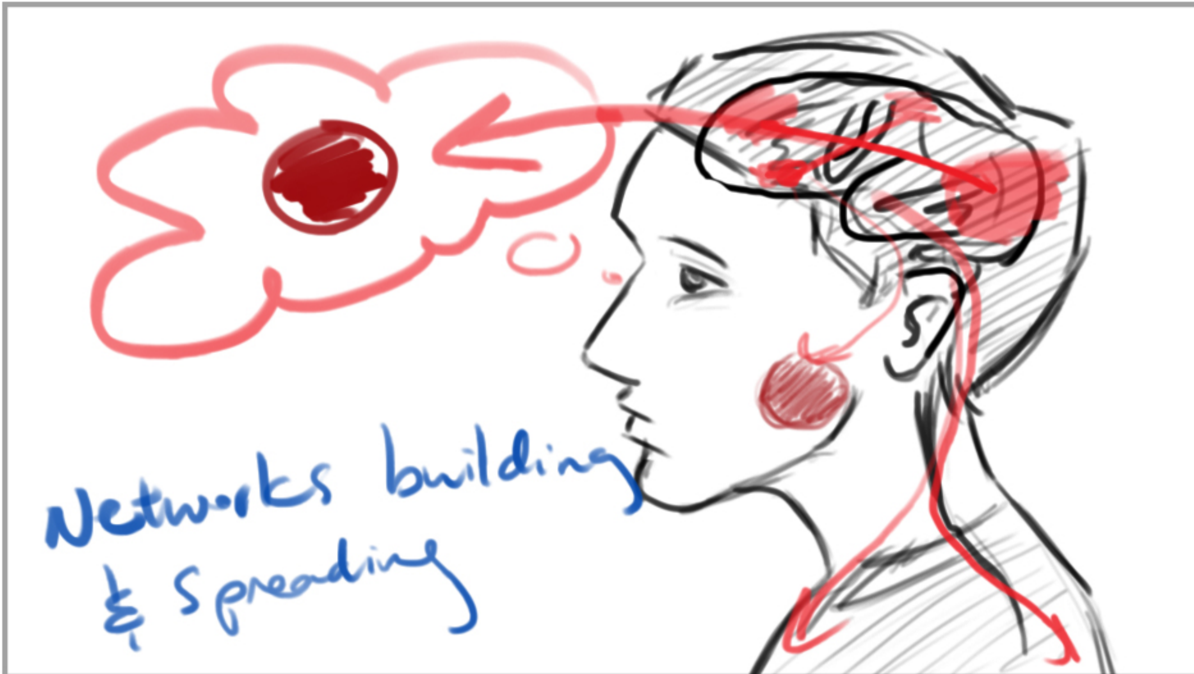
to cognition



to behaviour.



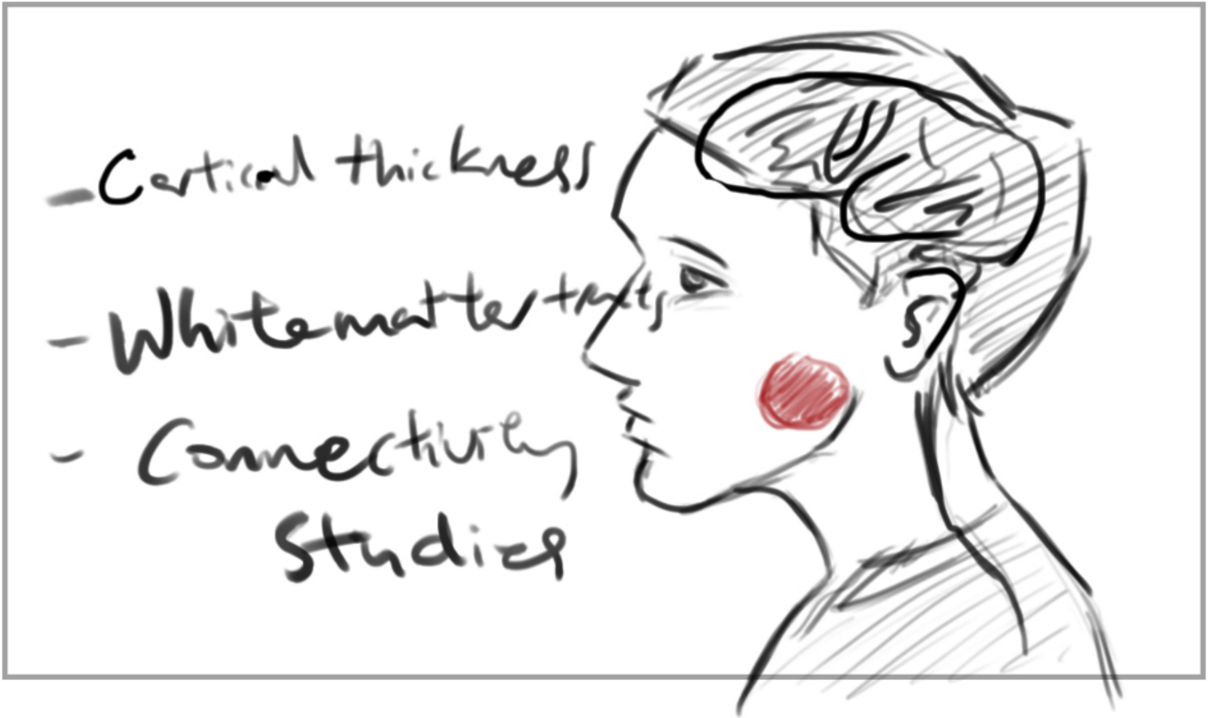
Since the experience of pain can be incredibly diffused and multi-dimensional,



Connectivity studies can help tease out the precise networks and regions involved in specific chronic pain conditions. Knowledge of condition specific patterns of brain activation can guide us towards more targeted treatments.

Brain imaging is a powerful tool in the study of pain.

It is non-invasive,



and information about the brain's cortical thickness, white matter tracts, connectivity, and neural activity can be

collected in real time.

based on this research, we ca study how neuropathic pain results in specific footprints in the brain at the macro and microstructural level.

This will help us to understand pain more objectively, and ultimately allow for better diagnosis and treatment in the clinic.