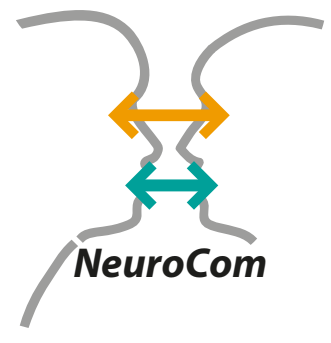


Dynamics of Functional Connectivity in Human Brains Modulated by (Un)pleasantness of Music

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Introduction

Music-induced pleasure

- Intensive pleasure "chill" [Blood et al., 2001]
- Response to unpleasant (dissonant) music [Koelsch et al., 2006]
- Functional connectivity (FCN) between nucleus accumbens (NAc) and cortical regions that are known to be related emotional response

was modulated by the reward value of music [Salimpoor et al., 2013]

[Mueller et al., 2015]

Dynamics of pleasure response

- BOLD in NAc slowly rose and fell around the second 10 s [Salimpoor et al., 2013]
- BOLD in NAc higher only during the first 10 s

Question on the Dynamic modulation of FCN

- Is the FCN-modulation by pleasantness of music constant or dynamic over the 30-s excerpt?

Methods

Data from [Fritz et al., 2013; Mueller et al., 2015]

- 23 healthy volunteers
- 20 musical excerpts
- 2-by-2 design: (Forward-vs-Backward) x (Consonant-vs-Dissonant)

STIMULI:



fMRI (3-T) & image proc.

- Fast (TR=1s) & partial-FOV
- (1 s) x (30+5 timepoints) x 20 mus. x 4 cond. = 2800
- SPM8 prep. (fwhm=8mm)
- 6 CompCor regressors

GLM for 4 conditions and 3 phases (10-s)

$$y = \begin{bmatrix} FC & FD & BC & BD \end{bmatrix} \beta + G\gamma + \epsilon, \quad FC = \begin{bmatrix} fc(1) & fc(2) & fc(3) \end{bmatrix}$$

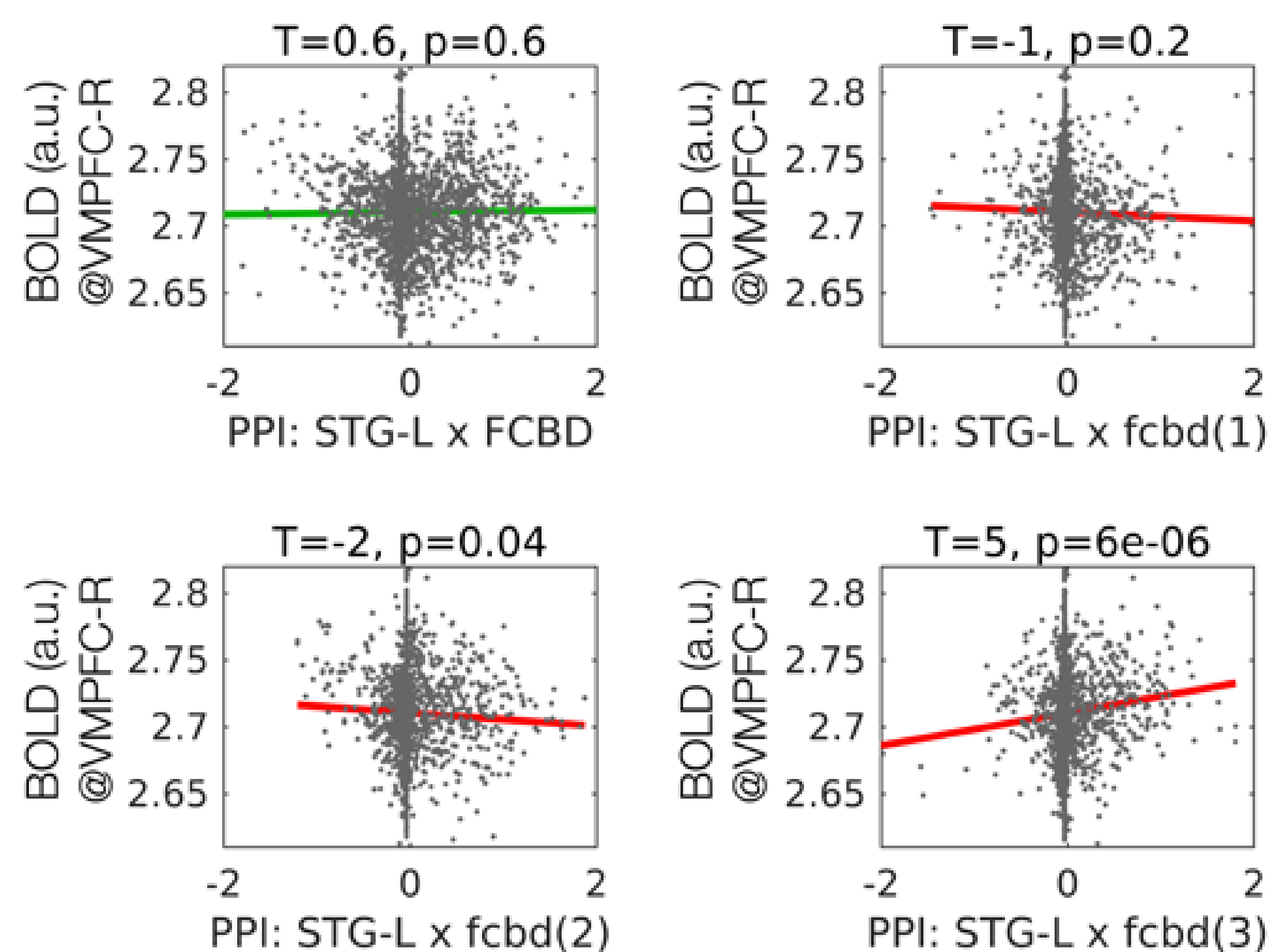
For most-pleasant (FC) vs. most-unpleasant (BD):

- Phase-specific contrast: $fcdb(i) = fc(i) - bd(i)$
- Overall contrast: $FCBD = \sum fcdb(i)$

Psychophysiological interaction (PPI)

- Overall PPI:
 $FCN(aSTG, cortex | FC) > FCN(aSTG, cortex | BD)$
- Phase-specific PPI (for the i-th phase):
 $FCN(aSTG, cortex | FC(i)) > FCN(aSTG, cortex | BD(i))$
- E.g.: single subject in the right VMPFC with a STG-L seed

overall PPI (FCBD), phase-specific PPI (fcdb(i))



Findings and discussion

Overall PPI

- Increased FCN(aSTG, MFC/PT/PC)
- Decreased FCN(aSTG, FoC/INS)

aSTG, anterior superior temporal gyrus
MFC, medial frontal cortex
PT, planum temporale
PC, precunes; FoC, frontal operculum
INS, insula; LOC, lateral occipital cortex
cerb6, cerebellar lobule VI

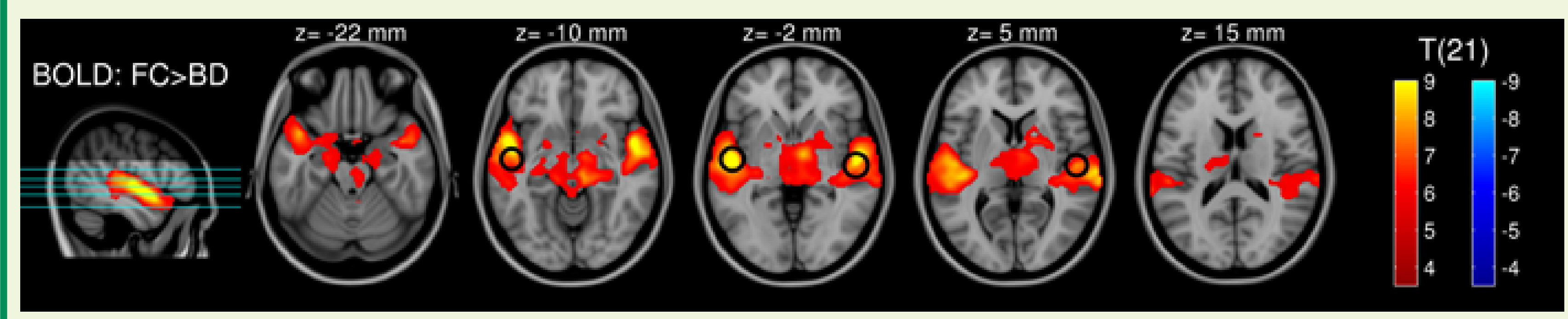
Phase-specific PPI

[Phase 1] Increased FNC(aSTG, PTs): perceptual processing?

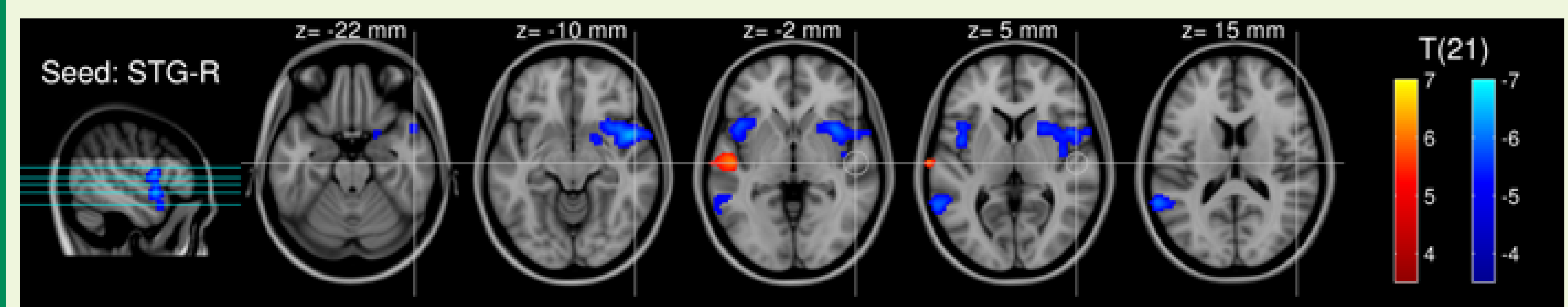
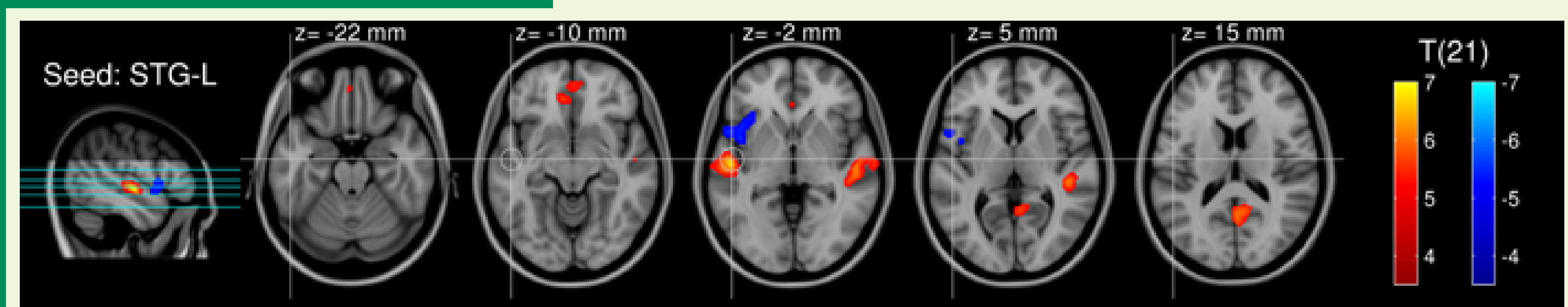
[Phase 2] Decreased FNC(aSTG, Foc/INS): similar to FCBD contrast

[Phase 3] Increased FCN(aSTG, MFC/PC/LOC/-cerb6): emotional response to the musical structure?

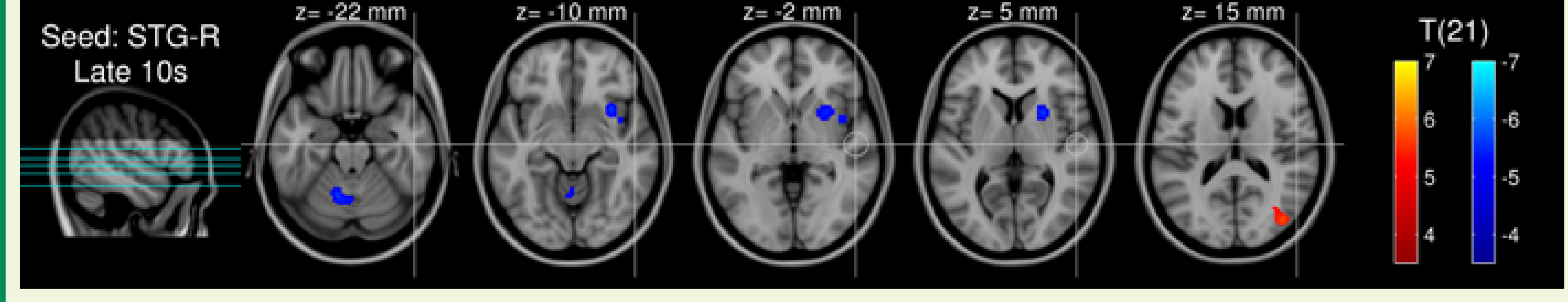
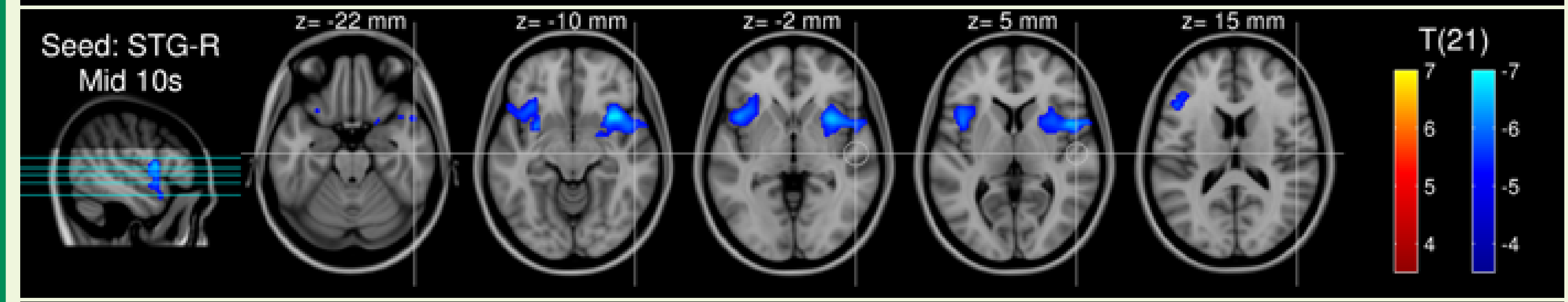
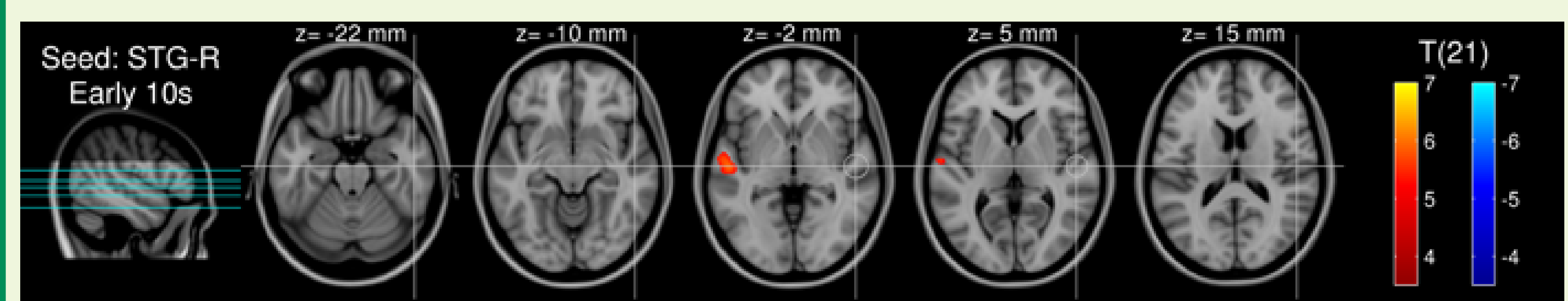
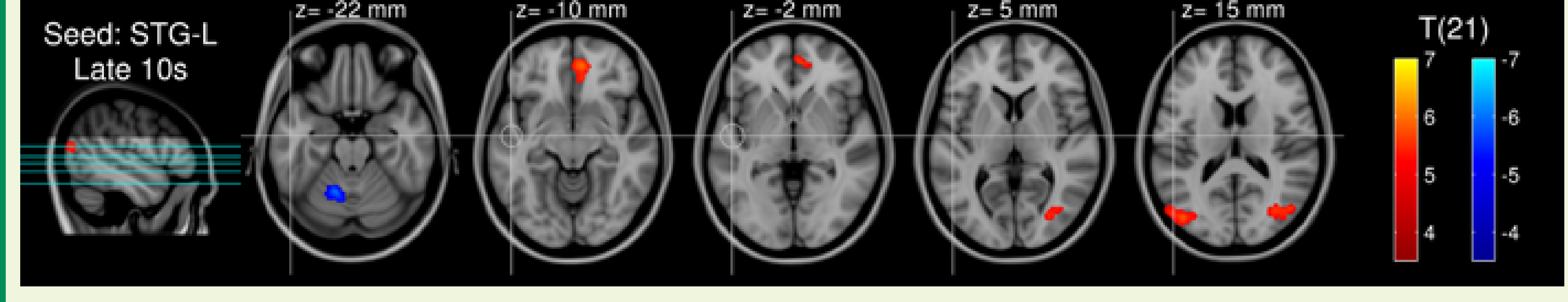
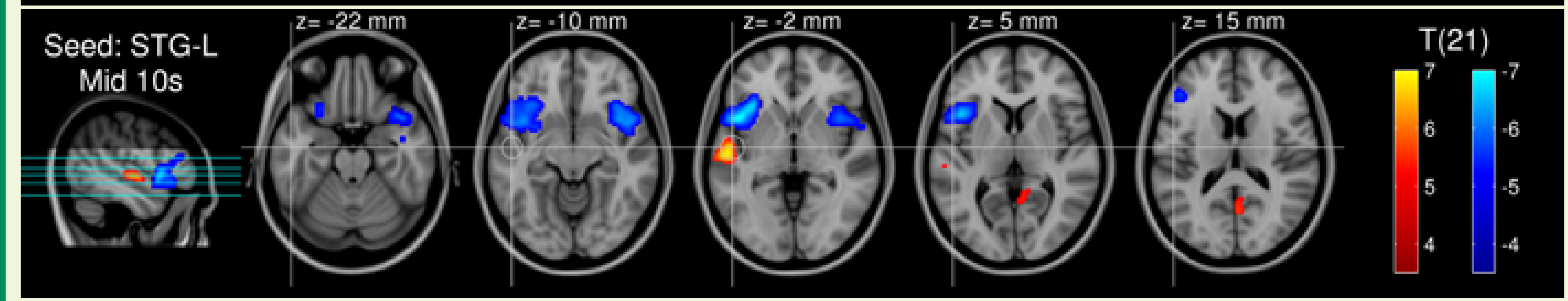
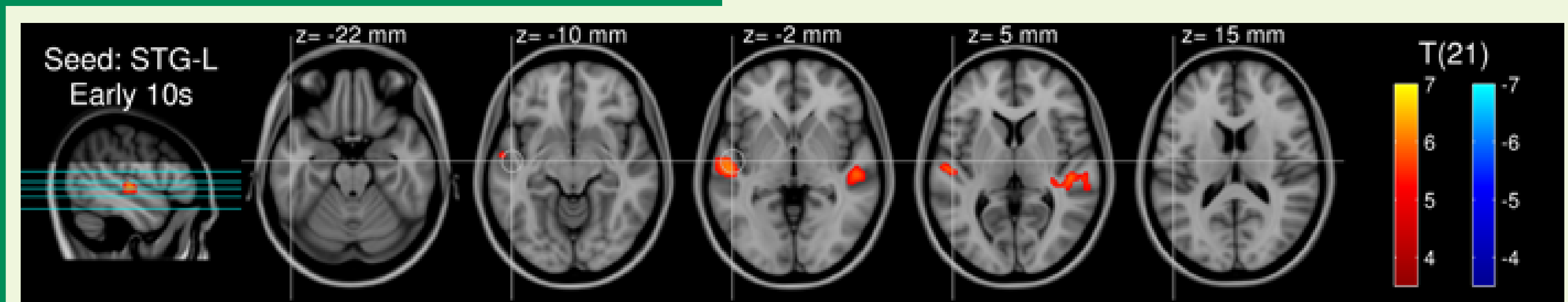
Pleasantness (FCBD) effect



Overall PPI (STG x FCBD)



Phase-specific PPI (STG x fcdb(i))



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