Music and Memory Study

Stimuli:

- Spoken word
- Lyrics only (a capella)
- Instrumental only
- instrumental and lyrics (whole)

Participants:

- 14 healthy young adults

First fMRI scan – participants listen to all 16 songs in the scanner
Then, participants train on 8 of the stimuli (group A and group B train on 8 different songs)
Second fMRI scan – participants listen to all 16 songs in the scanner (identical scan to first fMRI scan)

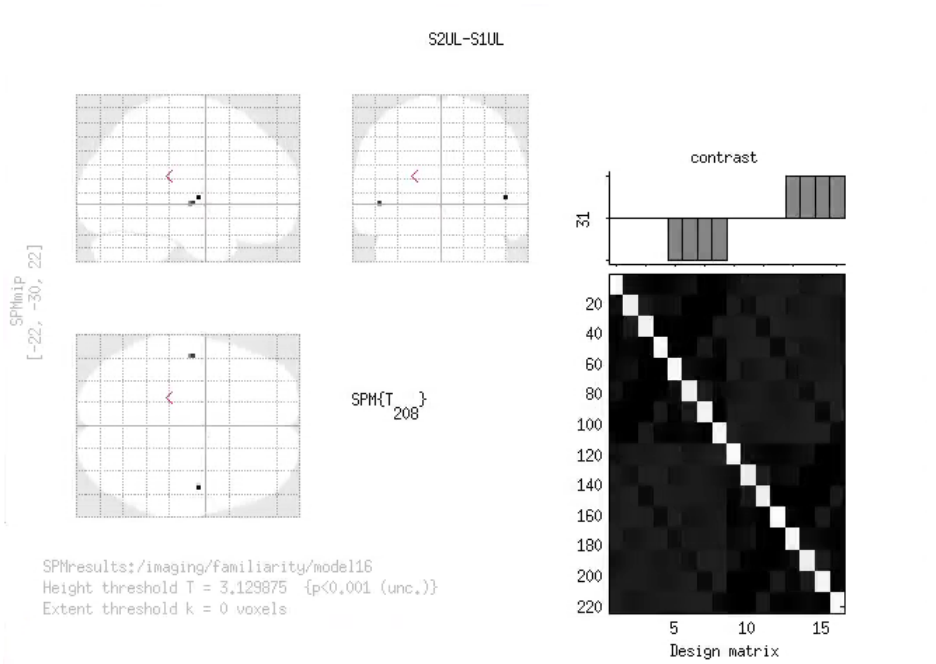
Why this project is different than previous studies:

- tightly controlled familiarity manipulation
  - I know exactly how many times each participant has listened to each song
- the familiar and unfamiliar songs are identical
  - control for acoustic differences in the stimuli across familiarity
- stimuli are varied in presence of lyrics and instrumentation
  - can investigate whether behavioural measures of memory vary based on presence/absence of lyrics
  - can investigate what aspects of the auditory stimuli drives synchrony

Why it's important

- localize areas that are specific to memory for music – if done in older adults and/or Alzheimer's patients can investigate how this area changes with age/disease
  - may provide insight into why memory for music is spared in late Alzheimer's

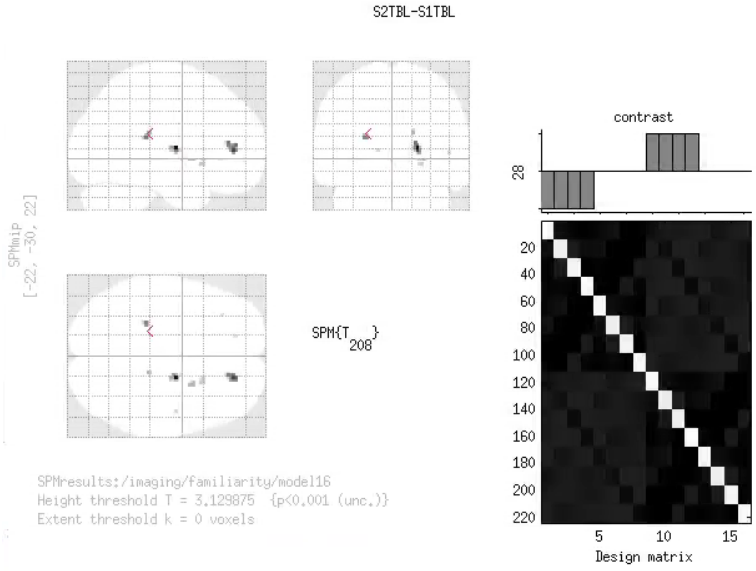
Overall contrasts
Unlearned songs – Session 2 vs Session 1



Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}			
0.996	2	0.998	0.781	2	0.781	0.997	0.796	3.25	3.21	0.001	48	-8	4
		0.996	0.781	3	0.724	0.998	0.796	3.22	3.18	0.001	-50	-12	0

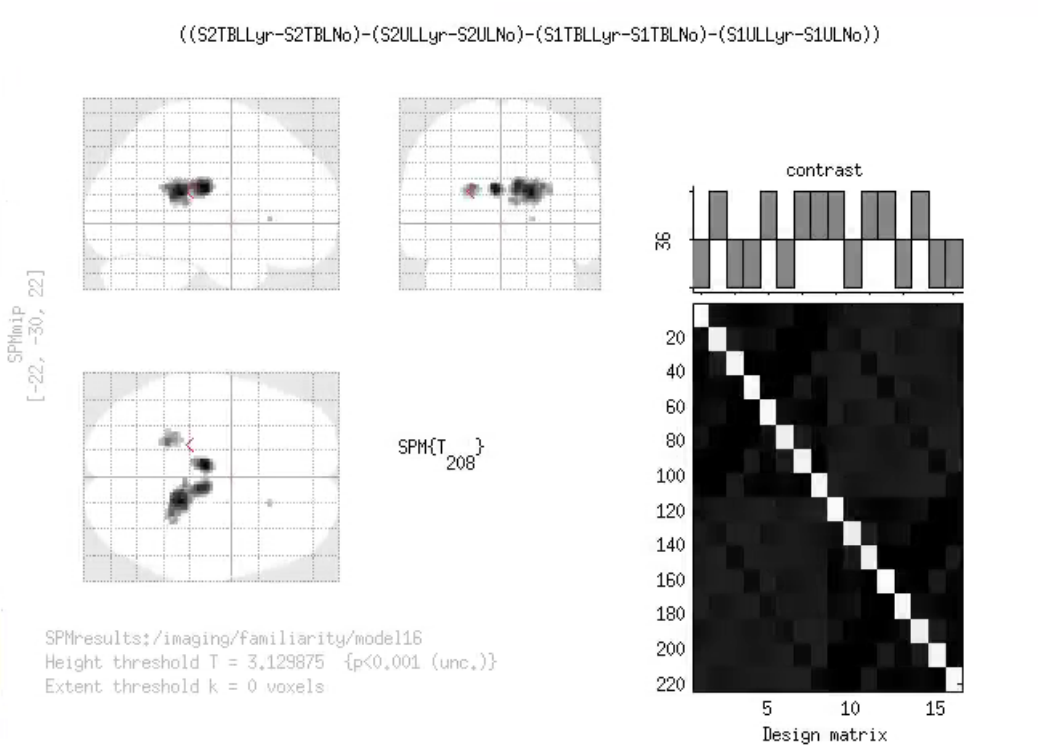
Session 2 Learned Songs – Session 1 To be learned songs



Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}			
0.256	10	0.963	0.856	13	0.423	0.343	0.648	4.15	4.06	0.000	20	-8	8
		0.890	0.856	23	0.284	0.642	0.690	3.87	3.80	0.000	20	42	6
		0.981	0.856	9	0.510	0.893	0.690	3.61	3.55	0.000	-26	-34	16
		0.996	0.856	3	0.724	0.982	0.922	3.40	3.35	0.000	16	-32	20
		0.993	0.856	5	0.635	0.988	0.922	3.36	3.31	0.000	26	6	-2
		0.996	0.856	3	0.724	0.996	0.922	3.27	3.22	0.001	24	14	-6
		0.999	0.856	1	0.856	0.996	0.922	3.26	3.22	0.001	20	16	-2
		0.999	0.856	1	0.856	0.999	0.922	3.20	3.16	0.001	48	-8	4
		0.999	0.856	1	0.856	0.999	0.922	3.20	3.16	0.001	-14	44	6
		0.999	0.856	1	0.856	0.999	0.977	3.14	3.10	0.001	-32	32	-2

Interaction of session x learned/unlearned x lyrics/no lyrics



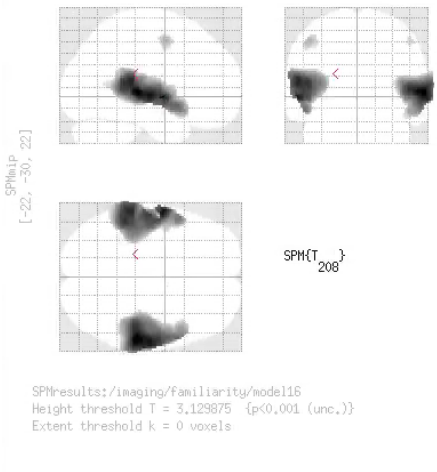
Statistics: p-values adjusted for search volume

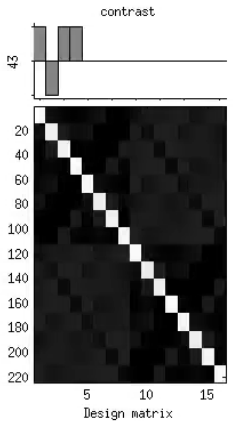
set-level		cluster-level				peak-level					mm mm mm
p	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}	
0.951	4	0.268	0.080	94	0.040	0.140	0.129	4.44	4.34	0.000	-6 -20 22
		0.000	0.000	496	0.000	0.187	0.129	4.35	4.25	0.000	18 -36 18
						0.259	0.129	4.25	4.15	0.000	10 -24 24
						0.622	0.295	3.89	3.81	0.000	24 -42 20
		0.387	0.084	75	0.063	0.682	0.295	3.83	3.76	0.000	-22 -46 22
						0.993	0.636	3.31	3.27	0.001	-22 -36 18
		0.998	0.781	2	0.781	0.982	0.571	3.40	3.35	0.000	20 24 2

fornix?
Striatum?
Activation in the ventricles...

Individual comparisons in interaction
Auditory cortex

S1TBLLyr-S1TBLNo



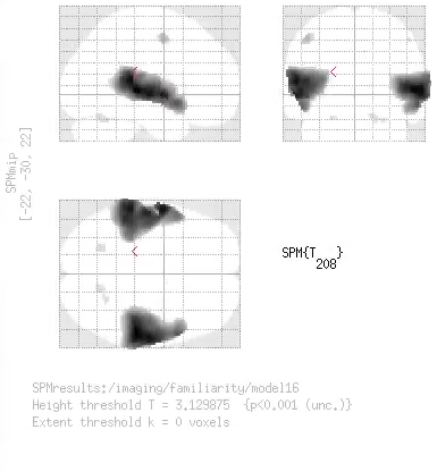


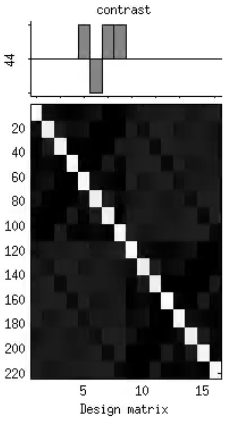
SPMresults:/imaging/familiarity/model16
Height threshold T = 3.129875 {p<0.001 (unc.)}
Extent threshold k = 0 voxels

Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	PFWE-corr	qFDR-corr	kE	Puncorr	PFWE-corr	qFDR-corr	T	(Z$_\Theta$)	Puncorr			
0.951	4	0.000	0.000	3388	0.000	0.000	0.000	10.37	Inf	0.000	60	-30	4
						0.000	0.000	9.76	Inf	0.000	62	-16	0
						0.000	0.000	7.71	7.22	0.000	58	-4	-6
		0.000	0.000	3229	0.000	0.000	0.000	9.49	Inf	0.000	-58	-4	-2
						0.000	0.000	9.27	Inf	0.000	-58	-34	12
						0.000	0.000	8.74	Inf	0.000	-50	-40	10
		0.216	0.042	105	0.031	0.029	0.004	4.87	4.74	0.000	-48	-2	50
		0.923	0.330	19	0.330	0.933	0.369	3.54	3.49	0.000	50	2	50

S1ULLyr-S1ULNo



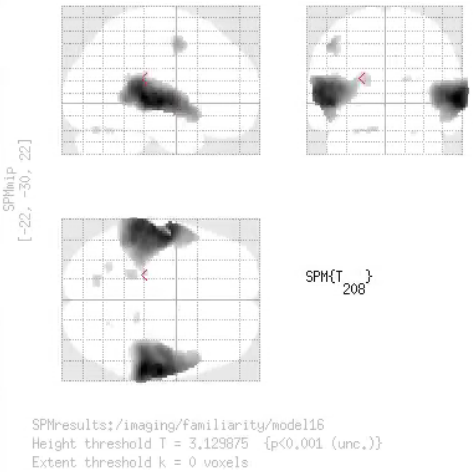


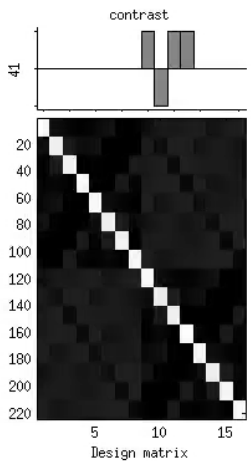
SPMresults:/imaging/familiarity/model16
Height threshold T = 3.129875 {p<0.001 (unc.)}
Extent threshold k = 0 voxels

Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	PFWE-corr	qFDR-corr	kE	Puncorr	PFWE-corr	qFDR-corr	T	(Z$_\Theta$)	Puncorr			
0.658	7	0.000	0.000	3441	0.000	0.000	0.000	10.12	Inf	0.000	58	-28	4
						0.000	0.000	9.53	Inf	0.000	62	-16	0
						0.000	0.000	7.55	7.09	0.000	58	10	-10
		0.000	0.000	3329	0.000	0.000	0.000	9.53	Inf	0.000	-58	-34	10
						0.000	0.000	9.45	Inf	0.000	-56	-4	-2
						0.000	0.000	9.06	Inf	0.000	-54	-18	4
		0.521	0.221	59	0.095	0.044	0.008	4.77	4.64	0.000	-48	-2	50
		0.977	0.567	10	0.486	0.970	0.564	3.45	3.40	0.000	26	-58	-24
		0.945	0.567	16	0.372	0.972	0.564	3.44	3.39	0.000	-20	-64	-22
		0.957	0.567	14	0.405	0.984	0.609	3.38	3.33	0.000	18	-64	-24
		0.995	0.676	4	0.676	0.994	0.651	3.30	3.26	0.001	50	2	50

S2TBLLyr-S2TBLNo



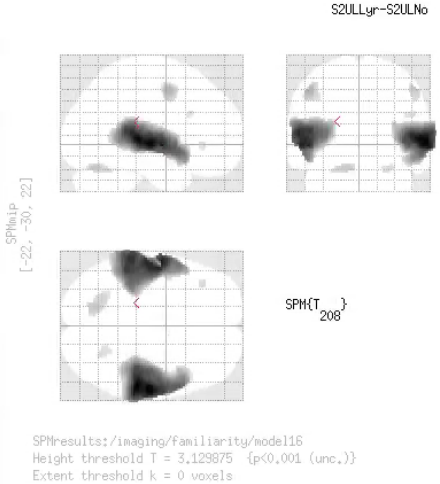


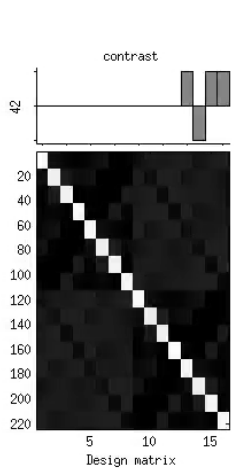
SPMresults:/imaging/familiarity/model16
Height threshold T = 3.129875 {p<0.001 (unc.)}
Extent threshold k = 0 voxels

Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	PFWE-corr	qFDR-corr	kE	Puncorr	PFWE-corr	qFDR-corr	T	(Z$_\Theta$)	Puncorr			
0.376	9	0.000	0.000	3026	0.000	0.000	0.000	10.76	Inf	0.000	60	-30	4
						0.000	0.000	10.71	Inf	0.000	62	-18	0
						0.000	0.000	9.07	Inf	0.000	62	-6	2
		0.000	0.000	3032	0.000	0.000	0.000	9.76	Inf	0.000	-50	-12	0
						0.000	0.000	9.60	Inf	0.000	-56	-22	4
						0.000	0.000	9.52	Inf	0.000	-58	-34	8
		0.175	0.074	116	0.025	0.002	0.001	5.50	5.31	0.000	-50	0	48
		0.579	0.251	53	0.111	0.548	0.149	3.95	3.88	0.000	-20	-44	18
		0.863	0.460	26	0.255	0.766	0.253	3.76	3.69	0.000	-14	-72	-24
		0.981	0.690	9	0.510	0.910	0.392	3.58	3.53	0.000	-24	-62	-24
		0.985	0.690	8	0.537	0.992	0.703	3.32	3.27	0.001	18	-38	18
		0.999	0.856	1	0.856	0.998	0.840	3.22	3.18	0.001	24	-58	-26
		0.999	0.856	1	0.856	0.999	0.923	3.16	3.12	0.001	22	-62	-26

S2ULLyr-S2ULNo





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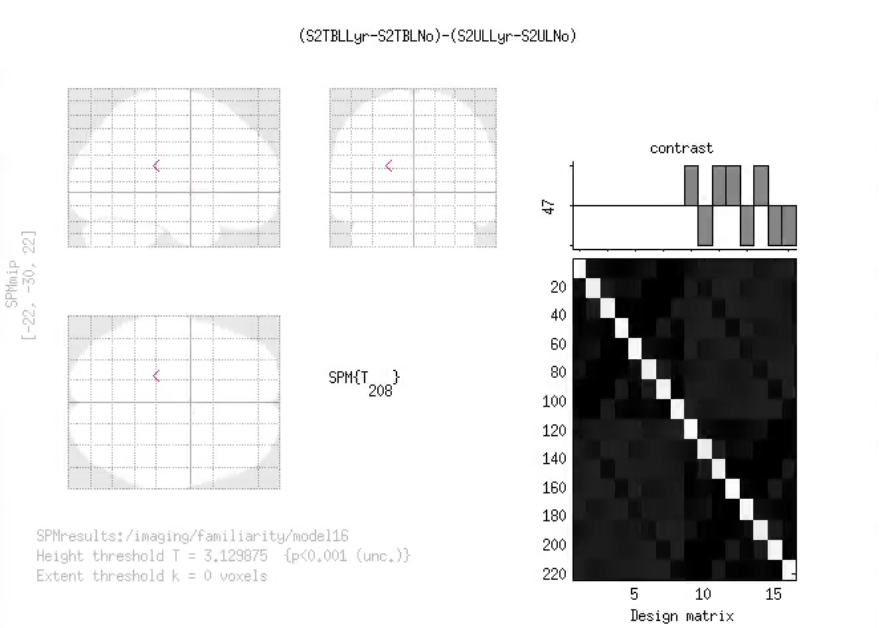
Extent threshold k = 0 voxels

Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm		
p	c	PFWE-corr	qFDR-corr	kE	Puncorr	PFWE-corr	qFDR-corr	T	(Z$_\Theta$)	Puncorr			
0.515	8	0.000	0.000	3977	0.000	0.000	0.000	12.24	Inf	0.000	60	-18	0
						0.000	0.000	11.94	Inf	0.000	58	-30	4
						0.000	0.000	9.99	Inf	0.000	62	-6	2
		0.000	0.000	3709	0.000	0.000	0.000	11.21	Inf	0.000	-56	-6	-2
						0.000	0.000	10.75	Inf	0.000	-50	-14	-2
						0.000	0.000	10.56	Inf	0.000	-58	-34	8
		0.072	0.020	163	0.010	0.002	0.000	5.47	5.28	0.000	-50	0	48
		0.313	0.077	86	0.048	0.142	0.029	4.44	4.33	0.000	50	2	50
		0.075	0.020	161	0.010	0.257	0.054	4.25	4.16	0.000	-14	-70	-22
						0.588	0.152	3.92	3.84	0.000	-22	-62	-24
		0.833	0.307	29	0.230	0.905	0.386	3.59	3.53	0.000	28	-64	-22
						0.921	0.392	3.56	3.51	0.000	24	-58	-26
		0.915	0.318	20	0.318	0.927	0.392	3.55	3.50	0.000	-36	32	-2
		0.907	0.318	21	0.306	0.978	0.550	3.41	3.36	0.000	48	20	26

Breakdown of interaction
Session 2 Lyrics x Learning

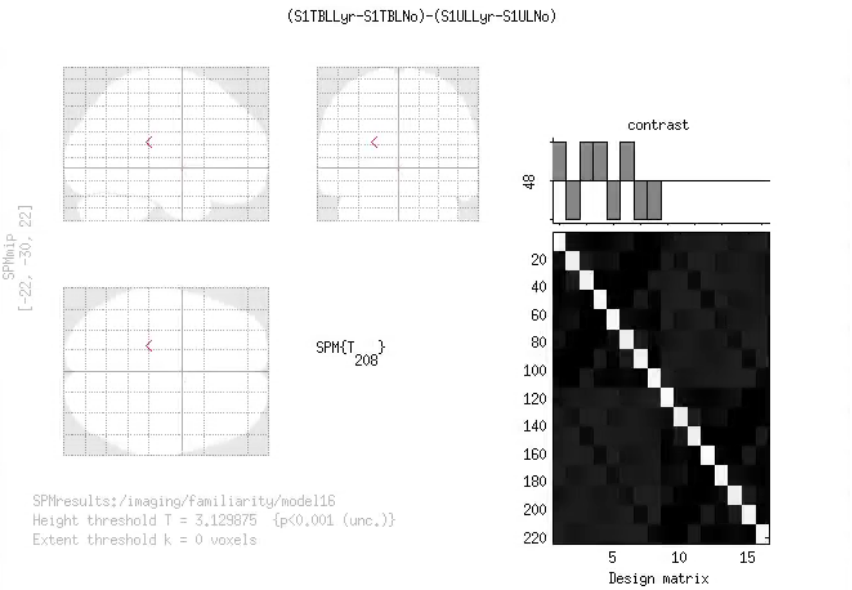


Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level				
p	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}

no suprathreshold clusters

Session 1 Lyrics x Learning

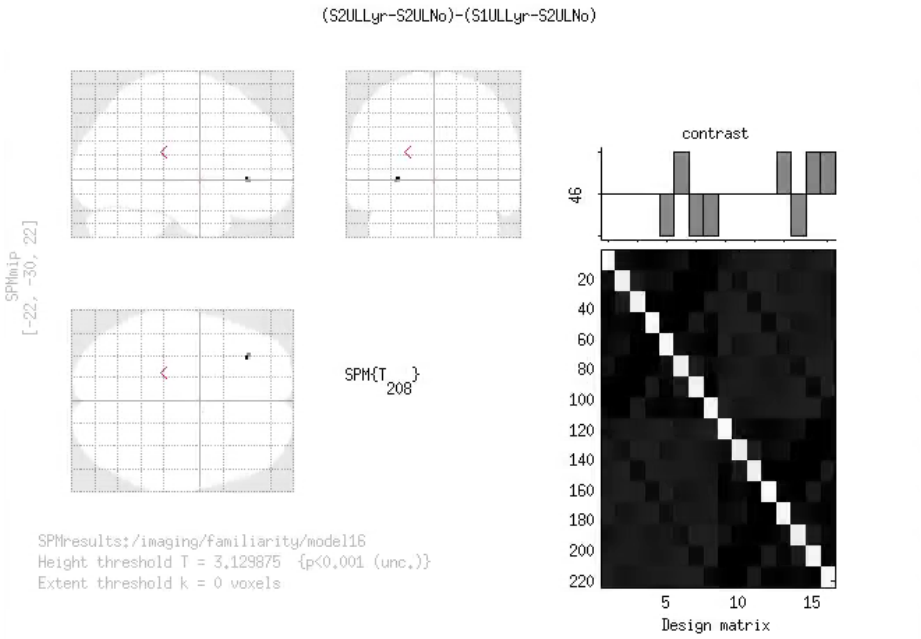


Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level				
p	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}

no suprathreshold clusters

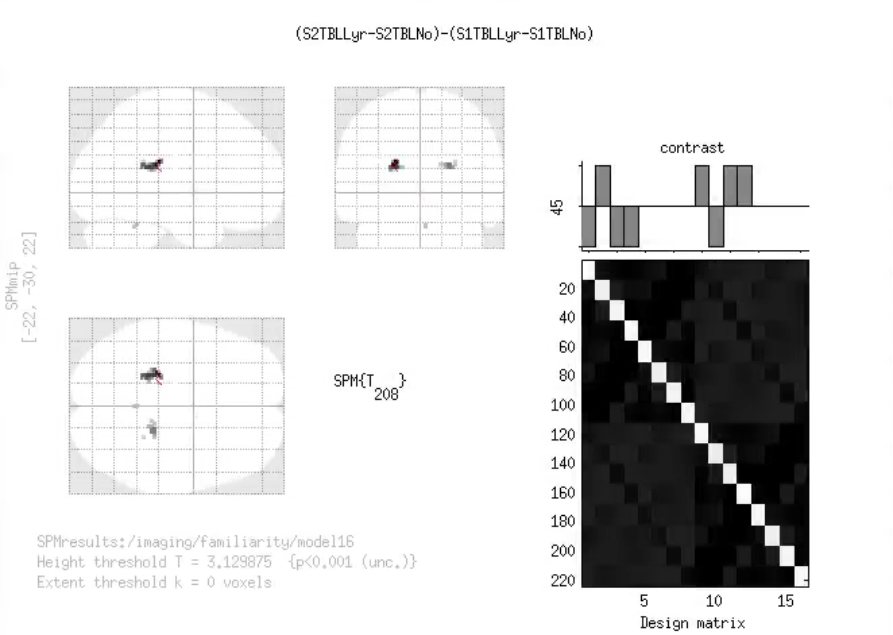
Unlearned Songs
Session 2/Session 1 x Lyrics/NoLyrics



Statistics: p-values adjusted for search volume

cluster-level				peak-level					mm mm mm
$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}	
0.995	0.676	4	0.676	0.930	0.664	3.55	3.49	0.000	-30 34 0

Learned Songs
Session 2/Session 1 x Lyrics/NoLyrics



Striatum

Statistics: p-values adjusted for search volume

set-level		cluster-level				peak-level					mm mm mm	
P	c	$P_{FWE-corr}$	$q_{FDR-corr}$	k_E	P_{uncorr}	$P_{FWE-corr}$	$q_{FDR-corr}$	T	(Z_e)	P_{uncorr}		
0.951	4	0.684	0.593	43	0.148	0.921	0.921	3.56	3.51	0.000	-22 -30	22
						0.967	0.921	3.45	3.40	0.000	-22 -38	18
		0.945	0.745	16	0.372	0.990	0.921	3.34	3.29	0.000	22 -36	20
		0.998	0.856	2	0.781	0.998	0.921	3.21	3.17	0.001	2 -48	-26
		0.999	0.856	1	0.856	0.999	0.921	3.16	3.12	0.001	26 -42	22