

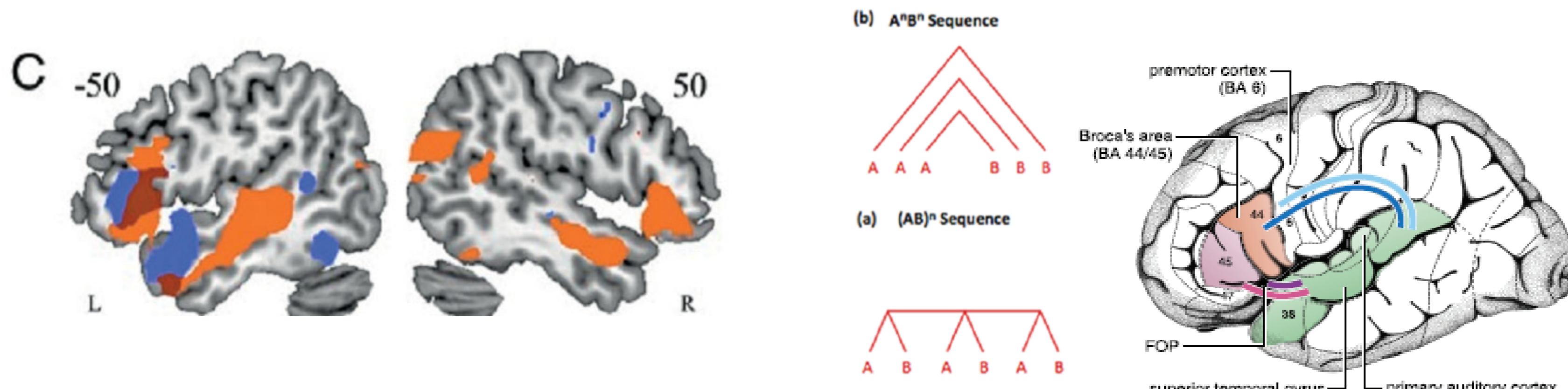
## Introduction

**Inflection and syntax** are two functionally similar linguistic devices: they both use combinatorial mechanisms to express relational information about sentential arguments.

**There is a substantial overlap in LH perisylvian regions (BA44/45 and STG/MTG) activated for inflectional and sentence processing:**

For inflected forms LIFG-left STG activation is associated with the analysis of the stem+suffix combination and parsing (1, 2, 3).

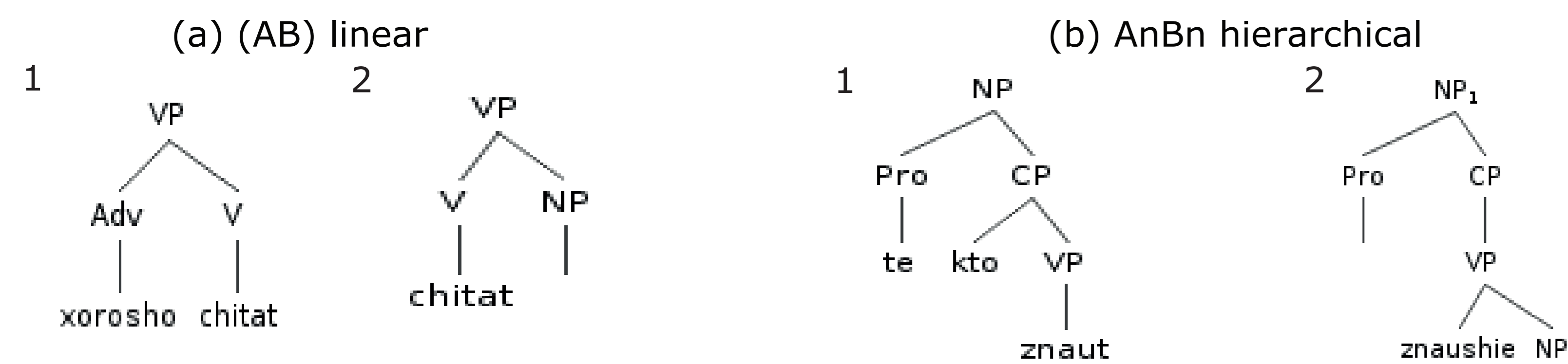
For syntax, the ventral route (BA 45, FOP mid STG) is associated with simple linear [ABAB] processing (Figure II, III); while the dorsal route (BA44-pSTG) is claimed to support complex and hierarchical [A(AB)B] syntax (4, 5).



### Questions:

- To what extent does the left perisylvian activation in inflection reflect relational processing (integration of the arguments referenced by the suffix) or morpho-phonological parsing (suffix detection)? Can we dissociate the two?
- Can we see processing differences between stimuli used in the linear versus hierarchical syntactic structures?

The Russian language allows us to address these questions since complex grammatical relations can be expressed both through inflectional suffixes and as phrases.



The Simple Syntax condition (a1) requires linear syntactic processing; Simple Inflection (a2) signals linear syntactic structure; Complex Syntax (b1) requires hierarchical processing; Complex Inflection (b2) signals a hierarchical structure (Table I)

We added derivation conditions as a control as they do not express grammatical relations and arguably do not require parsing.

## Methods

Table I - Experimental Stimuli

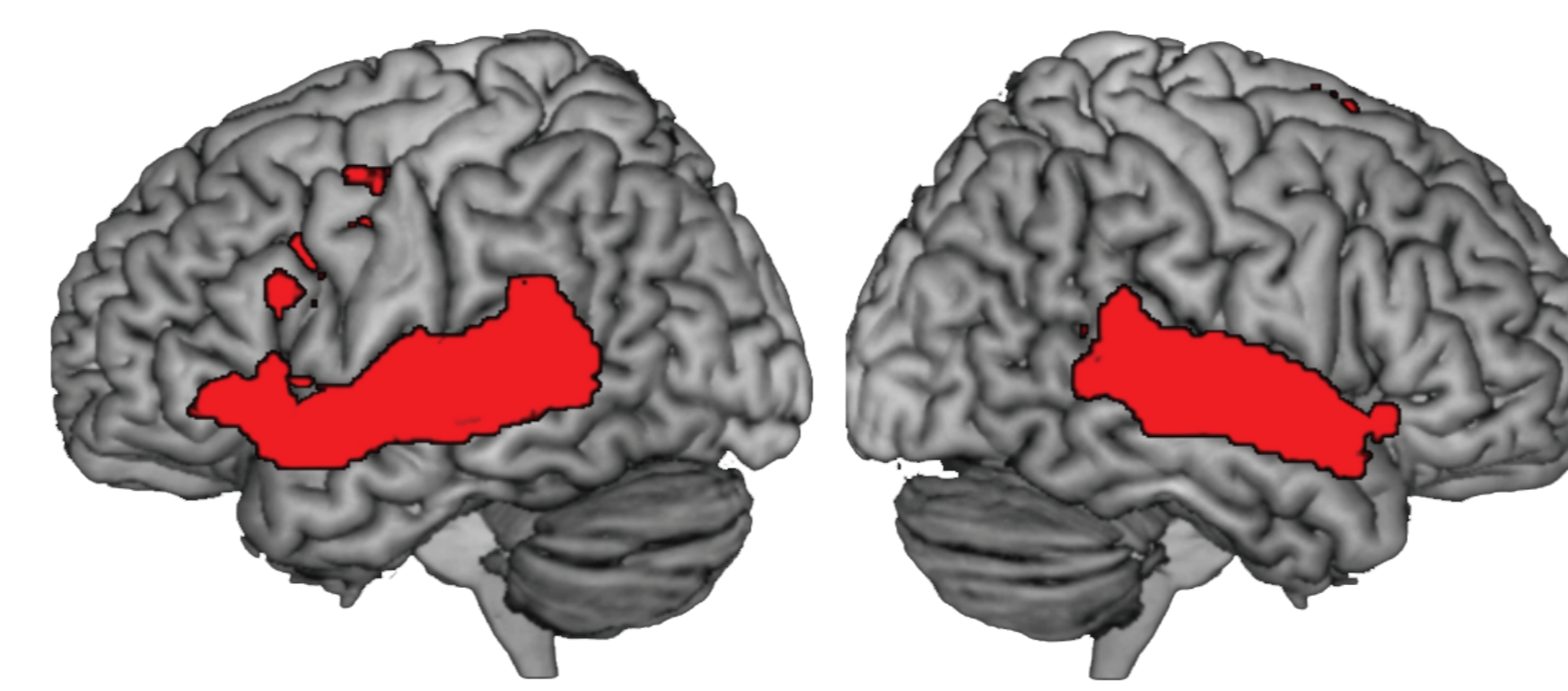
Conditions	Simple	Complex
<b>Inflection</b>	<b>chit-at</b> to read (infinitive suffix)	<b>znau-shi-e</b> those who know (3 <sup>rd</sup> person participle, plural suffix)
<b>Syntax</b>	<b>xorosho chit-at</b> to read (inf. suffix) well	<b>te kto zna-ut</b> those who know (3 <sup>rd</sup> person plural suffix)
<b>Derivation</b>	<b>prikaz</b> an order	<b>perevozshik</b> delivery man

**Participants:** 20 right-handed Russian native speakers. **Baseline:** Musical rain (MuR). Unintelligible sounds that are closely matched to speech in acoustic complexity and are equivalent in length. **Procedure:** auditory presentation, passive listening with one back recognition task; **Acquisition and Analysis:** fast sparse imaging, auditory presentation, analysed in SPM8 using standard univariate analysis, ANOVA on all conditions, regression analysis.

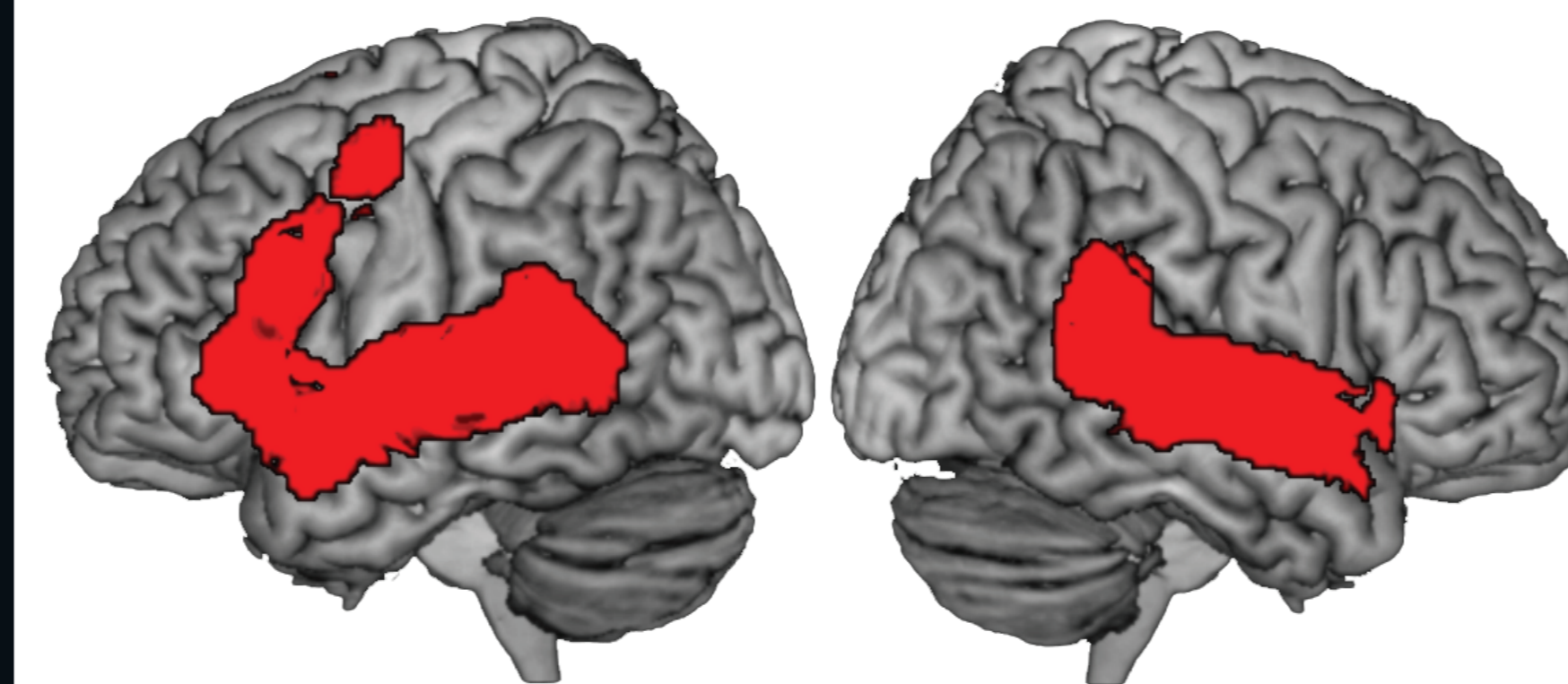
## Results

**The effects of lexicality in each condition, estimated by subtracting MuR. Results significant at  $p < .001$  voxel level and  $p < .05$  cluster level corrected for multiple comparisons**

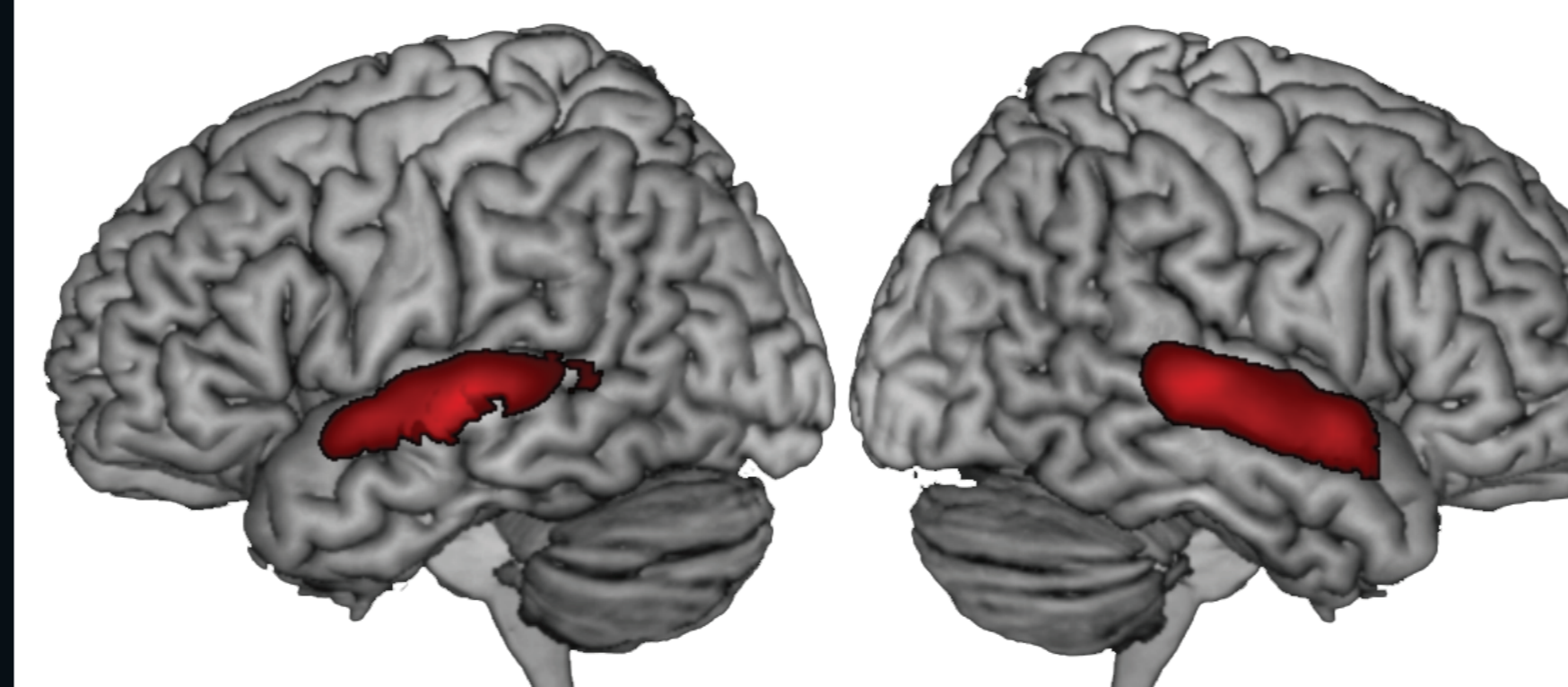
### Simple Conditions



Simple Inflection



Simple Syntax



Simple Derivation

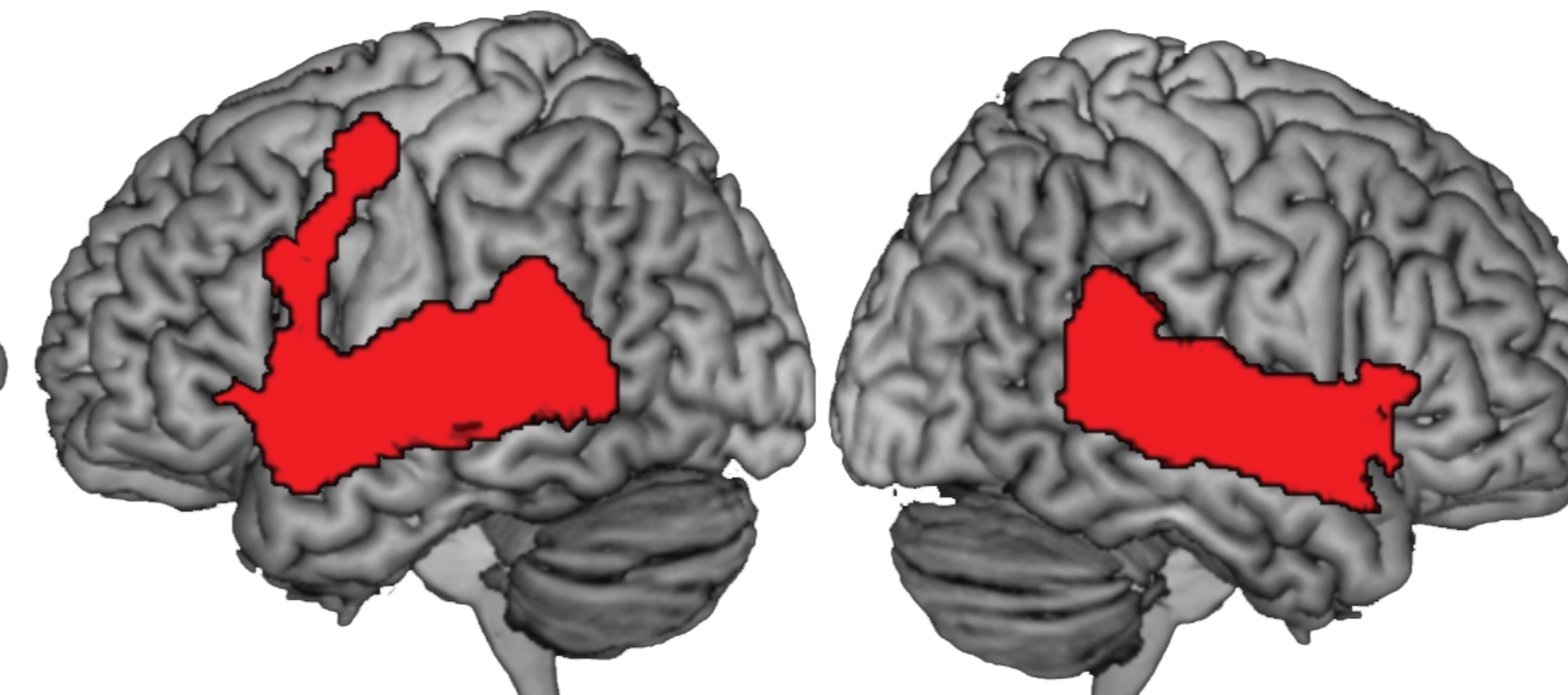
Extended left fronto-temporal activation with BA 44 and 45 posterior and anterior STG and MTG for all conditions related to relational structure processing. No distinction between hierarchical (Complex Syntax and Inflection) and linear processing (Simple Syntax and Inflection).

### Simple Conditions:

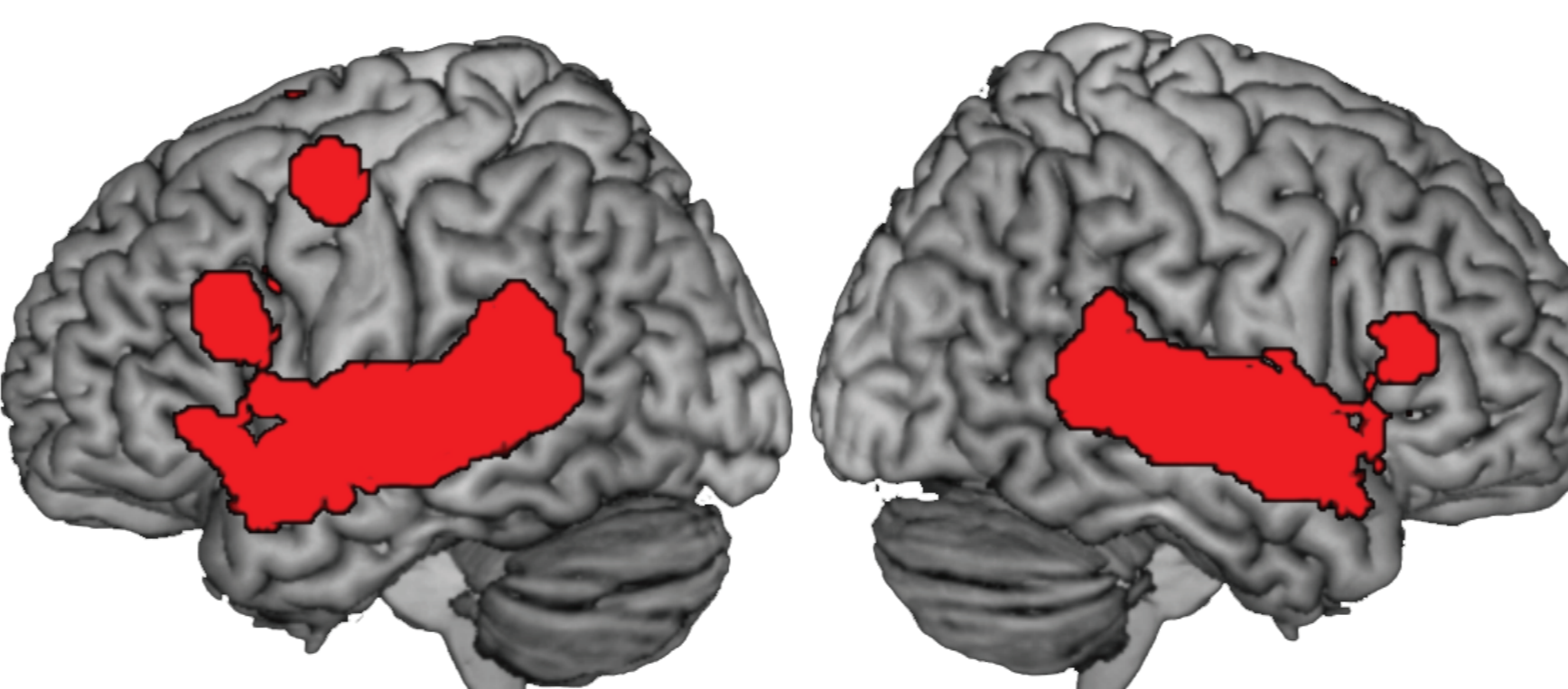
Simple Syntax and Simple Inflection activated STG and MTG bilaterally; LIFG (BA 44 and BA 45), extending to L Precentral gyrus.

Simple Derivation only activated STG bilaterally.

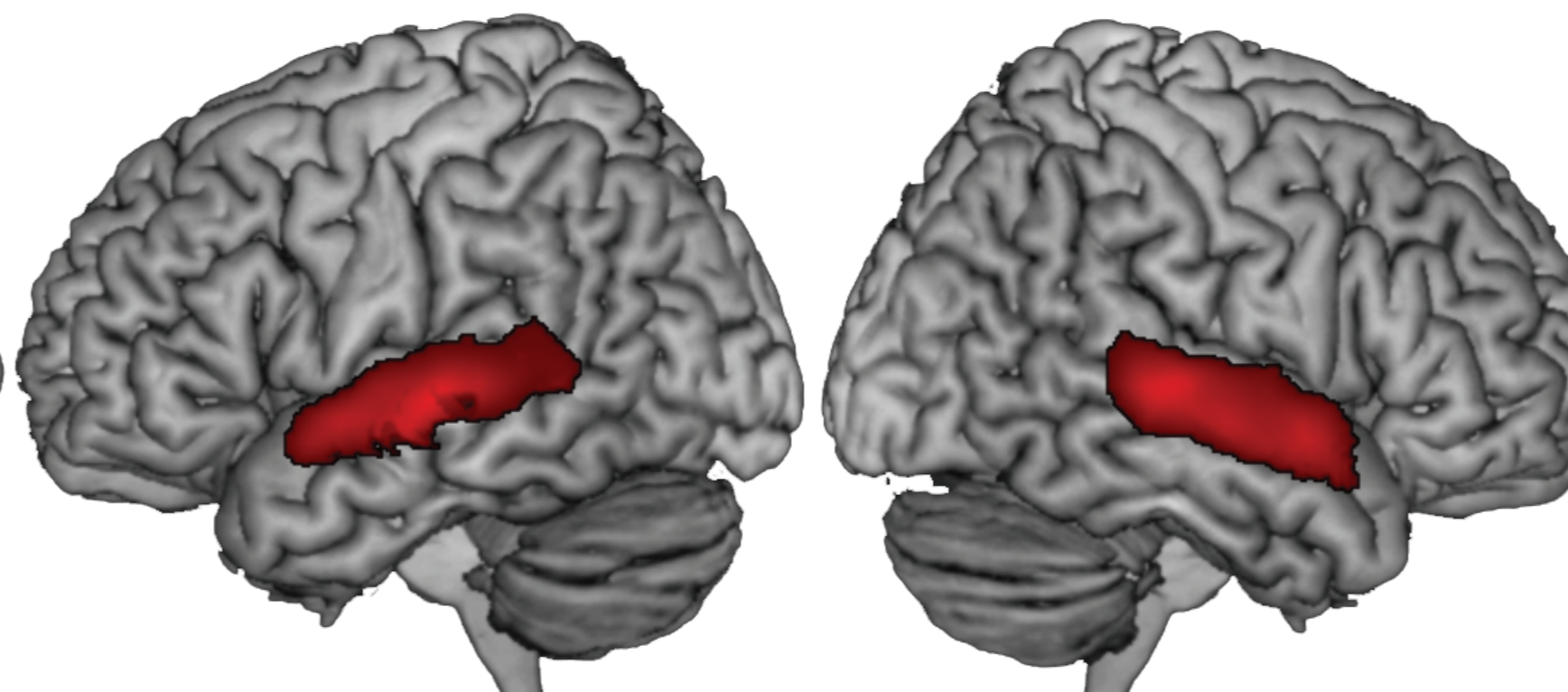
### Complex Conditions



Complex Inflection



Complex Syntax



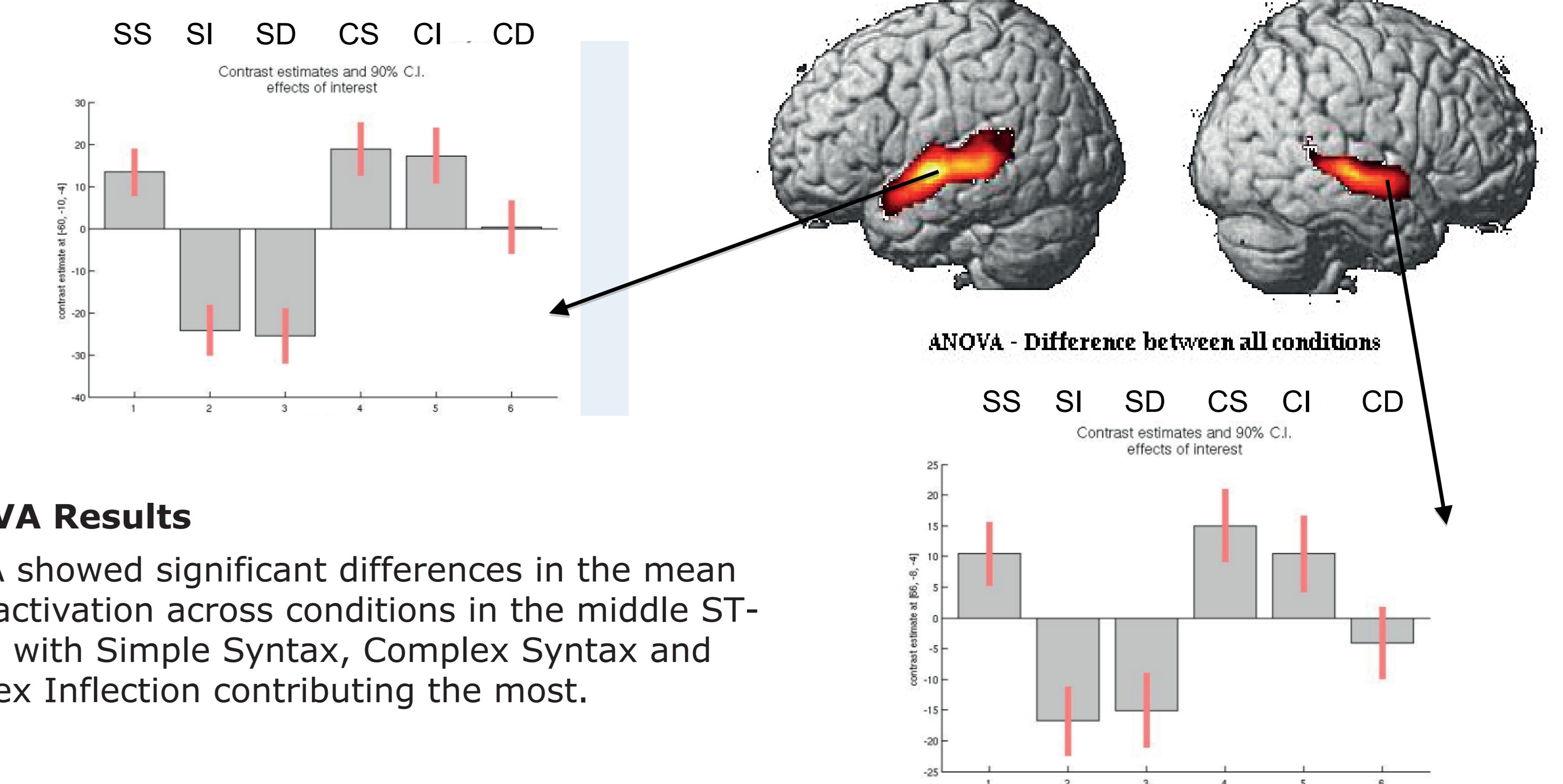
Complex Derivation

### Complex conditions:

Complex Syntax and Complex Inflection activate both BA 44 45, left insula, superior motor area and the Precentral gyrus, STG/MTG bilaterally;

RIFG (BA 45) activation for Complex Syntax.

## ANOVA



### ANOVA Results

ANOVA showed significant differences in the mean BOLD activation across conditions in the middle STG/MTG with Simple Syntax, Complex Syntax and Complex Inflection contributing the most.

## Summary and Conclusions

(1)

We see a clear preference of the left lateralised perisylvian language network for grammatically complex conditions. Inflection and Syntax activate the left hemisphere language network (L STG/MTG, LIFG), while Derivation does not (STG/MTG bilaterally).

Grammatical relations expressed through inflectional suffixes or through phrases activated syntax related areas (pSTG, BA 44, 45, L and R temporal poles) in a comparable way. This suggests that the relational information expressed by inflections is accessed and integrated.

It is unlikely that these effects can be reduced to the stem-affix decomposition, as conditions that were most morphologically complex did not produce greater activation across the language areas (similar results were obtained in 6).

(2)

We did not find a distinction between hierarchical (Complex Syntax and Inflection) and linear (Simple Syntax and Inflection) syntactic processing.

In the univariate analysis areas associated with the ventral and dorsal routes were equally active for all syntactic condition showing no preference for either linear or hierarchical structure processing in Russian.

We are currently developing better estimates of syntactic complexity processing to determine whether they modulate the observed activations.

(3)

Complex Syntax and to a lesser extent Complex Inflection produced R BA 45 activation. RIFG was previously observed in syntactic ambiguity processing when LIFG was damaged.

Here, following previous research (7), we suggest that since RIFG is most active in the most linguistically complex condition (Complex Syntax) it may be required when L BA45 is insufficient to sustain the processing demand; although RIFG itself is not functionally specialised for syntactic processing.