CEMS Webinar Series

March 20th, 2020

13:00 CET

Ewa Miendlarzewska | *Homo oeconomicus vs. Homo sapiens*

Ewa Miendlarzewska graduated from CEMS International Management at Bocconi University and University of St. Gallen in 2007.

Ewa is currently Associate Professor in Neuroscience and Management at the International Business School Geneva and Lecturer at the University of Geneva. She teaches Psychology of Finance and created the course "Neuroscience for Managers" that aims to endow future business leaders with understanding of human nature, to develop future imagination and prepare them for ambiguous problem-solving. Her research areas include neuroscience of emotions, decision making and learning, and agility in management. She promotes a humanistic future of work, in harmony with (human) nature, that embraces more empathy, self-awareness, distributed decision making and a shift in value to social and environmental impact.

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CEMS Webinar Series

Homo oeconomicus vs Homo sapiens with Ewa Miendlarzewska

March 20th, 2020

13:00 CET

Agenda

- Neuroscience of decision-making in economics and neurosciences. Rationality, value (moral) & emotions.
- Q&A session

Ewa Miendlarzewska, PhD

Associate Professor of Neuroscience & Management,
International Management School Geneva (*Chair Mutation & Agility*)

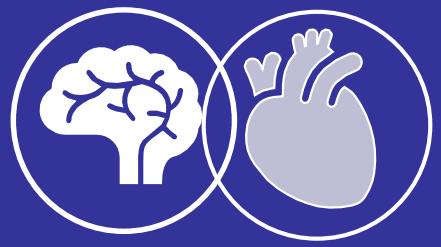
Lecturer "Psychology of Finance"
Geneva Finance Research Institute, University of Geneva

Sci-fi writer "Project Unison: Mirador de la Memoria" published by ProdigyGoldBooks

Academic and Applied Research 2009 - now	• International Management School Geneva • Geneva Finance Research Institute • University of Geneva, Maastricht University
Corporate 2007-2011	• Scientist at Philips Research • Business Development at Philips Medical Systems
Education	• CEMS MSc in International Management Bocconi/HSG 2007 • Bachelor Economics & Management • IB in Wroclaw, Poland 2002

@miendlarzewska

About me
study of how humans make economic and financial decisions through neuroscience



Human nature and behavior

- Teaching future decision makers
- Ethical Finance
- Future speculation; we shape the world
  thebusinessromanticsociety.com

Science communication

- Science-fiction novels
- Collaboration with artists
  - Film
  - Ceramics
  - VR
  - Ballet choreography

Application

- Executive education
- Master classes, workshops
- Applied research
  - Accessible finance
  - employability

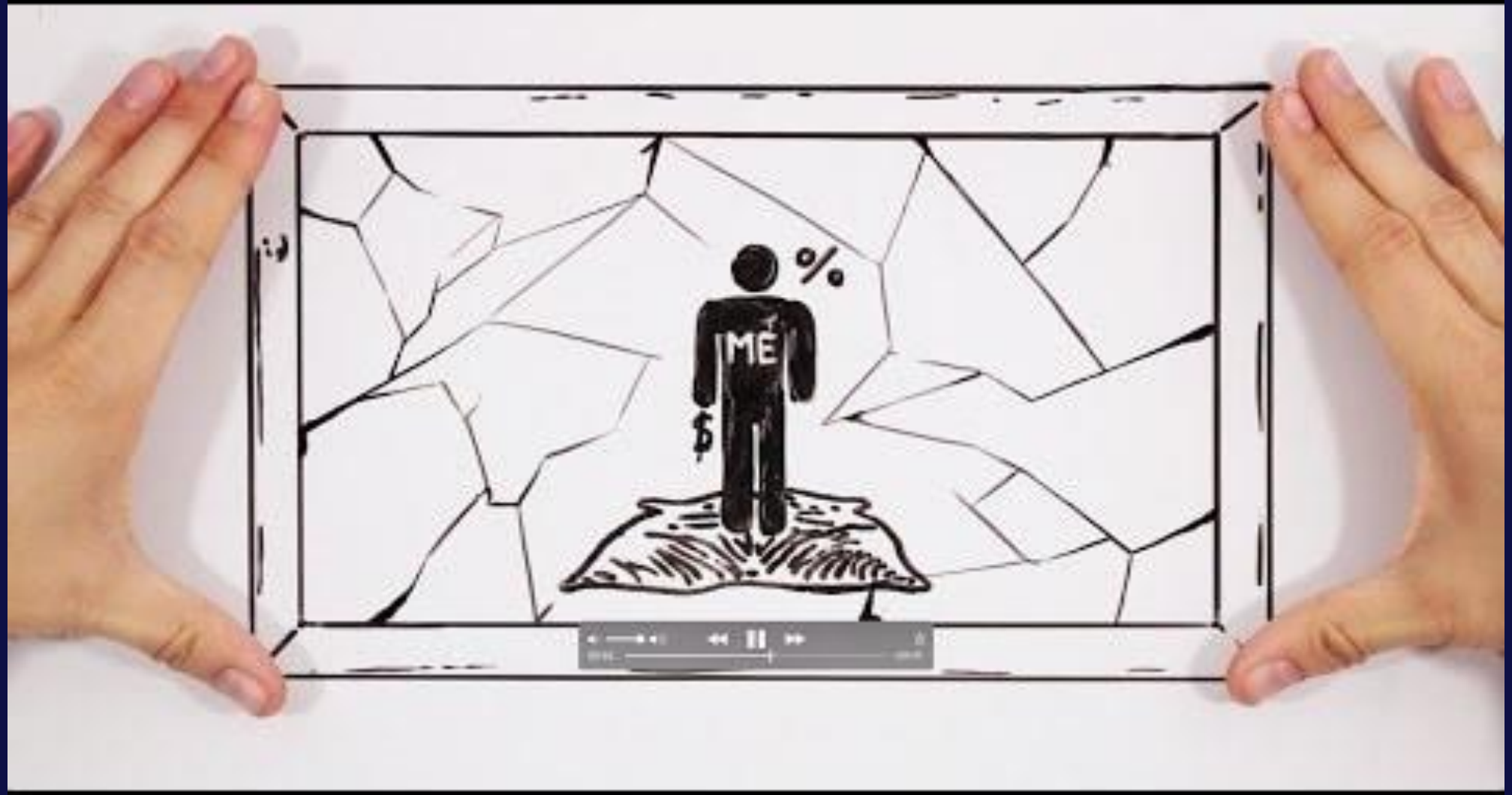
Objectives

1. Why is knowing how the brain works important?
   - The world is changing very fast. It poses ambiguous problems and offers mysterious “big data” machine learning solution-support systems.
   - In many markets, Attention is the new currency
   - Sustainability problems are big “wicked” problems that require joint, collective action
   - The world is non-linear, so are these problems, and so are we. Humans are amazing learning machines that should realize their full potential or be replaced by machines.
   - We need a paradigm shift
2. What can you learn with neuroscience?
   - Apply bio-scientific findings to support your own brain-mind hygiene and self-management.
   - Improve leadership capabilities by understanding the science of decision-making, including how neural constraints can lead to poor decisions and how to overcome them

HOMO OECONOMICUS V/S HOMO SAPIENS

WE ARE HOMO SAPIENS SAPIENS.

Who Is Homo Oeconomicus?



“Nurture Human Nature”, pp.94-128 in Raworth, Kate. *Doughnut economics: seven ways to think like a 21st-century economist*. Chelsea Green Publishing, 2017.

A Brief History Of Rational Decision Making

- 1944 **Von Neumann & Morgenstern** (mathematicians) outline the theory of expected utility. Based on a game of poker (risk)
- **1952 Markovitz** introduces theory of portfolio selection
- 1957 Raiffa and Howard combine it with **Bayesian statistics** (rules for changing one's probability beliefs in the face of new information) to decision analysis and business students start drawing decision trees
- For the next 30 years, Economists think that this is the way humans decide because, thanks to market forces, rational thinking will prevail. **Herbert Simon** begins to question that in the 1950s => humans have 'bounded rationality'
- 1969 - 1973 **Kahneman and Tversky** write "In making predictions and judgments under uncertainty, people do not appear to follow the calculus of chance or the statistical theory of prediction. They rely on a limited number of **heuristics** which sometimes yield reasonable judgments and sometimes lead to severe and systematic errors."
  - Over the years they assemble a list of these decision-making flaws called biases…
  - Yes, they show that human choices are not well described by the rational-agent model
- 1980s Gerd Gigerenzer argues that we shouldn't dismiss all of heuristics, gut feelings and snap judgments, intuitions, as necessarily inferior to probability-based decision making statistics.
  - "When there's a lot of uncertainty, you have to simplify to be robust. You cannot optimize anymore."
    - Ecological rationality
- ~2008- **Neurofinance**: The brain represents subjective value. There's computational limitation to how the brain can decide and most rationality principle-based models are biologically **implausible** (Bossaerts & Murawski, 2017)

How Do We Make Decisions?
The Rich Story Of Decision Sciences

Normative

Rationality: the best choice is rational, given that everyone's aim is to maximize subjective utility

Descriptive

Behavioral sciences: describes the mechanisms underlying decision making

- Preferences are built from experience
- A decision takes time: drift decision model
- Mental and energetic costs
- Computational limits of the brain

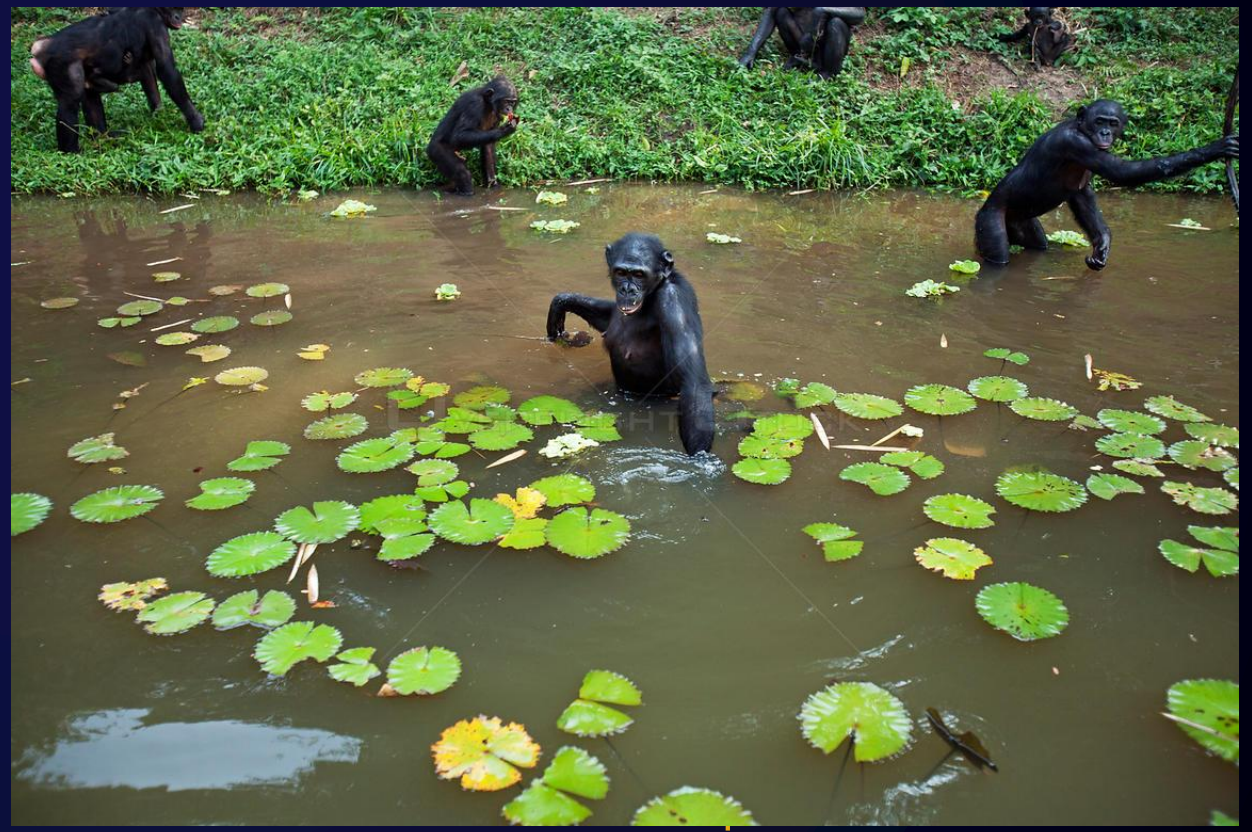
Biological Realism In Decision Neuroscience

HOMO ECONOMICUS

how we assumed we decided

HOMO SAPIENS

how we evolved to decide



Mobbs, D., Trimmer, P. C., Blumstein, D. T. & Dayan, P. Foraging for foundations in decision neuroscience: Insights from ethology. *Nat. Rev. Neurosci.* **19**, 419–427 (2018).
https://greenbookblog.org/2012/08/28/4-common-myths-about-human-decision-making/

Biological Realism In Decision Neuroscience

HOMO ECONOMICUS

how we assumed we decided

A rational agent has stable preferences and acts independently to maximize their subjective utility in the presence of complete information

Has "Irrational Biases"

HOMO SAPIENS

how we evolved to decide

1. Value (Energy)-based decisions (Foraging): decisions that contribute to homeostatic well-being
   - Competitive foraging;
   - Foraging under the risk of predation
2. Reproduction

Computational Rationality: the brain contains a set of heuristic mechanisms that evolved to make fast and accurate decisions due to computational limits.

Mobbs, D., Trimmer, P. C., Blumstein, D. T. & Dayan, P. Foraging for foundations in decision neuroscience: Insights from ethology. *Nat. Rev. Neurosci.* **19**, 419–427 (2018).
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SUBJECTIVE UTILITY

VALUE IN ECONOMICS AND IN NEUROSCIENCE

SECONDARY REWARD

PRIMARY REWARD

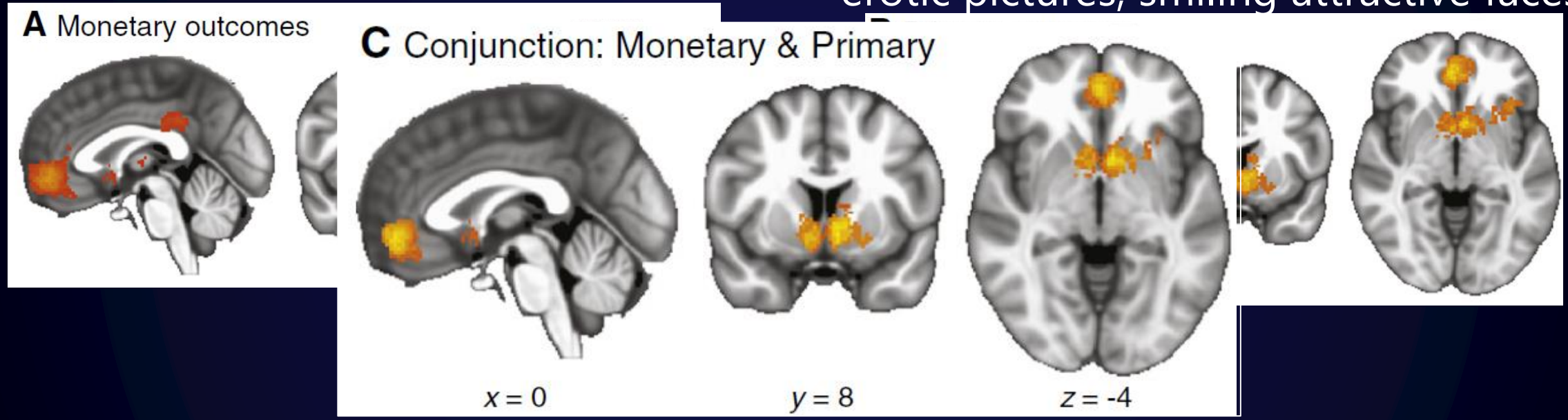
Why is money interesting to a neuroscientist?

Value For Money v/s Value In The Brain

The Brain's (subjective) Valuation System

Outcome delivery: money

Outcome delivery: food, pleasant odors, erotic pictures, smiling attractive faces



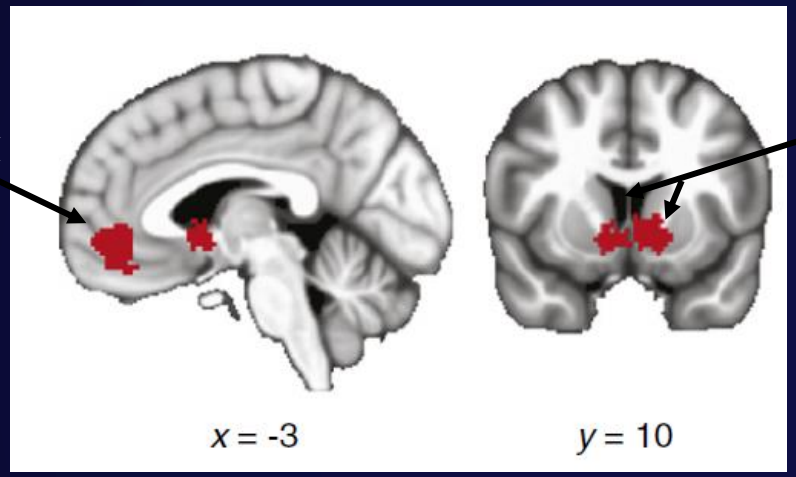
Money accumulated for later consumption

Primary rewards directly consumed in the experiment

Bartra et al., 2013 The **valuation system**: a coordinate-based meta-analysis of BOLD fMRI experiments examining neural correlates of subjective value; Neuroimage 10.1016/j.neuroimage.2013.02.063

Subjective Value As A Common Currency For Evaluating Choices

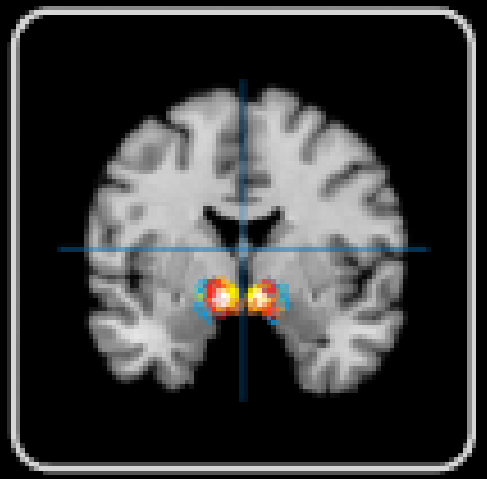
Ventro-medial prefrontal cortex (vMPFC)



Ventral striatum (NAcc + v.Pallidum)

- Brain encodes subjective value both when outcomes are received and prospectively, during decision making.
- These areas are consistently activated for subjective value across different modalities of outcomes (primary and secondary, in various sensory forms).

Bartra et al., 2013 The **valuation system**: a coordinate-based meta-analysis of BOLD fMRI experiments examining neural correlates of subjective value; Neuroimage 10.1016/j.neuroimage.2013.02.063



VENTRAL STRIATUM

Music you like
Cuddly animals
Facebook likes
Winning virtual points
Being right
Being generous
Beauty
Erotic stimuli
Curiosity, Novelty
Opiate drugs
Exercise-induced stress
Being in love
Being cared for
(Meaningful) Hugs
(Honest) Smiles
…

- Contains dopaminergic + endogenous opioid receptors
  - Rewards are Inter-changeable?
- Uncertain rewards produce higher activation
- Individual differences in reward sensitivity
- Depends on memory, adapts to counterfactuals, social norms and comparison
- Reflects future prediction (optimism/pessimism) and the unchosen option (regret)
  - Feeling poor (deprivation) is a relative state of mind?
- This computation and the resultant feeling often happen nonconsciously

VALUE COMPUTATION

Neurofinance studies how humans make decisions under **uncertainty**

HOW DOES THE BRAIN COMPUTE VALUE?

Miendlarzewska, E. A., Kometer, M. & Preuschoff, K. Neurofinance. *Organ. Res. Methods* 109442811773089 (2017).

Biological Realism In Decision Neuroscience

HOMO ECONOMICUS

how we assumed we decided

HOMO SAPIENS

how we can possibly decide

Mobbs, D., Trimmer, P. C., Blumstein, D. T. & Dayan, P. Foraging for foundations in decision neuroscience: Insights from ethology. *Nat. Rev. Neurosci.* **19**, 419–427 (2018).
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Biological Realism In Decision Neuroscience

HOMO ECONOMICUS

how we assumed we decided

A rational agent has known, stable preferences and acts independently to maximize her subjective utility in the presence of complete information.

Expected utility theory:

$EU(X)=\sum(p(x) * u(x)), \quad u(x)=\log(x)$ (ex)

BIAS

HOMO SAPIENS

how we can possibly decide

- Computational (ecological) Rationality: the brain contains a set of heuristic mechanisms that evolved to make fast and accurate decisions due to computational limits.
- Emotions are information signals and the primary currency for computing subjective value.

Biases can be attentional, emotional, cognitive, etc..
Many of the "irrational" biases in this list are defined as deviations from statistical principles.

Mobbs, D., Trimmer, P. C., Blumstein, D. T. & Dayan, P. Foraging for foundations in decision neuroscience: Insights from ethology. *Nat. Rev. Neurosci.* **19**, 419–427 (2018).
https://greenbookblog.org/2012/08/28/4-common-myths-about-human-decision-making/

Quiz: Bust Your Brain Myths

Which one is FALSE :

- We only use ~20% of our brain
- The brain continues to **develop** until age 25-30
- There is a specialized part of the brain that computes **risk** (mean, variance and even skewness)
- The brain's "cognitive" and "emotional" functions are inseparably **intertwined** during most mental processes in a healthy brain.

Uncertainty

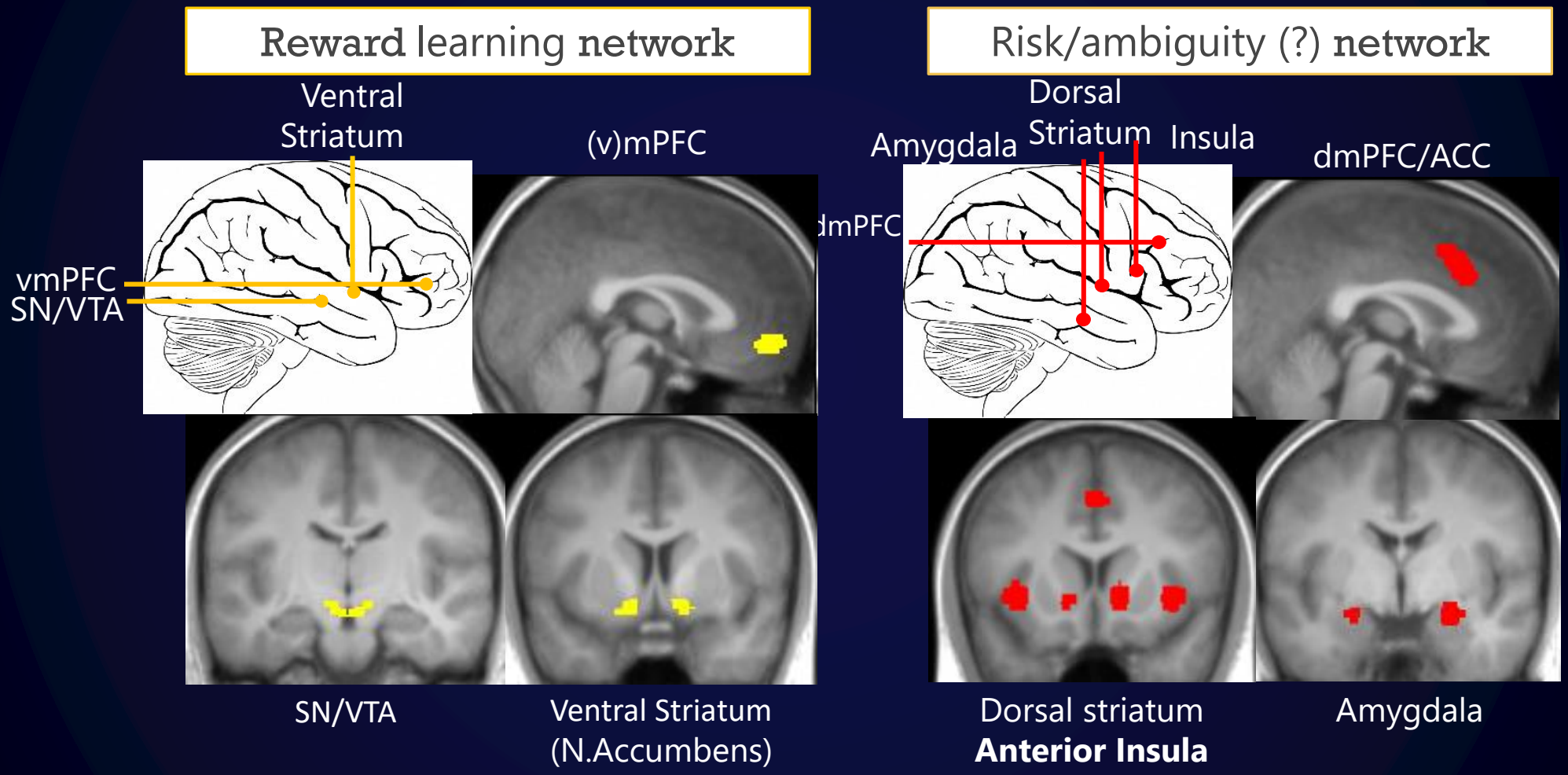
RISK	AMBIGUITY
Probabilities of outcomes objectively known (roulette) Risk: the spread of outcomes (variance) or asymmetry between the best and the worst outcome (skewness) Ex: Rationality axiom; expected value theorem	The real world! = Probabilities of outcome incompletely objectively known Ex: heuristics; belief updating models (Bayesian stats)

Level 1	Level 2	Level 3	Level 4	Level 5
Perfect Certainty	Risk	Fully Reducible Uncertainty	Partially Reducible Uncertainty	Irreducible Uncertainty
Net present value				"black swans"

$$NPV = \frac{\text{Cash flow}}{(1+i)^t} - \text{initial investment}$$

Lo, Andrew W., Warning: Physics Envy May Be Hazardous to Your Wealth!. Journal of Investment Management (JOIM), Second Quarter 2010. Available at SSRN: https://ssrn.com/abstract=1639085

The Economic Decision-Making Networks



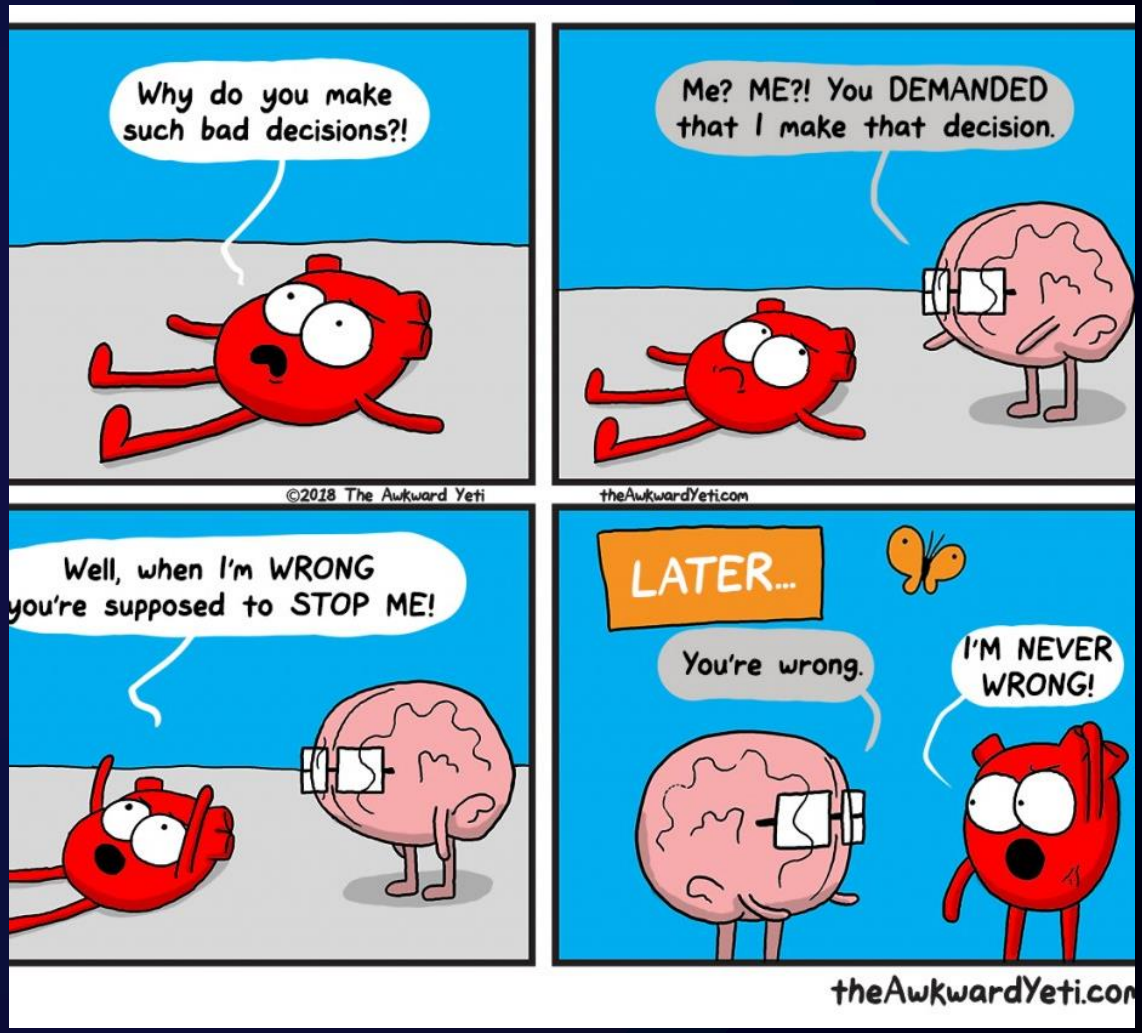
Miendlarzewska, E. A., Kometer, M. & Preuschoff, K. Neurofinance. *Organ. Res. Methods* 109442811773089 (2017). doi:10.1177/1094428117730891

BE RATIONAL.
DON’T BE EMOTIONAL?

ROLE OF EMOTIONS IN DECISION MAKING

Should We Control **Emotions** With **Cognitive** Control?

- There is no separation in the brain between "cognitive" and "emotional" functions. In fact, it sounds very odd to use these terms at all. Even investment decisions made on numbers use a distributed network of neural structures many of which tend to specialize in some emotion-related processing.
  - "Emotional Intelligence" is controversial (psycho, not neuro)
- There is no such thing as reptilian, mammalian and human brain that supposedly sits above and controls the other two brain layers…



Is financial decision making a battle of emotions with cognition?

Emotions form the basis of decision making and are radically goal-oriented.

However, the brain did not evolve them to make financial decisions

- **Ventral Striatal** (NAcc) activity should predict approach
- **Anterior Insula** activity should predict avoidance

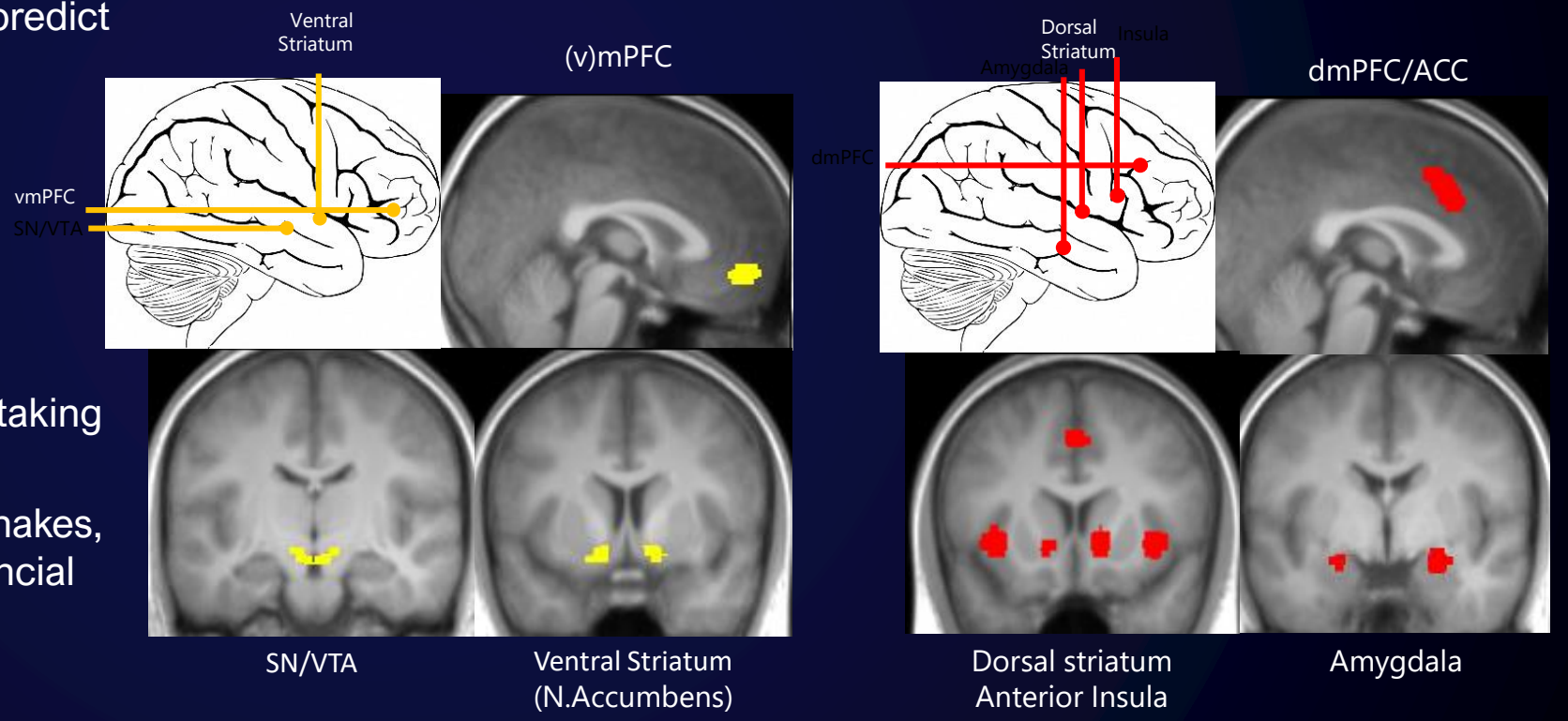
- But also:
- ✓ Incidental stimuli that increase positive arousal should encourage financial risk taking (attractive faces; erotic stimuli)
- ✓ stimuli that increase negative arousal (snakes, mutilated bodies) might discourage financial risk taking, even when those stimuli are irrelevant to the task at hand.

Approach

Avoidance

Reward learning **network**

Risk network



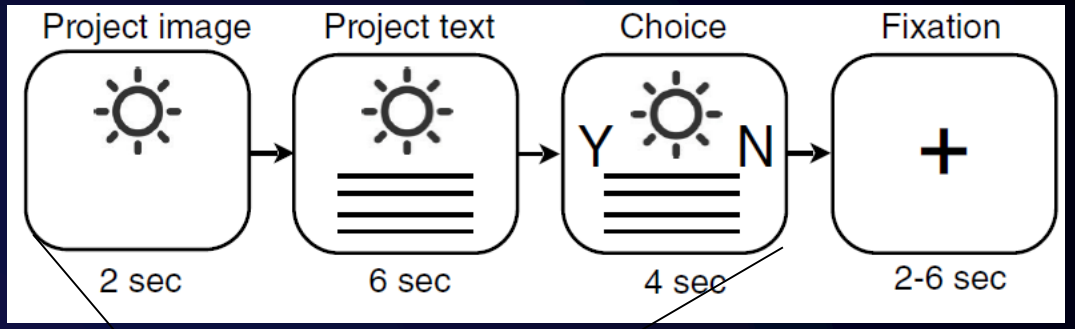
Miendlarzewska, Kometer & Preuschoff, 2017, *Neurofinance,* Org Res Methods
http://journals.sagepub.com/doi/10.1177/1094428117730891

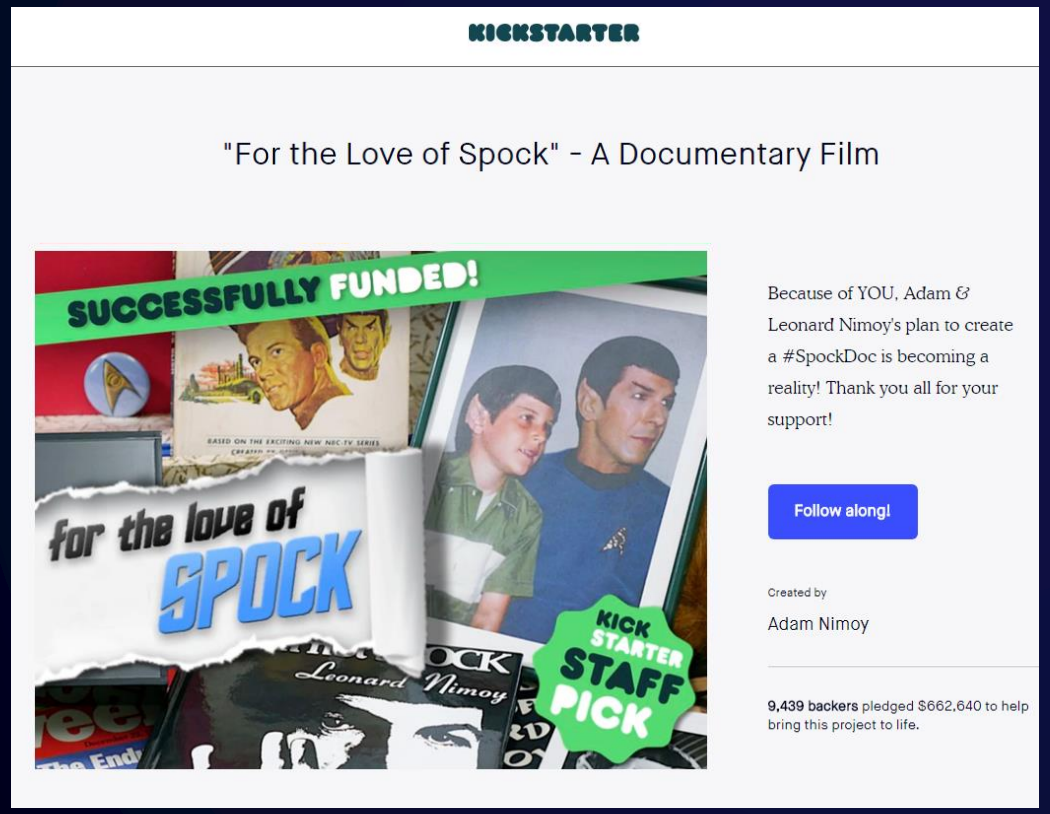
Neuroforecasting: Towards Market Decision Prediction?

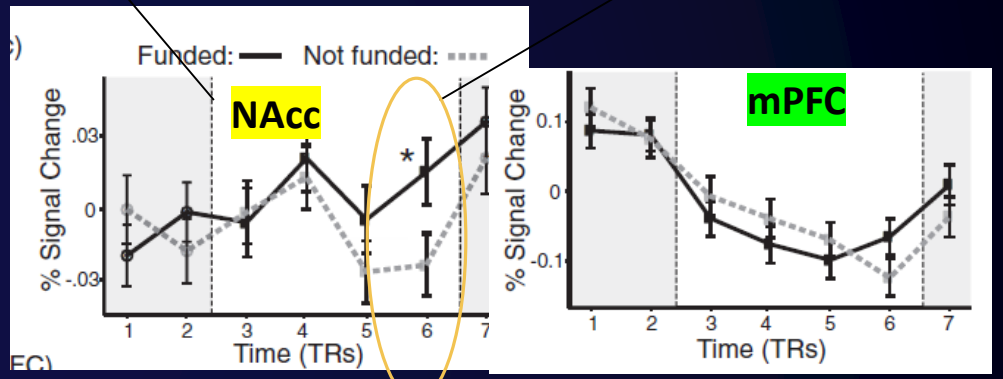
- Traditionally, an individual's past (behavioral) choice is a best predictor for future choice
- The efficient-market hypothesis implies that individual choices should "wash out" at the aggregate level, such that no individual's choice provides information about future market behavior (Fama,1970).
- But there is hidden information in brain activity that can predict group choices better than subjective ratings.
- Can we come up with better models of decision making than Markowitz's Modern Portfolio Theory (1952)?

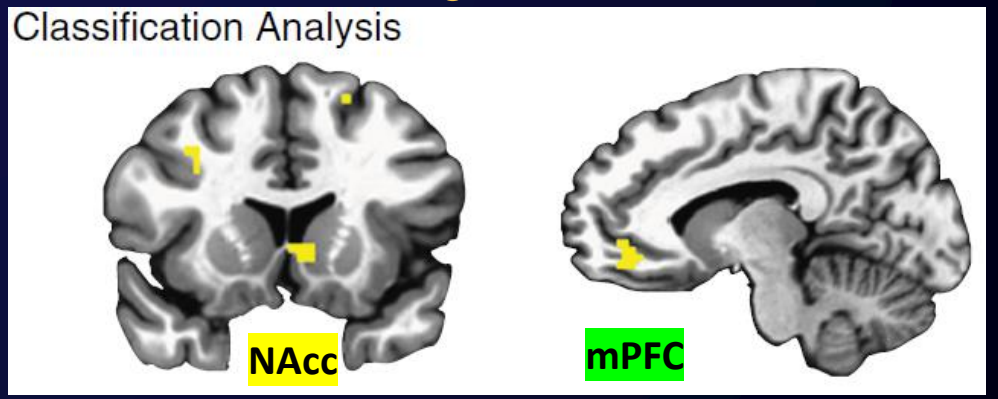
Predicting Crowd-funding

Contrasted trials with campaigns that later got crowd-funded (18) and those that didn't (18) within pre-specified regions of interest









Genevsky, A., Yoon, C. & Knutson, B. When brain beats behavior: Neuroforecasting crowdfunding outcomes. *J. Neurosci.* **37,** 1633–16 (2017). 10.1523/JNEUROSCI.1633-16.2017

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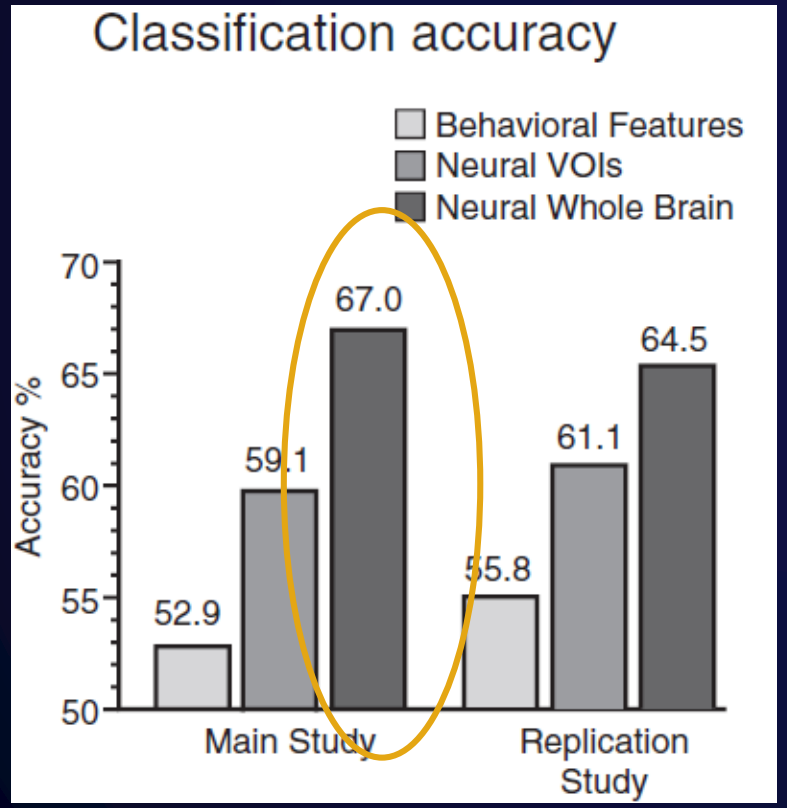
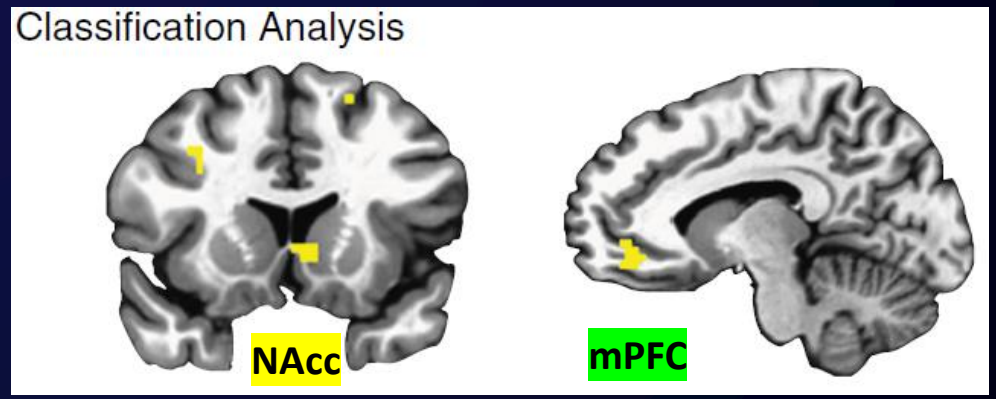


- Subjects chose to fund 14.3/36 projects
- mPFC and NAcc activity predicted individual choices
- But only **NAcc activity generalized to predict market funding** weeks later (kickstarter.org)
- Ratings of liking and perceived probability of success were correlated with individual choice
- But behavioral measures from the participants did not forecast market funding



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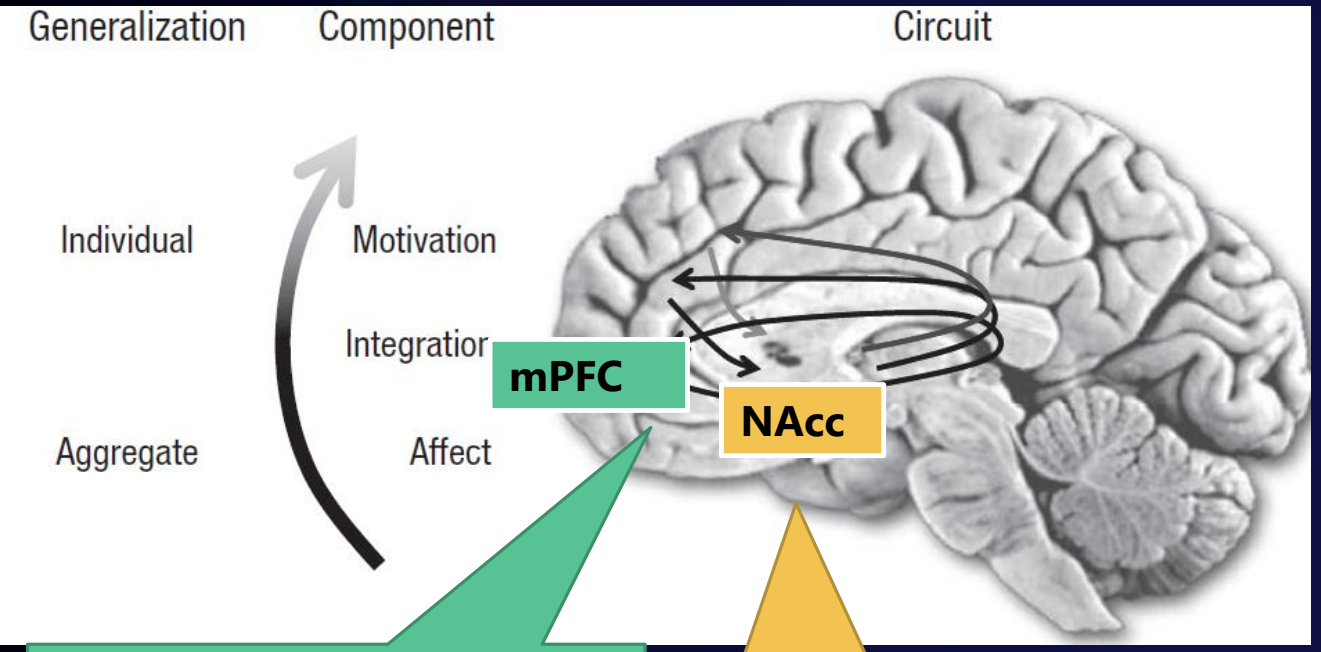
Affect-integration-motivation Framework (AIM)



Rationalizing choice (Value Integration)
- Personal goals
- Learning from others
- Probability, risk, time

Affective evaluation
- Liking
- Probability

- While both affective and integrative components might support individual choice, **affective components may generalize more broadly across individuals** than **integrative components**, which instead should show more precise sensitivity to idiosyncratic **goals** and contexts.
- Identifying which choice components best forecast aggregate choice could indicate the **most salient features of associated markets**

Knutson, B. & Genevsky, A. Neuroforecasting Aggregate Choice. *Curr. Dir. Psychol. Sci.* 96372141773787 (2018). doi:10.1177/0963721417737877

PARADOXES OF SUBJECTIVE UTILITY : ALTRUISM AND MORAL VALUE

CAN WE MODEL MORALITY?

PRIMARY REWARD

SECONDARY REWARD

Moral Value

Economic Models Of Prosocial Behavior

Motivation:

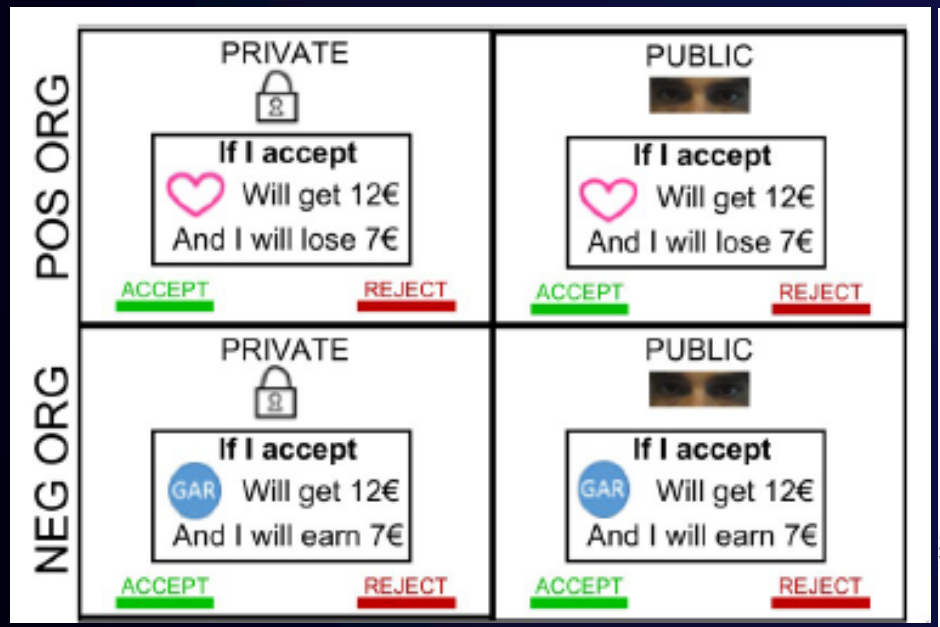
- extrinsic (the material rewards associated with the action)
- intrinsic (the moral benefits associated with the action)
- attached to image (the concerns for what others think of us)

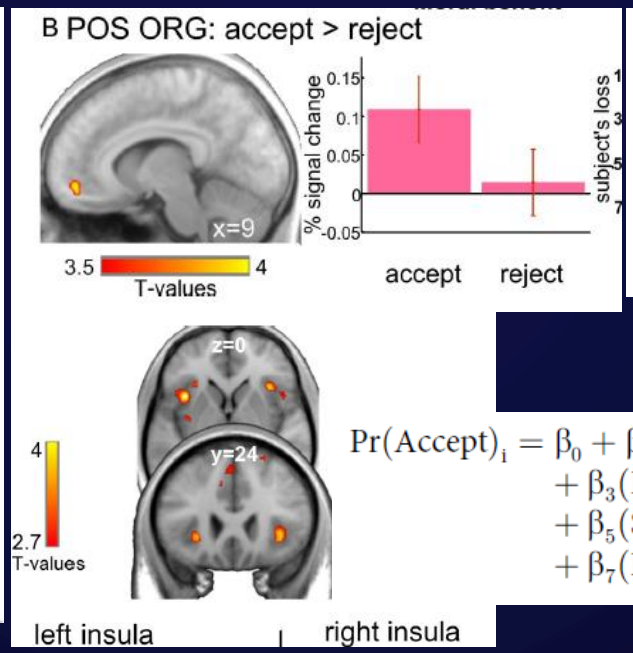
- How many decision making systems does the brain have? Separate for monetary, primary, moral values?
- Has the brain evolved a mechanism that incorporates moral values into a Decision Value?
- How do we model this computationally?

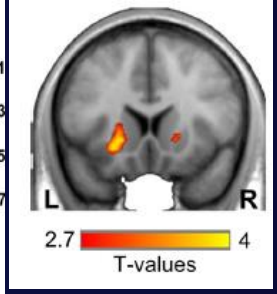
According to these models, humans exhibit preferences for dishonest or prosocial behavior not because they are intrinsically bad or good but because they weigh a mixture of these different sources of motivation.

The Dilemma Task

- Decision Value = weighted Monetary Benefits – Moral Cost
- Donating money to an organization for personal gain (monetary reward)
  - in one case, such a gain reflected a moral cost to the individual. In the other case, the gain to the organization reflected a moral benefit for the individual





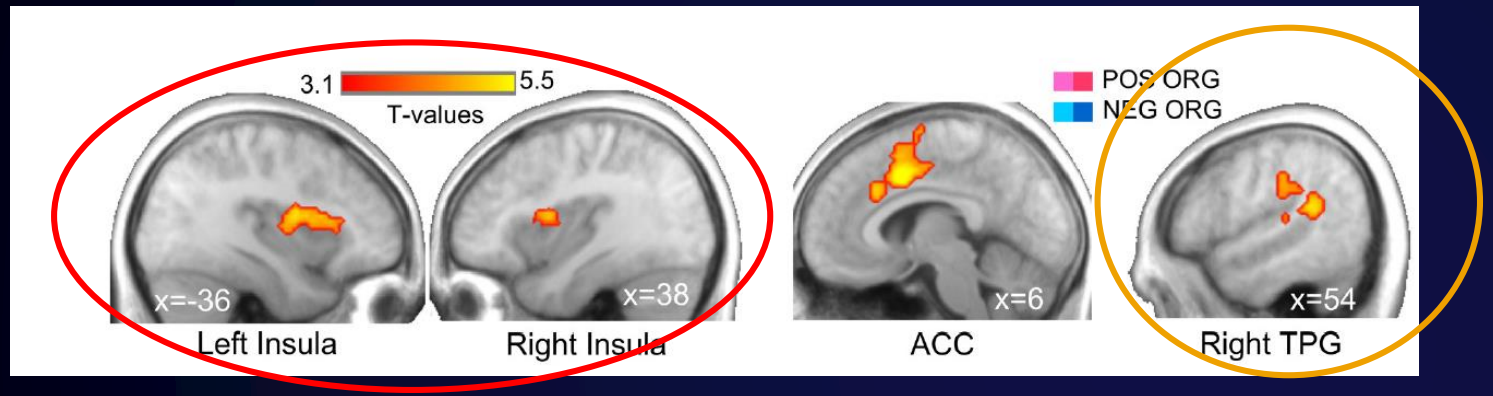


$$\Pr(\text{Accept})_i = \beta_0 + \beta_1(\text{Organization Gain})_i + \beta_2(\text{Subject's Payoff})_i + \beta_3(\text{Public Condition})_i + \beta_4(\text{Organization Gain} \times \text{Public Condition})_i + \beta_5(\text{Subject's Payoff} \times \text{Public Condition})_i + \beta_6(\text{Time})_i + \beta_7(\text{Response Time[RT]})_i + \varepsilon_i$$

Qu, C., Météreau, E., Butera, L., Villeval, M. C., & Dreher, J. C. (2019). Neurocomputational mechanisms at play when weighing concerns for extrinsic rewards, moral values, and social image. *PLoS Biology*, *17*(6), e3000283. https://doi.org/10.1371/journal.pbio.3000283

The Dilemma Task

- Decision Value = weighted Monetary Benefits – Moral Cost



Intrinsic moral stick

Intrinsic moral carrot

Brain network of meta-representation of what others think of us: TPJ, ACC and the Insula.
Represents the desire to conform to social norms.

- When the moral cost is not too high, people are willing to transgress their moral standards (i.e., act unethically)
- That is because immoral actions do not originate in rational self-interest (i.e., choosing more money) **but in affective responses to social value of their behavior.**
- Specifically, **social image motivation** is the driver and people have to carefully weigh the intrinsic value of their own moral values, the monetary reward and maintaining a positive self-image.

Qu, C., Météreau, E., Butera, L., Villeval, M. C., & Dreher, J. C. (2019). Neurocomputational mechanisms at play when weighing concerns for extrinsic rewards, moral values, and social image. *PLoS Biology*, *17*(6), e3000283. https://doi.org/10.1371/journal.pbio.3000283

The brain computes subjective value, risk and moral value. It uses emotions to detect subtle changes in valuation and guide decision-making.

There is intrinsic common currency system in the brain and it can be used for predicting subjective value of a decision, and it is much more precise than the homo economicus models.

CAN MONEY EVER REFLECT WHAT OUR BRAINS VALUE?

Conclusion

- Towards a "utopia for realists": new, human-centered **valuation** for a new eco-nomy? Can Money reflect what our brains value?
- Contrasting the two perspectives – of economics and neurofinance – brings to question many models of "valuation". This emerging science of human decision-making may invite us to redefine *money* as a veritable representation of *value* in an updated, human-centered science of economics.

What Kind Of Leadership Do We Want For The Future?

OPTIMAL USE OF BRAIN:

- Respect of individual differences: harnessing of strengths and talent
- Work designed around our best human abilities and with respect to our biological limitations
- (brain hygiene) & Brain-optimization
- Education that leads to self-awareness and empowerment
- Emotional self-regulation

COMPETENCIES THAT DISTINGUISH HUMANS FROM MACHINES:

- Empathic insight
- Communication & conflict resolution
- Critical thinking and critical information selection
- Ability to read and assess data-heavy information
- Future thinking
- Change intelligence (adaptability; ability to learn)
- Complex (ambiguous) problem solving

- Neuroscience for Decision Makers in CEMS MIM
- Courses, masterclasses and retreats at “Mind-Change Academy” MindFormationacademy.mystrikingly.com

More Resources

Scientific articles:

- **Neurofinance, available at** www.ewamien.com/research

General audience articles

- Humanizing Finance, One Student at a Time
- *How to make finance more beautiful?* The Book of Beautiful Business, 2019

Other resources:
https://www.youtube.com/watch?v=th3KE_H27bs

Nick Hanauer "A Dirty Secret of Capitalism"

"Nurture Human Nature", pp.94-128 in Raworth, Kate. *Doughnut economics: seven ways to think like a 21st-century economist*. Chelsea Green Publishing, 2017.

My neuroscience-fiction novel

amazonkindle iTunes available at amazon