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Anticipating morphological and syntactic structures

investigating the pre-activation negativity

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Anticipating morphological and syntactic structures An analysis of the pre-activation negativity (PrAN)







- Listeners constantly try to predict upcoming words when processing speech
- A brain potential the 'preactivation negativity' (PrAN) – has been suggested to reflect morphological pre-activation of likely word endings [1-4]
- We tested whether PrAN could be found in syntactically predictive contexts as well

PrAN -tèn/-tar/-t-hus... bå-. boat-...-the/-s/-house

- gyrus

Jim hävdar at

Jim hävdar att Caesar_{High tone} intog inte Gallien 'Jim claims that Caesar conquered not Gaul'

Method and results

•	19 native speakers of Swedish (11 female,	136-
	mean age 24.5 years)	later
•	Concurrent event-related fMRI/ERP (Brain	0.01
	• Products GmbH)	Agl
•	50% of sentences had invalid word orders	neur
	based on tonal cue (LoInvalid/HiInvalid)	5.69
•	ERP data from 16 participants analysed	= 5.2
•	Two time points: predictive tone onset, and •	P60
	word order disambiguation point	(F(1
•	Low tones gave rise to ERP negativity in •	Slov
\mathbf{X}		

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The present study

Using a concurrent fMRI/ERP paradigm, we tested whether syntactic structure could be pre-activated based on strongly constraining tonal cues • In Swedish, clause-initial tones (low/high) function as cues to syntactic structure • Low tones are more predictively constraining (cueing only one type of structure), whereas high tones are less constraining (cueing a larger class of structures)

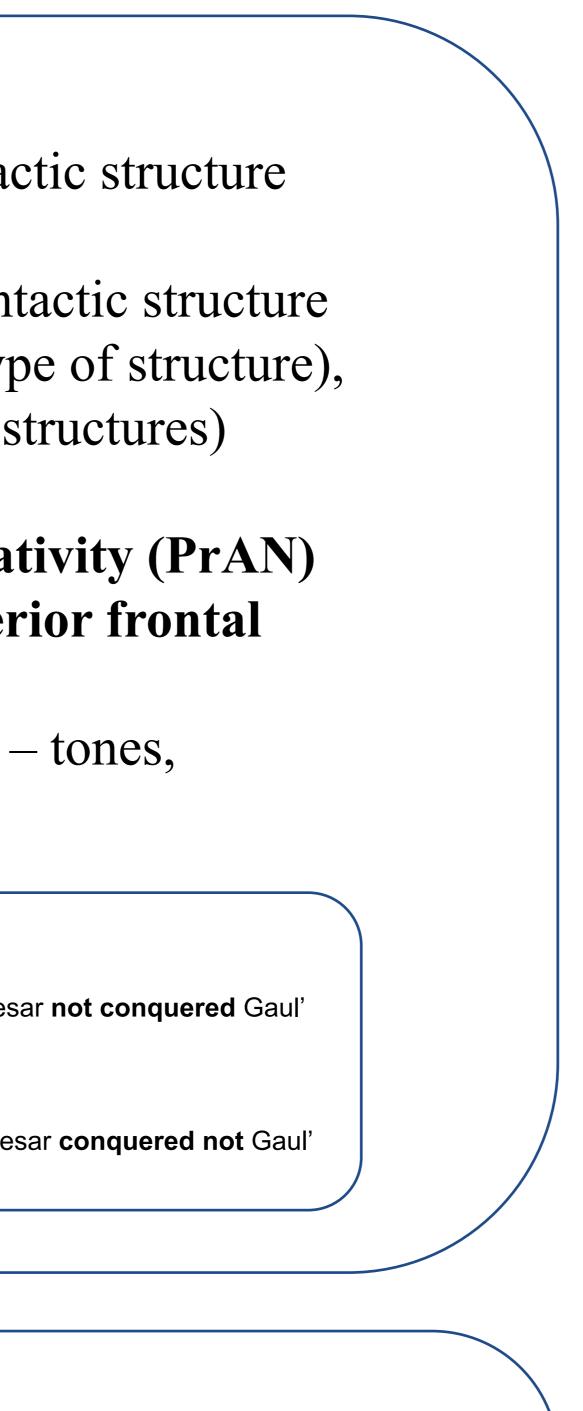
More predictively useful tones gave rise to left frontal ERP negativity (PrAN) 140 ms after tone onset, as well as activity in left insula and inferior frontal

Invalidly cued word orders elicited **P600** after low – but not high – tones, suggesting the disconfirmation of a syntactic prediction

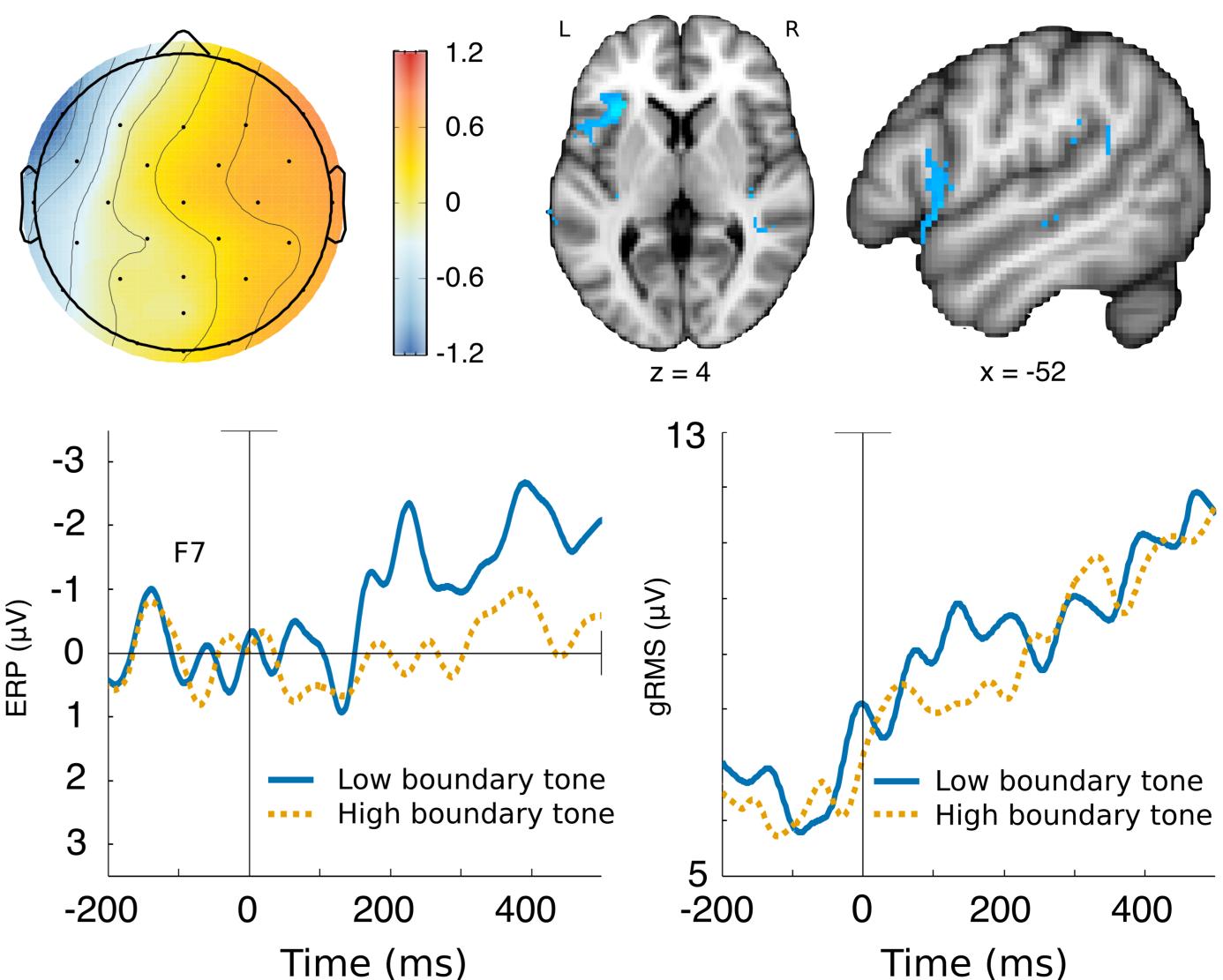
- 6-280 ms time window (cf. [3]) over lefteralised electrodes (F(1,15) = 7.252, p = 6)/17)
- RMS analysis revealed two peaks of ral activity at 100-150 ms (F(1,15) =591, p = 0.031) and 150-230 ms (F(1,15)) .264, p = 0.037) for low tones 00 over left electrodes for LoInvalid (1,15) = 5.354, p = 0.035)

ower response times for LoInvalid as

well (F(1,15) = 5.944, p = 0.028) A conjunction analysis (to isolate effects of tone) was performed on fMRI data (zthreshold = 3.2, p = 0.001, GRF statistics) Largest cluster for the low minus high tone contrast spanned the left anterior insula and left inferior frontal gyrus Subject variability correlation between BOLD in prefrontal cluster and gRMS (r =0.609, p = 0.024)



Low minus high tone 136-280 ms



Top left: ERP topography (left frontal) for the ERP negativity found for more predictively constraining (low) tones. Top right: The low minus high tone contrast gave rise to activity in left insula and IFG. Bottom left: ERPs revealed a negativity for low tones beginning at 136 ms. Bottom right: A gRMS analysis suggested more neural activity for low tones in the same time window [5].

Conclusions

- (PrAN) as early as 140 ms after cue onset
- Disconfirmed predictions gave rise to P600
- left insula and IFG (cf. [6-9])
- constraining cue

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Low minus high tone BOLD contrast

Strong cues to syntactic structure elicited ERP negativity PrAN was found to mainly be underpinned by activity in Syntactic structures can be pre-activated based on a strongly