

Anastasia Klimovich-Smith^{1,2}, Elisabeth Fonteneau^{1,2} & William D. Marslen-Wilson^{1,2}¹ Department of Psychology, Cambridge, UK; ² MRC Cognition and Brain Sciences Unit, Cambridge, UK

Introduction

The context of listening or reading modifies the way individual linguistic items are processed:

- Relative to unpredicted inputs, contextually predictable words elicit **anticipatory eye movements** (1), **quicker word recognition** (2), and **less neural activation** (3,4,5).
- What context based prediction mechanisms enable these effects?
- **Integration view:** No top-down effects on primary perceptual processes. Effects start post stimulus onset, at a decisional stage when word candidates are integrated with high-level sentential representations.
- **Pre-activation view:** Contextual expectations generate top-down effects on perceptual processing at lexical and sublexical levels, affecting neural responses even before stimulus onset. Predicted items are pre-activated.
- Can only distinguish between these views using time-resolved measures, preferably without the potential contamination of response task demands.

Here we combined **MEG +EEG**, giving high resolution spatiotemporal readings of neural activity, with **Russian sentences containing inflectional affixes** (marking subject-verb number agreement)

that contrast in their predictability.



Figure 1 – Experiment Design & Stimuli

4 conditions – 100 sentences each.

SUFFIX	Predicted (PS)	Unpredicted (US)
-ayet	Segodnya sestra Marii igr-ayet na pianino 'Today sister of Maria plays piano'	Segodnya na pianino igr-ayet sestra Marii 'Today piano plays sister of Maria'
-ayut	Segodnya sestri Ani igr-ayut v sadu 'Today sisters of Ana play-3.PL in the garden'	Segodnya v sadu igr-ayut sestri Ani 'Today in the garden play-3.PL sisters of Ana'

Does a predictive context affect suffix processing and, if so, when?

We expect: **Integration effect** - US>PS post suffix onset

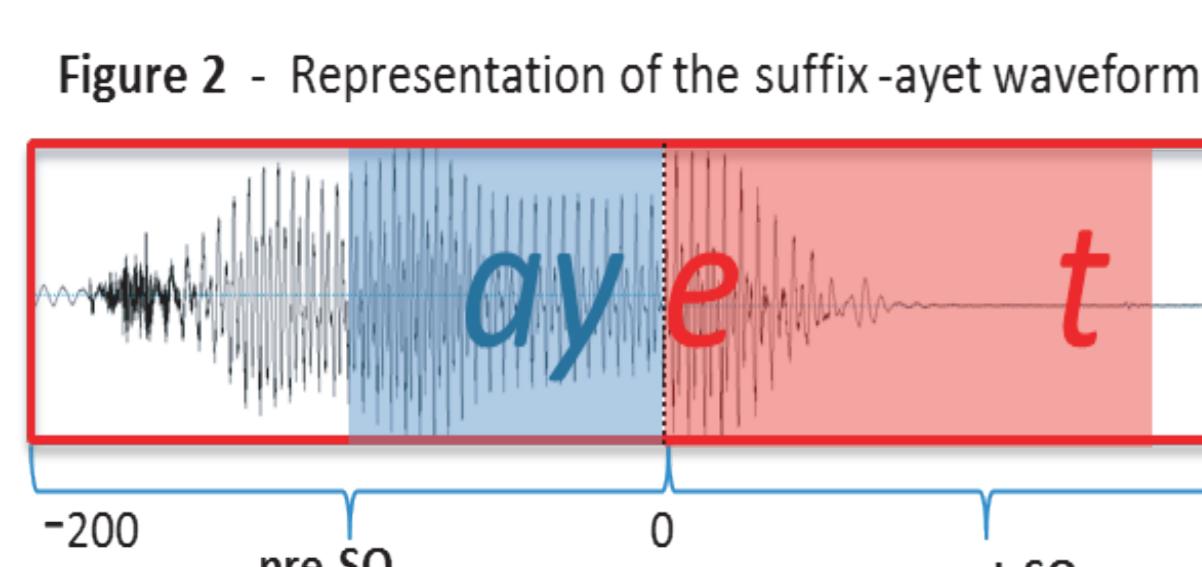
Pre-activation effect - PS>US pre suffix onset

Does context enable pre-activation of specific suffix-related information?

We expect: effects of the suffix form /-ayet/ vs /-ayut/ before suffix onset, but only for the PS condition.

Methods

MEG Experiment Passive listening + occasional (5%) 1-back memory task. N = 17. 306 MEG +70 EEG. **Pre-processing:** Maxfilter, ICA (blinks). **Source space:** Freesurfer (individual MRI), 3-layer BEM, minimum-norm solution (MNE). Alignment point: SO (suffix onset). **Mask:** frontotemporal language areas (Figure 4)



Analysis:

Acoustic analysis: • auditory differences between -ayet and -ayut suffixes originate in vowels /e/ and /u/ • due to co-articulation they are already present in /ay/, on average 68ms before SO (SD = 27.5) • predictability has no effect on intensity, pitch or spectral contents of F1,F2 of the suffix pre-SO.

Overall activity in the frontotemporal ROIs:

ANOVA - activity averaged across LH & RH 16 ROIs; three factors: predictability (PS/US), time-window (pre- or post-SO) and hemisphere (left or right).

Spatiotemporal activity within individual ROIs:

Activation time course (1ms temporal resolution) for each condition and subject, extracted, baseline-corrected (-300 to -200ms), averaged across ROI, corrected for multiple comparisons (6).

Cortical multivariate analysis: RSA Searchlight

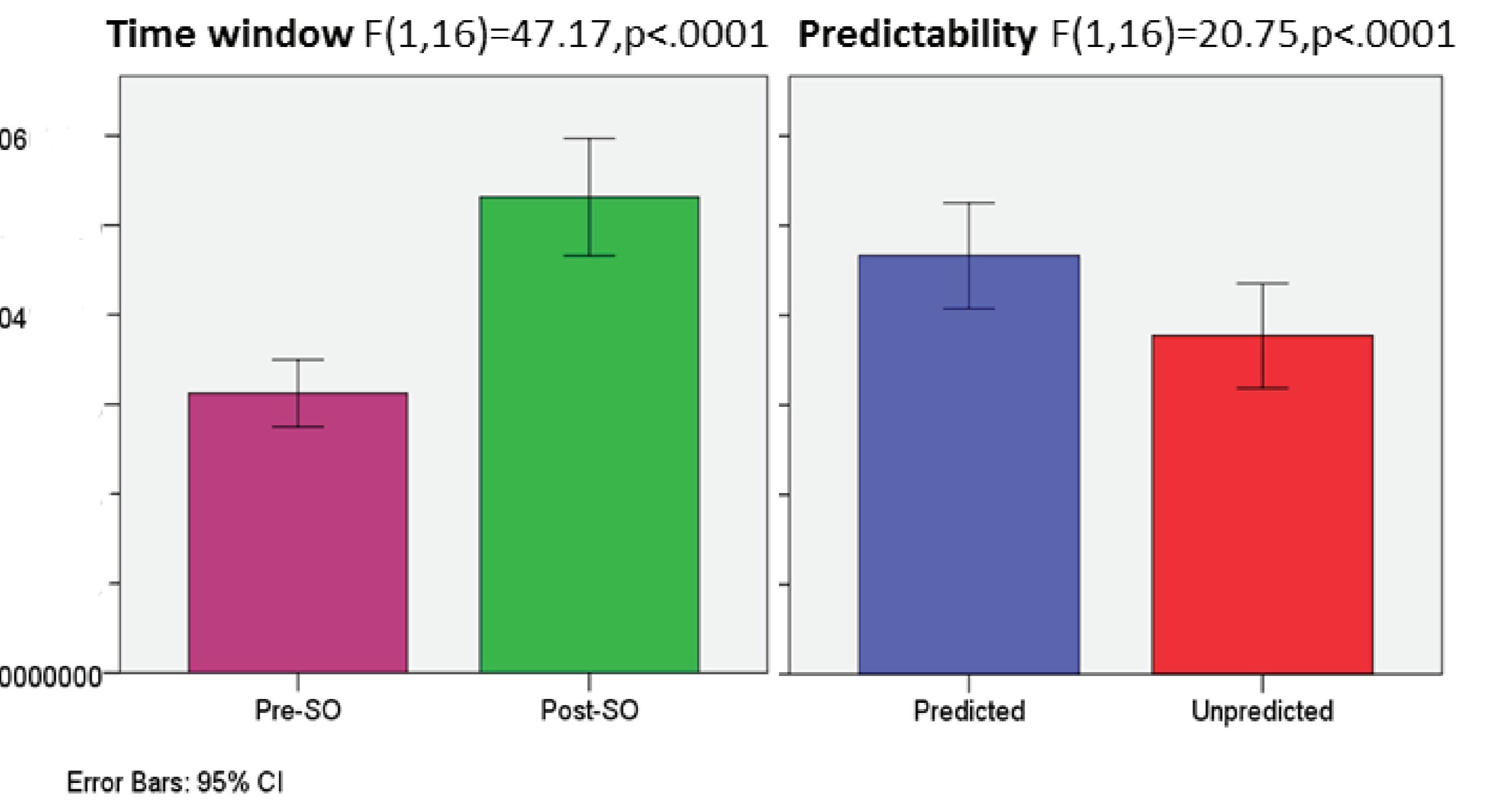
Figure 5, right - model & data RDMS - 20 conditions, 20x20 matrices; Activity averages for 4 main conditions split into 5 sub-conditions related to 5 different subject referents - R1,R2,R3,R4,R5; 20 trials per cell. Searchlight parameters: time window 50ms, radius 20mm, time step 10ms.

References

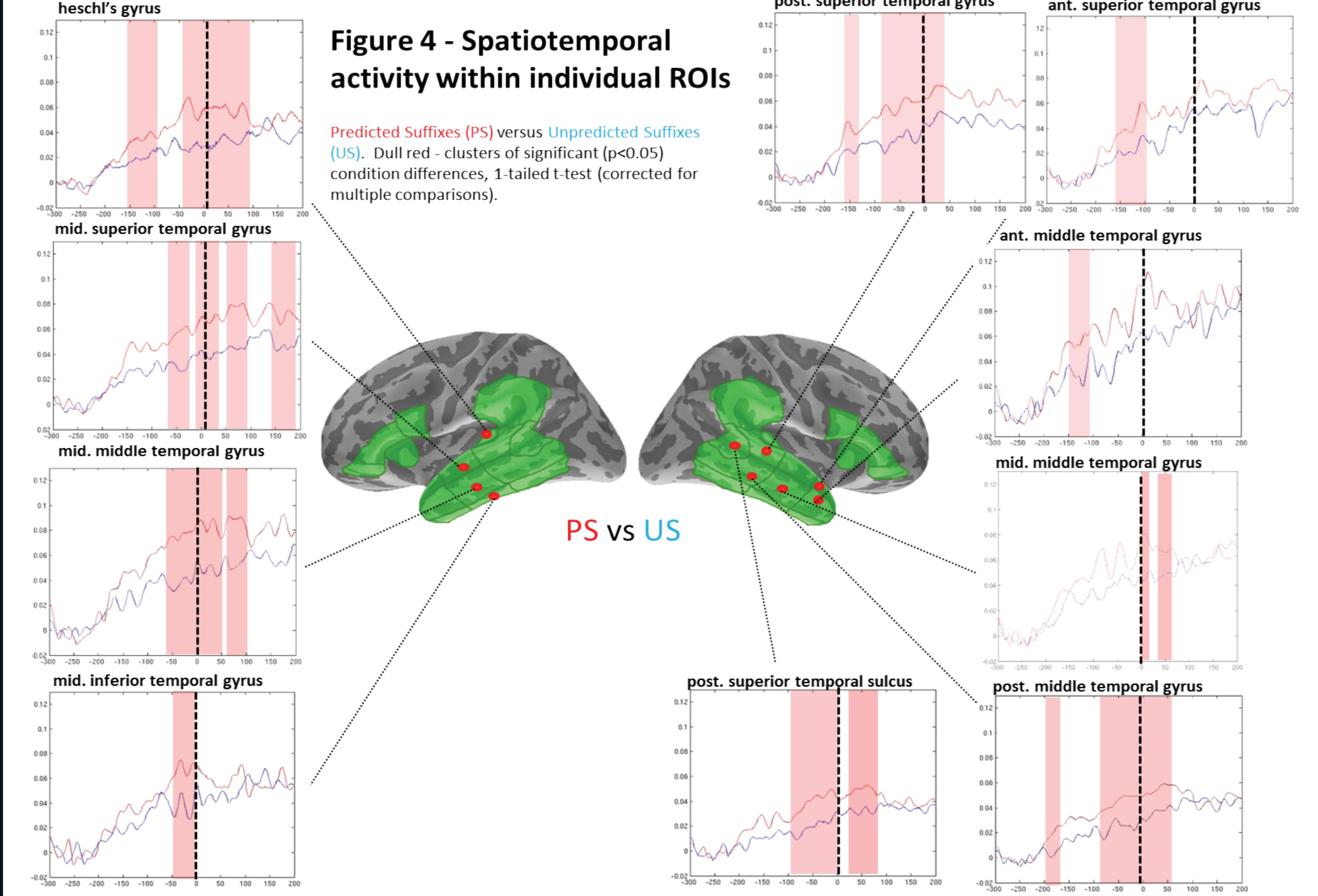
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• Univariate

Figure 3 - Overall activity within frontotemporal ROIs



- Overall greater signal amplitude for PS>US in all frontotemporal ROIs before and after SO
- Post-SO activity> Pre-SO • No effects of laterality (LH vs RH)



- Signal amplitude PS>US in all frontotemporal ROIs before and after SO.
- Varied effect latencies for different temporal ROIs --> earliest -190ms RH pMTG, at -150ms RH pSTG, aSTG & MTG, LH HG; -100ms RH pSTS and MTG, at -50ms LH mMTG, STG & ITG, RH mMTG.

Results

• Multivariate

Figure 5 – Schematic overview of the RSA ‘Searchlight’ for EMEG data

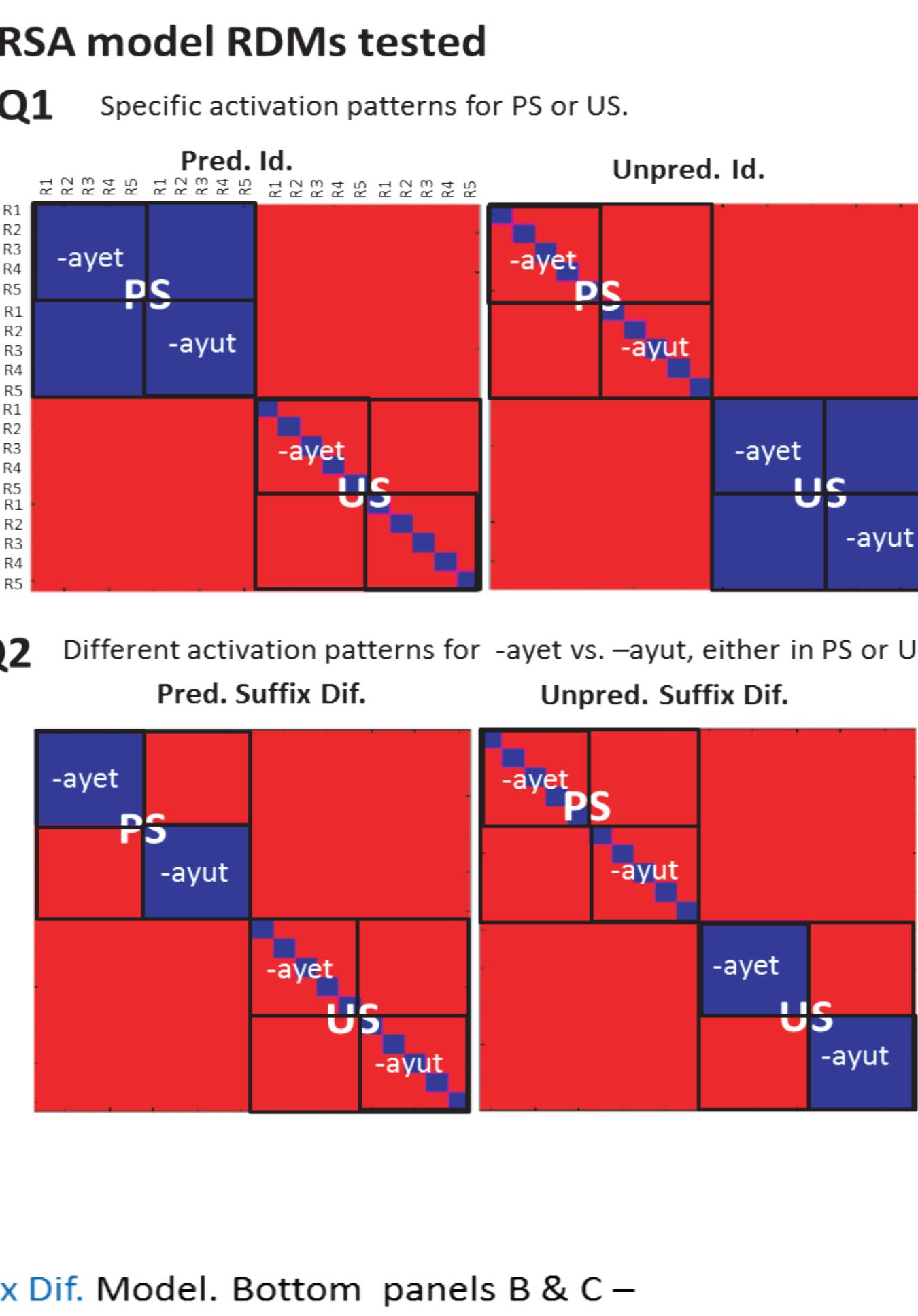
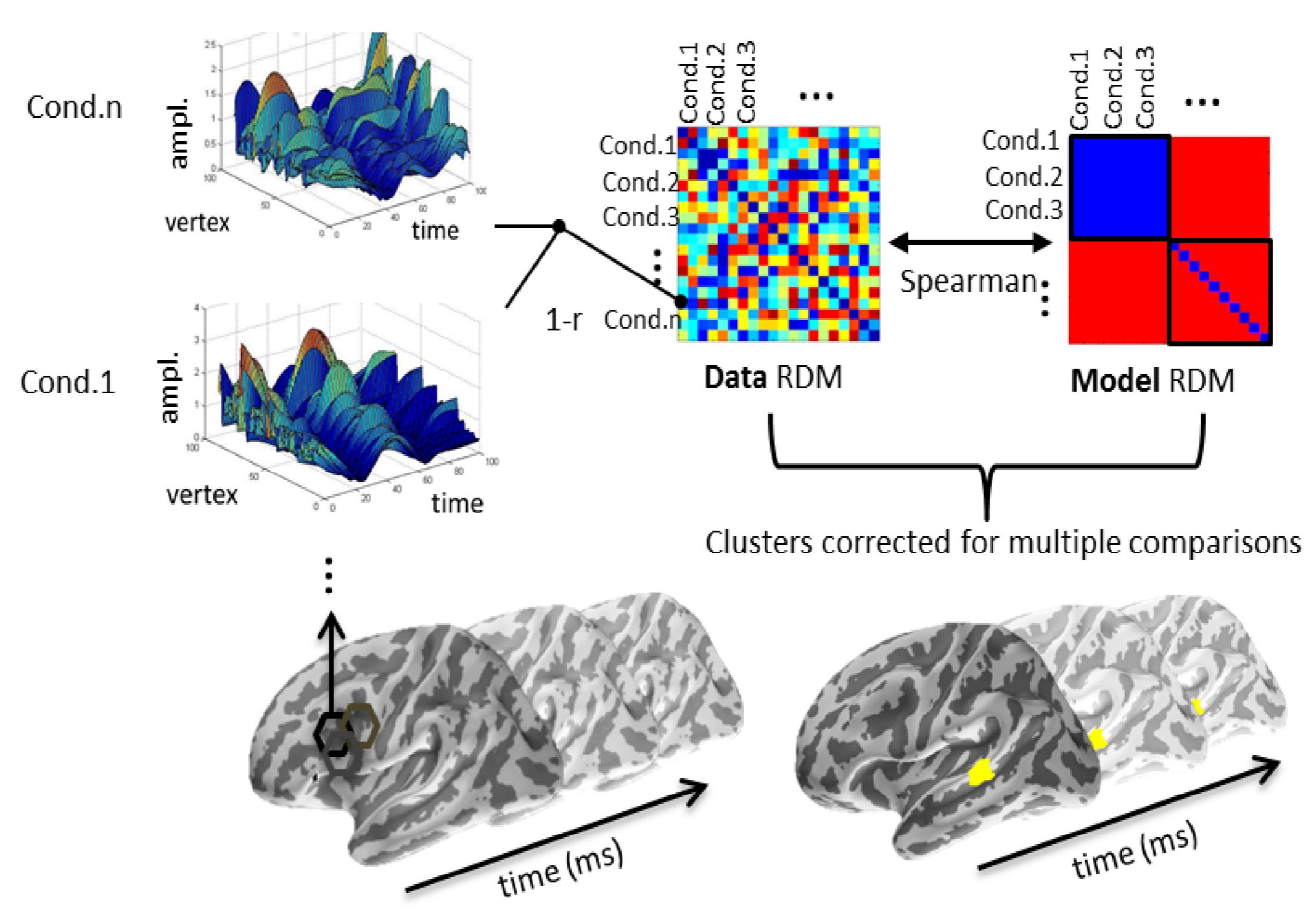
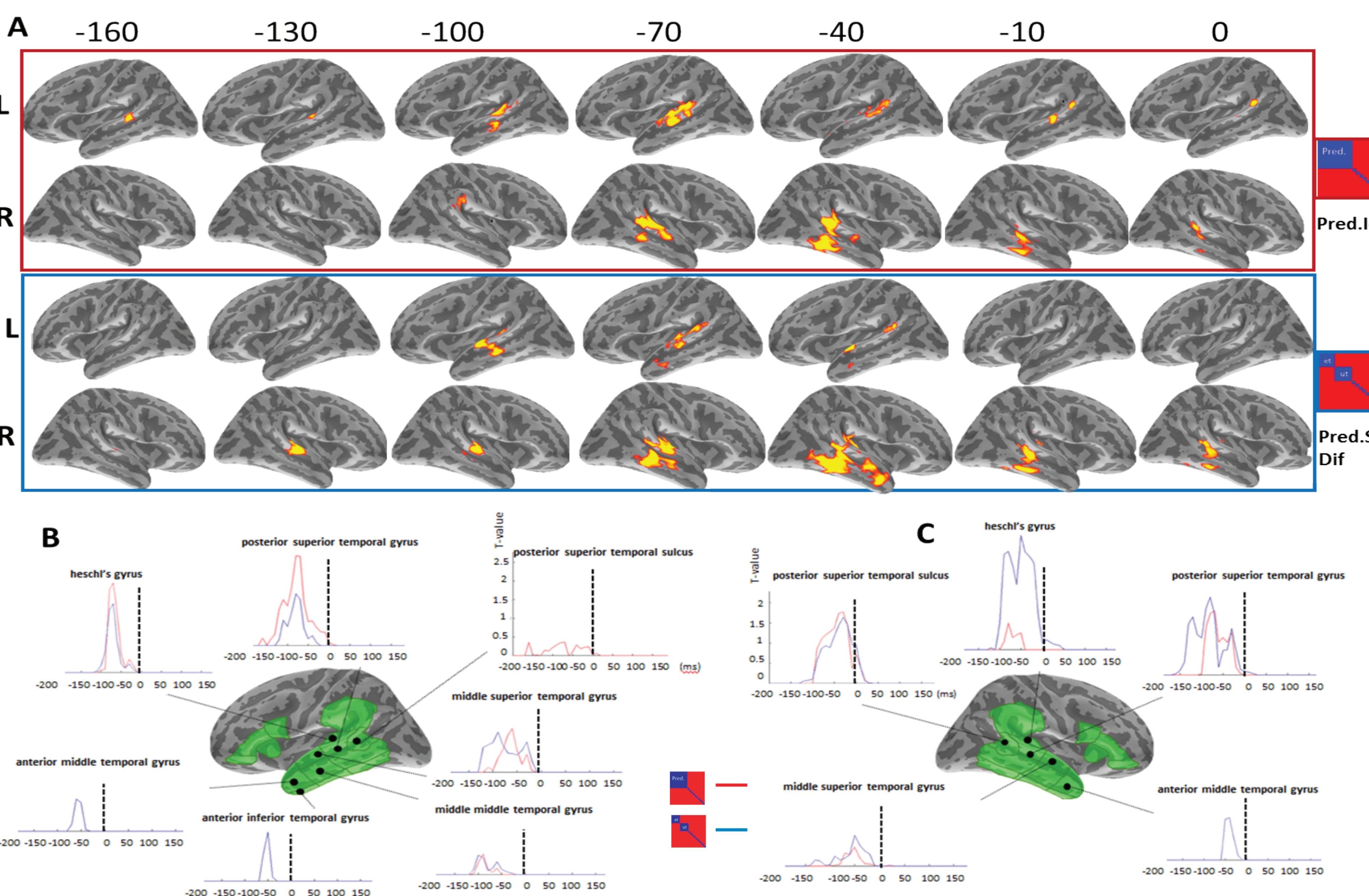


Figure 6 – Multivariate RSA Searchlight

Panel A, top – spatiotemporal model fit ($p<0.05$) clusters for the **Pred. Id** model, bottom – **Pred. Suffix Diff.** Model. Bottom panels B & C – ROI-specific t-value time-courses extracted for both models, overlaid for visual comparison.



Conclusions

Russian inflectional morphology + EMEG made it possible to examine effects of predictability in a naturalistic language context both pre and post predicted item perceptual onset.

Does a predictive context affect suffix processing and, if so, when? Predicted suffixes show early amplitude increase (from -190ms RH pMTG) and produce similar activation patterns (from -160ms LH pSTG) in bilateral temporal areas. These results before suffix onset support the pre-activation view.

Does context enable pre-activation of specific suffix-related information? Bilateral temporal areas begin to differentiate between predicted -ayet and -ayut suffixes from -160ms (RH pSTG) before suffix onset. This is earlier than any acoustic information about suffix identity (-68ms pre-SO).

What information is pre-activated? Early posterior STG effects (-160ms RH, -120ms LH) suggest phonetic and phonological form processing ; middle (-100ms) and anterior temporal (-70ms) effects imply processing of the suffix meaning.

ak798@cam.ac.uk