Syntactic categories in the brain

Update: March 24, 2015

Experiment "SyntCat": basic info

Blocked design:
• 5 main conditions: nouns (N), verbs (V), adjectives (AJ), adverbs (AV), prepositions (PR)
• N, V, AJ and AV further have 2 sub-conditions (morphologically simple vs. morphologically complex), so there are actually 9 total conditions

Materials:
16 unique items per condition (N, V, AJ and AV are matched for length and frequency)

Timing:
A block consists of 8 trials (14 sec total duration).
Trial timing: 1,750 ms (1,200 ms word presentation, 550 ms ITI).
Run timing: 18 experimental blocks (2 for each of 9 conditions) + 3 fixation blocks, so 21 blocks x 14 sec = 294 sec (4 min 54 sec).

In each run, participants see 2 blocks per condition. Thus, all the stimuli are used once per run. Participants do 3-4 runs.

Across 3-4 runs participants get 6-8 blocks for each of 9 conditions (or 12-16 blocks for the 4 main conditions: N, V, AJ and AV).

Experiment "SyntCat": materials

| Nouns		Verbs		Adj		Adv		Prep
action	meat	replace	tell	physical	robust	quickly	seldom	during
decision	youth	arise	hear	available	gentle	strongly	together	beside
president	title	realize	bring	apparent	fickle	suddenly	often	with
reaction	animal	discover	would	substantial	glad	truly	too	of
population	autumn	calculate	write	beautiful	odd	especially	never	among
committee	technique	remind	get	happy	able	unnaturally	again	despite
owner	cabin	characterize	seem	bacterial	cruel	eastwards	also	toward
application	son	acknowledge	send	alphabetical	difficult	exactly	forth	at
guesswork	news	emphasize	continue	legislative	tall	maybe	amok	amid
truth	napkin	recommend	should	economic	mad	functionally	quite	into
movement	loss	ensure	thank	basic	soft	probably	soon	per
incineration	hill	represent	appear	crazy	strong	merely	almost	upon
health	fun	withdraw	ask	impossible	afraid	completely	askance	against
growth	friend	enable	add	various	solar	slightly	ever	atop
production	door	encourage	shall	nuclear	huge	obviously	hither	via
education	hour	disappear	lose	industrial	hot	effectively	ago	from

Experiment "SyntCat": results (n=16)
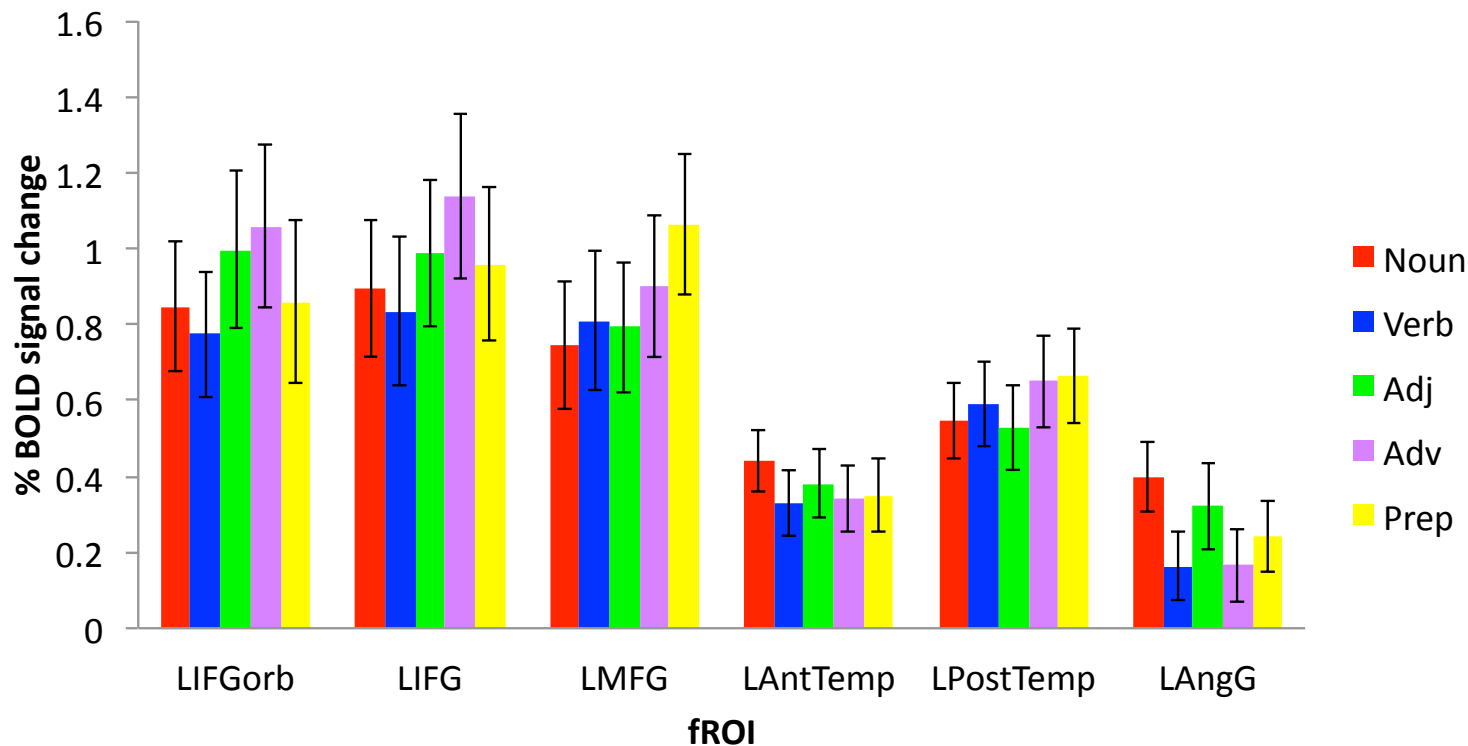
Responses in the language fROIs:

<u>fROI definition:</u>
In each subject and each parcel* we took top 10% of voxels for the
Sentences>Nonword-lists contrast.

Parcels were created using a simple watershed algorithm applied to a probabilistic overlap map for the Sentences>Nonword-lists contrast in an independent group of subjects (n=220).
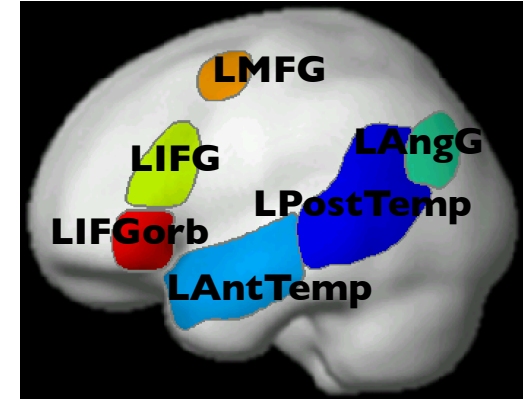

Language fROIs: response to SyntCat

NB: Here, I am collapsing across the morphologically simple vs. complex conditions within each of Noun, Verb, Adj and Adv.

Legend:
- Noun
- Verb
- Adj
- Adv
- Prep

Experiment "SyntCat": results (n=16)

Fine-grained activation patterns in the language fROIs:

NB: looking within parcels without functionally masking with individual language localizer activation maps for now.
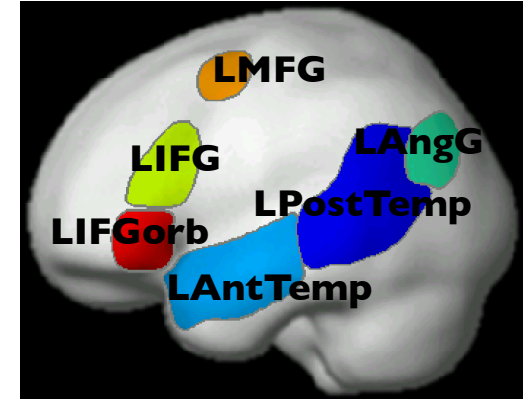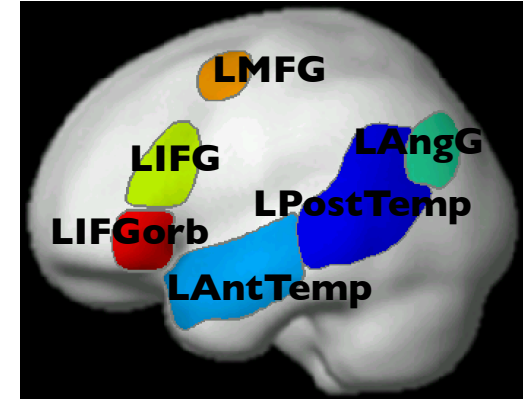

LIFGorb

	N	V	Adj	Adv	Prep
N		$F_{(2,14)}=8.0$; $p<0.005$	n.s.	$F_{(2,14)}=4.22$; $p<0.05$	n.s.
V			n.s.	n.s.	n.s.
Adj				n.s.	n.s.
Adv					n.s.
Prep					

Experiment "SyntCat": results (n=16)

Fine-grained activation patterns in the language fROIs:

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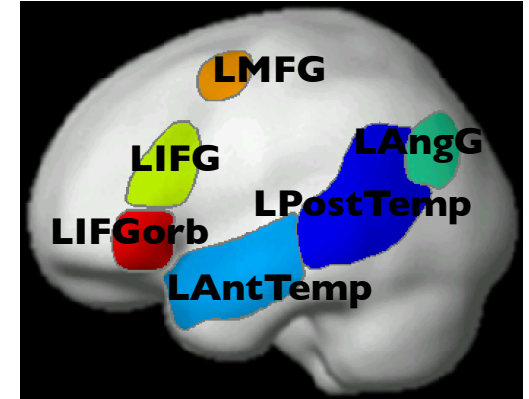

LIFG

	N	V	Adj	Adv	Prep
N		n.s.	n.s.	n.s.	n.s.
V			n.s.	n.s.	n.s.
Adj				n.s.	n.s.
Adv					$F_{(2,14)}=3.60$; $p=0.055$
Prep					

Experiment "SyntCat": results (n=16)

Fine-grained activation patterns in the language fROIs:

NB: looking within parcels without functionally masking with individual language localizer activation maps for now.
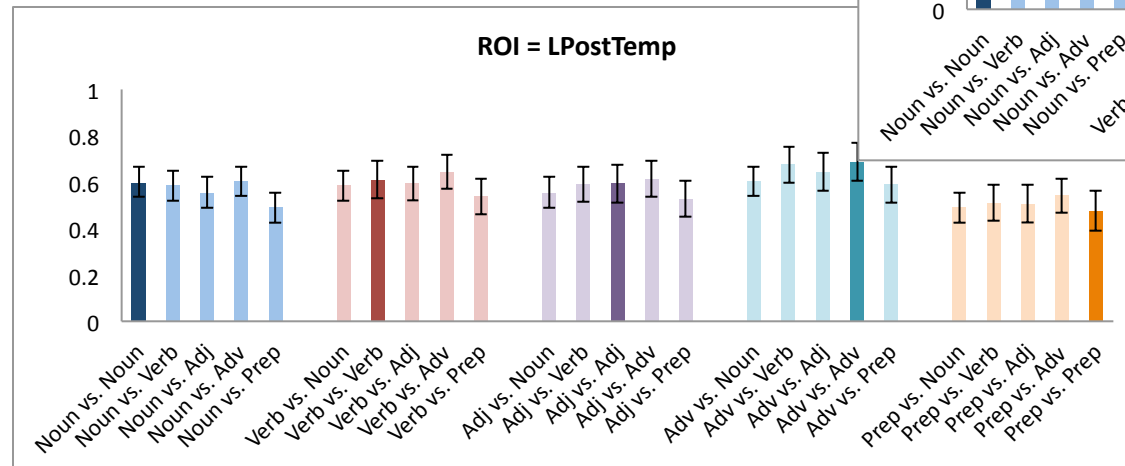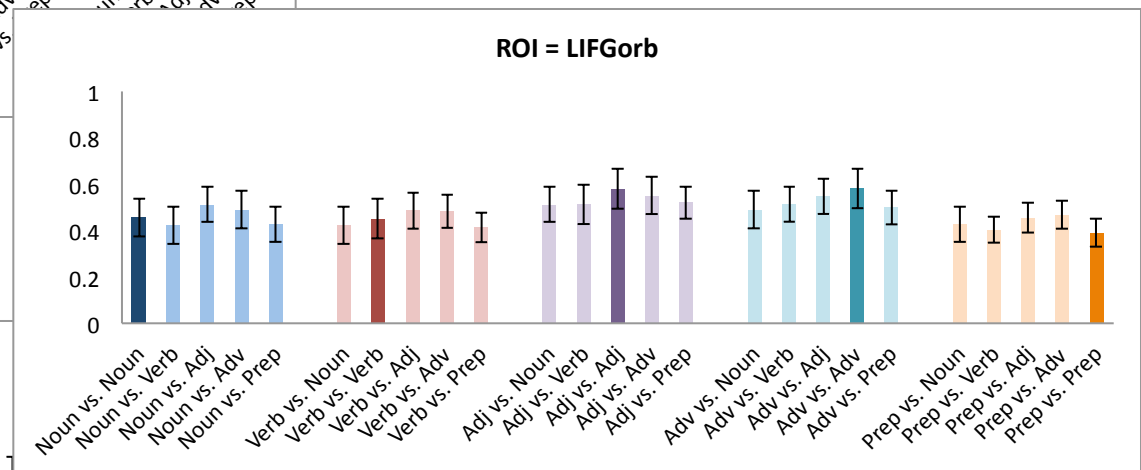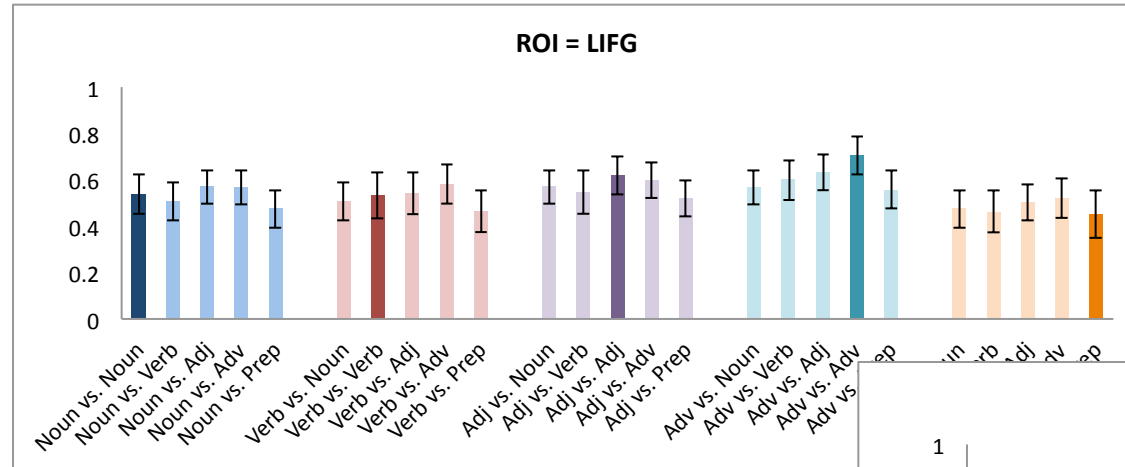

LAntTemp

	N	V	Adj	Adv	Prep
N		n.s.	n.s.	F(2,14)=2.81; p=0.094	n.s.
V			n.s.	n.s.	F(2,14)=2.87; p=0.090
Adj				n.s.	n.s.
Adv					F(2,14)=4.43; p<0.05
Prep					

Experiment "SyntCat": results (n=16)

Fine-grained activation patterns in the language fROIs:

NB: looking within parcels without functionally masking with individual language localizer activation maps for now.
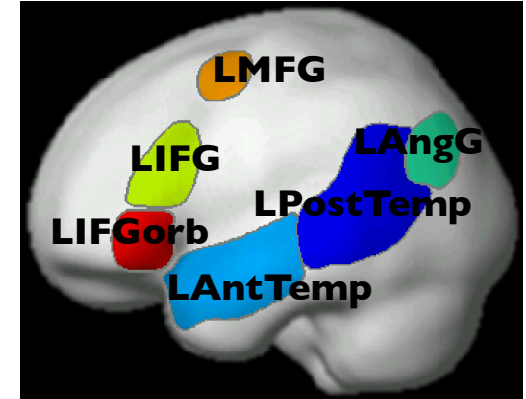
Experiment "VerbLoc": basic info

Blocked design:
• 2 conditions: object nouns and action verbs

Materials:
20 unique items per condition (from Peelen et al.)

Timing:
A block consists of 3 trials plus a memory probe (8.5 sec total duration).
Block timing: 3 words presented one at a time (1.5 sec presentation + 0.5 sec ISI), followed by 1.5 sec of extra ISI, followed by a memory probe (1 sec). The inter-block interval was 2.5 sec.
Run timing: 24 experimental blocks (12 per condition) + 3 fixation blocks (13 sec in duration), so 24 expt blocks x 11 sec + 3 fix blocks x 13 sec = 303 sec (5 min 3 sec).

In each run, participants saw 36 words for each of the two conditions. Thus, all the stimuli were repeated within a run (same as in Alfonso's earlier studies), but we made sure that a) the three words in each block were unique, and b) the two instances of any given word appeared at least a couple of blocks apart.

Participants did 2 or 3 runs.
Across 2 runs, participants got 24 blocks for each of the noun and verb conditions; across 3 runs they got 36 blocks for each condition.
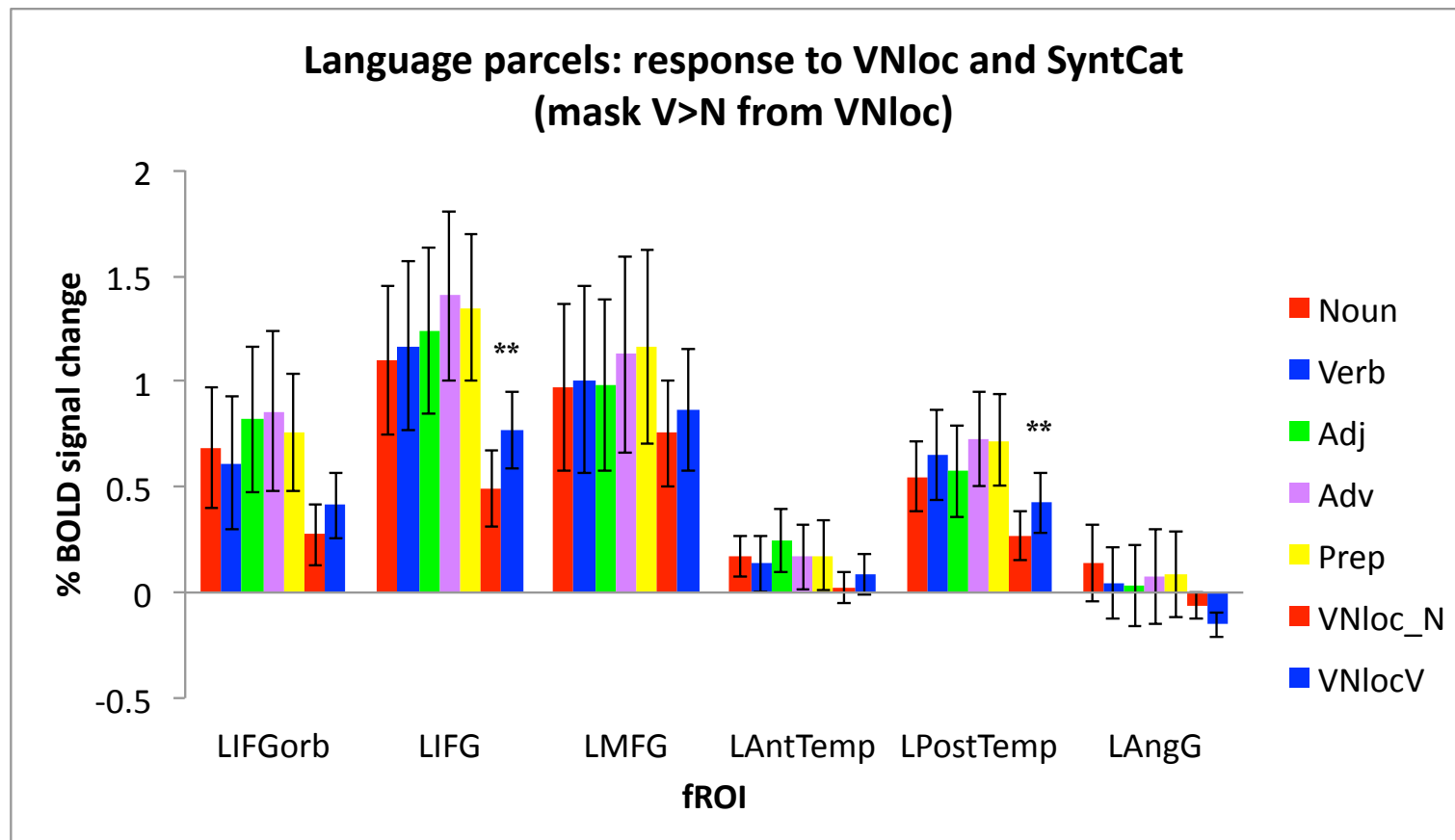
Experiment "VerbLoc": results

Responses in the V>N fROIs:

fROI definition:
In each subject and each parcel we took top 10% of voxels for the **verbs > nouns contrast** in the VNloc expt.

To estimate the responses to the SyntCat conditions, all of the data from the VNloc expt were used. To estimate the responses to the conditions of the VNloc expt, we used an across-runs cross-validation procedure, so that the data used to define the fROIs and estimated the responses are independent.

Language parcels: response to VNloc and SyntCat
(mask V>N from VNloc)

Experiment "VerbLoc": results

Responses in the N>N fROIs:

<u>fROI definition:</u>
In each subject and each parcel we took top 10% of voxels for the **verbs > nouns contrast** in the VNloc expt.

To estimate the responses to the SyntCat conditions, all of the data from the VNloc expt were used. To estimate the responses to the conditions of the VNloc expt, we used an across-runs cross-validation procedure, so that the data used to define the fROIs and estimated the responses are independent.

Language parcels: response to VNloc and SyntCat (mask N>V from VNloc)