

Lecture 10: Decisions

Insula - self-awareness of negative impact, negative emotions, e.g. disgust; cost/risk/pain

- Insula firing more = reduced perceived value (increased cost)
- Another signal (together with NAcc) that feeds into the decision making
- All conceptual costs are accounted in the decision, not just price (e.g. risk)

Q. If we can locate the neural regions linked with reward magnitude and also those linked with cost/risk in both financial and psychological forms, can we determine choice?

A. **Not reliably.** Need to incorporate other factors as well e.g. context of the decision

Framing and decision-making

Scenario 1:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

Scenario 2:

If Program C is adopted, 400 people will die.

If Program D is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

Response towards a guaranteed outcome vs. risky outcome

- **Value = (benefit + cost) x risk** (or some other form of equation where risk is incorporated)

All options provide identical value - 200 people will be saved.

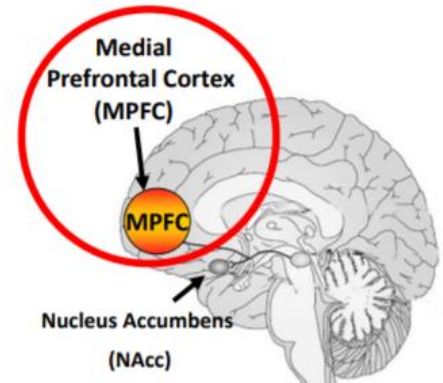
- In scenario 1, people prefer the guaranteed outcome over the outcome that has a risk associated with it.
- In scenario 2, people prefer the more risky option.
- People make decisions very differently based on the **context of the decision**
 - **People are risk-averse in seeking gains**
 - **People are risk-seeking to avoid losses**

Prospect theory / Framing effects

- Not just benefits and cost, but decision is made depending on the context
- Decision-making influenced by the framing of information used to make decision.
- So...costs and benefits used in the value process are framed within a decision-making context.
- Context frames the decision

Neural regions linked with framing

- **Medial prefrontal cortex (MPFC)** – reward circuit region with crucial role in assessing and integrating emotional and other implicit information during decision-making.
- How do decision frames influence MPFC role in integrating value signals?
 - Takes in all the signals from insula and NAcc
 - Weighting the signals depending on the context (are we chasing gain or avoiding loss)

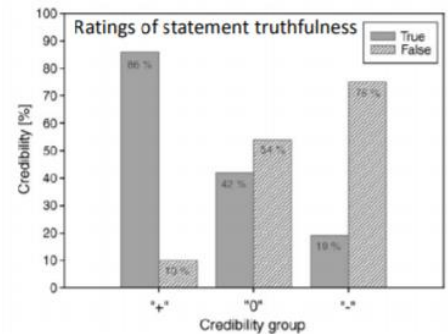
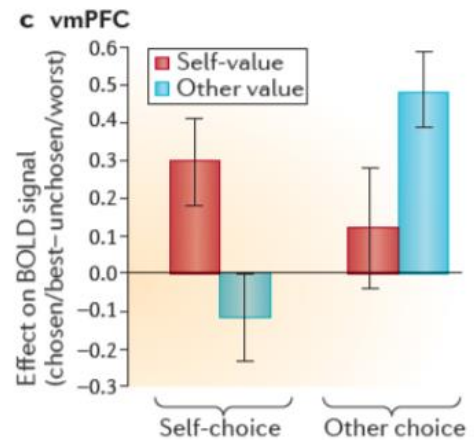


Framing effects

- Framing effects influence valuation processes that underpin consumer behaviour
- **The endowment effect**
 - **The tendency to place greater value on items that one owns**
 - E.g. when you test drive a car, you perceive an increased value of that car
 - Likely to be due to loss aversion: the tendency to weigh losses more heavily than gains of similar size
- Knutson et al (2008) examined fMRI responses associated with the endowment effect
 - Aim: identify brain regions that mediate the influence of decision frames (buy/sell) on value-based decisions
- As in previous research, **NAcc** linked with product preference, but no influence of buy/sell frame on NAcc
- fMRI responses to product prices in prefrontal cortex reversed for **buy vs. sell frames**
 - **MPFC** more activated by:
 - low prices in buy condition (value increases due to lower cost)
 - high prices in sell condition (value increases because price is now a benefit)
 - **MPFC** takes **NAcc** and **insula** signals and combine it together with decision frames to influence decision
 - **MPFC** integrates contextual factors (such as decision frames) in decision-making by **weighting** value cues

What influences context?

- Value is **socially influenced** - Magnitude of value signals in the reward circuit are dependent upon the social frame of reference
 - eg an outcome with higher self-value compared to other person evoked higher subjective value signal when making choices for self
 - When making choices for others rewards value signals increase in proportion to others reward value compared to self
- Framing effects are also driven by **brand associations**
 - Deppe et al (2005) examined fMRI responses linked with individuals' susceptibility to framing information from more or less credible newspaper/magazine brands.
 - During fMRI scans, participants rated the truthfulness of statements that were **sourced** from reliable or less reliable news sources
 - Susceptibility to the influence of the magazine brand was linked with activity in the MPFC.
 - The more the person was affected by branding, the more MPFC was involved in the decision**
 - MPFC involved in framing information to guide decisions



Reward probability

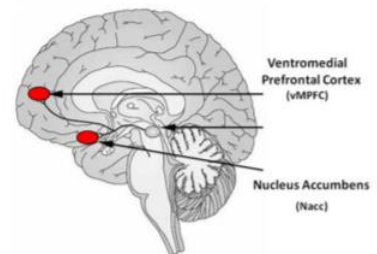
- value = reward magnitude x reward probability**
- MPFC** also integrates reward probability in value signals
- Assigning value engages reward circuit regions associated with both reward size (**NAcc**) and probability (**MPFC**)
- In consumer decisions, **MPFC** integrates gain and cost with environmental context to guide decision-making
- MPFC** integrates signals from regions including **NAcc** and **Insula** to guide decision
 - MPFC** *activated* during choice for chosen product
 - MPFC** *de-activated* in advance of not choosing product
 - Higher/bigger signal wins

Reward magnitude

&

Reward probability

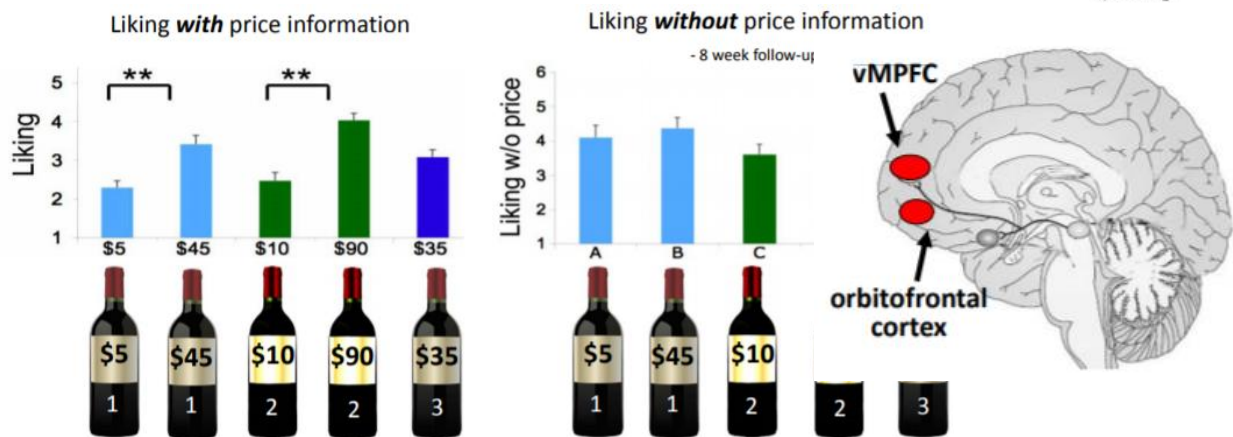
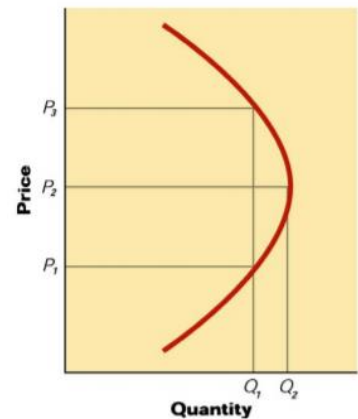
Reward circuit



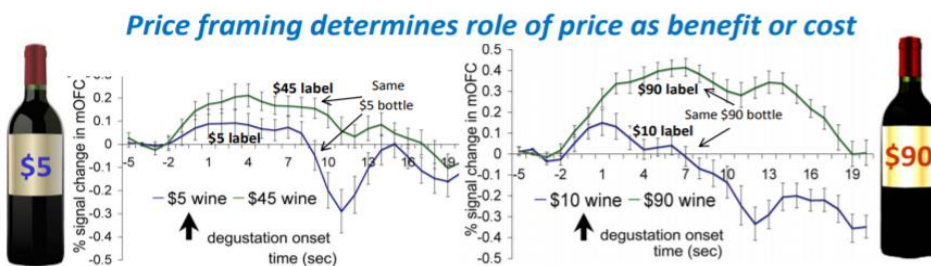
Prestige pricing

- When value judgements are difficult to make based on explicit product cues (e.g. judging wine quality), how does price influence neural signals of value?
- Price can indicate benefit/quality
- But higher price doesn't always equal value
- Wine price information significantly impacted on wine ratings
 - Price Labelled: More expensive = Significantly more liked
 - Price not identified: No effect of previous price/quality link

Prestige pricing demand curve

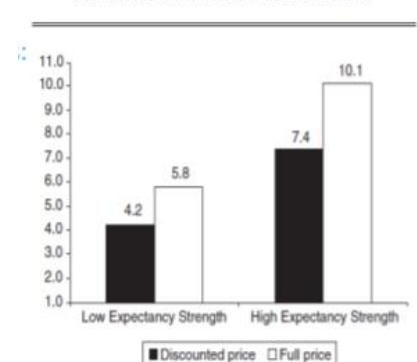


- Wine price information significantly influenced frontal lobe fMRI responses
- Higher priced version of wine linked with increased preference and fMRI increases in:
 - VMPFC and Orbitofrontal cortex (indicative of the level of pleasantness of the experience)
 - Insula not activated for higher price - price is now regarded as a benefit not cost



Energy drink impact on behaviour

NUMBER OF PUZZLES SOLVED: EXPERIMENT 3



Price/quality signaling

- fMRI findings show that price signals influence brain regions linked with actual **experienced pleasantness**
- (NB: for our purposes relevant regions equivalent to MPFC region)

- Among other roles, areas that responded to higher priced wine are involved in linking emotional responses with sensory experience
- strongly connected with **olfactory system**

Cueing consumer expectation

- Consumer expectations impact on consumer experience (likely via **Nacc** and weighting of **MPFC** value signals)
- **Expectations of affective ratings shape subjective ratings of experiences**
- Price and promotion-based expectations determine energy drink performance
 - High expectancy or low expectancy (packaging had different claims on its strength)
 - Number of puzzles solved doubled for stronger expectancy
 - Placebo effect
 - Drinks on discounts were devalued (less puzzles solved)
- **Extrinsic product factors shape ratings of intrinsic qualities**

Expectations shape experience

- Cueing consumer expectations with the marketing mix impacts on the consumption experience itself
- Product consumption experience driven by
 - **Bottom-up attention** (physical dimensions of the experience)
 - **Top-down attention** (experience driven by what is expected).
- fMRI research shows that top-down attention processes guided by the marketing mix can **alter the actual experience of product consumption itself**
- When do top-down effects of marketing mix impact most on consumption experience?

Product categories

 - When search behaviour & trial does not increase certainty about likely product performance
 - When product performance varies
 - Lack expertise - therefore extrinsic cues bias our decision
 - Service products
- **NB!!! Consumer Satisfaction** depends not only the performance of a product, but also on satisfactory comparison with the expectation of performance – beware of setting expectation that cannot be matched by top-down influence on consumer experience!

How well does **MPFC** predict decision making?

- Behaviour change in response to sunscreen messages or quit smoking advertisements was predicted more accurately by functional magnetic resonance imaging (fMRI) data than participants' own predictions
- medial prefrontal cortex (**MPFC**) was reliably associated with behavior change ($r = 0.49$, $p < 0.05$)
- **fMRI responses at MPFC may predict consumer response more accurately than conscious/explicit measures such as interviews or surveys**

Signals used in decision making

- Neural signals in **MPFC** appear to underpin choices.

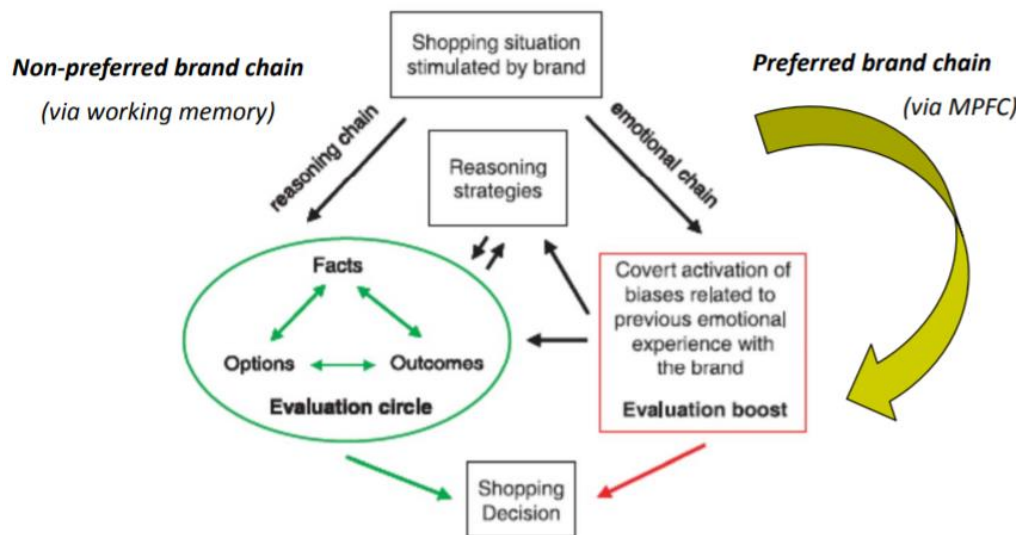
- However, other brain areas (such as those involved in self-control) may also modulate **MPFC** signals

Brands and reward circuit

- **Media prefrontal cortex (MPFC)** strongly linked with influence of brands on decision-making
 - e.g. MPFC activated more strongly by luxury or sports brands than 'value' brands
 - Luxury and sports brands linked with greater MPFC response
 - 'Value' brands activate frontal areas linked with information processing
- **vMPFC** damage abolishes brand effects
 - With a series of Coke and Pepsi taste tests we show that patients with damage specifically involving ventromedial prefrontal cortex (vMPFC), an area important for emotion, did not demonstrate the normal preference bias when exposed to brand information

MPFC supports emotional basis for brand choice

- **Evaluative conditioning** impacts on consumer decisions by moderating the affective (**somatic**) marker signal linked with a brand



Further insight from **temporal discounting** (immediate rewards vs. delayed rewards)

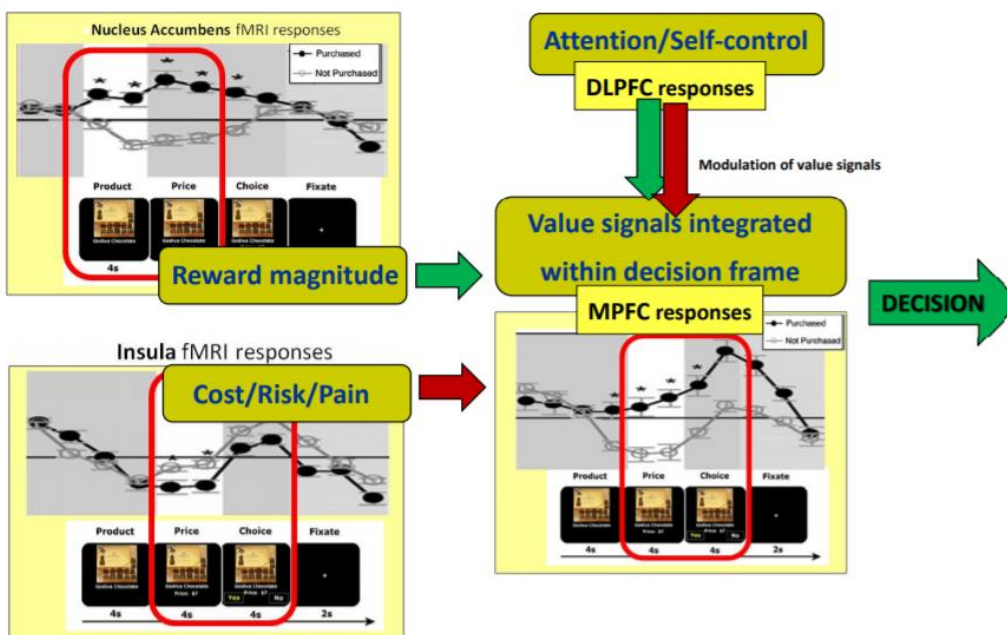
- A unique temporal discounting project used a powerful magnet (i.e. Transcranial Magnetic Stimulation, or TMS) to disrupt activity from specific neural regions during value/time decisions
- Disruption of the same brain regions that mediate working memory and explicit information processing (lateral prefrontal cortex) increased choices of immediate rewards over delayed rewards
- **Implications: Specific brain regions support self-control over impulsive drive for immediate rewards**

Self-control biases MPFC signals

- **Working memory** puts 'the brakes' on (self-control) - another signal feeding into **MPFC**
- Self-control biases weight assigned to value signals in **MPFC** e.g. Focus on health related aspects of food increases the weight that healthiness receives in the MPFC value signals
- Signals from the same brain regions that mediate working memory (**dorsolateral prefrontal cortex**, or **DLPFC**) bias value signals in MPFC

Cognitive biases

- Cognitive biases lead to shifts in relative balance of value signal inputs from different sources
- We try not to give cognitive resources when we don't have to
- Cognitive miser bias – the tendency to default to the processing mechanisms that require less computational effort, even if they are less accurate.
- Promotes weaker involvement of **DLPFC** in value signals
 - Working memory wants to be efficient - doesn't come on readily
 - Survival is now, not tomorrow
 - It's hard **not** to consume (now vs. tomorrow)
- **Implication**
 - Make the default option the choice people want to make
 - People don't want to do otherwise/ put extra effort to choose otherwise



Brands mediate involvement of value signal sources in decision-making

- Brands cue predicted value:
 - emotional/implicit brand influence on preference via **NAcc**
 - deliberative/explicit brand influence on preference via **DLPFC**
 - cost signals via **Insula**

- Brands bias experienced value and **frame the relative impact of benefit** (magnitude and probability) **and cost signals** on the decision-making process via **MPFC**
 - Framing role of brands weights value signals originating in reward system (**NAcc**), **insula**, and **DLPFC**
 - Note strong connection between **MPFC** and emotional influences on behaviour via somatic markers – expect emotions to heavily influence brand value weighting

Wanting versus liking

- **Liking** relates to hedonic experience - **conscious expression of wanting**
 - pleasure or happiness experienced in relation to something
 - can be expressed through explicit preference statements
- **Wanting** relates to the drive to approach or avoid - **subconscious drive**
 - relates to the amount of work or effort to obtain/avoid
 - driven by subconscious processes = less validly expressed through explicit preference statements
 - **We can want without liking**, e.g. addiction, powerful motivation to approach/consume driven by reward system (eg **NAcc**) independently of hedonic response
 - **NAcc** drives consumption even if you don't like it
- We intuitively link both liking and wanting with choice - but how much influence does each of these have on our decisions?
 - **Reward system research shows that hedonic response to rewards (ie liking) drives choice less powerfully than the subconsciously driven 'wanting' response**
 - Berns and Moore (2012) played unknown music clips to 32 adolescents while capturing fMRI and explicit liking ratings, then tracked sales over 3 years
 - subjective ratings of songs did not correlate with future sales, the activation within the **NAcc** did
- Wanting and liking seem to go hand in hand but in actuality are driven by **separate neural systems that perform different roles**
 - reward value and **dopamine**
 - the value of rewarding stimuli is signalled by an increase in the neurotransmitter **dopamine** in brain regions linked with motivation (eg **NAcc**).
 - More **dopamine** = greater influence of a stimulus on impulsive behaviour
 - eg Parkinsons drugs that increase dopamine levels increase gambling behaviour!
- Value signals in the brain provide a flexible and efficient **neural currency** that underpins choice.
 - Remember: the brain uses a **relative** coding system to efficiently code value.
 - **Divisive normalisation** focuses on the **differences** between decision options to code value - biggest signal wins
 - Too many options means this system doesn't work as efficiently

- Relative neural coding (divisive normalisation) that underpins efficient decision-making doesn't always support optimal choice – the system is not designed to cope with the sheer range of choice options in modern consumer environment / difficulty computing the relative value (neural currency).
- **Implication: Limit choice options to enhance decision quality!**

Example: Webb, Glimcher and Louie (2016).

