Aging of Neural Circuits Underlying Decision-Making Behavior by Joshua O. S. Goh
Introduction prepared by Yungkuei Lu

1. What is the question?

It is noticeable that elders perform differently from their younger counterpart. It's intriguing to investigate the change in the neural system structure and the change in the neural network function

2. Why is it important?

As in a world with aging population, it's crucial to know that how the aging affect the way decision is made on the neurological basis. As for now, several studies about the difference in decision-making show different (sometimes contradictory) results, a unified mechanism to explain the effect aging put on the brain on bio-chemical and neural transmitter/inhibitor level is urgently needed. Hence we could derive corresponsive medication and psychiatric treatment.

3. What is the answer the author offered?

He did not offer a specific theory resolving the different findings on aging effects on decision making, yet he built a framework explaining how neural selectivity reduces with age, which is consistent with current studies.

4. How did he derive the answer?

The author reviewed on recent studies of the difference between young and old adults in decision-relevant neural network structure and brain function. Although the studies show mixed results in risk-tolerance. In contrast with the obtuse response shown by elders in feedback-adaptation studies. Probability of dissociable mental process over positive and negative feedback makes the mechanism even more complicated. Besides, the author drew a comparison among drug addict and ADHD to separate the question into 2 parts. Risk-tolerance and Feedback learning. Finally, he concluded that older are not more risk-averse or risk-seeking than the young adults. Actually, the older conducted inferior performance in both risk/probability measure and valuation.

Terminology:

AIM framework: Neural system consisted of 3 separate and cooperative circuits dealing with affect, integration and motivation respectively, which are considered relevant process of decision-making; Fig 2

fMRI: A type of MRI that usually detects the amount of oxygen being brought to a particular place in the working brain.

Fronto-striatal circuit: In supplement, fig 3

Neural selectivity: Difference in neural response to different type/range of stimuli.[1]

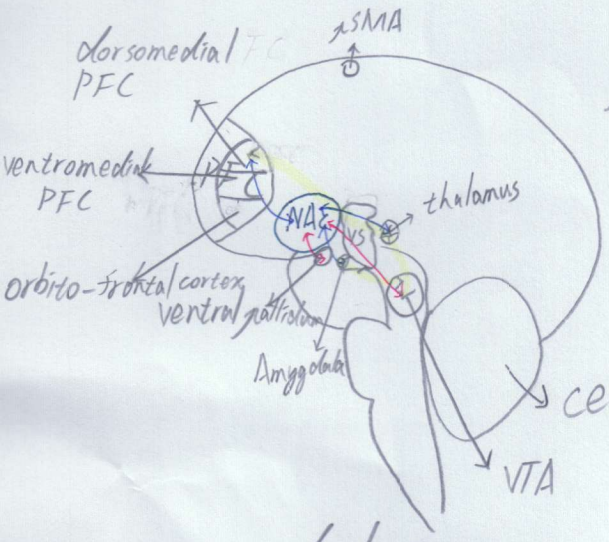
Reference:

Psychology in context 3rd, Stephen M. Kosslynn & Rolin S. Rosenberg
Reference for supplementary material listed in the end of each page.

[1] Unsure, no formal definition found online. By the Y. Liu & B. Jagadeesh (2007, Journal of Neurophysiology), this might be the proper idea for this article.

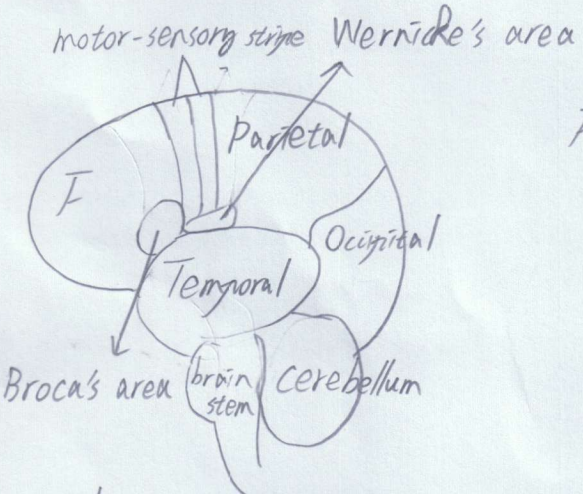
Fig. 1 Reward Circuit & Temporal anatomy of brain

NAc : Nucleus Accumbens
mPFC : medial prefrontal cortex
pSMA : pre-supplementary motor area
VS : ventral striatum
VTA : ventral tegmental area



medial view

Glutamate neural activity
GABA neural activity
dopamine neural activity



lateral view

F : Frontal cortex

ref:

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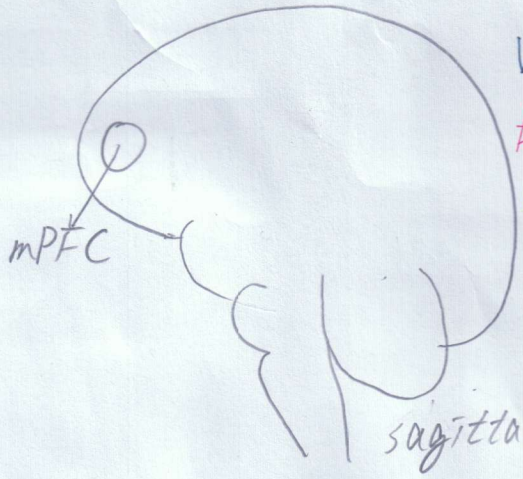
Fig. 1 Affect - Integration - Motivation framework, and how they co-work.

a. affect

coronal view



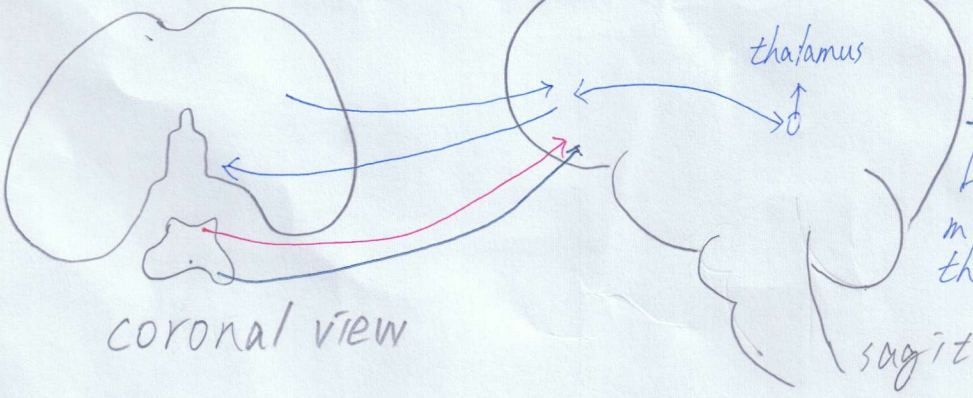
VTA ⟼ VS

~~AI ⟹~~ IC ⟼ AI

AI ⟼ VS

sagittal view

b. Integration



~~VTA, IC ⟹ mPFC~~

VTA ⟼ mPFC

IC ⟼ mPFC

AI ⟼ mPFC

mPFC ⟼ VS

thalamus ⟷ mPFC

coronal view

sagittal view

rSMA: rre-supplementary motor area

GABAergic: neurons rproducing gamma-Aminobutyric acid → Dopamine → Noradrenaline

rrimarily working as inhibitory neurotransmitter → Glutamine

AI: anterior insula

IC: locus coeruleus

VTA: ventral tegmental area

VS: ventral striatum

NAc: nucleus accumbens

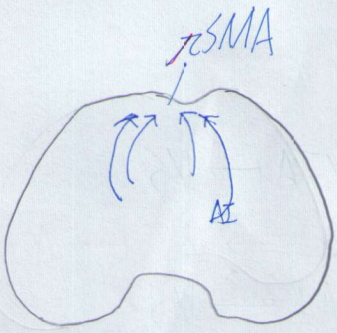
Affect:

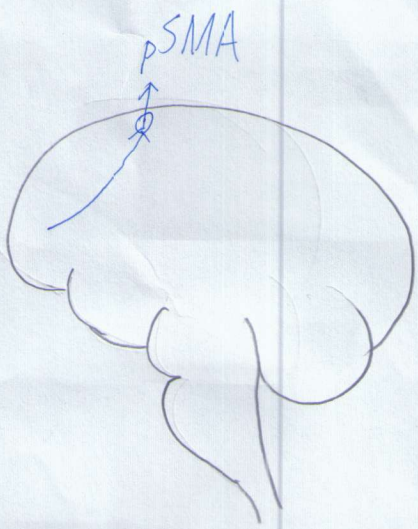
Integration:

Motivation:

Reference: Review article, Nature May 2015, vol. 16, r.280

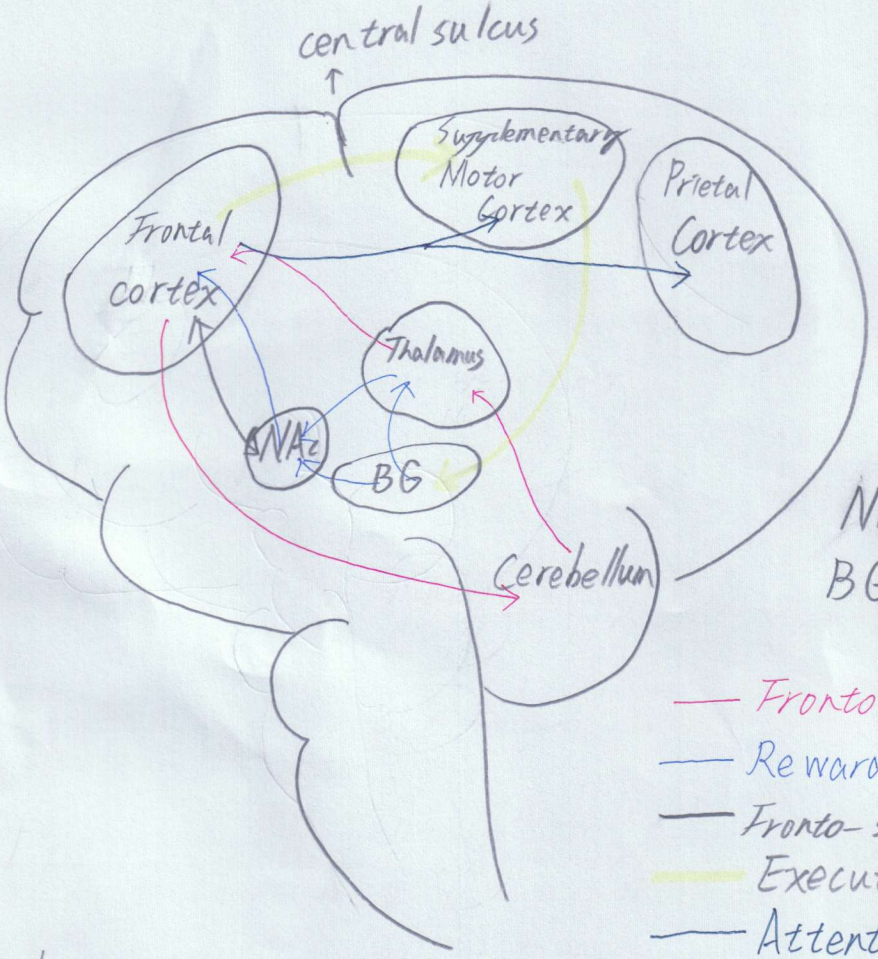
C. Motivation





Dorsal striatum ⟼ rcSMA
Insula ⟼ rcSMA

Fig. 3



NAc: as before
BG: basal ganglia

— Fronto-cerebellar
— Reward
— Fronto-striatal
— Executive function
— Attention

Neural circuits in function

ref. Nature official website