

JAMA Psychiatry | Original Investigation

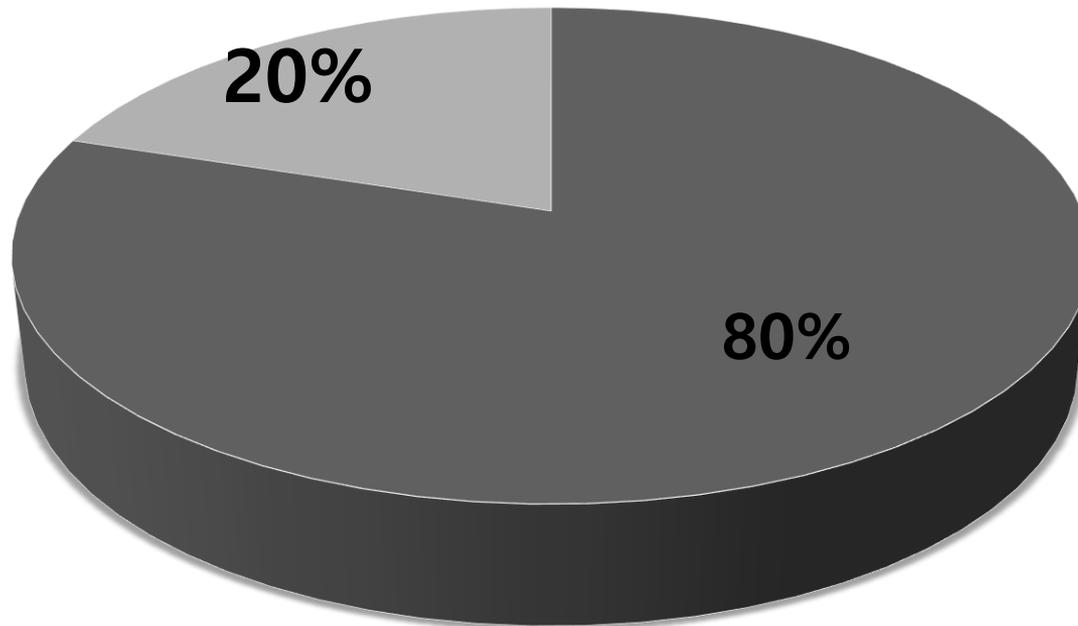
# Association of Neural and Emotional Impacts of Reward Prediction Error With Major Depression

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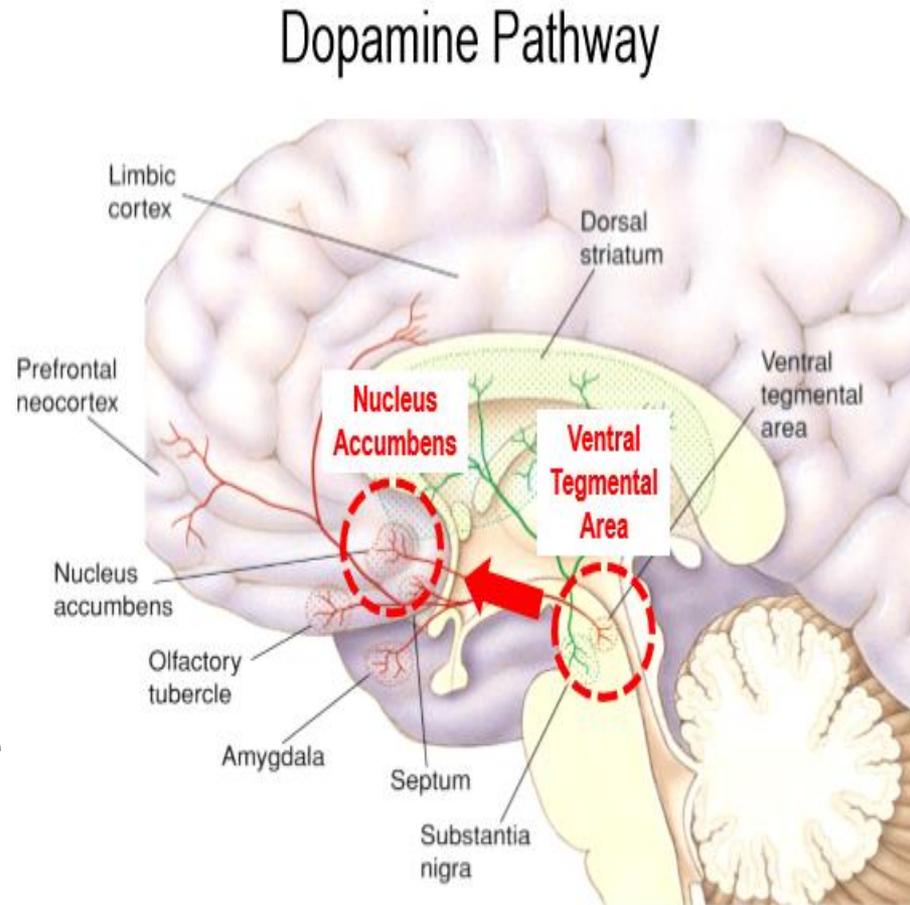
# Why studying Major depressive disorder (MDD) is important?

**Lifetime prevalence of mood disorders in US**



# Previous study

- Depression is associated with impaired **reward and emotion processing**
  - reward processing
    - Dopaminergic input -> ventral striatum -> Reward prediction error
  - emotion processing
    - relationship between dopamine & mood from the RPE

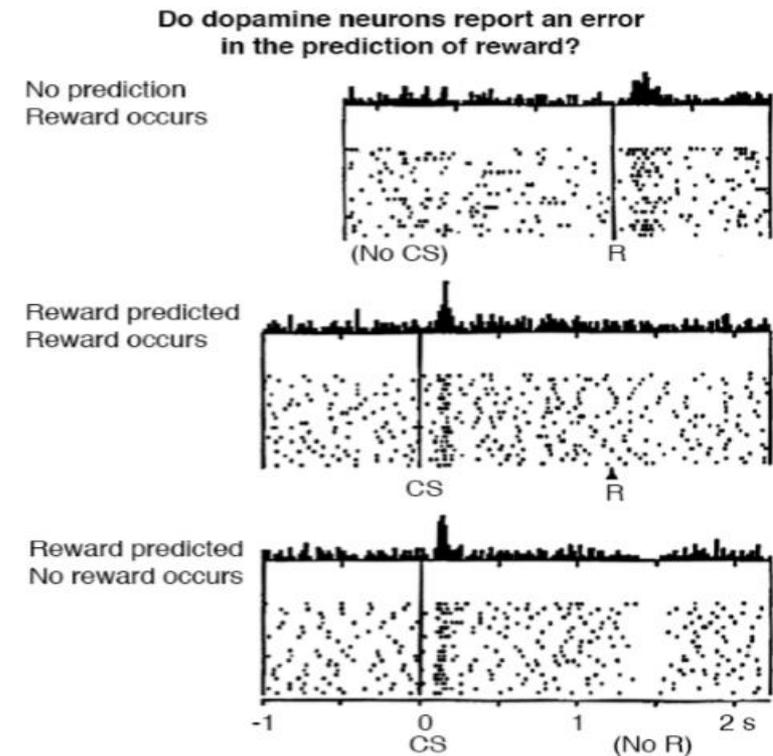






# Reward Prediction Error (RPE)

- difference between predicted & experienced reward
- predicted < experienced  
-> dopamine increase
- predicted > experienced  
-> dopamine decrease



Schultz et al., Science (1997)

**Dopamine Response = Reward Occurred – Reward Predicted**

# Purpose of the research

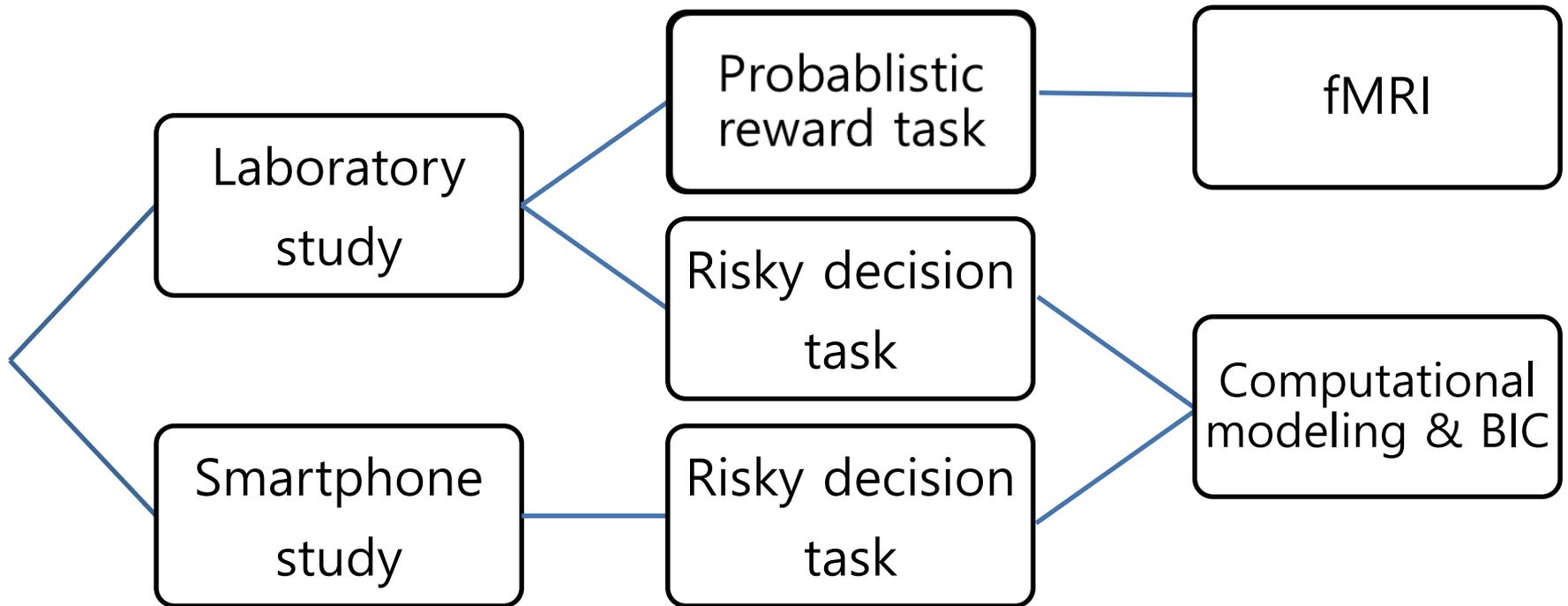
- Ventral striatum

: Does depression reduce RPE even in tasks without learning needs?

- Emotional reactivity

: Does depression reduce emotional changes due to RPE in task without learning?

# Methods



- Participants

- laboratory study

- probabilistic reward task: 35 depressed & 20 control
    - Risky decision task: same + 19 depressed

- smartphone study

- 1833 participants -> 30% had a history of depression

- Procedures

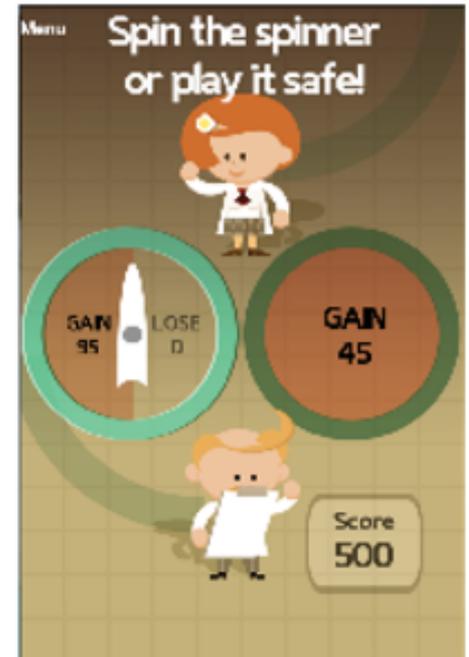
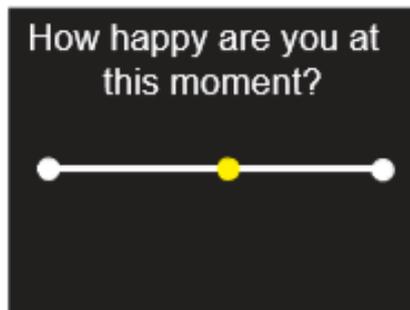
- Probabilistic reward task

- no learning requirement
    - 164 trials in the MRI scanner



## – Risky decision task

- every 2-3 trials -> happiness rating
- laboratory : 160 trials 66 ratings
- smartphone : 30 trials 12 ratings



- fMRI imaging
  - BOLD response
  - Physiological monitoring
  - preprocessing
  
- Computational modeling of momentary mood

$$\text{Happiness}(t) = w_0 + w_1 \sum_{j=1}^t \gamma^{t-j} \text{CR}_j + w_2 \sum_{j=1}^t \gamma^{t-j} \text{EV}_j + w_3 \sum_{j=1}^t \gamma^{t-j} \text{RPE}_j$$

EV : +1\$ \* 75% + (-1\$) \* 25% = .50

CR : -1\$

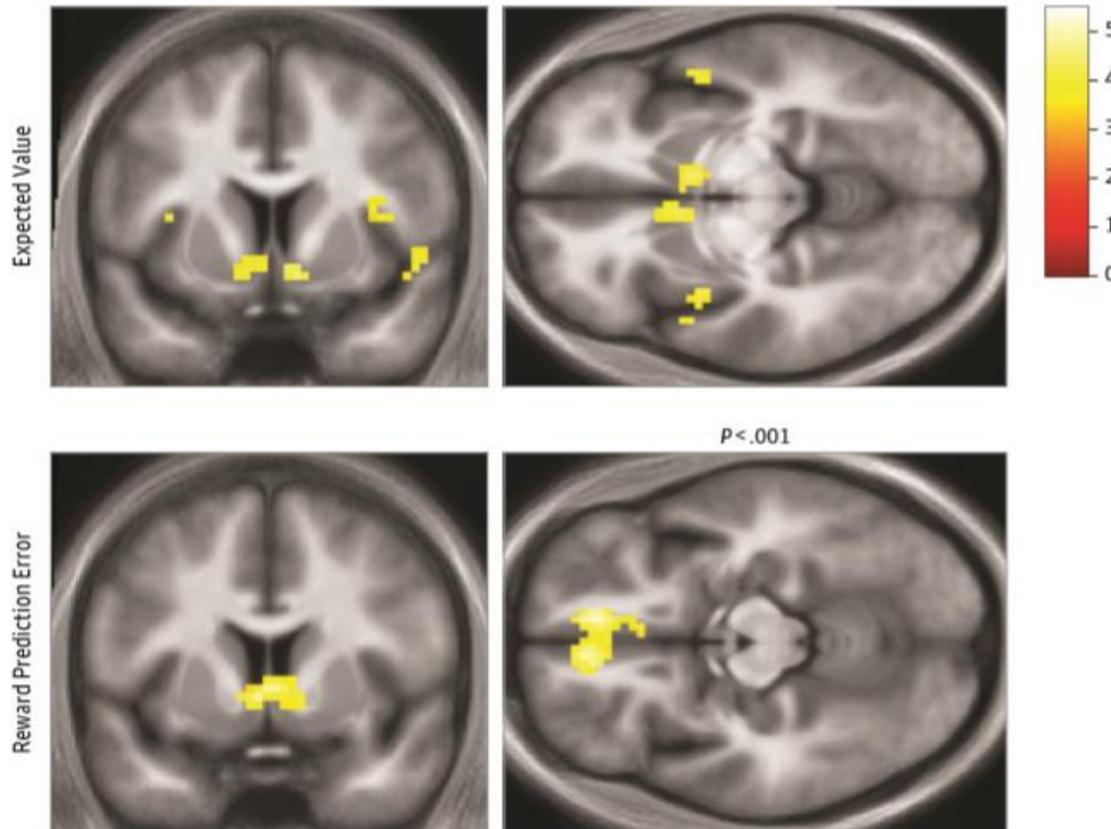
RPE : - | -1 - (.50) | = -1.50

- BIC for model comparison
  - Reward model
    - > 3 parameters
  - Reward and Expectation model
    - > 5 parameters

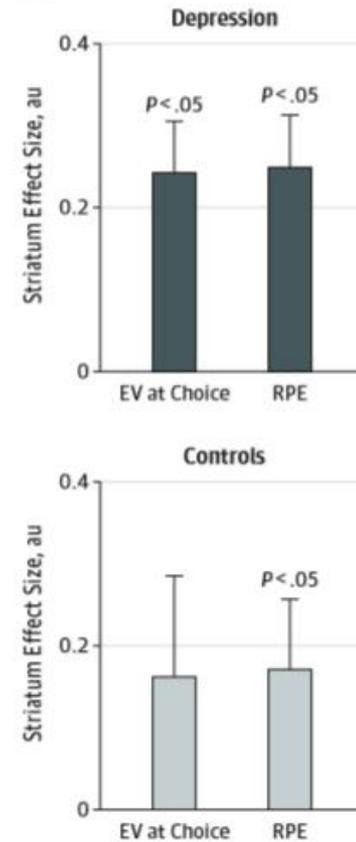
# Results

## Probabilistic reward task

**A** Depressed participants

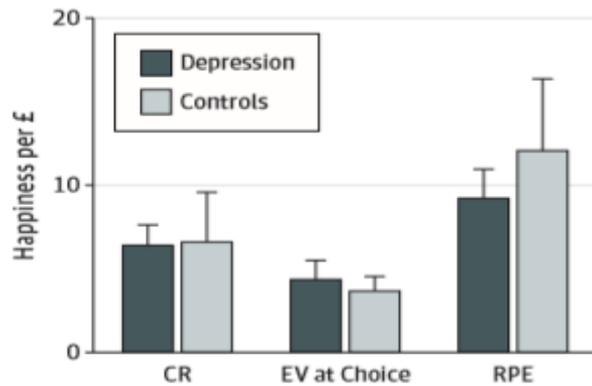


**B** Reward-related activity

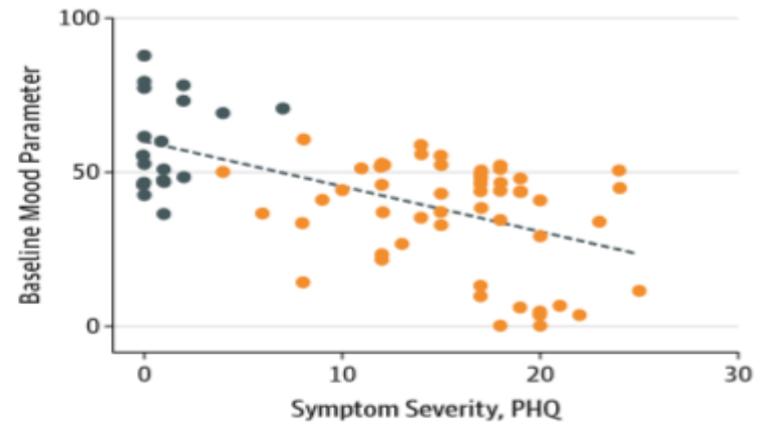


# Risky decision task

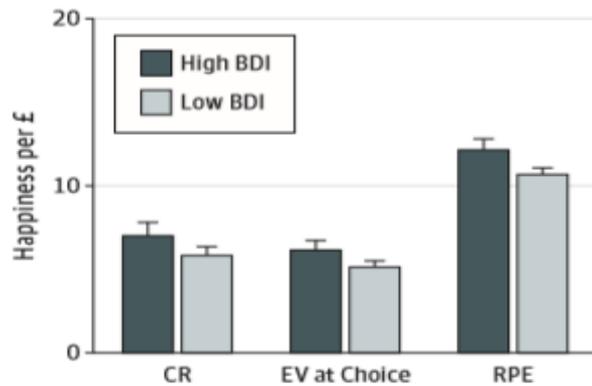
**A** Laboratory decision task



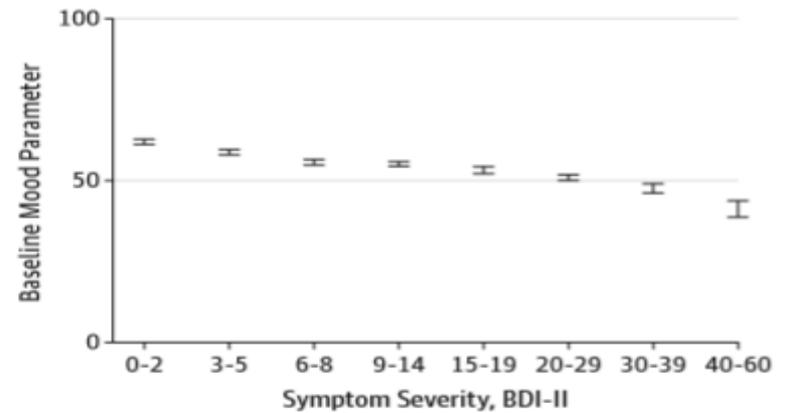
**B** Depression severity (PHQ)



**C** Smartphone decision task



**D** Depression severity (BDI-II)



*“Dopaminergic RPE signal is **NOT** fundamentally affected by depression”*

# Discussion

- Antidepressant efficacy of dopaminergic drugs  
⇒ modulate belief updating system and adaptive behavior?
- The cause of depression is probably a matter of goal-directed decision making

# Limitation

Participants with depression were receiving antidepressant drugs

<My opinions>

Participants from smartphone study..

Need more evidence

Any other limitations? or implications?