Introduction to Project 7: functional MRI of the auditory system

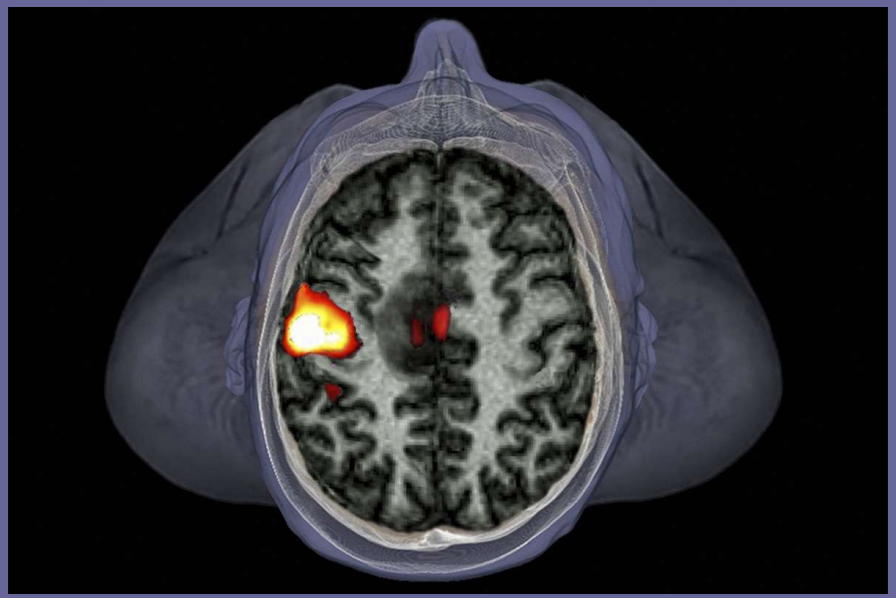
Quantitative and Functional Imaging

BME 4420/7450

Fall 2022

fMRI data analysis

- Auditory activation experiment
- Two imaging runs:
  - Hearing words, silence
  - Hearing chords, silence
- Create an activation map for each run

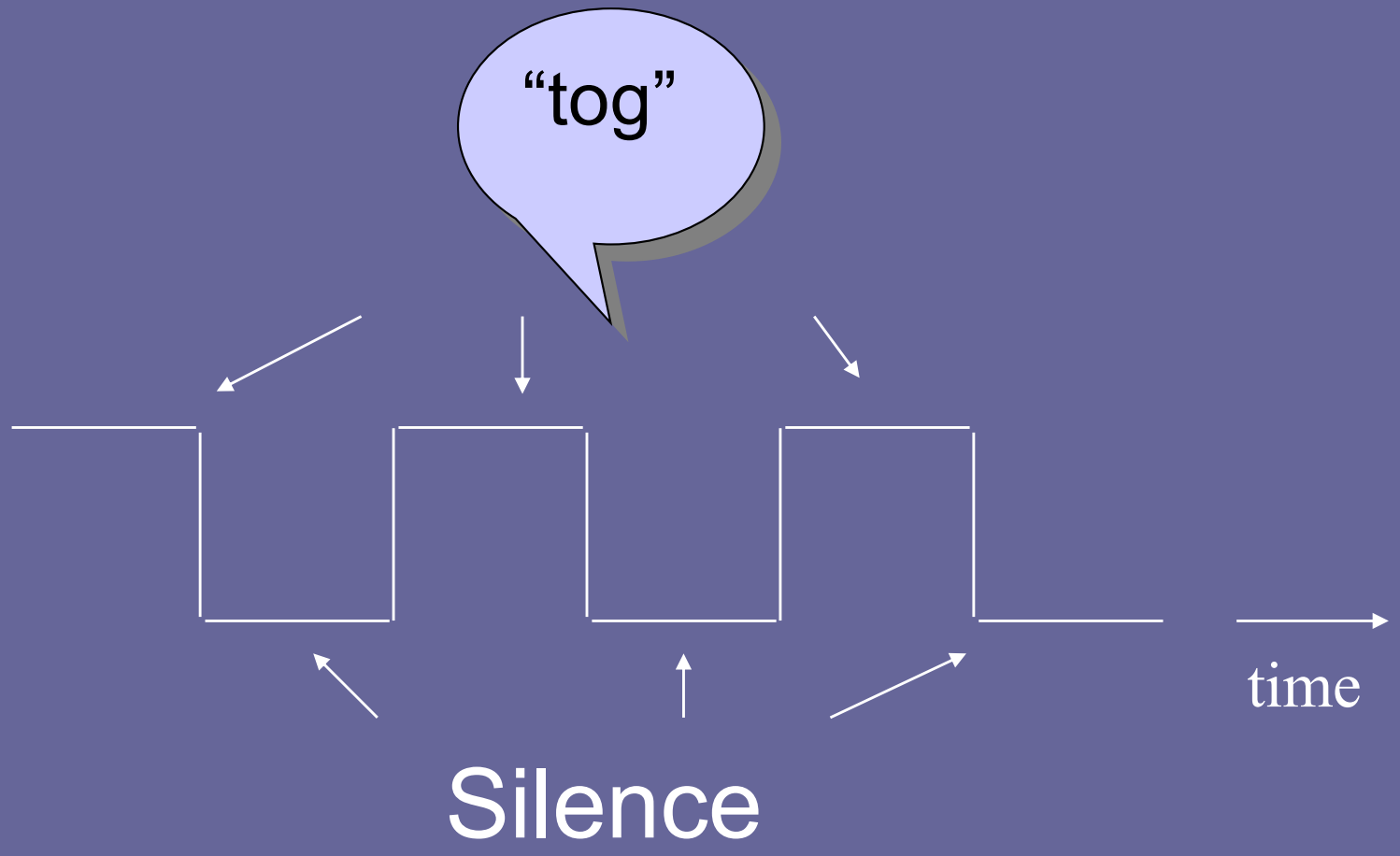


Zephyr/Science Photo Library

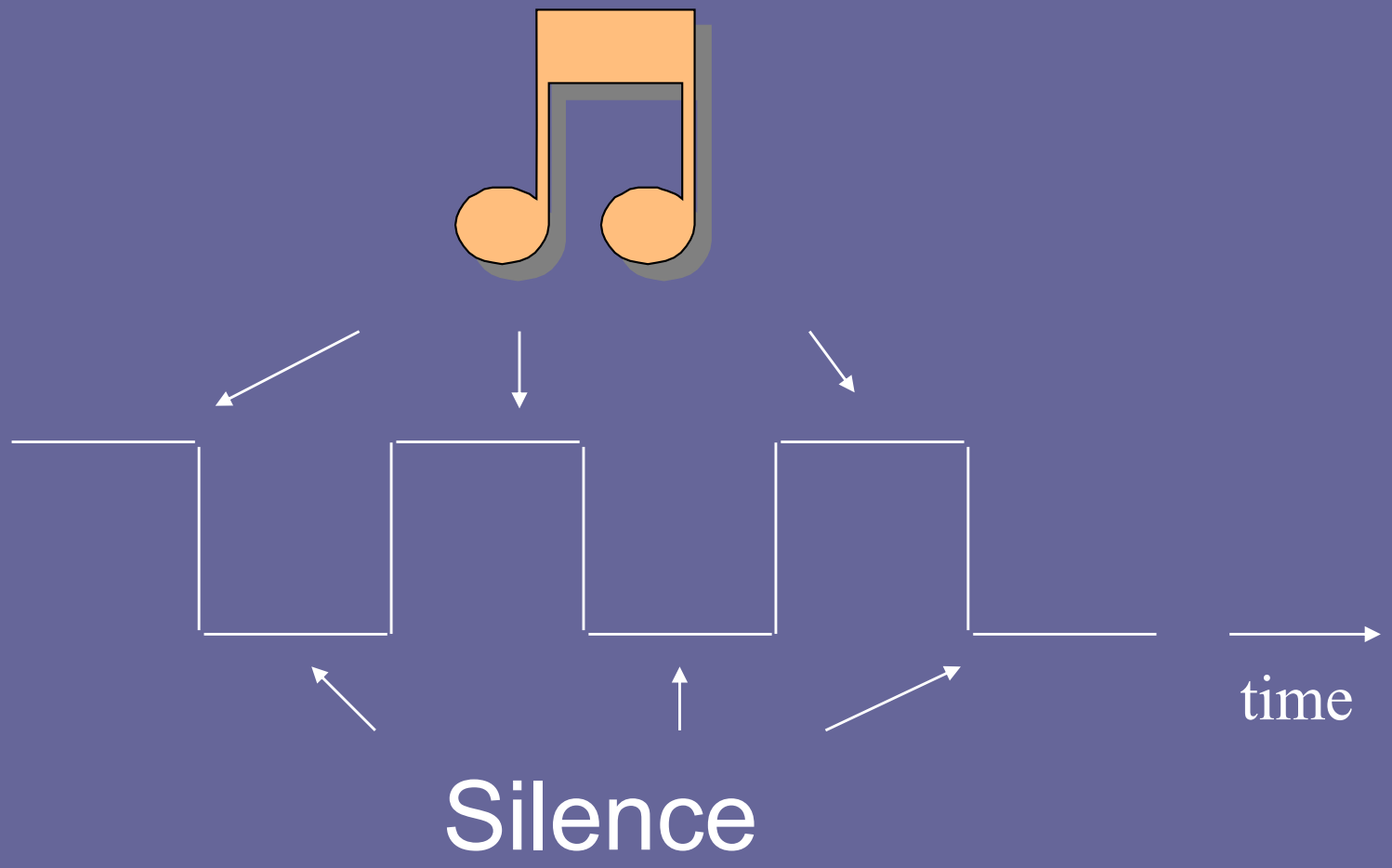
Signal changes in brain

- Neurons need energy (glucose+O_2) to do work
- Cerebral blood flow (CBF) increases locally
- Oxygen saturation increases locally
- Oxygen makes iron in Hb less magnetic
- Magnetic field around vessels becomes more uniform (T_2* increases) longer T2
  - Measure signal increase
- DeoxyHb is the (endogenous) contrast agent

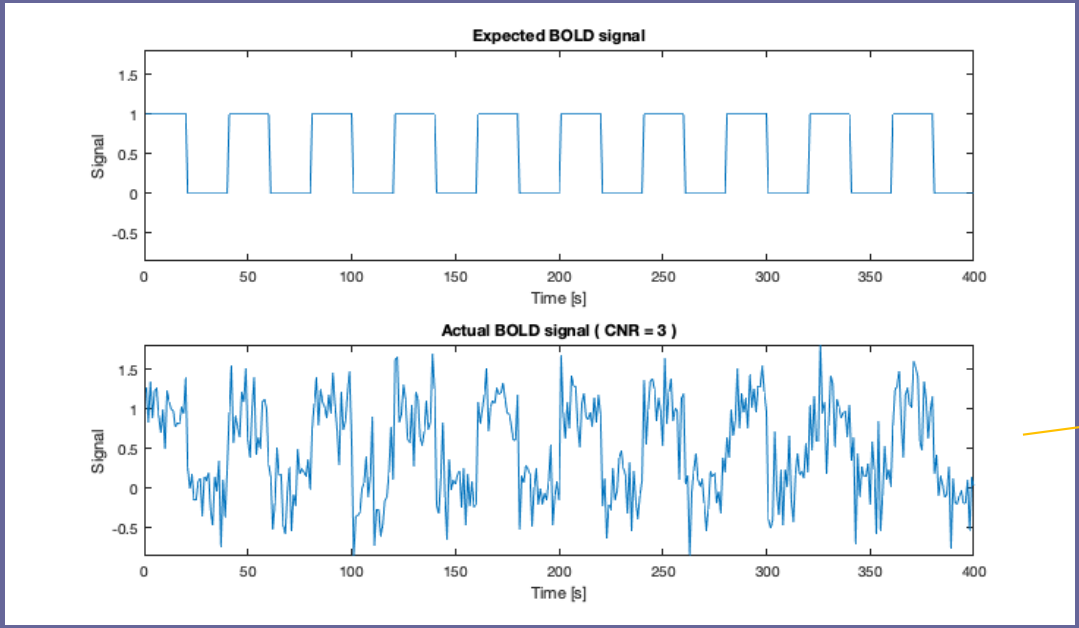
Auditory stimulation with words

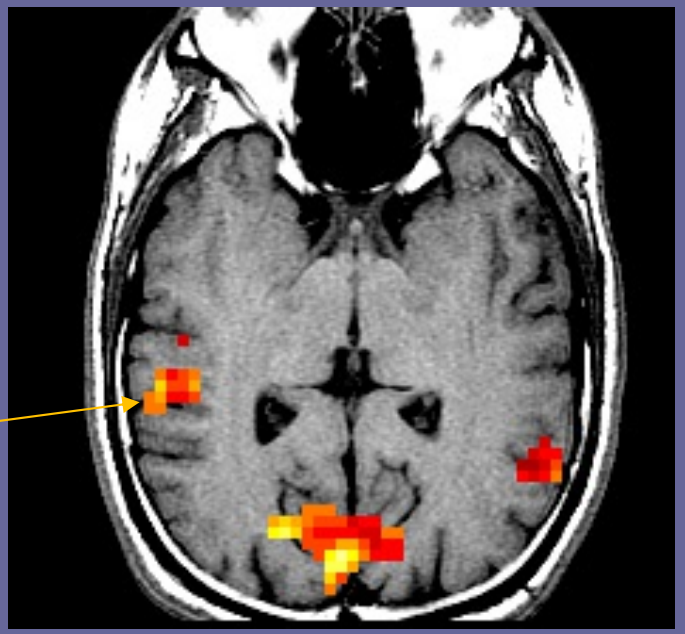


Auditory stimulation with chords



Map the correlation between expected and actual pixel signals





Correlation coefficients above some threshold are shown in color, superimposed on grayscale anatomical image

Steps in the project

- Smooth image data (to improve SNR)
- Create head mask
- Calculate correlation coefficient between ideal response to stimulus and the signal in each voxel
  - Words vs. silence
  - Chords vs. silence
- Identify a region of interest (ROI) in the auditory cortex using your activation map
- Calculate the contrast-to-noise ratio (CNR) in the ROI
- Calculate the center of activation
- Goal: compare activation to Words and Chords
- [Grad/extra credit:] Correct signal drift—does this improve CNR? model the drift & subtract from data