

Movie vs rest: a comparison of resting state and naturalistic FMRI paradigms



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Resting state FMRI:

- + popular!
- + view several functional networks from single scan
- largely uncontrolled and small BOLD signal change
- known variability even due to, e.g., eyes closed/open
- some populations (kids!) are prone to move or sleep

Data. 48 healthy volunteers (24 M, 24 F) watched six movie clips (three with positive and three with negative emotional valence), each with an average length of two and half minutes, in a 3T Siemens Trio scanner. Clips were separated by a black screen for 10-30s and preceded by a fixation cross for 30s, leading to a total scanning time of 1,050 seconds. Parameters for the BOLD EPI data were: voxel size of 3.8x3.8x4.0 mm³, 36 axial slices, TR = 2s, TE=30ms, in-plane FOV=240x240 mm², flip angle=90°. Subjects were also scanned under resting state for 4m 20s.

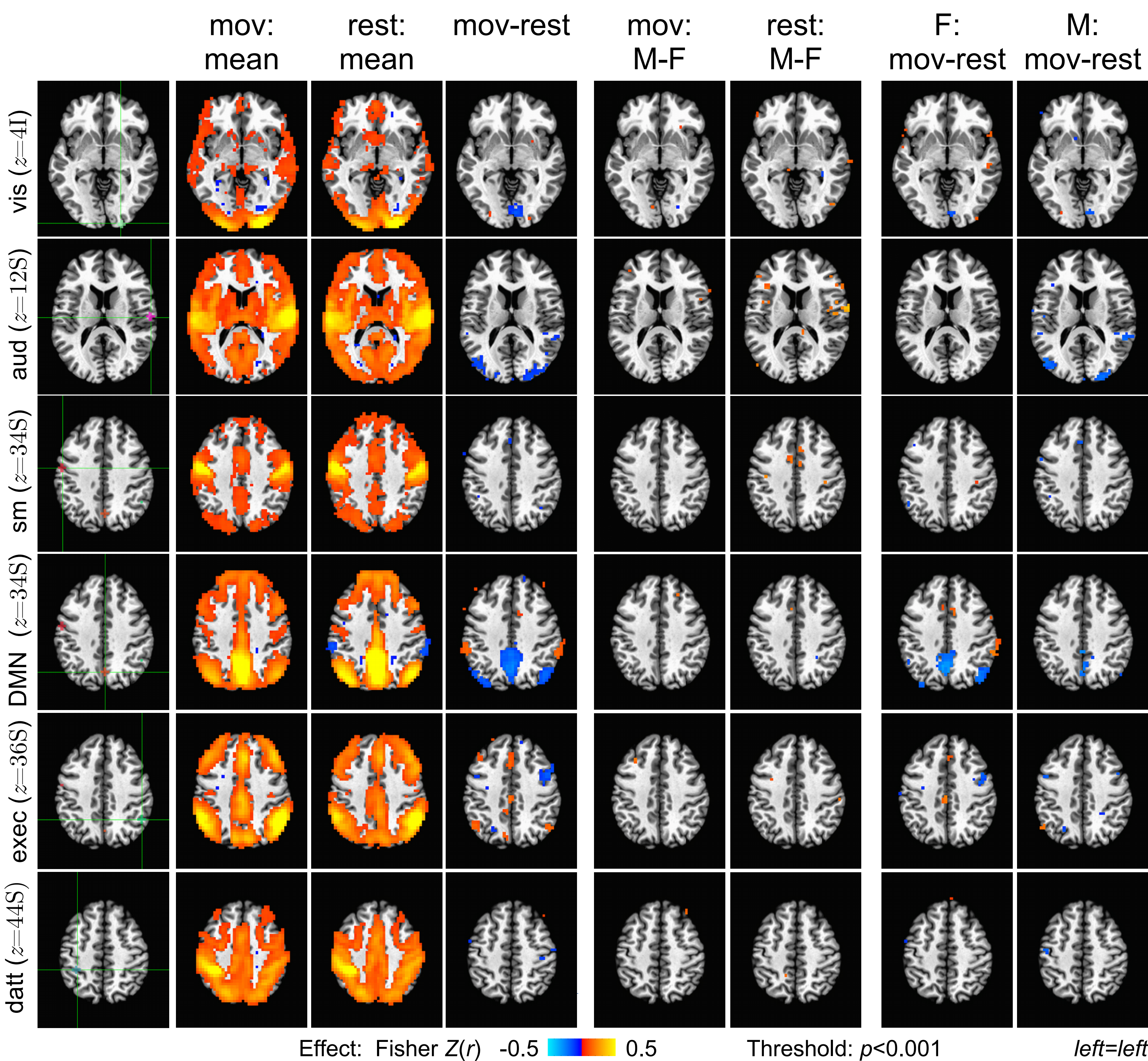
Processing. The EPI movie data was split into its individual sections, and each was treated as a separate scanning run. In total, three (positive valence) sections were combined for 208 time points of movie-watching, and there were 130 times points of RS-FMRI data. Preprocessing with `afni_proc.py` in AFNI⁴ included (see full details⁵): despiking, slice timing and motion correction, EPI/anatomical alignment, nonlinear registration to standard space (TT_N27), smoothing (4mm FWHM), and removal of confounding effects (slow drift, motion, ANATICOR, ventricles) while censoring.

Statistics. Seed-based correlation (SBC), ReHo and BOLD variance were calculated, and ANOVAs (2x2 mixed design) were used to compare main effects of movie (mov) vs rest across all subjects. 'mov-rest' was compared separately within the male (M) and female (F) groups, as was 'M-F' for the rest and mov categories. LME-based ISC analysis⁵ was performed to properly control for non-independence of terms. Statistical results were thresholded at voxelwise $p > 0.001$ (unless otherwise stated); effect sizes are displayed.

Comparisons: seed-based correlation (SBC)

Seeds were placed in 6 networks and whole brain correlation maps were calculated (5mm ball centered at the given TT coordinates and region):

Network	Seed ctr (TT)	Region
1. Visual (vis)	(21R, 92P, 4I)	R lingual gyrus/inf occipital gyrus
2. Auditory (aud)	(58R, 14P, 12S)	R transv. temp. gyrus/postcent. gyrus
3. Sensorimotor (sm)	(50L, 6P, 34S)	L precentral gyrus/Brodmann 6
4. Default mode (DMN)	(2R, 62P, 34S)	R precuneus
5. Exec. control (exec)	(47R, 48P, 36S)	R supramarginal gyrus/inf parietal lobule
6. Dorsal attent. (datt)	(32L, 37P, 44S)	L inf par lobule/postcentral gyrus

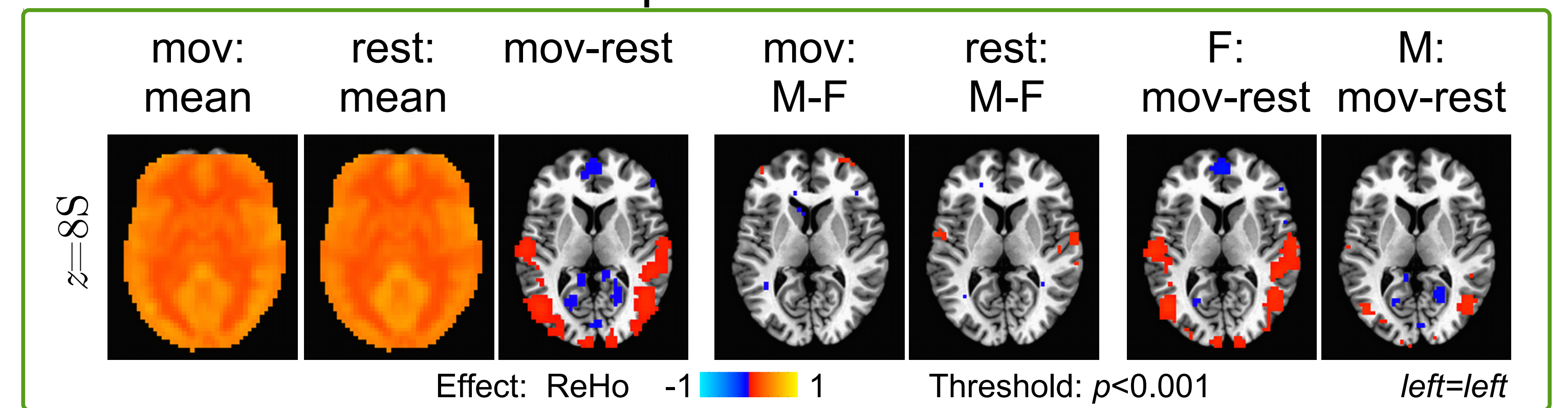


Mean correlation maps were broadly similar between the FMRI paradigms. The rest paradigm showed greater average functional connectivity (FC) in the DMN in the dorsal regions, the cingulate gyrus and precuneus, though movie connectivity was greater bilaterally in the supramarginal gyri. Interestingly, the attention network exhibited very few differences.

"Naturalistic scanning" FMRI:

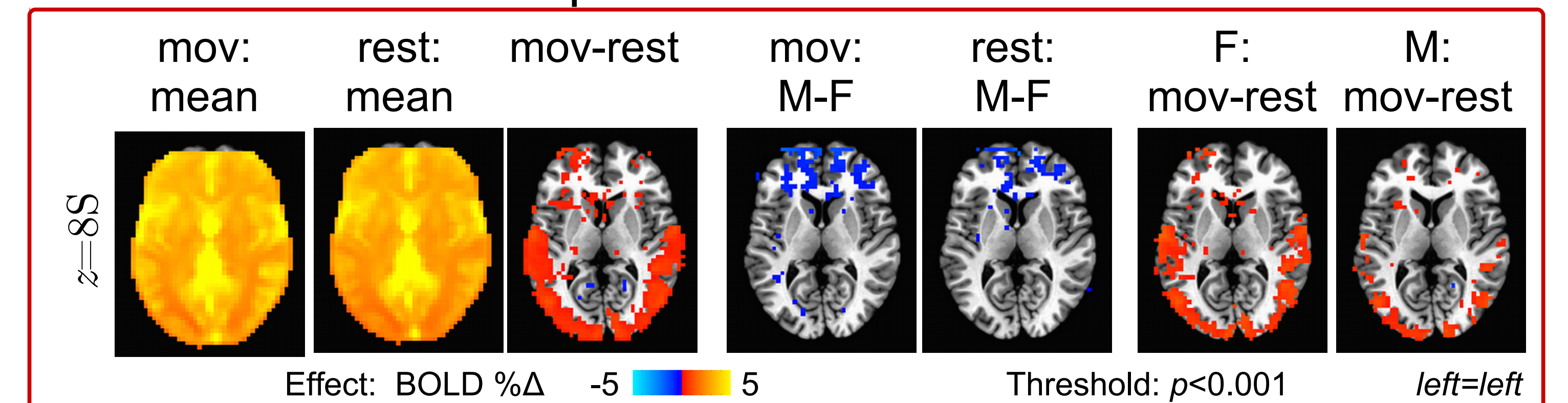
- + new, alternative paradigm¹⁻³: same video/audio for each subj
- + controlled presentation: subjects more engaged
- similarity of responses across a group is measured, e.g., intersubject correlation (ISC)
- +/- ... so how does it compare to RS-FMRI?

Comparisons: ReHo



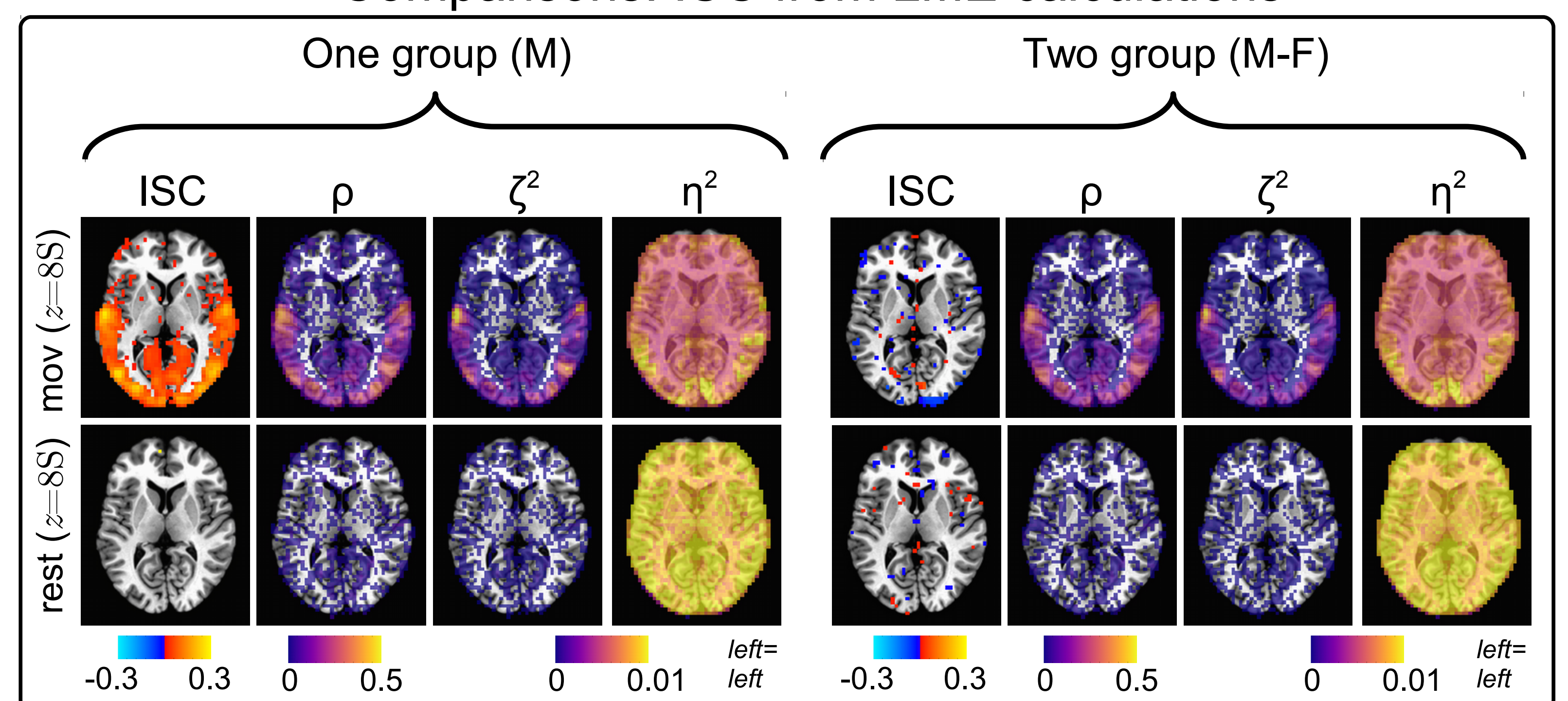
ReHo tended to be greater in the movie paradigm laterally and bilaterally, e.g., within the superior temporal gyri, middle occipital gyri and (dorsal) cuneus. In the resting paradigm ReHo was higher in the medial regions (bilaterally), such as the medial frontal gyri and posterior cingulate (PCC) regions.

Comparisons: BOLD stdev



The variance of the BOLD percent signal change tended to be significantly greater during the movie paradigm throughout much of the cortical GM. Small regions of the PCC showed greater time series variation during rest. During both movie and rest, the female group showed similarly higher stdev in the frontal cortex (with greater L-R homotopy for M-F in the movie paradigm).

Comparisons: ISC from LME calculations⁵



As expected, ISC values were much higher in gray matter during the movie paradigm for two group comparisons. The p values, the ratio of cross-subjects variability (ζ^2) compared to total variance, was uniformly higher in the movie case, as well. The within-subject variance (η^2) was much higher in the resting paradigm compared to the movie-watching, again as expected.

CONCLUSIONS

- + The movie paradigm has generally similar features to rest (e.g., mean ReHo, BOLD stdev and seed-correlation); it also permits ISC analysis.
- + Local BOLD signal homogeneity (ReHo) is *higher* in movie-watching.
- + The size of BOLD response appears *higher* for the movie task. NB: this increase may not be all "signal," instead including noise, hemodynamic components such as respiration, etc. This requires further study.
- + SBC patterns are most similar for attention and sensorimotor networks. Surprisingly, rest shows many locations of *higher* FC. The largest differences appear in the auditory and task-negative DMN (in both, rest mainly *higher* FC) and executive control (movie mainly *higher* FC).

References

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NB: if you are using naturalistic FMRI data, you should check out this paper!!

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