
DANS 2019 Group Project: Investigating the neural basis in decision-making under risk

Tom, S.M., Fox, C.R., Trepel, C., Poldrack, R.A. (2007). Science

Team 3

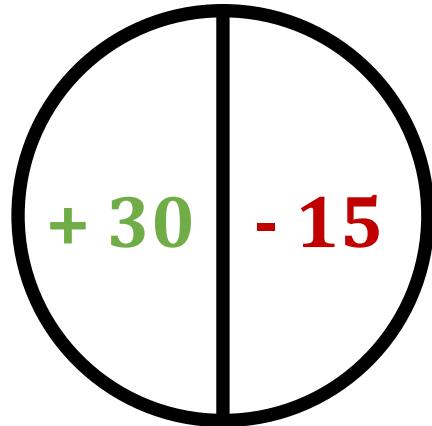
김택완, 박성오, 양재영, 진승우

The Neural Basis of Loss Aversion in Decision-Making Under Risk

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People typically exhibit greater sensitivity to losses than to equivalent gains when making decisions. We investigated neural correlates of loss aversion while individuals decided whether to accept or reject gambles that offered a 50/50 chance of gaining or losing money. A broad set of areas (including midbrain dopaminergic regions and their targets) showed increasing activity as potential gains increased. Potential losses were represented by decreasing activity in several of these same gain-sensitive areas. Finally, individual differences in behavioral loss aversion were predicted by a measure of neural loss aversion in several regions, including the ventral striatum and prefrontal cortex.

Task description



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Response Interval
(3 secs)

Inter-Stimulus Interval
(mean: 2.6 sec)



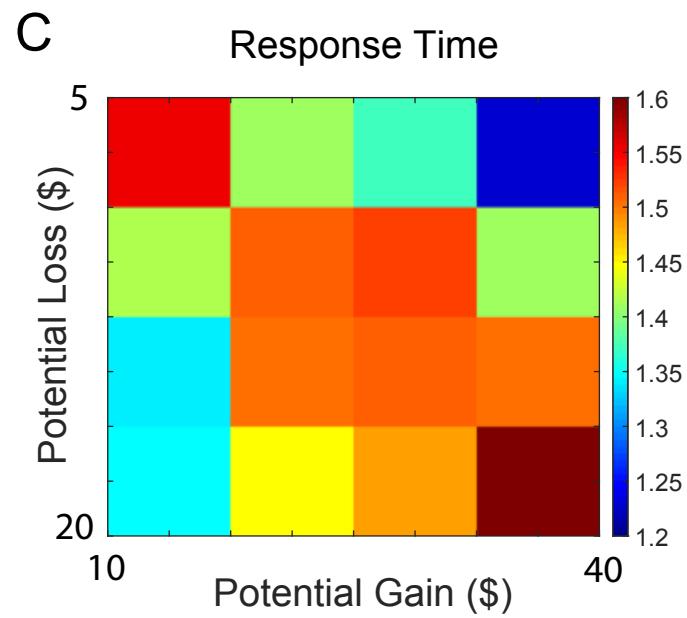
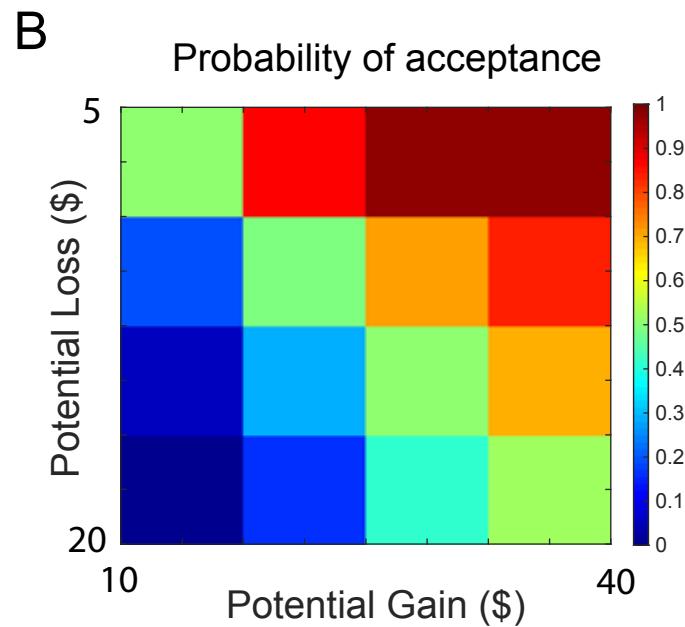
Task description

- N = 16 (9 females, 7 males; right-handed; English-speakers; mean 22 ± 2.9 years)
 - 3 runs (85 ~ 86 trials each)
 - Amount of rewards
 - Possible gain: \$10 ~ \$40 (in \$2 increments)
 - Possible loss: \$5 ~ \$20 (in \$1 increments)
- $16 \times 16 = 256$ possible combinations

Behavioral results

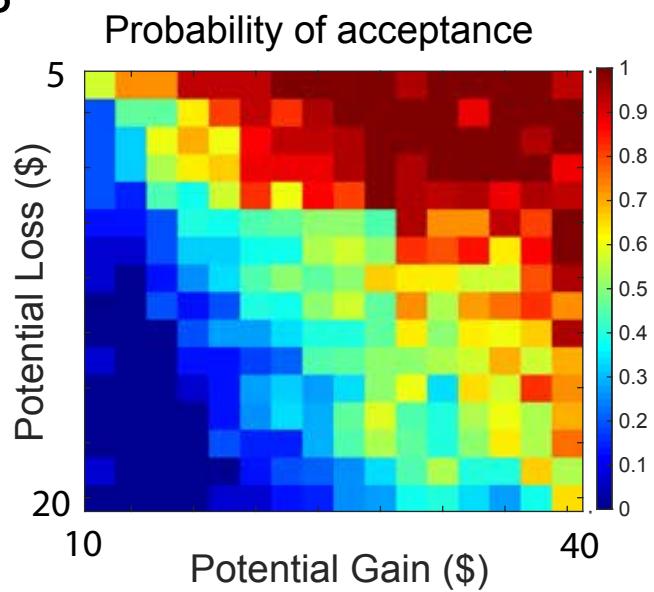
Question 1, 3

Behavioral results (Q1)

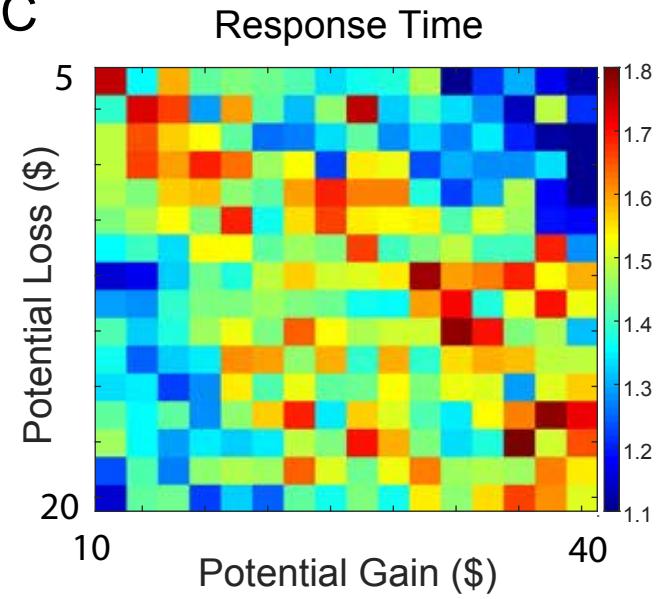


Behavioral results (Q1)

B



C



Two measures of loss aversion

1. Behavioral loss aversion (Tom et al., 2007)

$$\text{logit}(p) = \beta_0 + \beta_{\text{loss}} X_{\text{loss}} + \beta_{\text{gain}} X_{\text{gain}}$$

$$\lambda = -\frac{\beta_{\text{loss}}}{\beta_{\text{gain}}}$$

2. Prospect model (Sokol-Hessner et al., 2009)

$$u(x) = \begin{cases} x^\rho & x \geq 0 \\ -\lambda(-x)^\rho & x < 0 \end{cases}$$

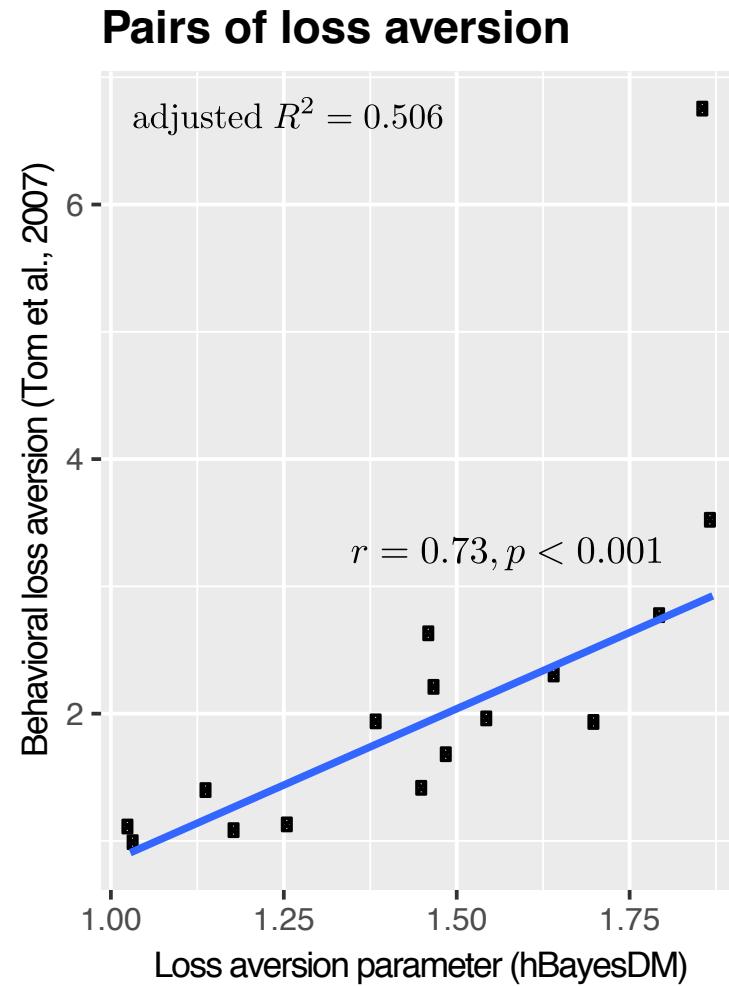
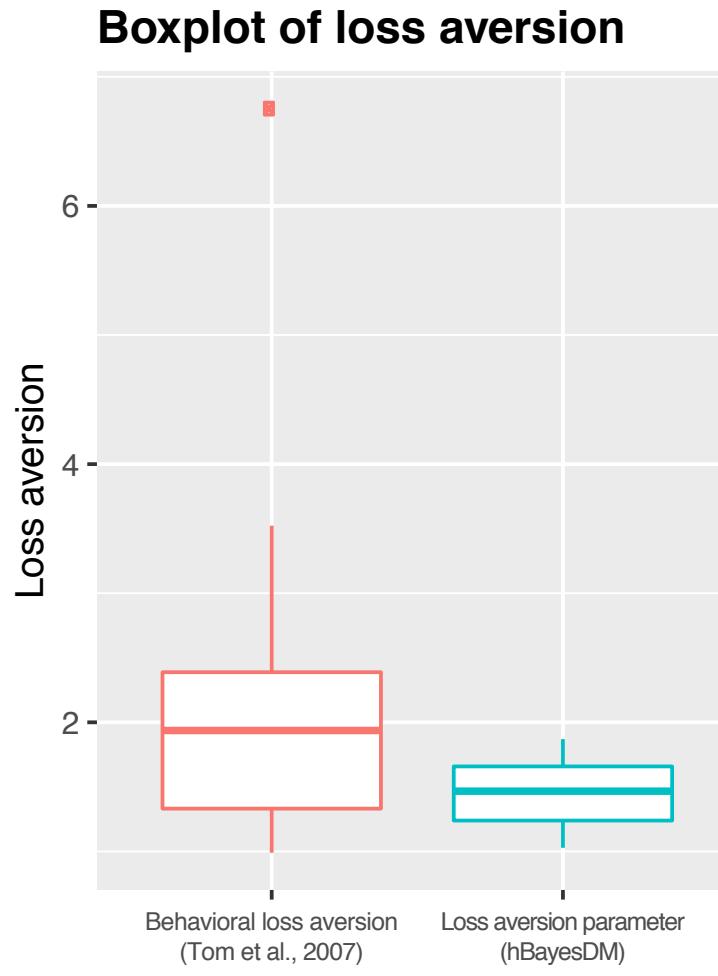
Risk preference parameter
Loss aversion parameter

$$v_{\text{gamble}} = 0.5 u(x_{\text{gain}}) + 0.5 u(x_{\text{loss}})$$

$$\text{logit}(p) = \tau(v_{\text{gamble}} - v_{\text{cert}}) = \tau v_{\text{gamble}}$$

Inverse temperature (slope of logistic function)

Comparison of two loss aversions (Q3)



Behavioral loss aversion (Tom et al., 2007)

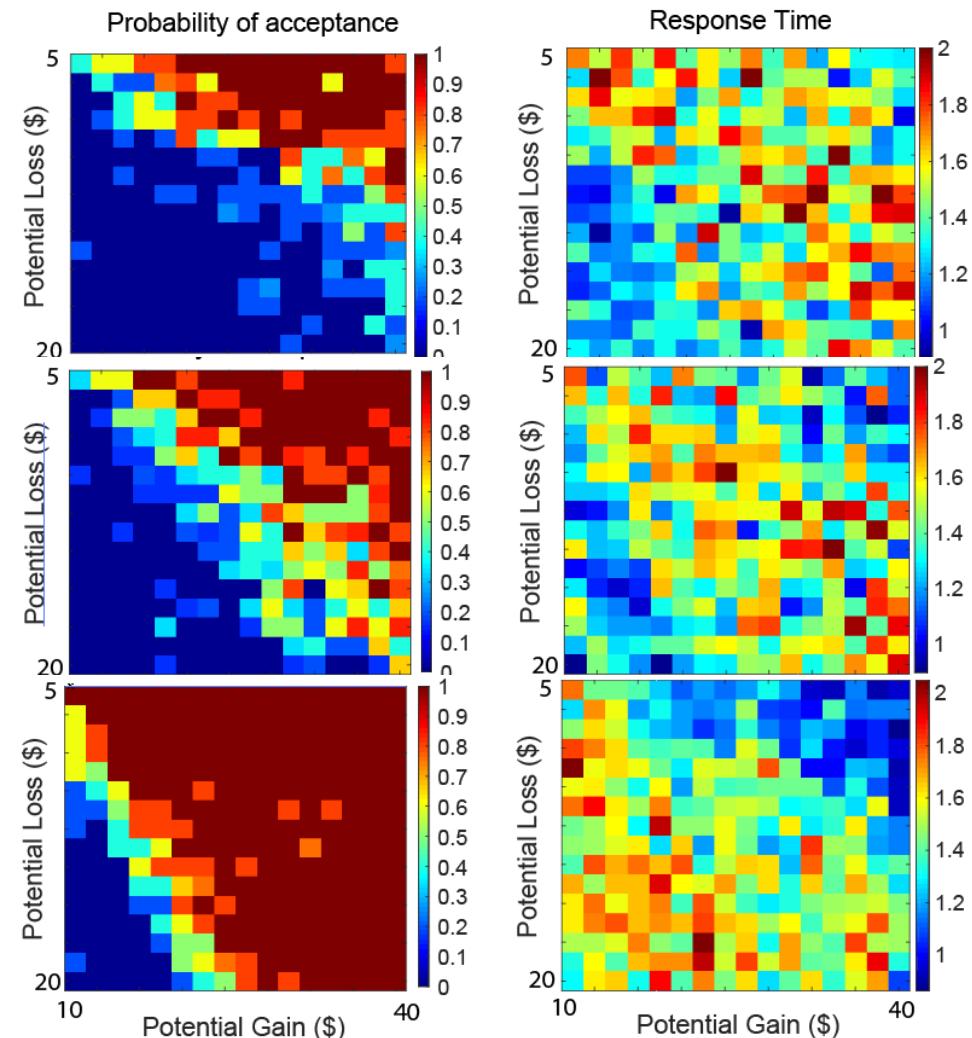
High λ ($N = 5$)

Relatively more **loss-averse**

Middle λ ($N = 6$)

Low λ ($N = 5$)

Relatively more **gain-seeking**



Loss aversion parameter (Prospect model)

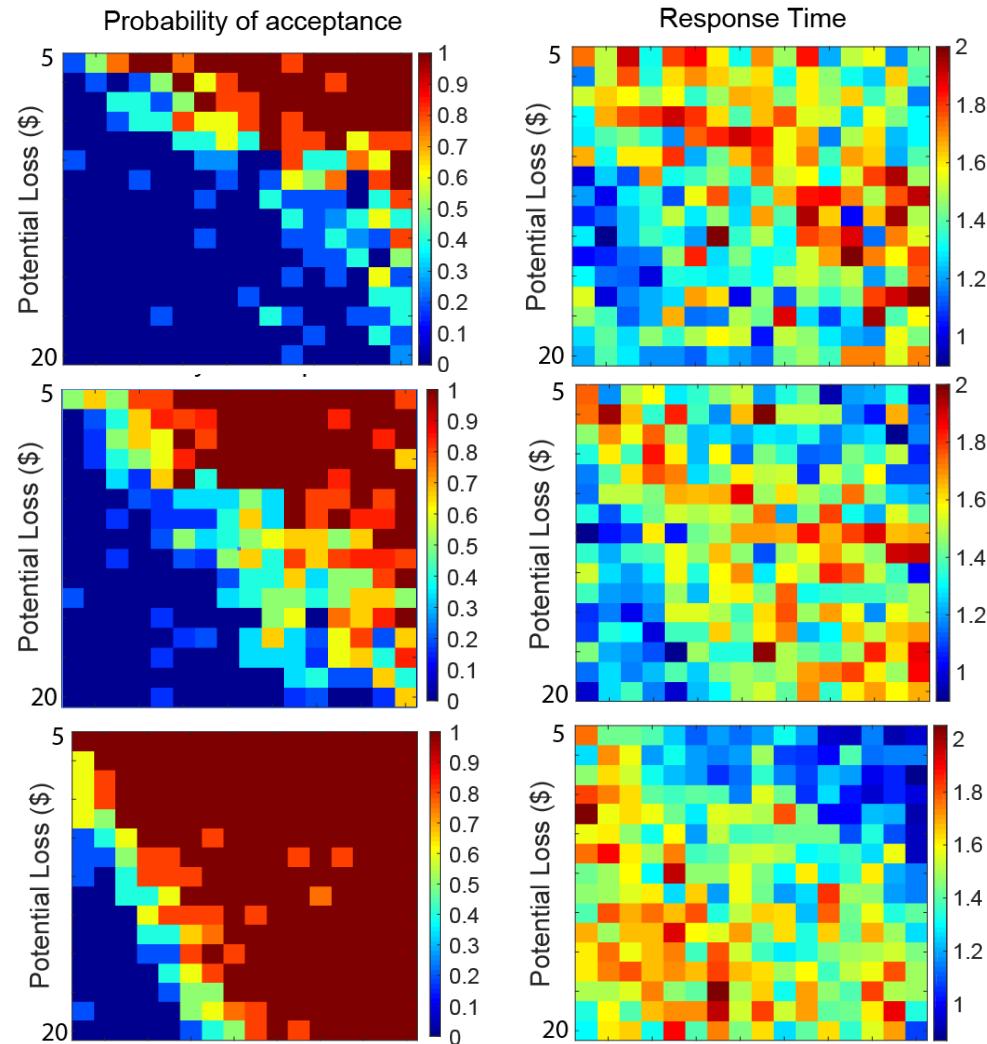
High λ ($N = 5$)

Relatively more **loss-averse**

Middle λ ($N = 6$)

Low λ ($N = 5$)

Relatively more **gain-seeking**

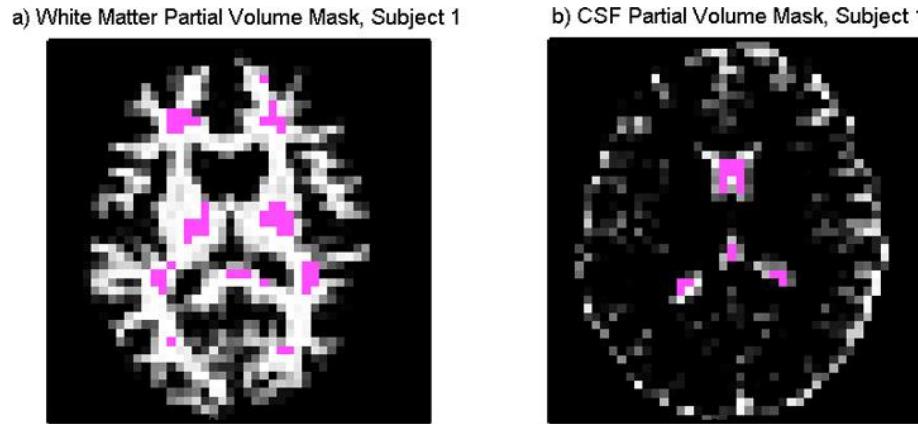


fMRI results

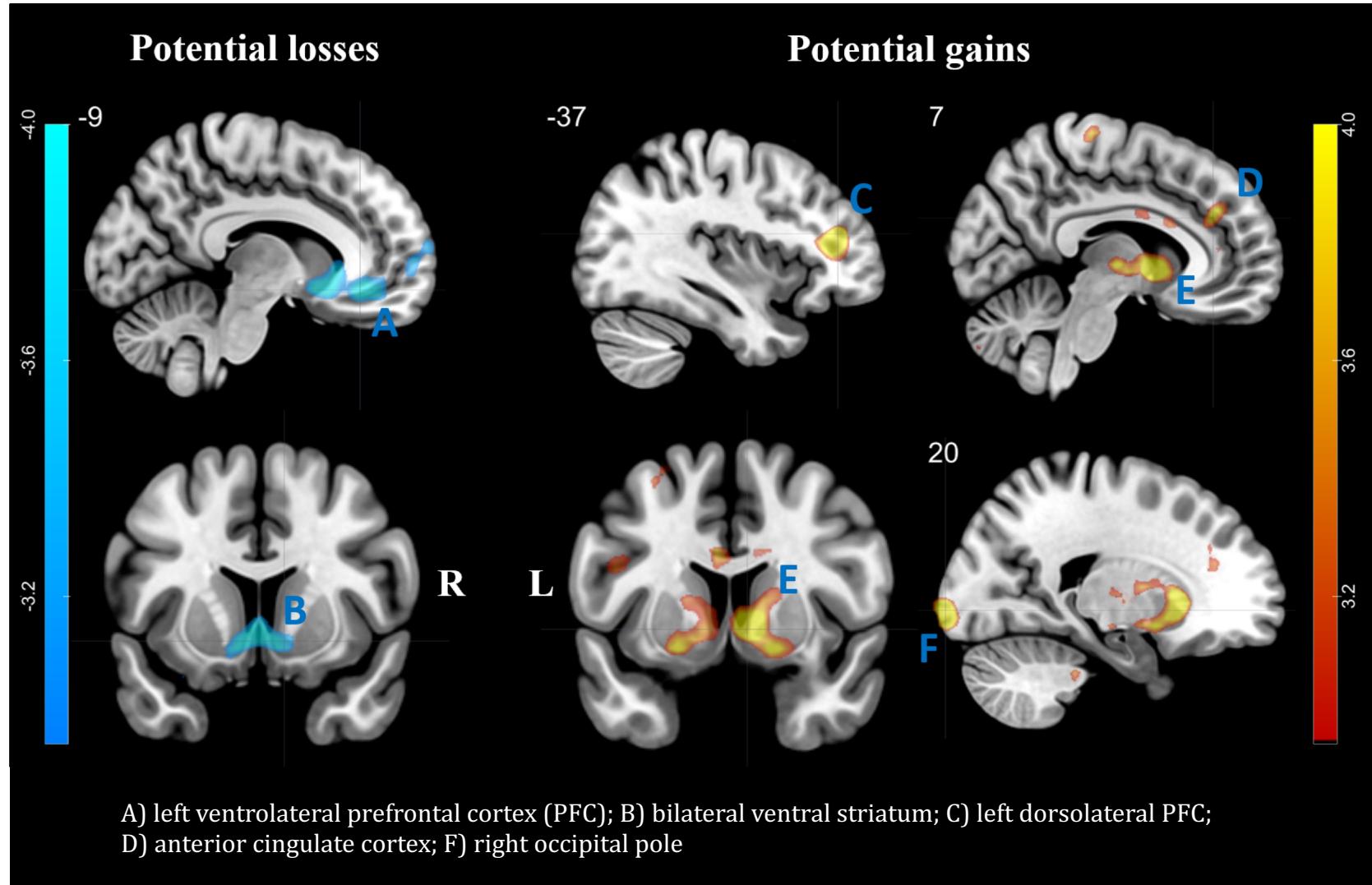
Question 2, 4, 5, 6, 7

Nuisance regression using CompCor

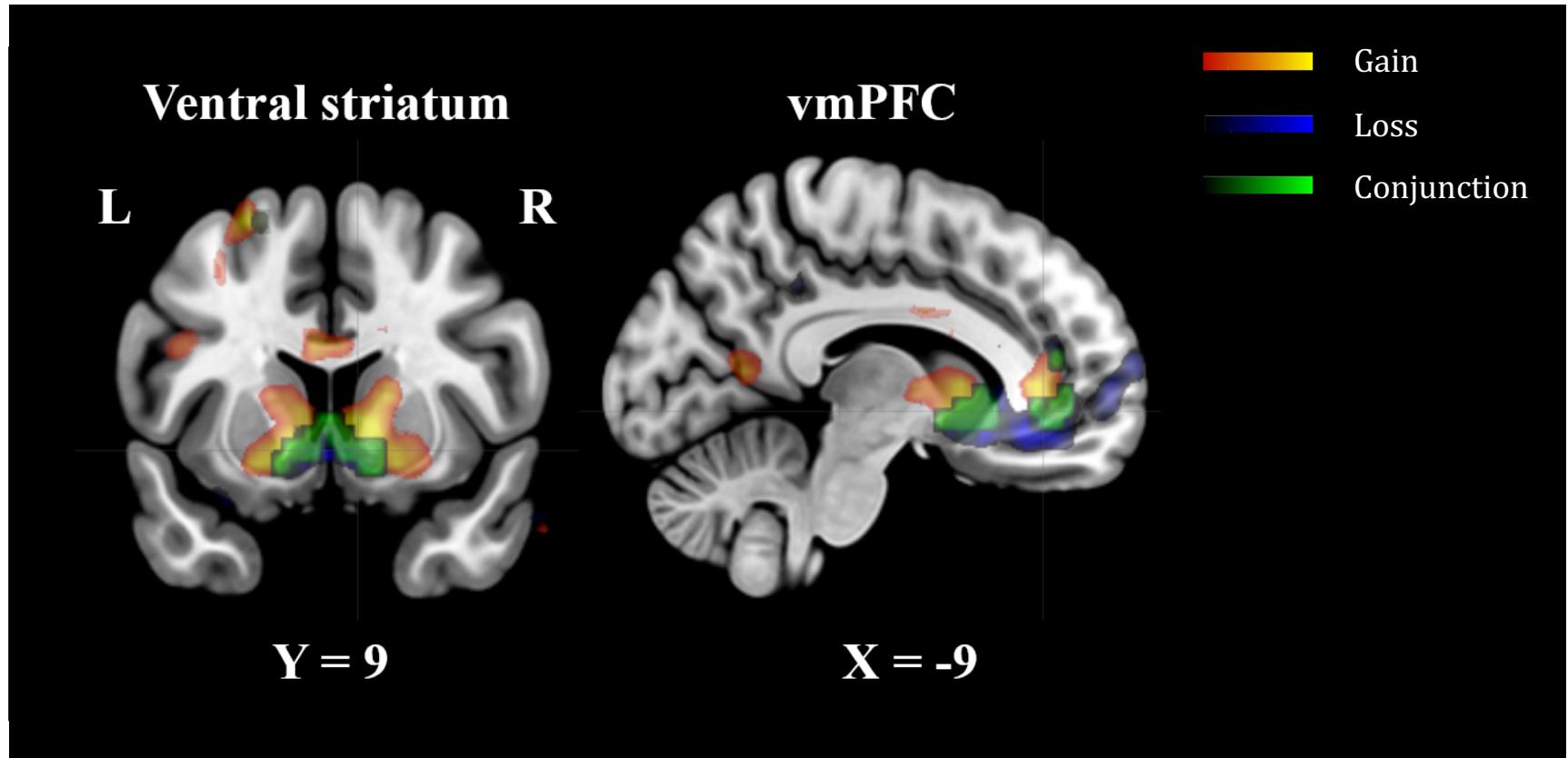
- A component-based noise correction method
(Behzadi et al., 2007, *Neuroimage*)
 - **tCompCor:** components of physiological noise signal using the temporal standard deviation
 - **aCompCor:** components of signal consisting of either WM and CSF using anatomical mask



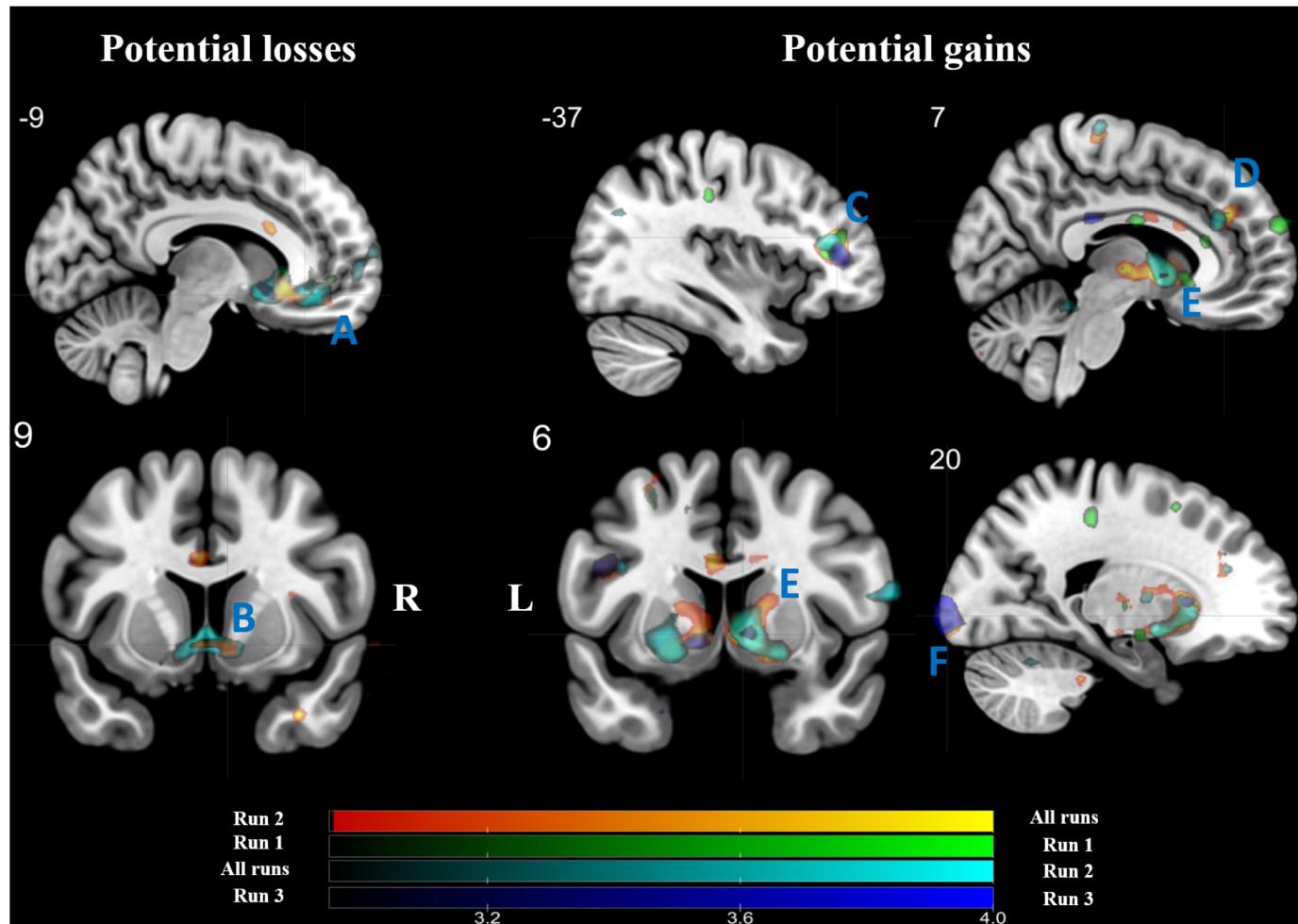
Related regions for gain & loss (Q2)



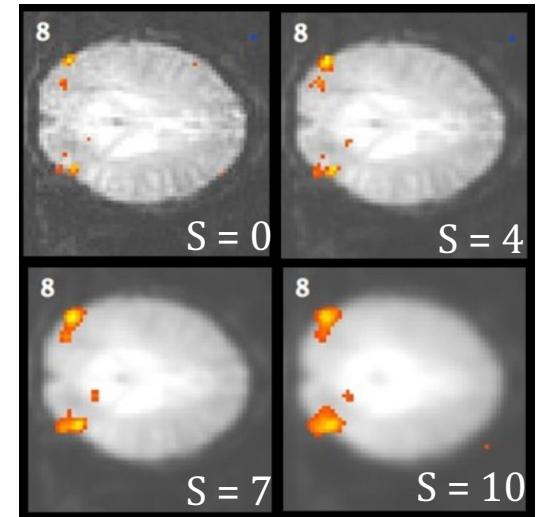
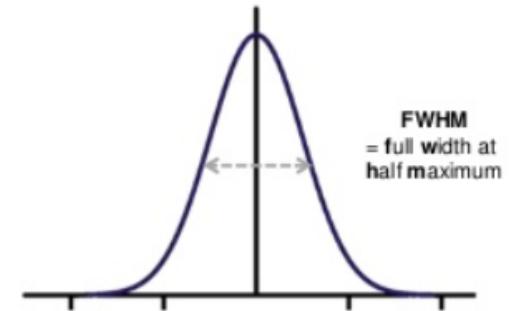
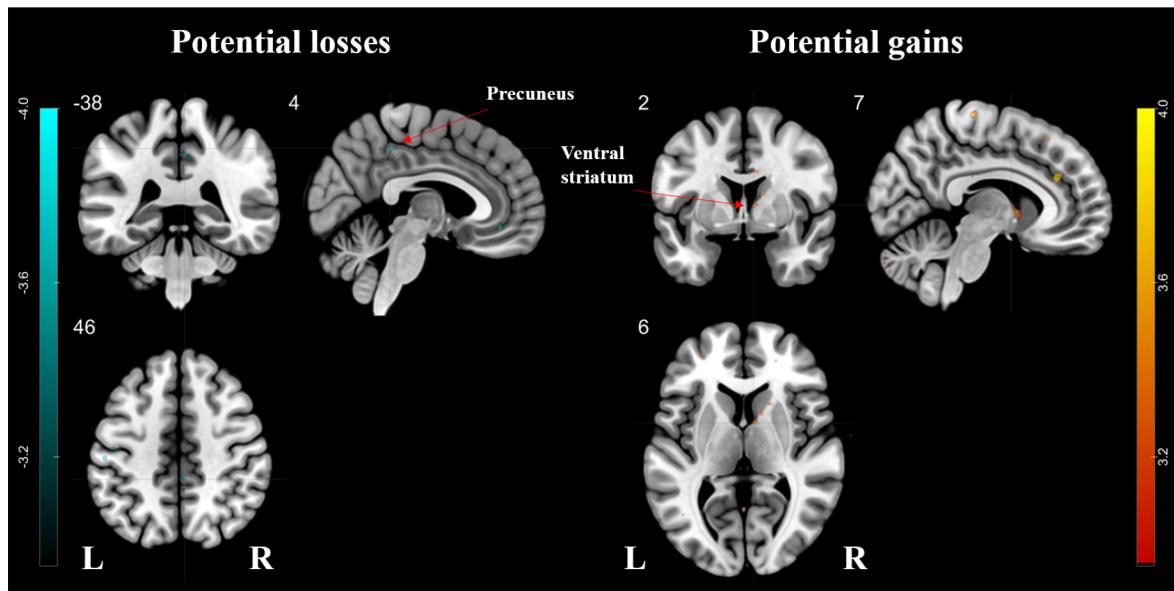
Common regions of gain & loss (Q4)



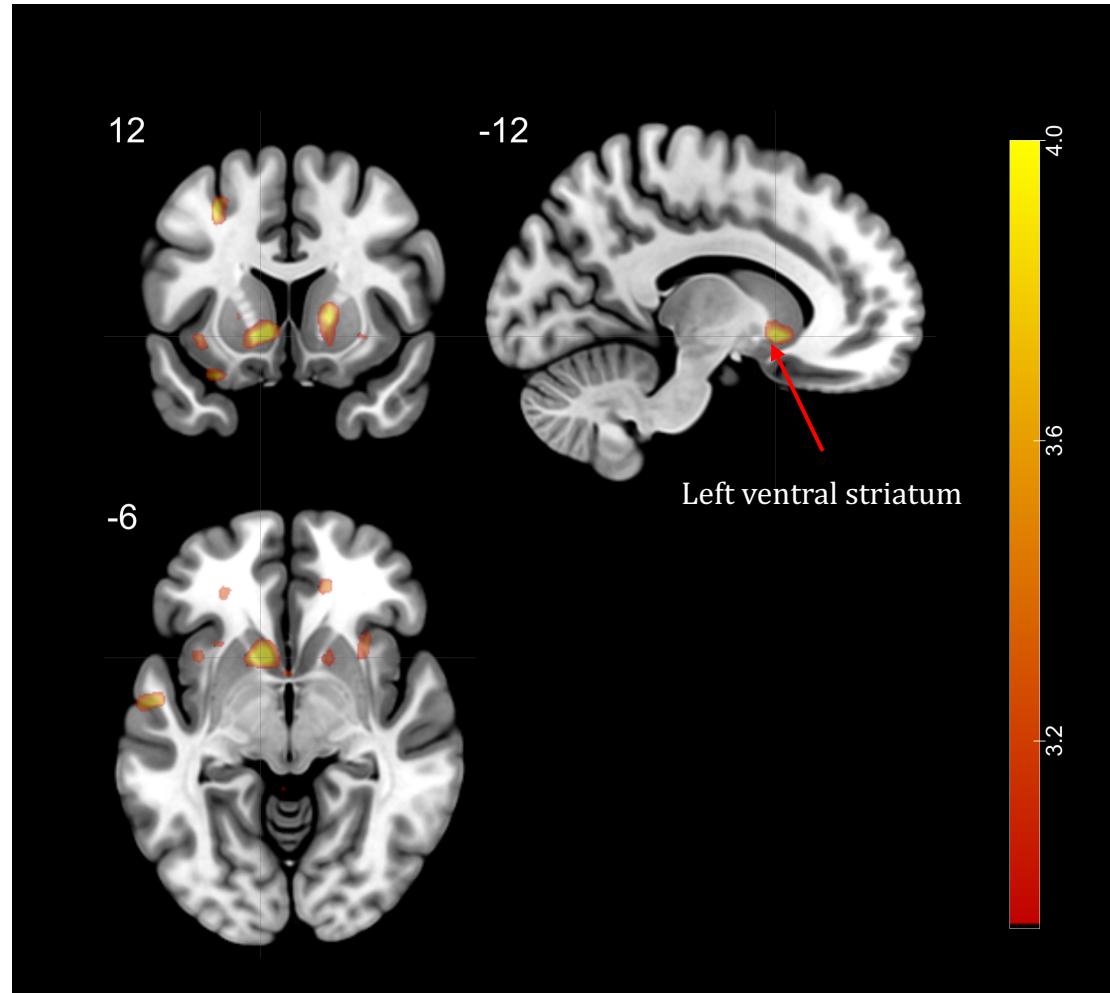
Using each run separately (Q5)



Lower SNR without smoothing (Q6)



Value of gamble (Q7)



Q & A