Dynamic neural representations of auditory selective attention

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Listening in complex, multi-talker settings is challenging.

People use **selective attention** to track one talker while ignoring other sound sources.

Attention's **neural mechanisms** differ depending on key features.

Representational similarity analysis lets us investigate dynamics of executive control.

Stimuli and Task

Target embedded in multi-talker babble comprising /ba/, /da/, and /ga/ syllables.

Spatialized to five positions using generic head-related transfer functions.

Visual cue gave each trial's attention type, then auditory cue gave the exact target.



After four overlapping syllables were played, subjects reported target's identity and received feedback.



Condition-Rich Design

Spatial Attention							Talker Attention					
Left			Right			Male			Female			
Near Distractor	\ (Far Distractor		Near Distractor		Far Distractor		r Distractor	r Distractor	d Distractor	r Distractor	r Distractor
e Gender	e Gender	it Gender	e Gender	it Gender	e Gender	it Gender	Colocatec	Near	Far	Colocated	Near	Far
Sam Sam	2 Dillerer Sam	D ifferer	Sam	9 Differer	Sam 2	8 Differer	9	10	11	12	13	14

Passive Listening

Same stimuli as Spatial and Talker Attention, grouped into 7 new conditions.



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After preprocessing, evoked & oscillatory activity were extracted from each trial & channel.



Preparing to Listen

Broadband, evoked activity carries transient information, while oscillatory activity carries sustained information about upcoming attention.



dissimilarity

dissimilarity

Transient broadband information is likely a stimulus-driven ERP. Oscillatory activity carries info from both attention type and target cues.



-1000 1000 0 Time relative to auditory cue onset (ms) dissimilarity between them.

Within each feature, concatenate across channels at time t.



Held-out trials

Detecting a Target

Attention type is represented, with relatively slow dynamics, in multiple frequency bands. It is not appreciable in the broadband data.



During stimulus presentation, many frequency bands carry information about attention type, but targetlocked effects are minimal.



- For each subject, feature, timepoint, and pair of conditions, SVM classifier performance estimated the
 - Train and test a linear SVM



- Repeat 100 times with random choice of testing samples

Mean SVM accuracy

gives dissimilarity

between conditions

Feature-specific RDM at time t

After preprocessing, data were fit with single-trial GLMs, yielding whole-brain maps of coefficients for each trial.





both EEG and fMRI.

large-scale networks for attention.



PDF & references

fMRI Representational Similarity

Define a neighborhood and concatenate across its voxels.

dissimilarity between them.





For each subject, searchlight neighborhood, and pair of

conditions, SVM classifier performance estimated the

hes with random choice of testing samples

Mean SVM accuracy gives dissimilarity between conditions.



Feature-specific RDM at time t

Attention Across the Brain