

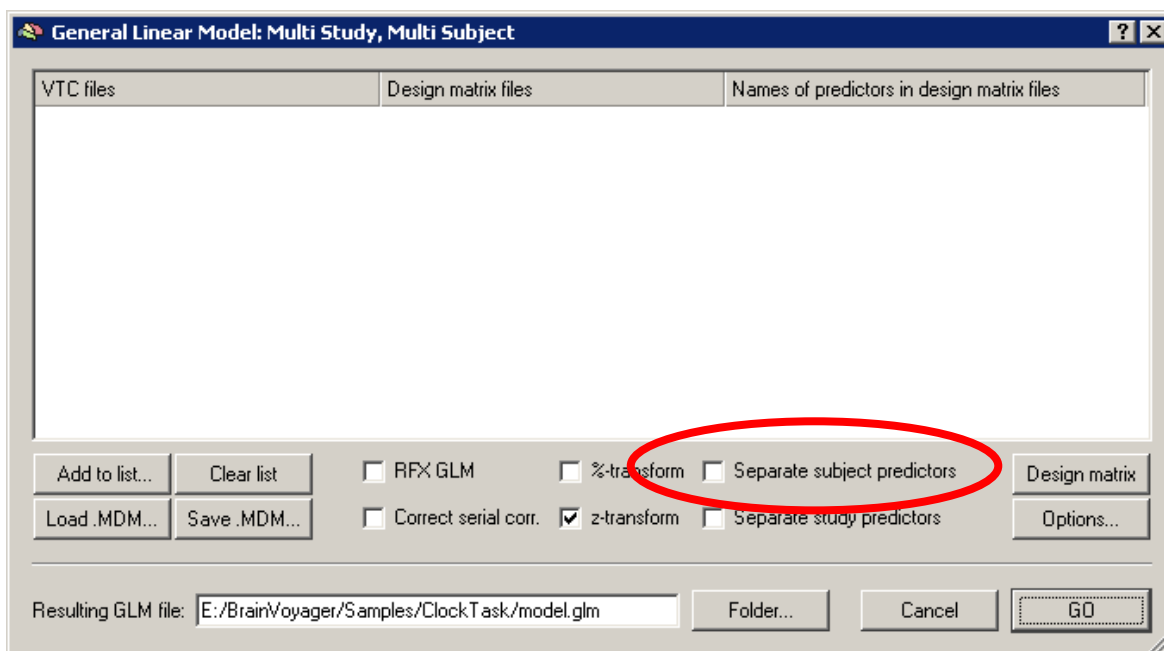
## Adaptation of the Design Matrix to compare different sessions of the same subject in a Random Effects Analysis:

This is not an official BrainVoyager support document.

Any detail question can be sent to [heinecke@brainvoyager.com](mailto:heinecke@brainvoyager.com)

1. For running a Random Effects analysis, the separation of effects between subjects is unavoidable. When using the standard Multi-study GLM approach in BrainVoyager, this means one has to use the “separate subjects” checkmark. The drawback is that this method averages the data of the subjects over their different runs.

Using the “separate studies” checkmark on the other hand will not be the proper option to run a Random Effects Analysis because one is separating all the runs (which may be multiple for each subject).



When one wants to compare the different runs in the course of the Random Effects analysis, there is an easy workaround that allows to compare predictors as well as runs in the course of statistical contrasts.

2. Normally, the protocol (PRT) as well as the design matrix (RTC) files have already been created at this stage of analysis. To be able to perform a separation

of subjects as well as runs, one has to adapt the design matrix file, which is the “heart” of the GLM statistics.

To do this, one might think to use the “Single Study GLM” dialog, that is normally used to build the design matrix for the Single and Multi Study analysis. But this dialog does not allow to change the predictor names in a way we need to. Using external tools (e.g. Excel, Matlab), the RCT files can be changed in an very flexible way, but there is a potential danger of getting typical import / export problems. Its always easier to apply changes within the software than to switch back and forth between different programs. Therefore, we go one step back and change the protocol file in BrainVoyager.

**3.** For this example, we have a simple slow event related paradigm (the so called “ClockTask” experiment). This is nicely described in some BrainVoyager course slides. Actually the details of the study are not so important, because we just want to have a look at the technique of adapting the RTC file.

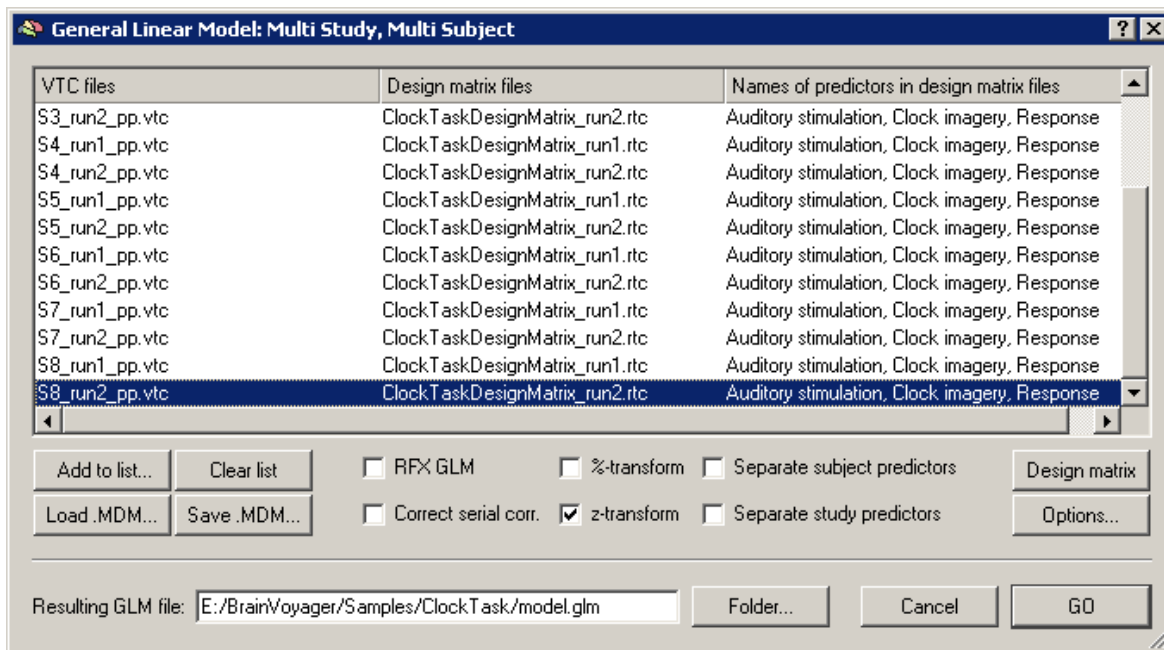
The original RTC file contains three predictors:

- A) Auditory stimulation
- B) Clock imagery
- C) Response

We have in total sixteen runs, belonging to eight different subjects S1 - S8(two runs each).

S1_run1_pp.vtc	S5_run1_pp.vtc
S1_run2_pp.vtc	S5_run2_pp.vtc
S2_run1_pp.vtc	S6_run1_pp.vtc
S2_run2_pp.vtc	S6_run2_pp.vtc
S3_run1_pp.vtc	S7_run1_pp.vtc
S3_run2_pp.vtc	S7_run2_pp.vtc
S4_run1_pp.vtc	S8_run1_pp.vtc
S4_run2_pp.vtc	S8_run2_pp.vtc

The data was processed with an older version of BrainVoyager, so the name does not provide us with detailed information about the way the data has been processed.

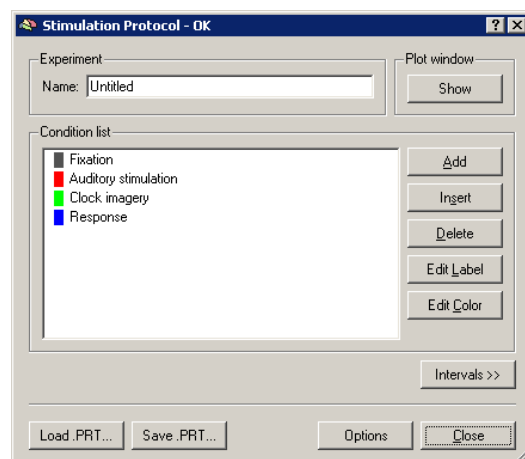


Using this design matrix (separating the three predictors) would allow us only to run either a simple Fixed Effects analysis or a Random Effects analysis on the basis of three predictors. As discussed above, the Random Effects Analysis requires (per definition) separate subjects predictors and will not separate the subjects.

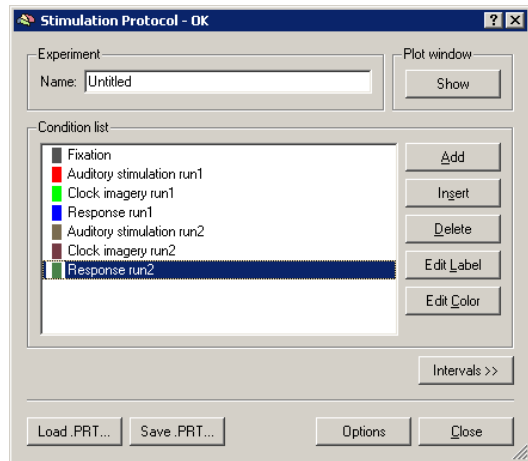
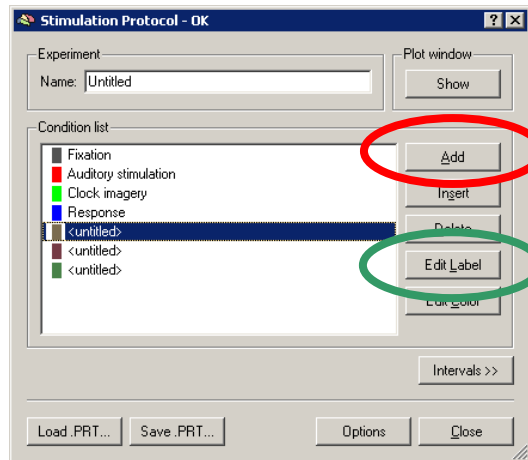
4. So we begin to change the protocol assigned:

a) We link the first run (VTC) and b) open the protocol dialog.

We notice that the three conditions as well as the Fixation conditions, which is not represented in the normal RTC used before (which is the standard procedure).

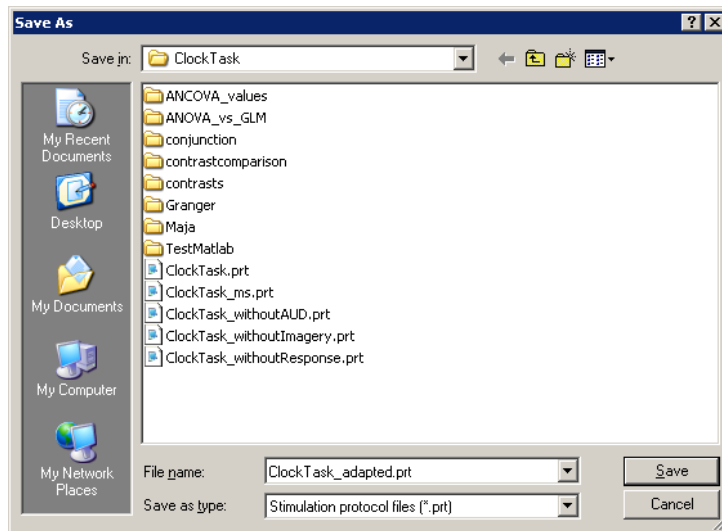


5. To enable the proper separation between the runs, we have to add three new predictors and change the names of the old predictors.



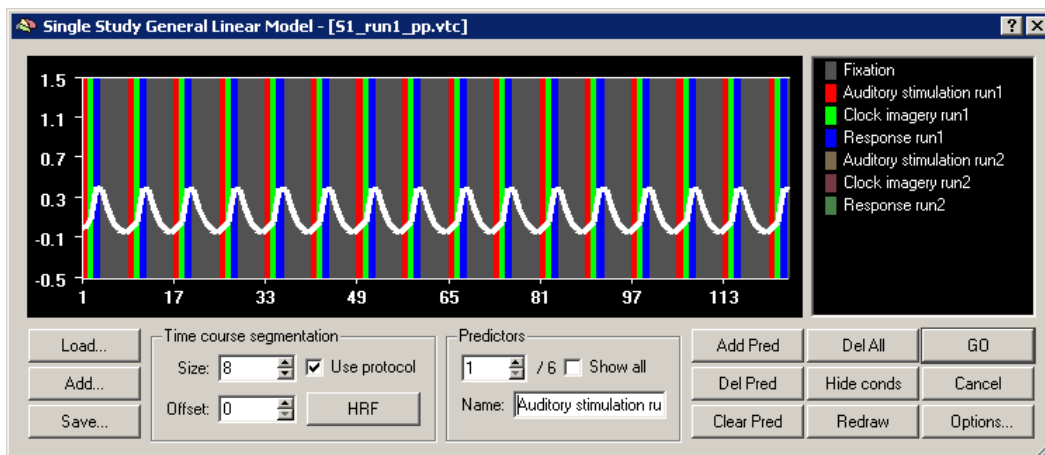
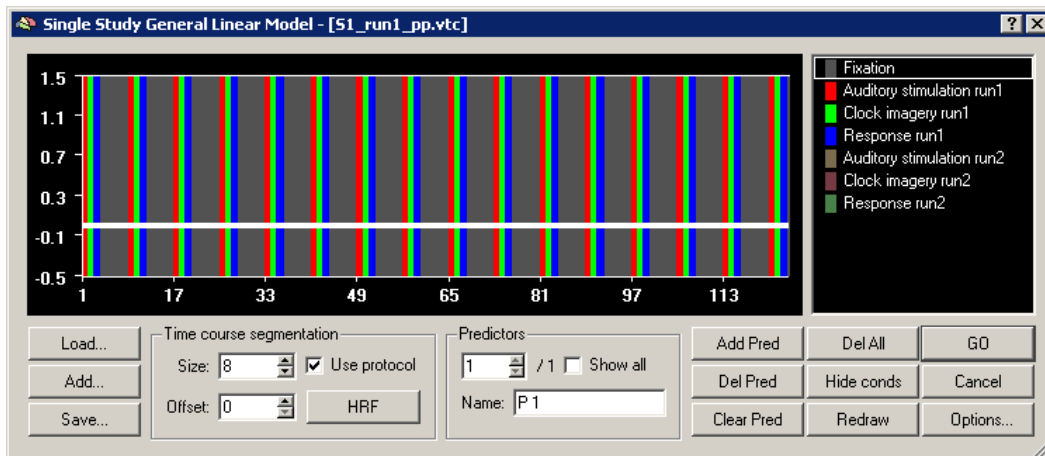
The three new predictors have no assigned time points in the new protocol. In the design matrix created later, they will be filled with zeros.

The new protocol has to be saved.

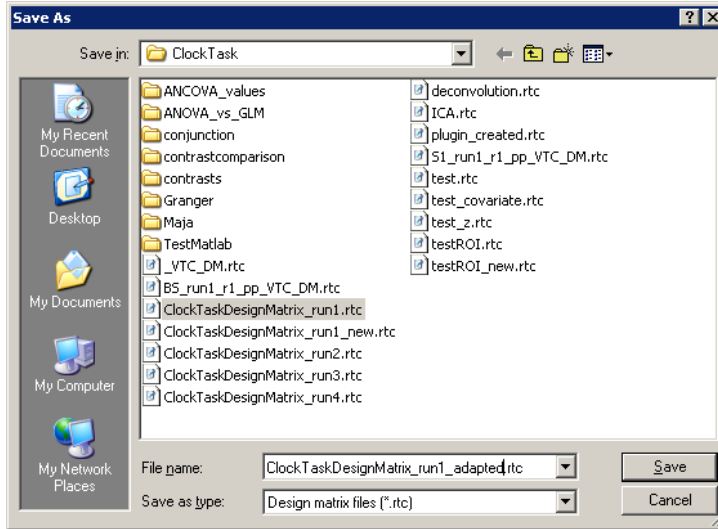


6. The same technique is applied to the protocol for the second run used.

7. Now, we create an RTC file from the adapted protocol file. One can see the list of predictors on the right side of the Single Study GLM dialog.

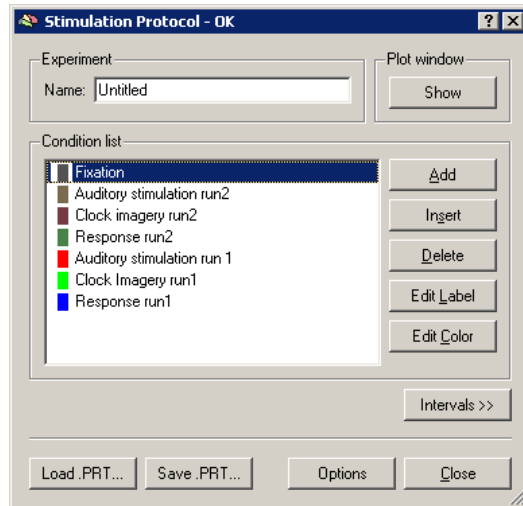


We save the new RTC file that has six predictors (three for the first and three for the second run).

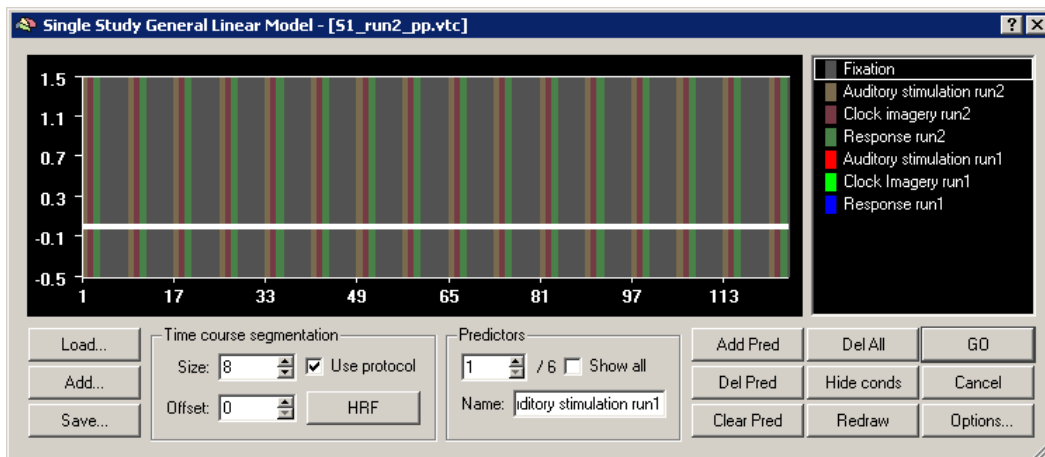
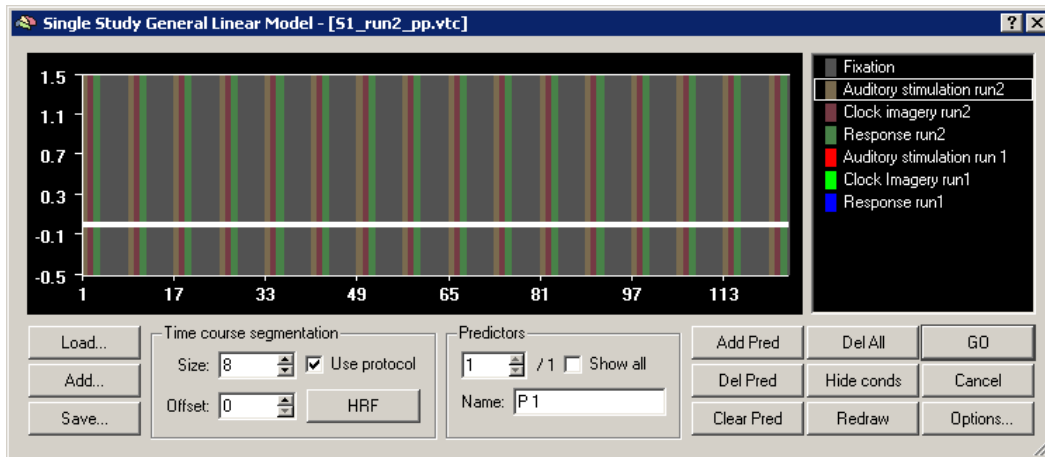


**8.** This step of RTC creation has to be redone for the second protocol file, too.

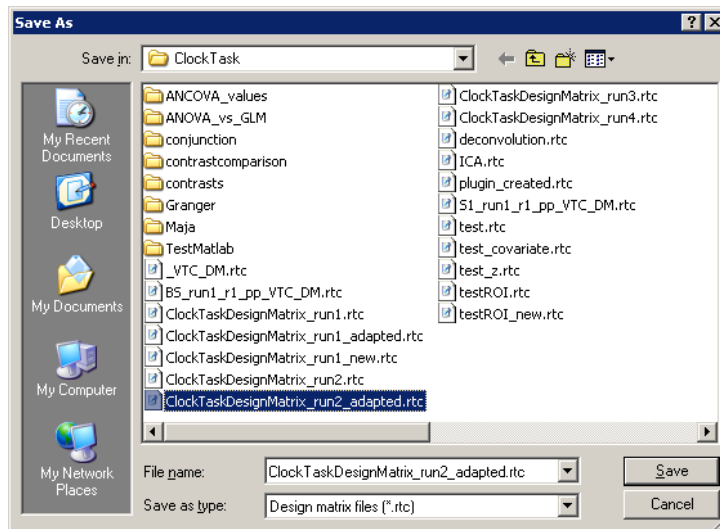
Here, one has to take care to keep the ordering of predictors the same for the different RTCs. That means that the predictors already defined before obtain the name [\*\*\* run2] in the RTC for run 2. When creating the new conditions automatically, their ordering will now be different from the ordering in the first run. This is no problem if the predictors for the RTCs are chosen manually (keep in mind: the ordering of predictors in the PRT file is not that important, but in the RTC, the ordering is really crucial). Only if the “automatic design builder” is used, one should take care to order the predictors accordingly already in the PRT file. I have adapted the colors here to make it easier to select the proper predictors for the RTC later.



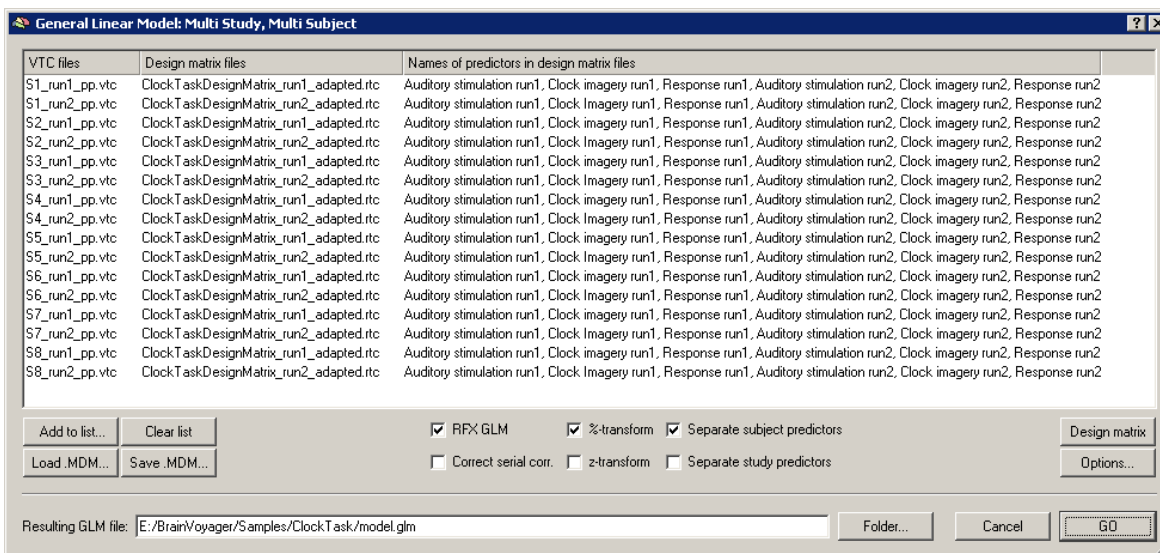
Now, the RTC for the second run is defined exactly as in the case of the first run.



Again, we save the RTC file.



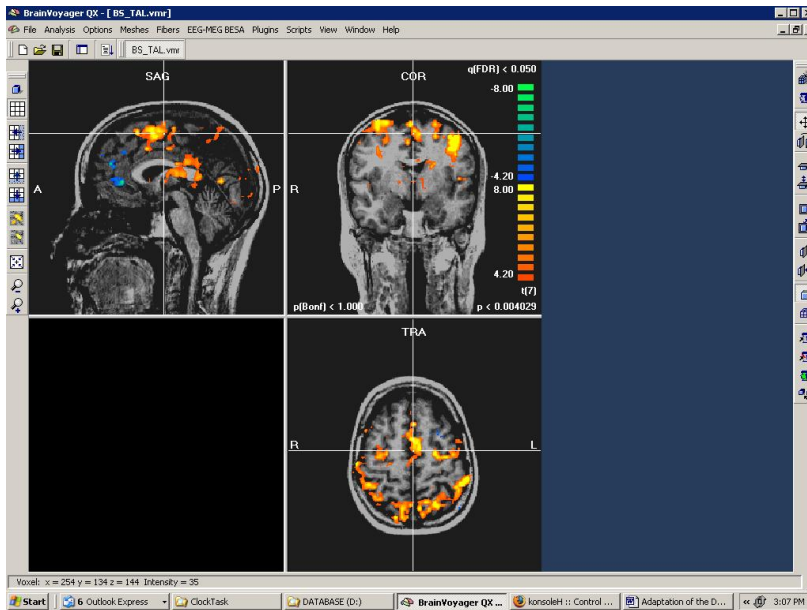
9. Now, we can finally create the necessary Multi-Study Design Matrix on the basis of the old VTC data and the adapted RTC files.



One can nicely see that the Design Matrix now contains six predictors. The names of the predictors and their order are the same in both RTC files. It's advised to save the new Multi-Study Design Matrix as an MDM file.

10. We run a Random Effects analysis (RFX GLM).





The result allows to compare runs as well as conditions between the subjects.

11. We open the “Overlay GLM” dialog and see the different run and condition predictors per subject:

Predictor Nr.	Predictor Name
1	Subject S1: Auditory stimulation run1
2	Subject S1: Clock imagery run1
3	Subject S1: Response run1
4	Subject S1: Auditory stimulation run2
5	Subject S1: Clock imagery run2
6	Subject S1: Response run2
7	Subject S2: Auditory stimulation run1
8	Subject S2: Clock imagery run1
9	Subject S2: Response run1
10	Subject S2: Auditory stimulation run2
11	Subject S2: Clock imagery run2
12	Subject S2: Response run2
13	Subject S3: Auditory stimulation run1
14	Subject S3: Clock imagery run1
15	Subject S3: Response run1
16	Subject S3: Auditory stimulation run2
17	Subject S3: Clock imagery run2
18	Subject S3: Response run2
19	Subject S4: Auditory stimulation run1

Keep in mind that you can specify the conditions only in the same way for every subject (because the analysis is already based on the difference between subjects).