Decide Already!
Starring: ventral Striatum
Recall - Neuroeconomics evaluation process

Stages in decision making process:
1. Problem is represented in the brain
2. Brain evaluates the options
3. Action is selected
4. Evaluate the results of our actions

Interaction of emotional & cognitive systems
EVALUATION STAGE IS THE MOST CRITICAL!

→ Think utility maximization

We will tend to select the option with the highest expected utility.

If we understand this, we can predict decisions!
1. It is all about VALUE
How does one assign value?
1. Objective valuation? 

price →

value for music fan vs value for sports fan? 

*real values are subjective

price: $200
Expected Utility Theory:

EU is the weighted average of all possible outcomes, with the weights being assigned by the probability of outcomes.

This means that we integrate the probabilities of the outcome and the expected values of the outcome.
Prospect theory:
Both the values AND our estimates of probabilities are subjective!

\[ U = \sum w(p) v(x) \]

- \( U \leftarrow \text{expected utility} \)
- \( v \leftarrow \text{function that assigns a value to the outcome} \)
- \( w \leftarrow \text{probability weighting} \)
NeuroEconomics Utility Valuation:
It is the average firing rate of a population of neurons which encodes the subjective value of the object.

The neuronal firing pattern is what predicts choices.

Subjective Value = \( r(firing \ rate) = \sum_{n} r_n/n \)

recall: DA system \( \rightarrow \) rewards.
To eat the apple, or not eat the apple. That is the decision to be made. 😊
To eat the apple, or not eat the apple. That is the decision to be made.

N. Accumbens (v. striatum) activation encodes its anticipated value gain magnitude.
Recall, the NAc neurons only fired when the monkey touched a rewarding obj.

It is important to remember that the neurons do not fire if the object is not rewarding!
Again - recall - DA neurons respond to predicted reward.

earlier stage

later stage due to predict reward

conditioned
Review

Anticipatory affect: neural correlates and consequences for choice

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‘Anticipatory affect’ refers to emotional states that people experience while anticipating significant outcomes. Historically, technical limitations have made it difficult to determine whether anticipatory affect influences subsequent choice. Recent advances in the spatio-temporal resolution of functional magnetic resonance imaging, however, now allow researchers to visualize changes in neural activity seconds before choice occurs. We review evidence that activation in specific brain circuits changes during anticipation of monetary incentives, that this activation correlates with affective experience and that activity in these circuits may influence subsequent choice. Specifically, an activation likelihood estimate meta-analysis of cued response studies indicates that nucleus accumbens (NAcc) activation increases during gain anticipation relative to loss anticipation, while anterior insula activation increases during both loss and gain anticipation. Additionally, anticipatory NAcc activation correlates with self-reported positive arousal, whereas anterior insula activation correlates with both self-reported negative and positive arousal. Finally, NAcc activation precedes the purchase of desirable products and choice of high-risk gambles, whereas anterior insula activation precedes the rejection of overpriced products and choice of low-risk gambles. Together, these findings support a neurally plausible framework for understanding how anticipatory affect can influence choice.

Keywords: anticipation; affect; accumbens; insula; reward; functional magnetic resonance imaging
Monetary Incentive Delay (MID) cued response task:

1. Subjects initially see a cue indicating that they will have an opportunity to either gain or avoid losing a certain amount of money.
2. Subjects view a fixation cross.
3. A target briefly appears on the screen – and the subjects attempt to press a button before the target is replaced by a fixation cross.
4. Outcome: subjects see the outcome of their performance on that trial and cumulative earnings.

separates anticipation from outcome.

separation of gain/loss enables one to compare incentive. 


each condition can lead to either a hit or miss outcome.
Figure 9. (a) NAcc activation elicited by anticipation of monetary gain ($) versus non-gain (zero). (b) NAcc activation time courses for large gains and non-gains (s.e.m.). (c) Correlation of individual differences in NAcc response to large gain cue and cue-elicited positive arousal (i.e. ‘excitement’; $n=24$ and $r=0.58$; Bjork et al. 2004; Knutson & Gibbs 2007).
Recall, \( U \) 

\[ U = \sum p_i v_i(x) \]

Prospect Theory: Both the values AND our estimates of probabilities are subjective!
Different populations within the ventral striatum encode the reward magnitude and probability of the outcome.
NAc. activity is proportional to the magnitude of an anticipated gain.

There are subpopulations within the v. striatum that are sensitive to reward probability and others that are sensitive to reward magnitude.

NA – nucleus accumbens = ventral striatum
**Bottom line:**

NAC activity is proportional to the magnitude of an anticipated gain.

There are subpopulations within the v. striatum that are sensitive to reward probability and others that are sensitive to reward magnitude.

**Neuronal correlate of expected utility**

- \( U \) = expected utility
- \( v \) = function that assigns a value to the outcome
- \( w \) = probability weighting

**Prospect theory:**
Both the values AND our estimates of probabilities are subjective!

**Formula:**
\[
U = \sum w(p)v(x)
\]
Neural Predictors of Purchases

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SUMMARY

Microeconomic theory maintains that purchases are driven by a combination of consumer preference and price. Using event-related fMRI, we investigated how people weigh these factors to make purchasing decisions. Consistent with neuroimaging evidence suggesting that distinct circuits anticipate gain and loss, product preference activated the nucleus accumbens (NAcc), while excessive prices activated the insula and deactivated the mesial prefrontal cortex (MPFC) prior to the purchase decision. Activity from each of these regions independently predicted immediately subsequent purchases above and beyond self-report variables. These findings suggest that activation of distinct neural circuits related to anticipatory affect precedes and supports consumers’ purchasing decisions.

N. Ac. Predicts shopping decisions.