**Task subject-level general linear model**

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**Figure 1 – Figure supplement 1.** Left:Example general linear model used in each single subject lower level task analysis within FEAT. The FLOBS function creates three EVs for each regressor. The ‘resistance’ onset and duration were calculated from the recorded inspiratory pressure physiological traces, while the anticipation duration (‘anticipation’) was calculated from the onset of the stimulus to the beginning of the resistance. The ‘PETCO2’ trace was included to de-correlate the CO2-induced BOLD changes from the respiratory stimuli throughout the functional scan, and was formed by linearly interpolating between the end-tidal expired CO2 peaks. ‘No anticipation’ and ‘finger opposition’ onset and duration represented the presentation of the corresponding stimuli on the screen, and ‘relief from resistance’ was modelled as the rest periods immediately following each resistance application, prior to ratings (4 s duration). The ‘no resistance’ regressor was a single trial where no resistance was applied following an anticipation period, allowing greater decorrelation between the anticipation and resistance regressors. The ‘act of rating’ regressor was included to remove noise from the physical act of pressing the button box, and spanned each of the rating periods. Finally, ‘demeaned ratings’ matched the ‘resistance’ regressor for timings, and the intensity of the regressor was the demeaned intensity value assigned to each of the inspiratory resistance blocks, to remove the trial-by-trial variability of subjective perceptions of resistive loading from the mean ‘resistance’ regressor. Contrasts of interest were the first regressor of the ‘resistance’ FLOBS set for the breathlessness task, and a differential contrast between the first of each of ‘anticipation’ and ‘no anticipation’ for the anticipation task. Motion regressors were incorporated into the regression of ICA noise during preprocessing. Right: Additional ‘physiological’ and ‘PPI’ regressors used for PPI analysis. Physiological regressors were calculated from the mean timeseries of the vlPAG or lPAG seed under investigation, and the PPI was produced via an interaction between the physiological regressor and the task of interest (‘resistance’ for breathlessness, and an altered differential regressor of ‘anticipation’ above ‘no anticipation’ for anticipation). See <http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/PPIHowToRun> for more details.