ICA QC Guide

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Introduction

What is an fMRI?

- Functional magnetic resonance imaging is a neuroimaging procedure that measures brain activity by detecting changes associated with blood flow.

- Haemoglobin is diamagnetic when oxygenated but paramagnetic when deoxygenated. This difference in magnetic properties leads to small differences in the MR signal of blood depending on the degree of oxygenation

- Primary form of fMRI uses the blood-oxygen-level dependent (BOLD), used to map neural activity in the brain or spinal cord by imaging the blood flow (hemodynamic response) related to energy use by brain cells.
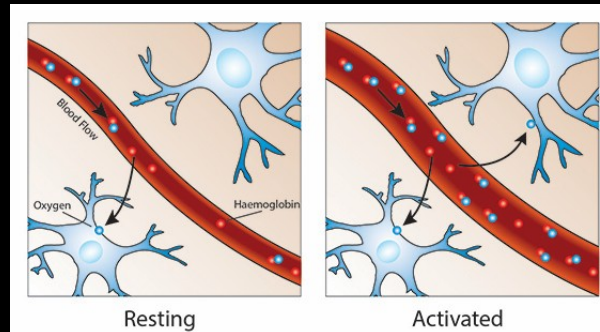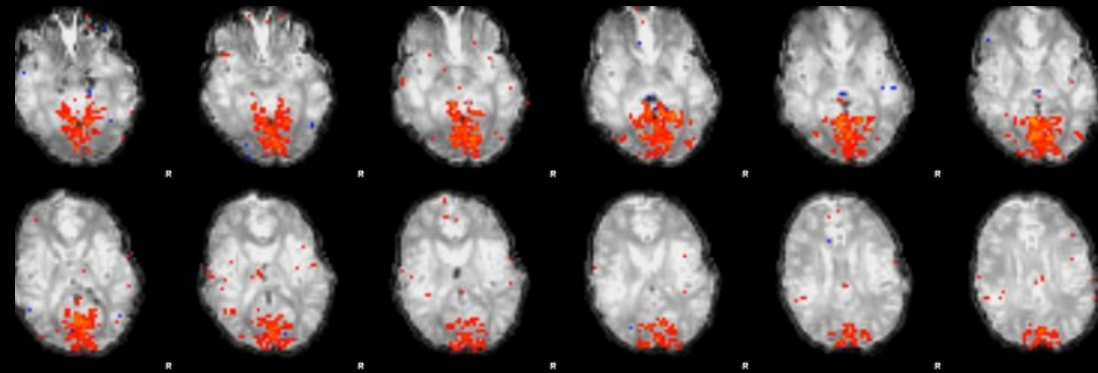
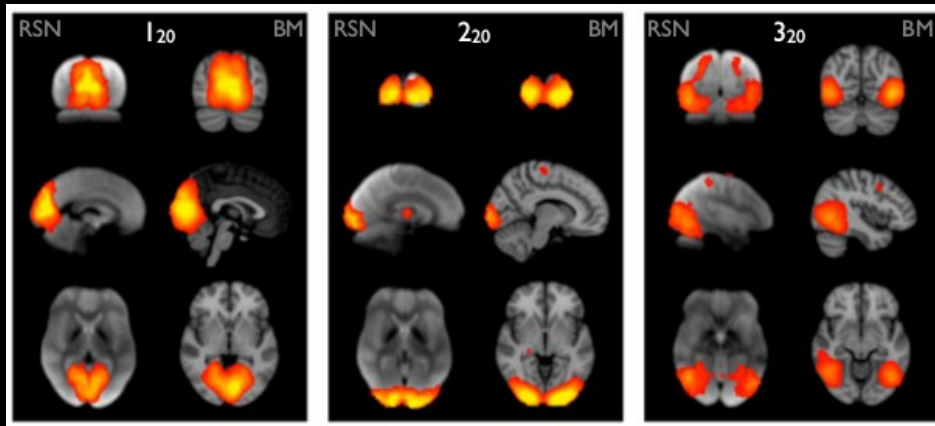

Independent component analysis

- Is a computational method for separating multivariate signal into additive subcomponents.

- What distinguishes ICA from other methods is that it looks for components that are both statistically independent and nonGaussian
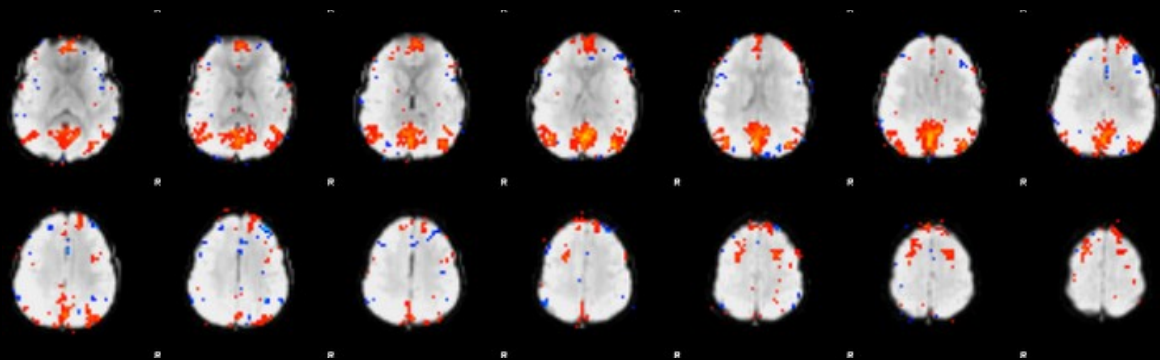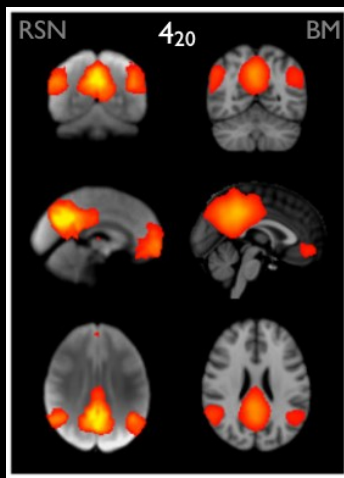
Introduction
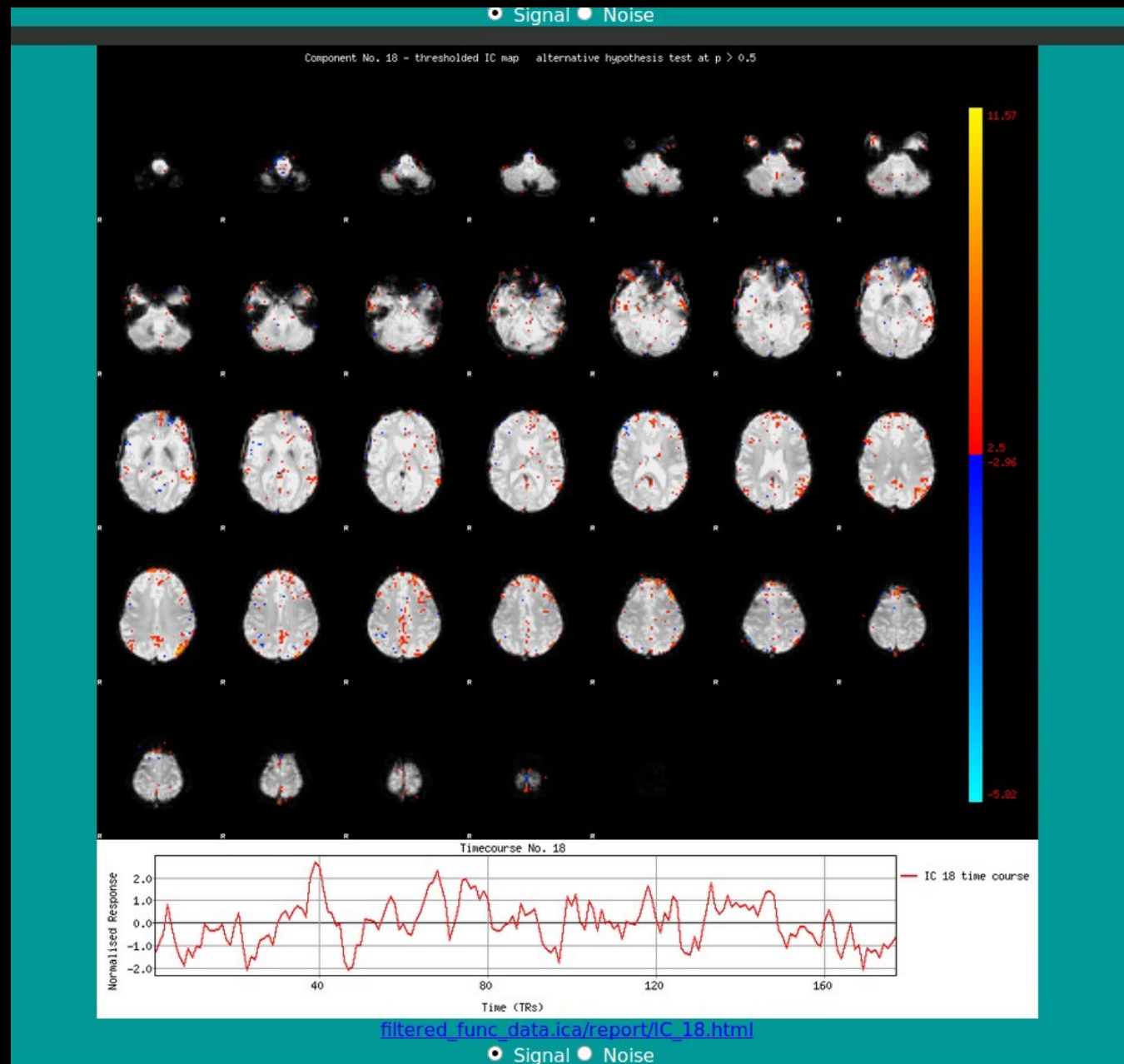
Signals

- 1 , 2 and 3 correspond to medial, occipital, and lateral visual areas.

Primary visual cortex activation

Default mode network
- The default mode network is most commonly shown to be active when a person is not focused on the outside world and the brain is at wakeful rest, such as during daydreaming and mind-wandering.
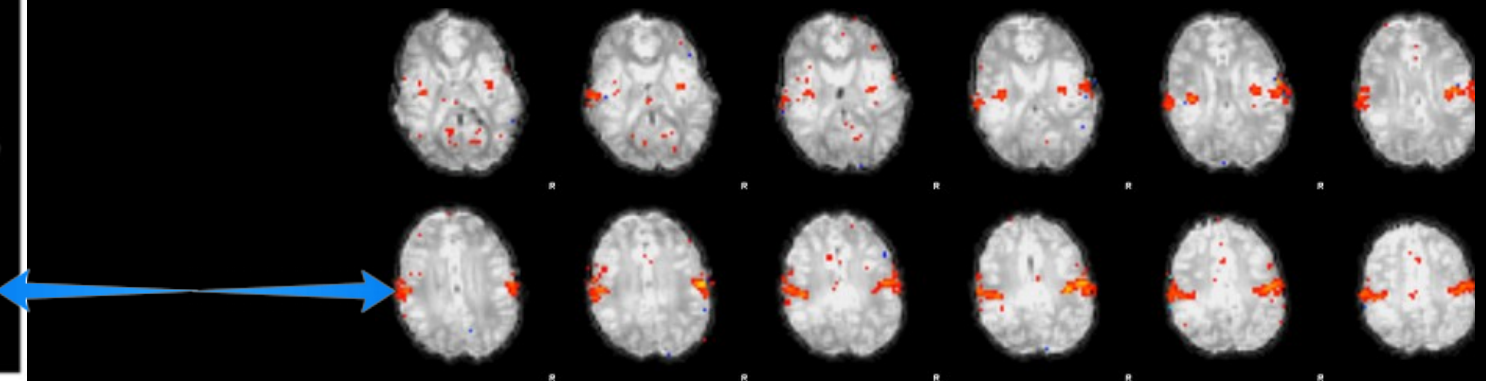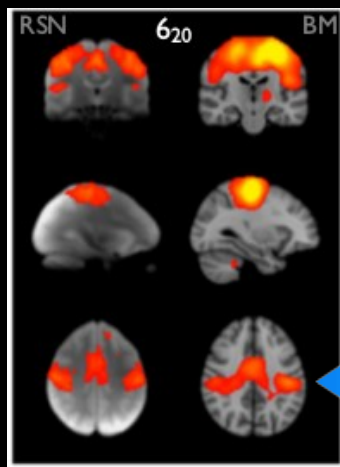
Signals

- 5 covers the cerebellum. This corresponds most strongly to action–execution and perception–somesthesis–pain domains.
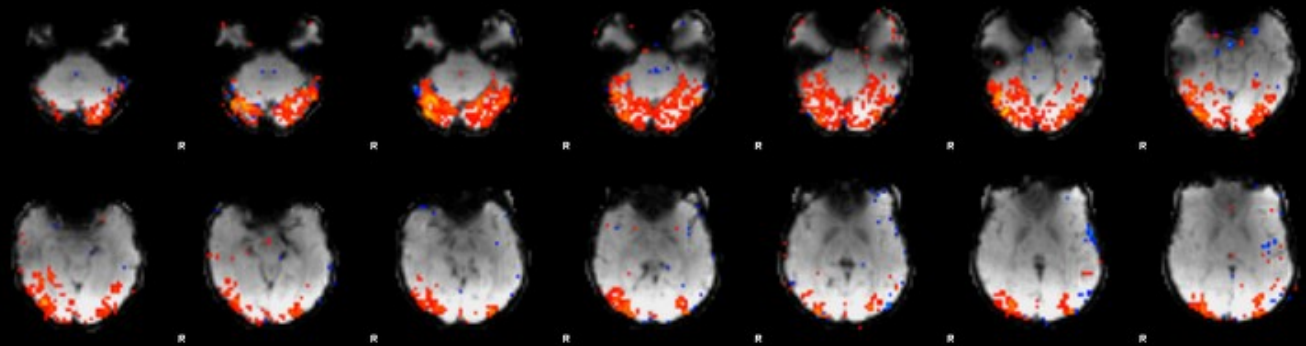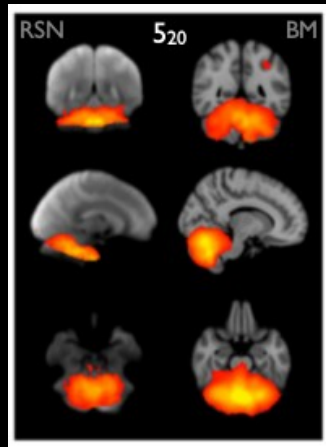

- 6 includes supplementary motor area, sensorimotor cortex, and secondary somatosensory cortex.

- This corresponds closely to the activations seen in bimanual motor tasks and was the first resting state network to be identified in FMRI data.
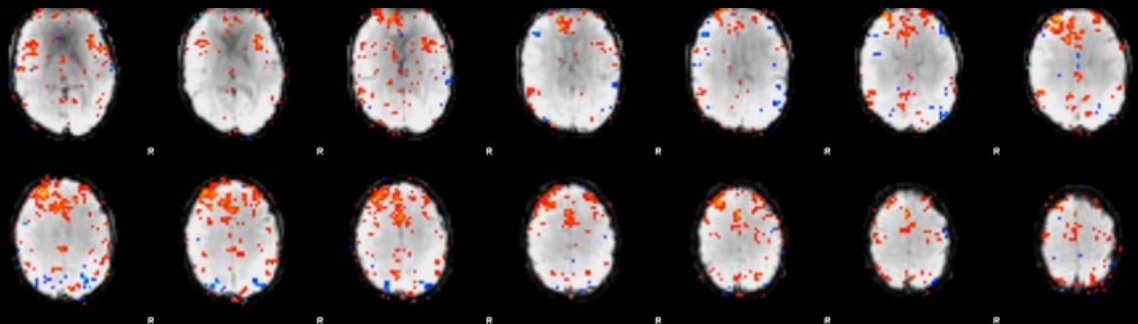
Signals

- 7 includes the superior temporal gyrus, Heschl's gyrus, and posterior insular cortex. It includes primary and association auditory cortices.
- This corresponds most strongly to action–execution–speech, cognition–language-speech, and perception audition paradigms.
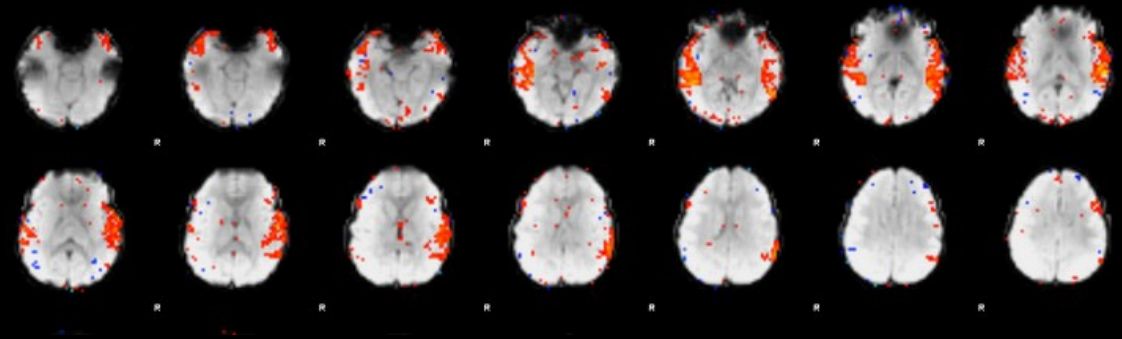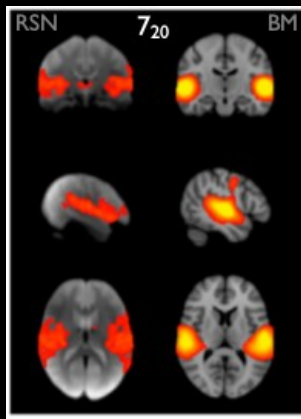
- 8 covers several medial frontal areas, including anterior cingulate and paracingulate.

- This corresponds strongly to several cognition paradigms, as well as action inhibition, emotion, and perception somesthesis pain.
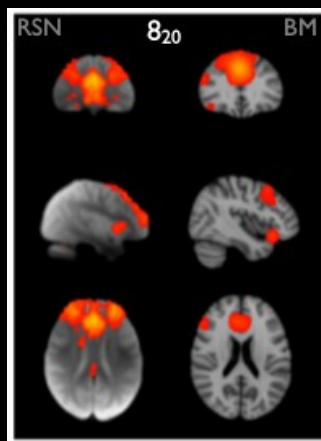
Signals

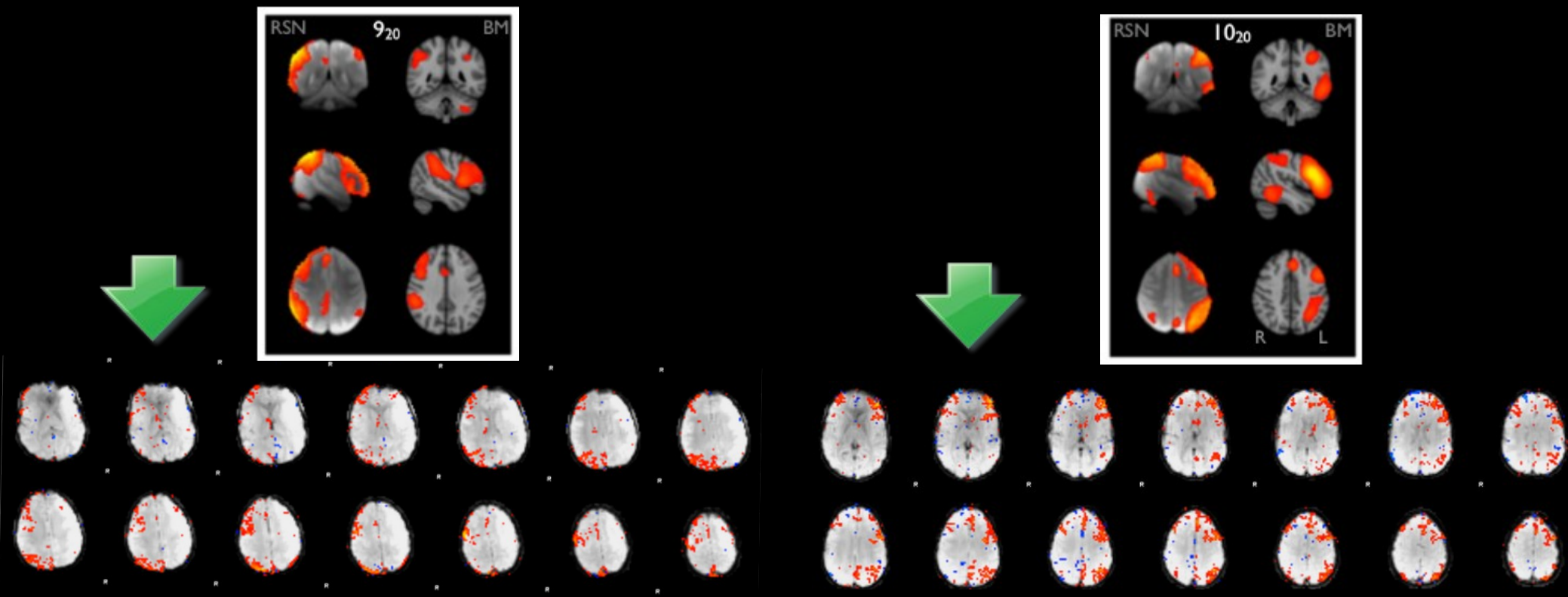9 and 10 cover several frontoparietal areas, they correspond to several cognition/language paradigms.

- 9 corresponds strongly to perception–somesthesis–pain.

- 10 corresponds strongly to cognition–language paradigms, which is consistent with the Broca's and Wernicke's areas seen.
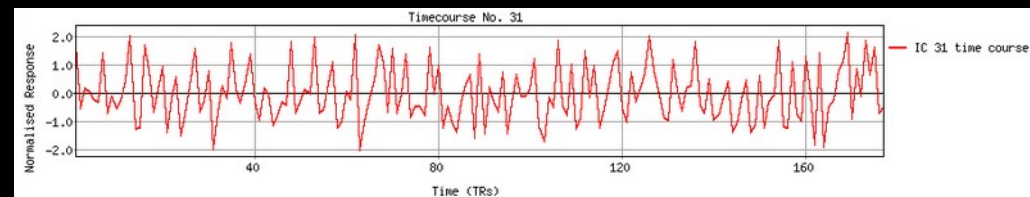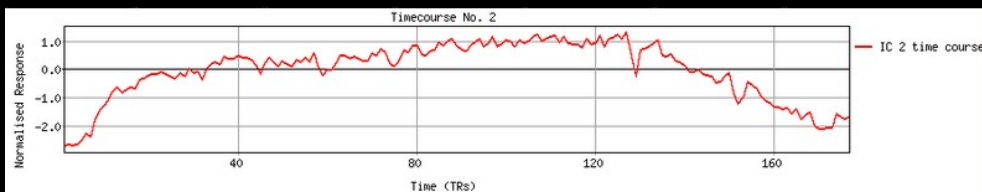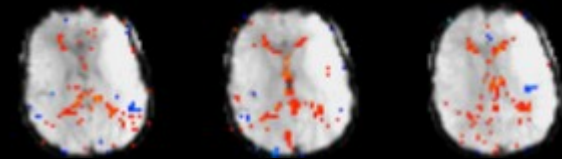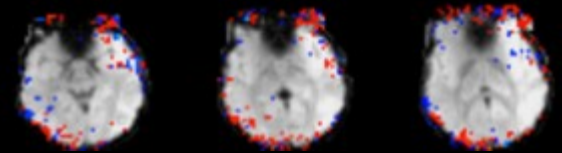
Noise

Sources of noise:
- Thermal motion of free electrons in the system
- Gradient and magnetic field instability
- Head movement
- Physiological effects such as heartbeat and respiration

Appear in data as:
- High frequency 'spikes'
- Image artifacts and distortion
- Low-frequency drift and periodic fluctuation over time
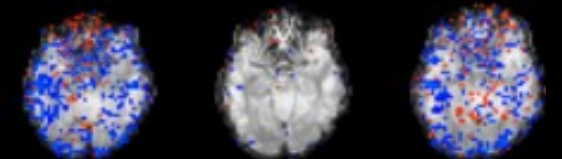
How to Identify a Noise

- Things to look for:
- Large spikes in the timecourse plots
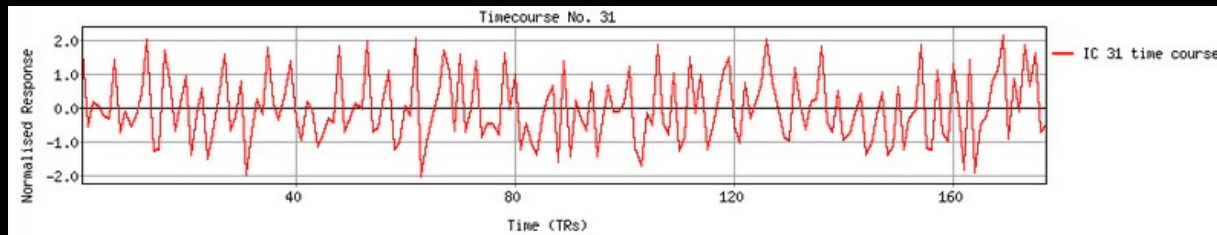
- Any signals in fluid containing regions of the brain

- Signals **<u>only</u>** around the outer area of brain

How to Identify a Noise

- Things to look for:
- Alternating signals

- A signal in a region without brain matter

- Drift

More Examples of Noise

References

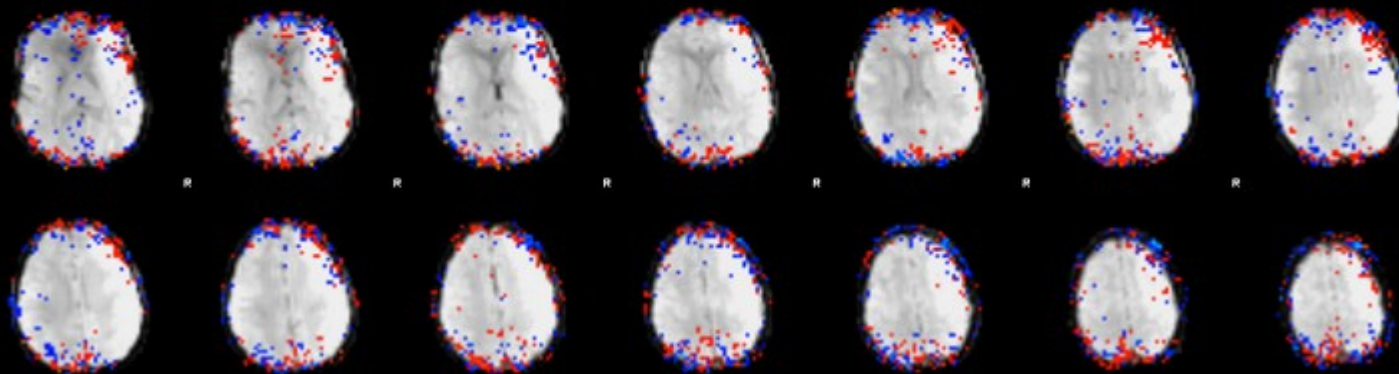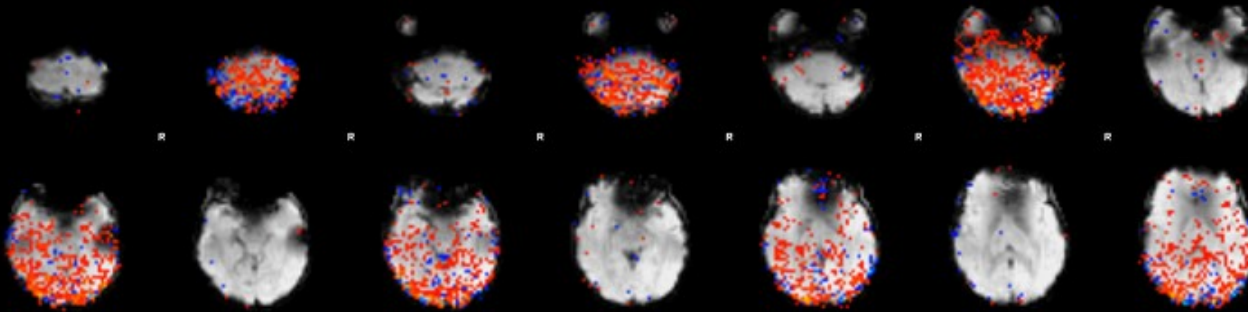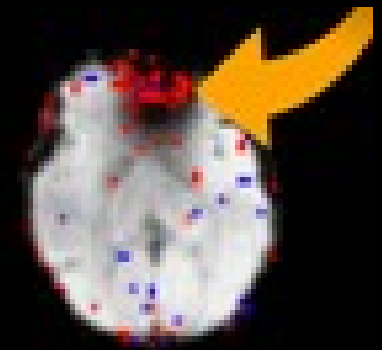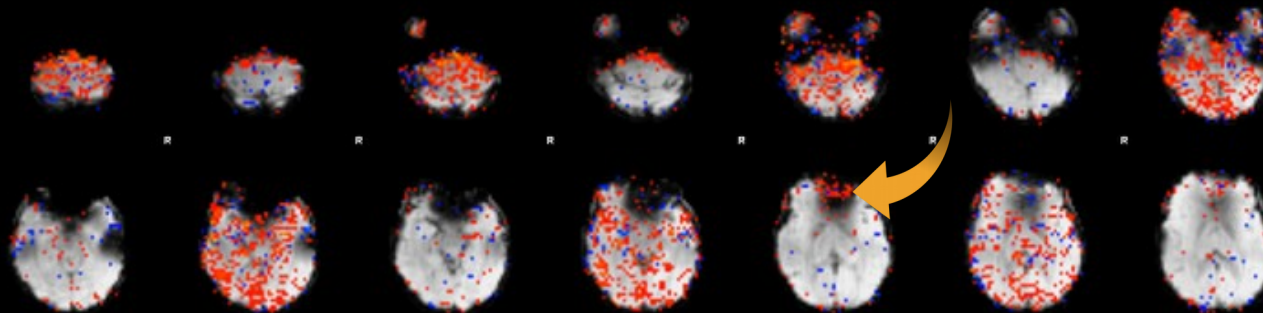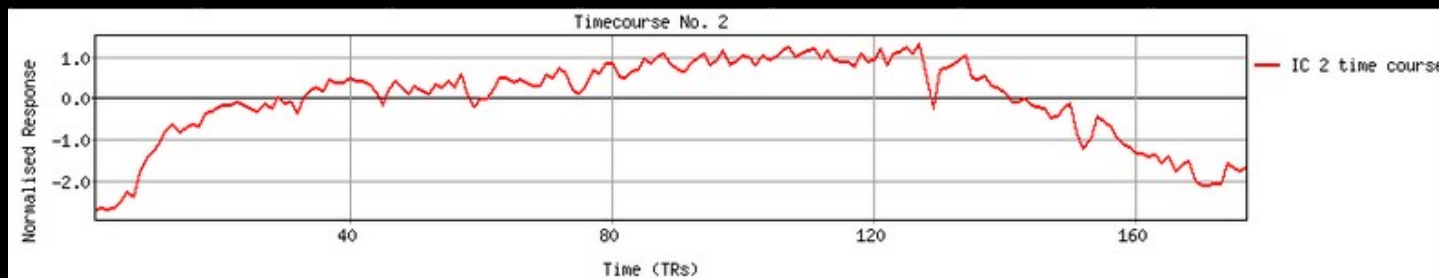- Smith, S. M., Fox, P. T., Miller, K. L., Glahn, D. C., Fox, P. M., Mackay, C. E., … Beckmann, C. F. (2009). Correspondence of the brain's functional architecture during activation and rest. Proceedings of the National Academy of Sciences of the United States of America, 106(31), 13040–13045.

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Thanks for listening