## Checking the positive and negative voxels in a conjunction map

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When running a conjunction contrast, the statistical map may contain positive as well as negative voxels. This document tries to check the underlying details constituting the conjunction map.

We load the result of a single subject GLM map. In this case, there are only two conditions called faces and objects contained in the design (simple face localizer study).



We open the Overlay GLM dialog

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	free		Add Contrast
± 2	objects		Clear Contrast
	Constant		
			Fill Contrast
			Fill Confounds
			Balance +/-
			Add "[+] > 0"
			Add "[-] > 0"
			Delete All
Conjunction	analysis Contrast name: 1 1	Nr	: 1 ÷ /
Load .GLM	Load .CTR	Options	ОК
1	Two set relative contribution		-

## We define a new contrast

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3	Constant		Fill Contrast
			Fill Confounds
			Balance +/-
			Add "[+] > 0"
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Conjunction a	nalysis Contrast name: 0 0		Nr. 1 📫 /
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We click the "Add Contrast" button and define the contrast (+) "faces" on the first tab and the contrast (+) "objects" on the second tab.

Predictor Nr.	Predictor Name		Add Contrast
± 1	faces objects		Clear Contrast
3	Constant		Fill Contrast
			Fill Confounds
			Balance +/-
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Overlay GLM	Contrasts - untitled.glm		? >
Predictor Nr.	Predictor Name	Add	Contrast
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C		Saus CTD   Two set relative contribution	Edit Name	Cancal

We choose the" Conjunction Analysis" checkmark and start the contrast calculation by clicking the "OK" button.



We open the "Overlay Volume Maps" dialog and save the conjunction map as a new volume map (to be used later)

To observe the results further, we create the two separate contrasts maps. We open the Options of the Overlay GLM dialog and click the "Create Maps" button. This will create on contrast map for each of the contrasts defined.

Overlay GLM Options	? ×
Two set color coding         Image: Show significance       p < 0.0001         Image: Show relative contribution (RC)         Show extreme values only:       0	Interpretation of only [+] selections • As contrast (linear function) • As contribution (ESS) Percent Signal Change Maps
Random effects analysis (old version)	Enable % Signal Change Maps
Enable Specify groups      Conjunction of RFX C RFX of Conjunction	GLM -> VMP resolution Confound predictors
-Info on serial correlation treatment Serial correlations corrected: yes - AR(2) Mean AR(1) before correction: 0.2150 Mean AR(1) after correction: 0.0028	Mask-based reduction of multiple comparisons Mask used: no Mask file: Nr of voxels for correction: 44413
Create maps for all defined contrasts	ate maps for each subject Create Maps
VTC list	Cancel OK

Sele	ection	Color	Map Name	8			
	1 2	•	faces objects				
ver	lay val	ues —		- Hires VMP creatio	n – Threshold	Browse maps	

srowse	Statistics	Map Options	Advanced		
Associate	d time course	data		Map selection mode	
☐ Sho	w <mark>tim</mark> e course	of selected map			Multiple selections
Protoco	I:			Apply immediately	,
Sorting op	ition ———			Upsampled VMPs (anato	omical resolution)
Column	Nr		-		Hires VMPs
Combine r	naps, perform	n simple statistics -		Analyze series of maps	with ANCOVA
		Combine	Maps		ANCOVA

We choose the Multiple selections radio button on the Advanced tab.

rowse Sta	tistics Map	Options Adva	nced			
Selection C	olor Map Nar	ne				
± 1	faces					
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			ian Thresh		Brauna and	
iverlay values		Hires VMP creat	tion — Thresho	old	Browse ma	aps
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We add the "conjunction" map save before. This allows us to check the origin of negative and positive voxels in the conjunction map.

It is advised to switch off the "Interpolate" checkmark.

election	Color	Map Name     continues
± 2		faces
<b>∃</b> 3	-	objects

In this case, we first switched off the negative voxels within the single contrast maps to check the origin of positive and negative voxels in the conjunction map. In addition, we changed the color code of the conjunction map. This can be done on the "Statistics" tab. The new color allows an simpler evaluation of results.

Browse Statistic	Map Options Adv	anced	
Thresholding	False Discovery Ra	te (FDR)	Map info
Use FDR	q: 0.0	05 ▼ (• c(V) = 1	_
O Use statistic v	alue NrOfVoxels: 33	576 $C_{c}(V) = ln(V) + E_{c}$	Type:   t
	100	575 Store St	
Degrees of freedom	Cluster threshold	CC overlay type	— CC lag range — — — — — — — — — — — — — — — — — — —
DF 1: 261	Enable	C Lag values	Max: 0 🐥
DF 2: -	4 🔹 voxels	${f C}$ Correlation values	Min: 0
Confidence range –			
Max: 8,000	Color +Max:	-Max: 📃 🔽 Use range colo	rs Options
Min: 2,703	Color +Min:	-Min: Use LUT:	lefault>
Load A	dd Save As	Delete All Un	date VMR Close

When switching off and on just the conjunction map, we can easily see the origin within the single tmaps. Of course we can do this same thing with only negative values in exactly the same way.

conjunction map switched off:



conjunction map switched on:



We can see a couple of details.

- no negative conjunction voxels seem to overlap positive original voxels

- there are some voxels in the original map(s) that are not in the (positive) conjunction map. In those voxels, the smallest t-value has not been significant and the voxel thus did not appear as significant in the conjunction map.

We check the t-values within a single voxel by moving the mouse over it.

Significant conjunction voxel:



In this case, the first map has a t-value of 8.621, the second map has a t-value of 12.09 and thus the conjunction (following the mimimum t-logic) shows again the t-value of 8.621.

nonsignificant conjunction voxel:



In this case, the first map has a t-value of 1.491, the second map has a t-value of 2.715 and thus the conjunction (following the mimimum t-logic) shows again the t-value of 1.491

In the next screenshot, we overlay negative conjunction map to the original positive map and can see that there is no apparent overlap.



The next screenshots shows the opposite depiction: positive conjunction voxels overlayed to negative original voxels. Again, there is no overlap.



To perform a more holistic numerical test and not just a visualisation of effects, we create VOIs on the basis of the four original maps:

- 1. all positive voxels from the original contrast maps
- 2. all negative voxels from the original contrast maps
- 3. positive voxels in the conjunction map
- 4. negative voxels in the conjunction map

In the VOI tool, we mark a) the "positive" voxels in the original maps and the "negative" conjunction voxels and b) the "negative" voxels in the original maps and the "positive" conjunction voxels and click the "A AND B" button to check for an overlap of voxels.

Volumes-Of-Interest list		Time course (VTC) files
<ul> <li>original contrasts negative</li> <li>conjunction positive</li> <li>conjunction negative</li> </ul>	Show VOIs Hide VOIs Show time course In new window	Add Remove
Show "VOIs x Subjects" view	Significant voxels          a AND b         a OR b         Delete         Edit	Can not add No voxels in computed RC
DI file: ve.voi* Load	Add Save	New Options Close
olumes-Of-Interest Analysis olumes-Of-Interest list original contrasts negative conjunction positive conjunction negative original contrast positive	Show VOIs Hide VOIs Show time course In new window	Time course (VTC) files

As expected, we find no overlapping voxels for maps with opposing signs in the original contrast and the conjunction map.

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