# Rewards are categories.

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## Chapter 3 – fMRI analyses

*In acquisition*

Scanning data was acquired at the Intermountain Neuroimaging Consortium (INC) facility located at the University of Colorado at Boulder. All 18 right-handed participants were be pre-screened for the typical fMRI exclusion factors (e.g. metal implants, mental disorders, etc). *TODO - scan details, what were the scans 26 f slices.*

Following DICOM to nifiti-1 (4D) conversion using dicom2nii (`http://www.mccauslandcenter.sc.edu/mricro/mricron/dcm2nii.html`), each dataset was then subjected to the following preprocessing pipeline, carried out in SPM8 (`http://www.fil.ion.ucl.ac.uk/spm/software/spm8/`) using that program's batch mode (for complete code see, `https://github.com/andsoandso/fmri/tree/master/catreward/spm_m`). Anatomical data (MPRAGE) was first segmented in white and grey matter

regions (?, ?). Based on these segments, parameters necessary for normalization into T1 MNI352 space were calculated. Anatomical data was then resampled from 1.27 to 1.00 $mm^2$ using fourth degree $\beta$ splines and finally normalized into MNI space. Normalization has two steps. The first is a Bayesian 12-parameter affine transformation (?, ?). The second is a set of nonlinear deformations (approximated using 1127 parameter linear combination of three dimensional discrete cosine transform) (?, ?).

Movement regressors for all functional volumes were calculated. No participant moved more than 1.5 $mm$. Functional data was then slice-time corrected, using slice 13 (the middle slice) from the descending acquisition as the reference, then coregistered with the pre-processed (native-space) anatomical data (?, ?), resampled to 3 $mm^3$ again using $\beta$-splines, and normalized into MNI space using the anatomically-derived parameters above. Finally, the functional data was spatially smoothed using a 6 $mm$ FWHM Gaussian, though a copy of the un-smoothed data was retained for the ROI analyses. Each voxel's timecourse was also low-pass filtered (using FIR, 0.008 Hz, (?, ?)) just prior to regression analysis. For all whole-brain analyses, the movement regressors were entered into every model as covariates, thus accounting for any head movement.

*A better signal.* In fMRI (and in time-series analysis in general) there is an intrinsic trade-off between simply detecting a signal in the presence of noise and then estimating the timecourse (i.e. shape) of that signal (Dale, 1999; Birn, Cox, & Bandettini, 2002; Liu, 2004). One way to optimize over both these constraints is by

employing non-random, yet highly variable, trial order inside a rapid event-related design (Miezin, Maccotta, Ollinger, Petersen, & Buckner, 2000). One state of the art method for setting trial ordering in an attempt to maximize both signal detection and estimation is by genetic algorithm. Using code kindly provided by Kao, Mandal, Lazar, & Stufken, 2009, which was in turn inspires by (Wager & Nichols, 2003), trial orders for both part 1 and 2 of the behavioral experiment (see **??**) were optimized using this technique. *TODO* finish this....

# References

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