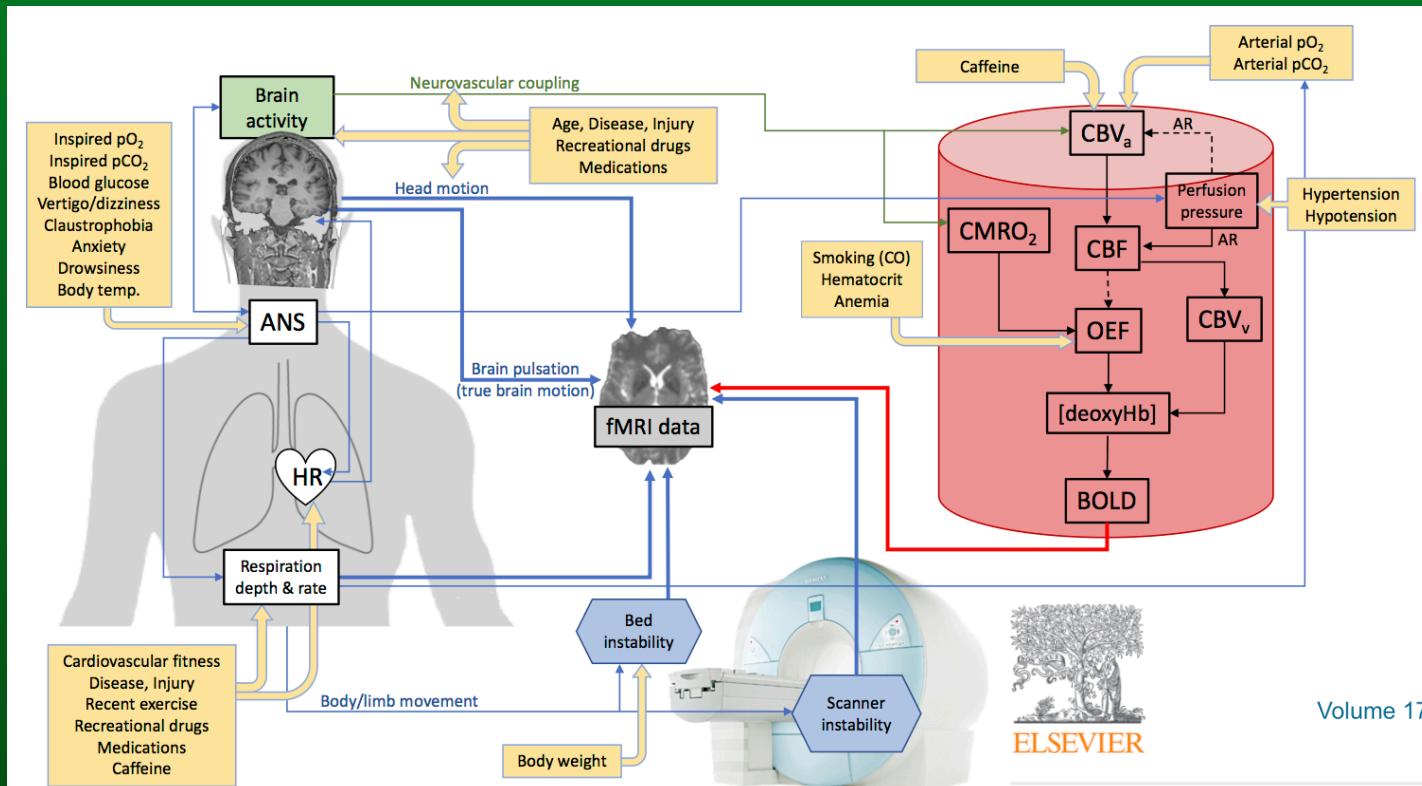


Pro short TR via SMS/MB imaging  
(500-1000ms)

# Contributors to EPI signal modulations



NeuroImage

Volume 173, June 2018, Pages 275-286



Ben Inglis 2017

Online resources for multi-band imaging:  
<https://practicalfmri.blogspot.com>  
<http://mvpa.blogspot.com>

The impact of in-scanner head motion on structural connectivity derived from diffusion MRI

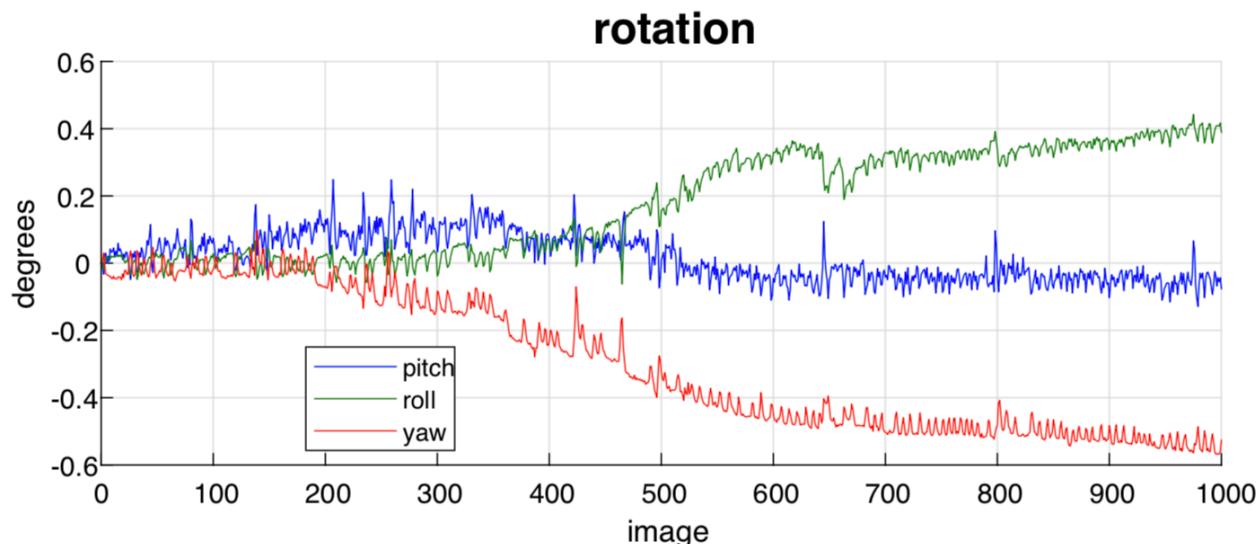
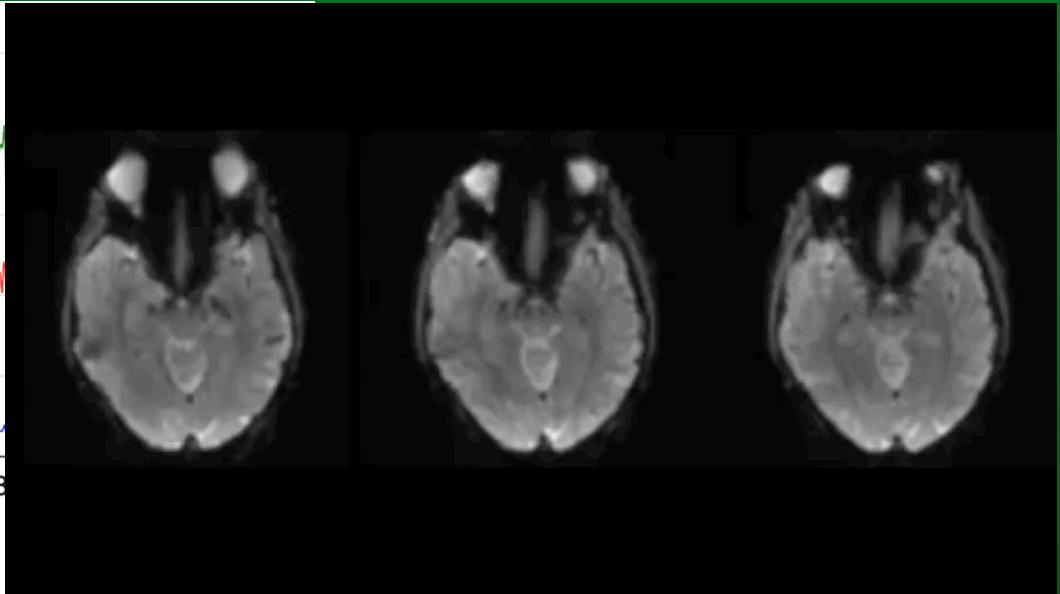
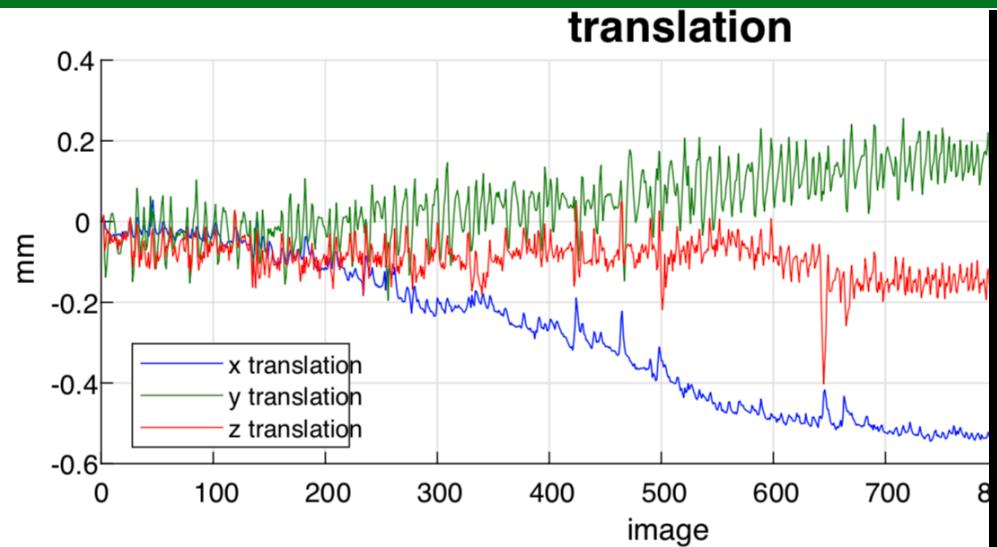
Graham L. Baum <sup>a</sup>, David R. Roalf <sup>a</sup>, Philip A. Cook <sup>b</sup>, Rastko Ceric <sup>a</sup>, Adon F.G. Rosen <sup>a</sup>, Cedric Xia <sup>a</sup>, Mark A. Elliott <sup>b</sup>, Kosha Ruparel <sup>a</sup>, Ragini Verma <sup>b</sup>, Birkan Tunç <sup>b</sup>, Ruben C. Gur <sup>a</sup>, Raquel E. Gur <sup>a</sup>, Danielle S. Bassett <sup>c, d</sup>, Theodore D. Satterthwaite <sup>a</sup>

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<https://doi.org/10.1016/j.neuroimage.2018.02.041>

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# More detailed modelling of head motion via MB-imaging



- Head motion regressors even reflect the pulse
- TR fast enough to even try eye movement analysis

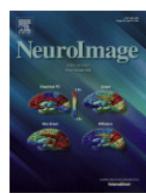
# How to deal with all the noise contributors



ELSEVIER

NeuroImage

Volume 90, 15 April 2014, Pages 449-468



Automatic denoising of functional MRI data: Combining independent component analysis and hierarchical fusion of classifiers

Gholamreza Salimi-Khorshidi <sup>a</sup>✉, Gwenaëlle Douaud <sup>a</sup>, Christian F. Beckmann <sup>b, c</sup>, Matthew F. Glasser <sup>d</sup>, Ludovica Griffanti <sup>a, e, f</sup>, Stephen M. Smith <sup>a</sup>

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<https://doi.org/10.1016/j.neuroimage.2013.11.046>

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- Further denoising of multi-echo data outside the echo properties does not seem to additionally improve the TSNR

- WM + CSF regression
- ECG/Pulse and breathing recording
- Videooculography
- Check out posters:
  - 2601
  - 2566
  - 2542 !
  - 2864
  - 1750



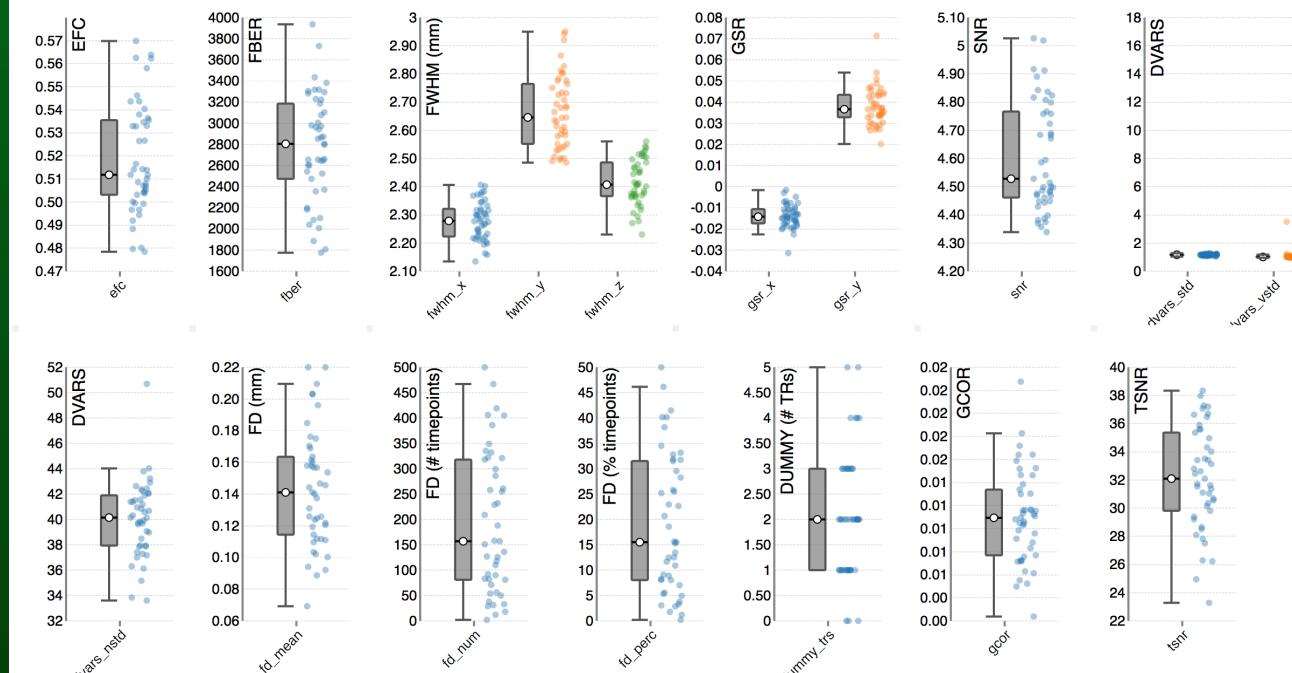
## Our standard whole-brain MB sequence for imaging with problematic head motion (e.g. vestibular/ocular motor tasks, children)

- 3T Siemens Skyra 64ch Head/Neck coil: TR 700 ms 2.5mm isotropic 56 slices interleaved MB6 with Prescan normalize TE 33ms Flip angle 45° (No GRAPPA / no SENSE!!)

### MRIQC: group bold report

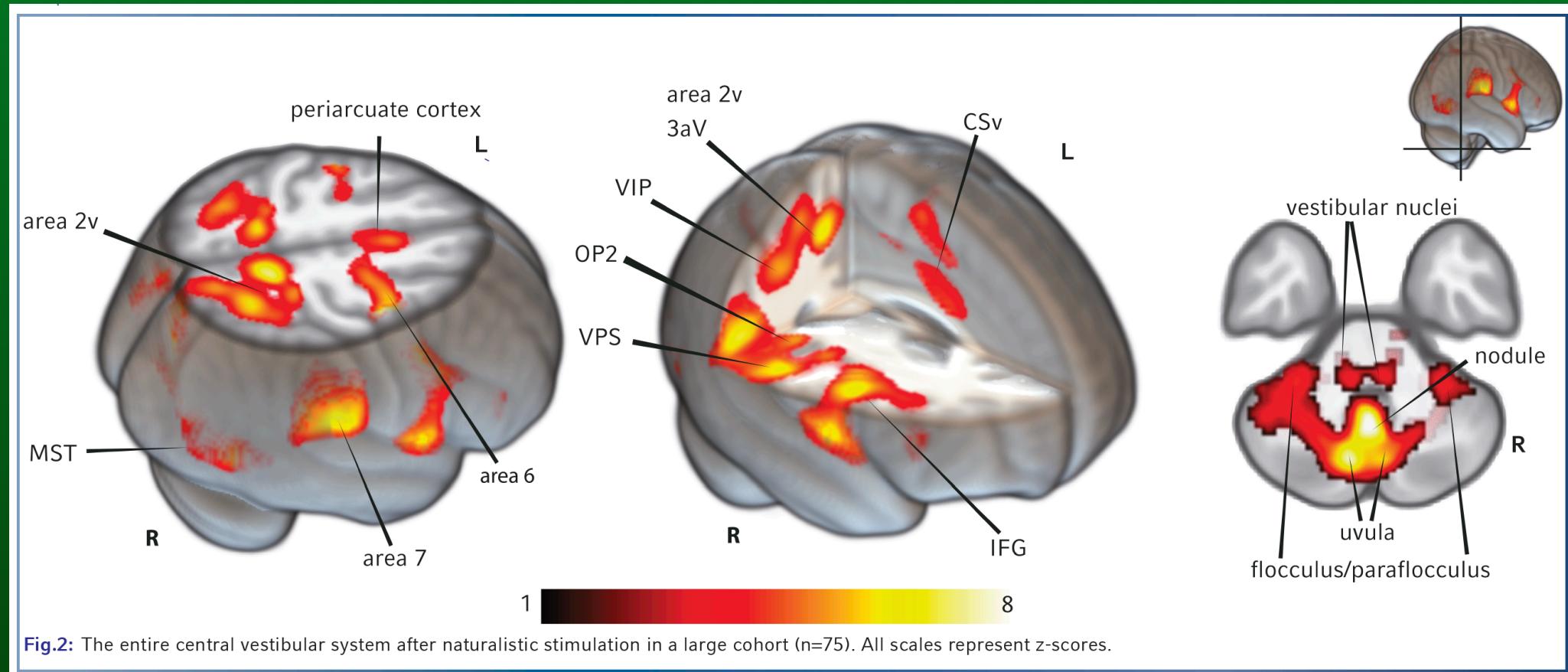
#### Summary

- Date and time: 2018-02-28, 13:45.
- MRIQC version: 0.10.3.



- TSNR (n=45):  
Cortex 70-100  
Cerebellum/Thalamus 30-60  
Brainstem 20-40
- If you need more TSNR (and less anatomical specificity subcortically) increase voxel-size and/or go to MB4

# Good signal from cortex / cerebellum / brainstem



# Summary

- Fast (TR<1s) multi-band imaging allows for finer head motion registration in problematic cohorts (e.g. vestibular/ocular motor task, children, restless patients, ADHD)
- You will still achieve high-quality TSNR across the entire brain (cortex, cerebellum, thalamus, brainstem)
- There are good denoising tools available (e.g. ICA+Fix in combination with WM and CSF regression) that potentially cover a larger noise/artifact spectrum than ME-EPI
- Multi-band multi-echo imaging might be a joint way forward (Kirilina et al. NeuroImage 2016) in the near future

