Top-down attention guidance shapes action encoding in the pSTS

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Introduction

pSTS is the GATEKEEPER

THE CLAIM:
The pSTS mediates **sensory** analysis of socially relevent events (LOTC, hMT+, FBA) and top-down **goal** directed expectations (IFG). As such, it does not encode *all* perceptual features of actions but a subset relevant for the current demands. We investigate how attentional demands influence the regional pattern response in the pSTS.

Design

Action Vignettes (3 s each)
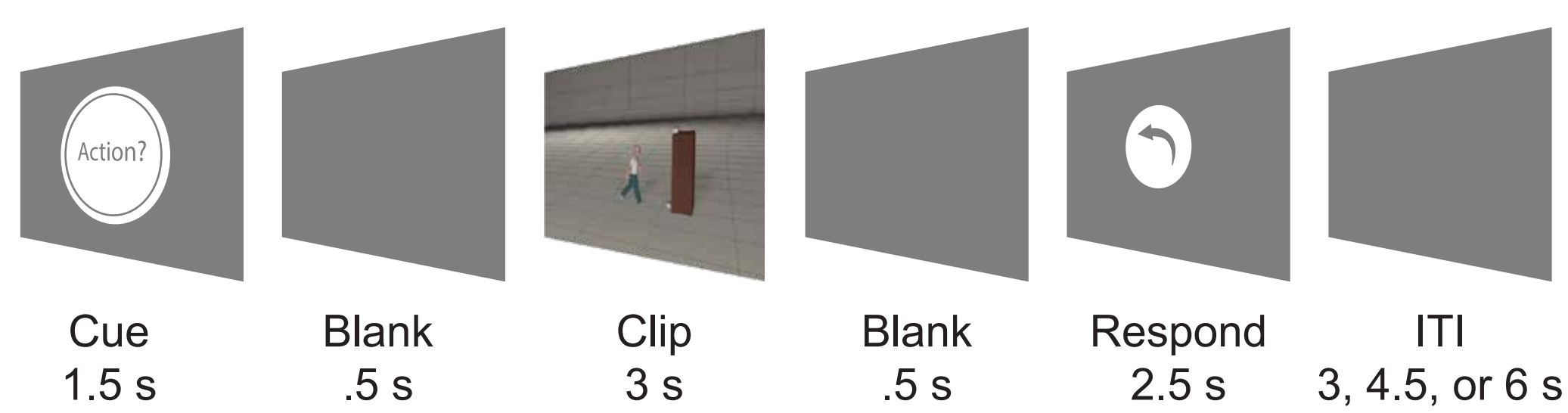

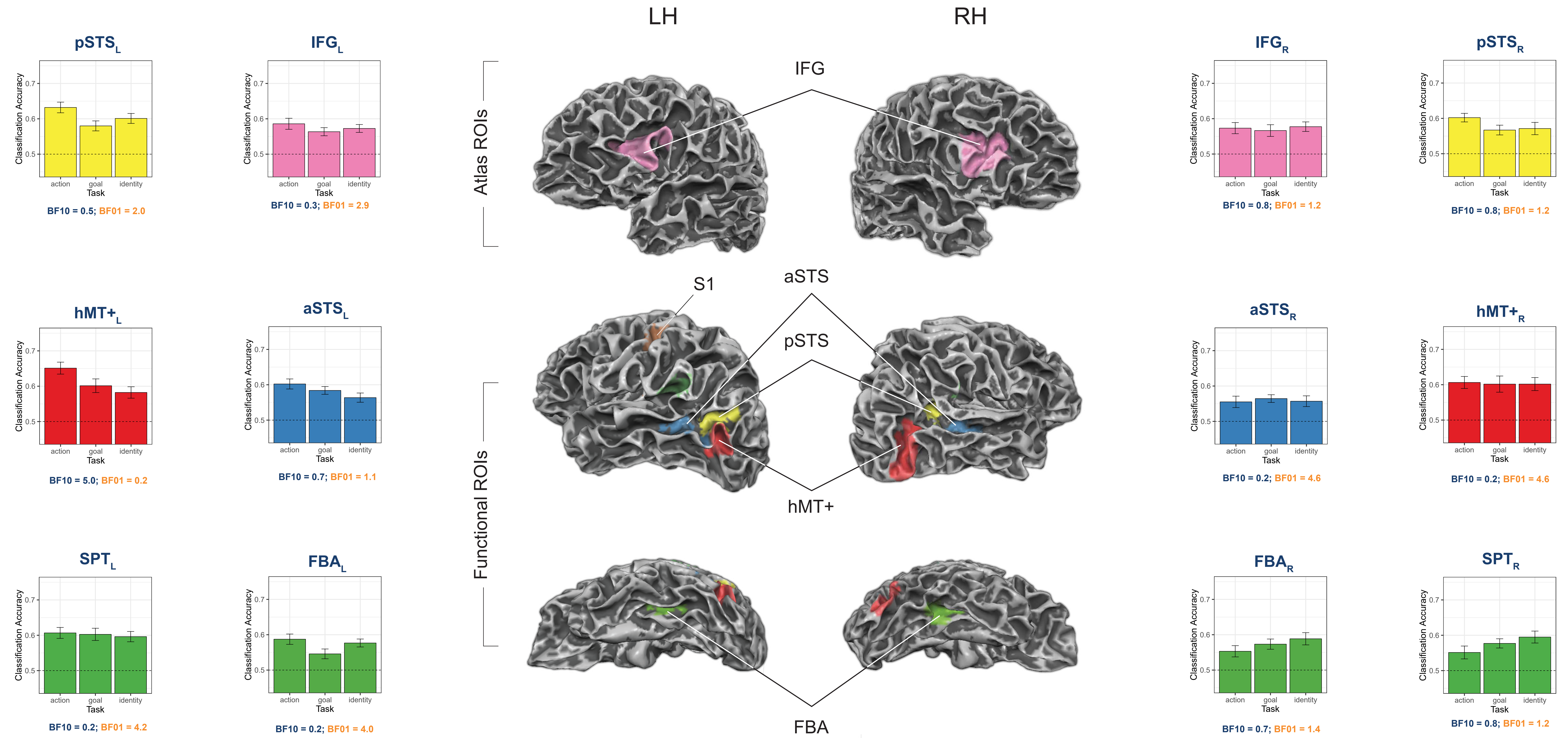**3 Attentional Demands**

1. Attend to ACTION
2. Attend to GOAL
3. Attend to actor IDENTITY

Trial Sequence

Cue	Blank	Clip	Blank	Respond	ITI
1.5 s	.5 s	3 s	.5 s	2.5 s	3, 4.5, or 6 s

action DECODING

All statistics reported are **Bayes factors** testing the null hypothesis that the difference between classification for "attend to **action**" trials is equal to classification for "attend to **identity**" trials.
- Noninformative Jeffreys prior placed on the variance of the normal population
- Cauchy prior placed on the standardized effect size.

BF10 = 3 means the **alternative** hypothesis (classification for "action" trials is not equal to classification for "identity" trials) is 3 times more probable than the **null**.
BF01 = 3 means the **null** is 3 times more probable than the **alternative**.

pSTS_L — BF10 = 0.5; BF01 = 2.0
IFG_L — BF10 = 0.3; BF01 = 2.9
hMT+_L — BF10 = 5.0; BF01 = 0.2
aSTS_L — BF10 = 0.7; BF01 = 1.1
SPT_L — BF10 = 0.2; BF01 = 4.2
FBA_L — BF10 = 0.2; BF01 = 4.0

IFG_R — BF10 = 0.8; BF01 = 1.2
pSTS_R — BF10 = 0.8; BF01 = 1.2
aSTS_R — BF10 = 0.2; BF01 = 4.6
hMT+_R — BF10 = 0.2; BF01 = 4.6
FBA_R — BF10 = 0.7; BF01 = 1.4
SPT_R — BF10 = 0.8; BF01 = 1.2

LH   RH

Atlas ROIs — IFG
Functional ROIs — S1, aSTS, pSTS, hMT+, FBA

Methods

1 Functional Localizers

pSTS
   biological motion > scrambled motion
hMT+
   optic flow > stationary
LOTC
   bodies + limbs > cars

2 Cortex-Based Group Alignment
- White matter meshes created in Freesurfer
- Brains aligned using curvature of sulci and gyri in BrainVoyager

3 Experiment
   8 runs (~ 5 min each), 24 trials per run

4 Data Cleaning
- 24 parameter Volterra expansion nuisance regression.
- Global signal (white matter + ventricles) nuisance regression.
- Despiking - timepoints > .4mm FD
- Trial censoring - 4 or more consecutive spikes > .4mm FD

5 Trial-Specific Beta Estimates

LSS   Least-Squares Single Approach
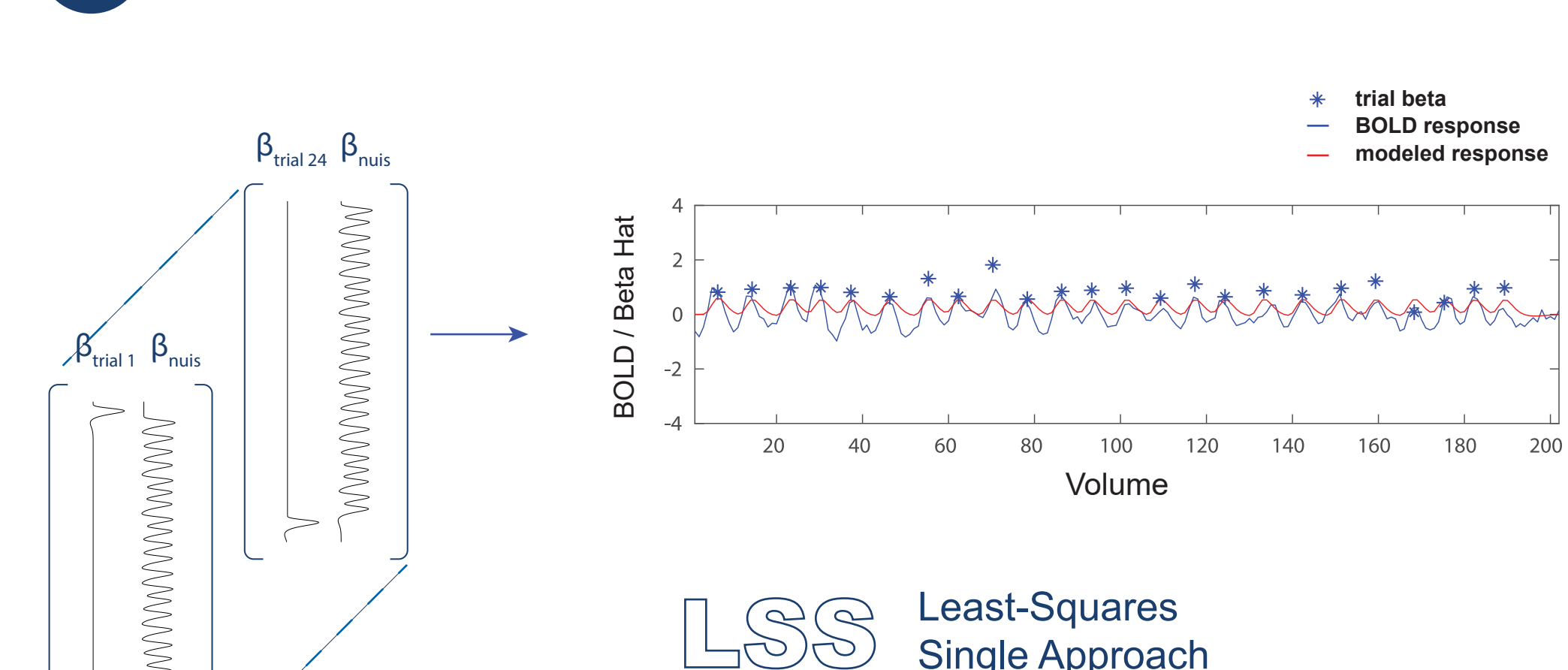
6 SVM Classification
- Linear kernel
- Leave-one-scan-out cross validation
- Optimized cost parameter (14 values between 2^{-12} and 2^{1}).
- Predict action class (crouch vs. jump).

Voxels

TRAIN   TEST
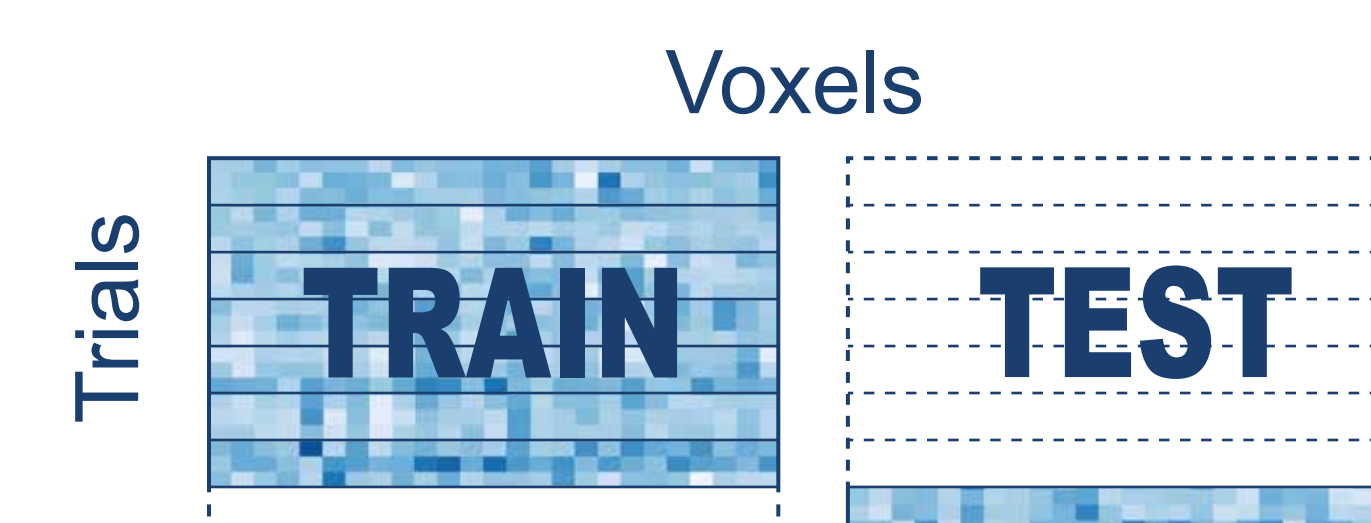
* Diagram only, not to scale

7 Feature Selection
- Backwards elimination
- Voxels ranked by SVM weights
- Eliminated in 18 steps from 5-90% of total voxels
- Nested cross-validation
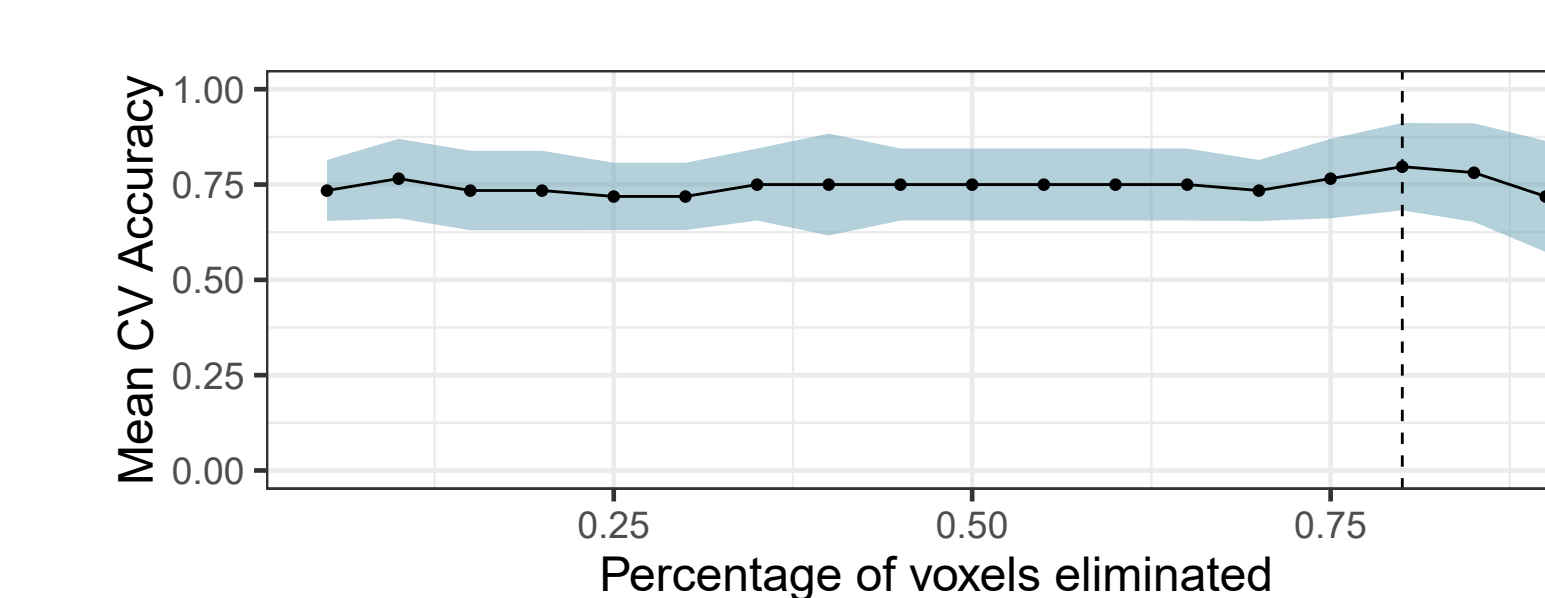
Takeaway

Although the data trends in the direction of our hypotheses, there is weak evidence that top-down attention shapes action representations in the pSTS.