



Society for
NeuroEconomics

NEUROSCIENCE • PSYCHOLOGY • ECONOMICS



Abstract Book

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CALTECH PLENARY LECTURE

Caltech

T&C Chen Center for Social
and Decision Neuroscience

Neural Economics

Drazen Prelec

*MIT Sloan School of Management
MIT Department of Brain and Cognitive Science
MIT Department of Economics*

Can Bayesian game theory provide a model for the brain? I will address this question through the lens of the Bayesian truth serum (BTS), a mechanism that provides incentives for honest reporting of private information by individuals, when neither honesty nor ground-truth accuracy can be independently verified. The main part of my talk will present these results in their original application setting — crowd wisdom and collective intelligence. However, similar problems of reporting and aggregating information appear at the level of unsupervised neural networks, that is, when individual neural units have to train themselves without external ground-truth reinforcement. I will outline a principal-agent economic model of neural networks, with neurons designated as the principals, sending messages to their synaptic agents. Information-theoretic utility functions and excitation-inhibition balance emerge as two key properties of well behaved ‘neural economies.’ This approach invites a broader inversion of the Neuroeconomics paradigm: Rather than using neural models to understand economic behavior, we can ask how economic theory, especially Bayesian games, might help us understand the internal logic of neural networks themselves.

WORKSHOP I: NeuroScience

Neural control of hunger and satiety

Amber L. Alhadeff

*Monell Chemical Senses Center
Department of Neuroscience, University of Pennsylvania*

Amber Alhadeff is an Associate Professor at the Monell Chemical Senses Center and Department of Neuroscience at Penn, where her lab investigates gut-brain communication. The Alhadeff lab employs a combination of modern neuroscience tools – with a focus on in vivo approaches – to understand the neural circuits underlying feeding behavior, and how they relate to diseases such as obesity. We eat every day, and although we may not realize it, this process is tightly controlled by neural communication between the gut and the brain. This presentation will explore the neural mechanisms for hunger and satiety, and how new weight loss medications leverage these brain circuits to help manage food intake in an environment replete with palatable, energy-dense foods.

WORKSHOP II: Social & Decision Sciences

Recovering preferences under cognitive constraints: The role of mental representations

Alex Imas

*Booth School of Business
University of Chicago*

Alex Imas studies behavioral economics with a focus on cognition and mental representation in dynamic decision-making. His research explores topics related to choice under uncertainty, applied AI, discrimination, and how people learn from information. Professor Imas’ work utilizes a variety of methods, including lab experiments, field experiments, analysis of observational data and theoretical modeling. Alex Imas is the recipient of the 2023 Alfred P. Sloan Research Fellowship, the Review of Financial Studies Rising Scholar Award, the New Investigator Award from the Behavioral Science and Policy Association, the Hillel Einhorn New Investigator Award from the Society of Judgment and Decision Making, the Distinguished CESifo Affiliate Award, and the NSF Graduate Research Fellowship.

S.01: Cognitive Constraints in Economic Choice

Symposium Chair: Ian Krajbich, University of California, Los Angeles

The goal of this symposium is to bring together scholars from economics and neuroscience who are working to understand how cognitive constraints influence economic choice. This is an emerging topic, with prominent papers in economics (Frydman & Jin 2022, QJE; Enke & Graeber 2023 QJE) and neuroscience (Polania et al. 2019, Nat Neuro; Shen et al. 2025 Nat Comm). This work has laid the foundation for what some are calling a “cognitive revolution” in economics. This year’s SNE conference will feature a satellite meeting on the topic of cognitive economics, emphasizing complexity. Here, we aim to offer a symposium at SNE that will complement the satellite. Our symposium features papers by four scholars: three postdocs and one professor. Their backgrounds include physics & economics, cognitive neuroscience & artificial intelligence, management & neuroscience, and behavioral finance – a truly interdisciplinary and diverse group (also in terms of gender and geographic location). The papers address how constraints on perception and representation influence risk preferences, probability weighting, strategic interactions, and numerosity judgments. The talks represent a mix of theory, behavior, and cognitive neuroscience. Lawrence’s paper provides an efficient coding model of how probabilities are represented in a Bayesian manner and thus sensitive to the decision-maker’s prior. He shows that manipulating participants’ expectations about probabilities creates different forms of non-linear probability weighting. Vered’s paper decomposes strategic interactions into social-iterative and arithmetic cognitive demands and empirically studies how these two cognitive demands tradeoff with each other as iterative or arithmetic demands vary. Gilles’s paper discusses numerical cognition, the neural representation of numerical magnitudes in parietal cortex, and how these relate to economic behavior, particularly risk preferences. Arthur’s paper investigates adaptive and efficient numerosity tuning of neurons in parietal cortex. In summary, these papers provide complementary theoretical and empirical discussions of how cognitive constraints influence an array of economic behaviors. While talks like these are occasionally presented at SNE, it’s rare to see more than one at a time, or to get the broader perspective of how understanding perception and representation can help us to understand many economic behaviors. Moreover, in combination with the Cognitive Economics satellite meeting, this symposium offers a rare opportunity to get more economists involved in the SNE discussion, bringing the society closer to its roots.

S.01.01 - On the source and instability of probability weighting

Lawrence Jin¹, Cary Frydman²

¹ Cornell University, ² USC Marshall School of Business

Details

We propose and experimentally test a new theory of probability distortions in risky choice. The theory is based on a core principle from neuroscience called efficient coding, which states that information is encoded more accurately for those stimuli that the agent expects to encounter more frequently. As the agent’s prior beliefs vary, the model predicts that probability distortions change systematically. We provide novel experimental evidence consistent with this prediction by manipulating and measuring a subject’s prior beliefs. The data reveal that lottery valuations are more sensitive to probabilities that occur more frequently under the subject’s reported prior beliefs.

S.01.02 - Risk attitudes are causally shaped by biases in parietal magnitude coding

Gilles De Hollander¹, Christian Ruff¹

¹ University of Zürich

Details

Recent theories propose that risk aversion may reflect perceptual biases rather than preferences. These theories emphasize that decision-makers do not have access to objective information about the choice problem but necessarily rely on noisy neurocognitive representations of the problem; these representations are biased due to characteristics of perceptual inference processes optimized for the capacity limits of our brains (Khaw et al., 2020). For example, larger (payoff) magnitudes are often perceived as smaller than they actually are, leading to choices that deviate from risk neutrality even for decision makers with risk-neutral preferences.

Can we identify neural origins of these perceptual biases? And can we use these neural measures to causally link apparent risk preference to purely perceptual acuity and biases? In three recent experiments, we applied innovative neuroimaging methods to answer these questions.

In all experiments, we used the numerical population receptive field (nPRF) model to characterise which brain regions are (non-linearly) tuned to numerical magnitudes. This identified the “approximate number system” in parietal cortex, which showed reliable tuning to payoff magnitudes. Critically, we could use the numerical tuning curves of individual subjects to assess the acuity of these neural representations and link them to behavior.

In Experiment 1 (n=64), we estimated individual differences in neural acuity for numerosity during a perceptual task. Neural acuity correlated with perceptual performance, as well as the degree of risk aversion in separate risky choices. In Experiment 2 (n=30), we measured neural acuity during economic choices, tracking trialwise fluctuations. Participants behaved more variable and less risk-neutral on trials where neural patterns in the ANS were less well-aligned with specific numerical magnitudes, indicating that fluctuations in risky choice behavior of an individual can be driven by the acuity of perceptual magnitude representations. In Experiment 3 (n=40), we perturbed numerically-tuned regions in the right intraparietal area using transcranial magnetic stimulation (TMS). Supporting the causal role of the ANS for economic decision-making, the nPRF model fits showed reduced responses and decreased neural acuity after stimulation, alongside more variable and less risk-neutral risky choices.

Together, our experiments show that risky choices are causally influenced by the acuity and biases of perceptual magnitude representations in parietal cortex. They also demonstrate how advanced neuroimaging methods from visual neuroscience allow empirical tests of theoretical choice models with neural data.

S.01.03 - Adaptive efficient coding of numerosity in parietal cortex

Arthur Prat-Carrabin¹, Gilles De Hollander², Saurabh Bedi², Christian Ruff², Samuel Gershman¹

¹Harvard University, ²University of Zürich

Details

Objective: Our ability to make economic decisions implies the ability to represent the elements relevant for decision. As the brain has limited processing capacity, its neural representational resources should be optimally allocated across the possible stimuli one may encounter. This principle — known as efficient coding — results in representations that are imprecise but efficiently adapted to the statistics of the choice-relevant information, such as prices or quantities. Consistent with efficient-coding models, psychophysical studies of numerosity judgments have shown that the variability of human responses scales with the width of the prior from which numerosities are sampled. The neural mechanisms underlying this adaptive efficient coding, however, remain unclear, even though they are crucial for our understanding of the neurocognitive mechanisms guiding our economic decisions.

Methods: We use 3T fMRI to investigate the activity of numerosity-tuned neural populations in the intraparietal sulcus (IPS) of 39 subjects, who estimated the numerosity of varying dot cloud stimuli. On each trial, the number of dots was sampled from a uniform prior whose width changed across two conditions: in the ‘Narrow’ condition, the prior ranged from 10 to 25 while in the ‘Wide’ condition it was twice as large (10 to 40). A numerical population receptive field model (nPRF) enabled us to investigate the tuning of neural populations in IPS. In particular, we examined their preferred numerosity in the two conditions, as well as their width and the amplitude of their receptive fields.

Results: We find that the numerosity tuning of IPS neural populations adapted to the prior. The distribution of the preferred numerosities observed in the Narrow condition remarkably ‘stretched’ in the Wide condition, i.e., neural populations tuned to a specific quantile of the prior in the Narrow condition shifted their preferences to the same quantile of the larger prior in the Wide condition. These changes were accompanied by a widening of receptive fields and a reduction of amplitudes across conditions, resulting in decreased precision of neural representations in the Wide condition, consistent with the increased variability in subjects’ responses.

Conclusions: Our findings demonstrate that neural encoding of magnitudes in parietal cortex dynamically changes across conditions with different statistical distributions of stimuli: Neural resources are re-tuned to efficiently adapt to the different prior. This adaptive and efficient encoding of numerosity in parietal cortex may be a fundamental representational mechanism shaping human economic decisions.

S.01.04 - Production functions and reasoning in strategic interactions

Vered Kurtz-David¹, Adam Brandenburger², Paul Glimcher²

¹Hebrew University of Jerusalem, ²New York University

Details

Objective: Finite capacity requires cognitive functions to compete for shared neural resources. Here, we decompose strategic interactions into social-iterative and arithmetic cognitive demands to study how individual strategic sophistication is varied when forced to integrate across distinct cognitive domains.

Methods: Drawing on the economic concept of production functions, we develop a novel framework that models strategic sophistication as a product of participants' capabilities across social-iterative and arithmetic dimensions. We posit that when one increases the depth of the strategic analysis, they must incur a cognitive cost, which is distributed amongst multiple cognitive domains. We allow individuals to have distinct innate cognitive capacities ($C > 0$ parameter) that are traded-off, in a subject-specific manner, across these two domains ($0 \leq \alpha \leq 1$ parameter).

We utilize the Ring Game (Kneeland, Econometrica, 2015) to directly test this framework in three studies ($N=136$). In the Ring Game, each subject's payoff depends on their own choices and the choices of the next player in the ring. The number of players in each ring determines the social-iterative burden of the task, while the structure of choice alternatives imposes arithmetic demands.

In study 1, we present subjects with an array of strategic interactions, which vary stepwise in their social-iterative and arithmetic demands. We then fit subjects' responses with our production function-inspired model, aiming to cluster individuals based on their estimated cognitive capacities (C), and trade-off tendencies (α). Studies 2 and 3 test the dynamic range of these two parameters once manipulating processing times and monetary payoffs.

Results: We demonstrate that strategic sophistication declines as social-iterative and arithmetic task demands increase ($\beta = -0.12$, $p < 0.01$). We find a great heterogeneity in recovered $C \in [2.97, 5.64]$ and $\alpha \in [0.35, 0.72]$, such that ~30% of subjects exhibit a far higher (relative) capability in one of the task demands (i.e., $\alpha > 0.55$ or $\alpha < 0.45$). Studies 2 and 3 indicate that C emerges as a logarithmic function of processing time ($\beta = 0.13$, $p < 0.01$) and linear with monetary payoffs ($\beta = 0.02$, $p < 0.01$). In contrast, α appears as a stable individual characteristic ($p > 0.05$).

Conclusion: Our results extend classic psychophysics into the domain of strategic choice. We are currently (1) extending this framework to other strategic settings, aiming to lay the foundation for a new neurocognitive model of limited reasoning in games; (2) applying this framework to a neuroimaging dataset with the prospect of a network-level mapping of subjects' utilization of social and non-social cortical resources.

S.02: The Human Side of AI: Learning, Decision-Making, and Social Dynamics

Symposium Chair: Laura Globig, New York University

As artificial intelligence (AI) becomes part of everyday decision-making, from how we engage online to how we seek out information and regulate emotion, understanding the cognitive and social consequences of AI-human interaction is both scientifically and socially critical. This symposium brings together four complementary talks that examine how AI systems shape behavior and cognition in contexts where human biases and social preferences, such as intergroup favoritism, affective expectations, and social norm sensitivity, typically dominate. Laura Globig will present results demonstrating that people prefer learning from AI over politically dissimilar humans across a different contexts, even when they know that these sources are equally competent. Drift-Diffusion Modelling suggests that this is due to biased weighting of AI evidence. These findings point to AI's potential to alter intergroup bias in learning. Raphael Köster will present reinforcement learning simulations in which tabula rasa agents, without any innate social motives, develop in-group favoritism based purely on information exposure. These findings demonstrate that group biases can emerge from general-purpose learning mechanisms, offering a powerful computational testbed for theories of social cognition.

Roya Mohammadsadegh will share work examining how the division of decision-making steps between humans and AI influences people's sense of agency. Their results reveal that agency is preserved when humans gather information and AI acts, but diminished when AI performs the information-gathering, highlighting how the locus of AI involvement fundamentally alters perceived control.

This symposium directly addresses SNE's methodological and topical innovation by confronting the urgent societal questions of human-AI interactions. The diverse group of presenters, spanning disciplines, methodologies, genders, and

institutions, underscores the breadth of inquiry critical to tackling these issues. Ultimately, all talks within this symposium converge on one key finding: AI possesses the profound potential for both great benefit and significant harm to human life and behavior and as such requires academic engagement.

S.02.01 - Using artificial intelligence to circumvent intergroup bias as a barrier to learning

Laura Globig¹, Jay Van Bavel¹

¹ *New York University*

Details

Objective: People often prefer advice from politically similar over dissimilar individuals, even when it leads to poorer outcomes, resulting in suboptimal learning. This intergroup bias distorts decision-making in both identity-relevant and identity-irrelevant contexts. In a recent cross-cultural, multi-generational study (N=6,300), we found that many people report turning to Artificial Intelligence (AI) to learn about political conflicts, citing its perceived neutrality and lack of social identity. Here, we test whether AI can circumvent intergroup bias and enhance learning outcomes.

Methods: Participants (Study 1: N=270; Study 2: N=270) completed either an incentivized shape-categorization task (identity-irrelevant) or a political fact-checking task (identity-relevant). On each trial, participants made an initial judgment (e.g., whether an abstract shape is a “blip” or whether a statement is true). To help them, they could choose to see the response of one of six advisors (AI, political ingroup human, or political outgroup human) whose performance (accurate or random) they had learned about in a training phase. After receiving the advice, they could revise their decision.

Results: Despite accurately estimating each advisor’s competence, participants consistently preferred AI advice over advice from politically dissimilar humans ($F(1,248)=66.13$, $p<0.001$, $\eta^2=0.21$), and were also more influenced by AI feedback during updating ($F(1,248)=7.13$, $p=0.01$, $\eta^2=0.09$). By contrast there was no difference between AI and politically similar humans ($F(1,248)=0.89$, $p=0.89$, $\eta^2<0.01$). Drift-Diffusion Modelling revealed that this outgroup derogation stemmed from preferential weighting of AI information ($v=0.38$; 95% CI [0.29; 0.47]), rather than a starting point bias ($v=0.50$; 95% CI [0.49; 0.51]).

Conclusion: Intergroup bias impairs decision-making by distorting both advisor selection and evidence integration. Critically, AI appears to circumvent these identity-driven distortions by functioning as a perceived neutral source. Yet this neutrality may be context-dependent: people may sometimes perceive AI as aligned with their own group, potentially amplifying bias. These findings offer a nuanced view of AI’s role in learning and decision-making, suggesting it can either reduce or reinforce intergroup divides depending on perceived identity alignment. By integrating behavioral and computational approaches, this study not only advances models of social learning but also reveals the cognitive mechanisms, such as selective evidence weighting, that underlie how identity cues, real or inferred, shape information processing and belief-updating.

S.02.02 - Behavioral mechanism design with neural network models of human behavior

Raphael Koster¹

¹ *Google DeepMind*

Details

When resources are allocated to people, who can either reciprocate with interest or keep the proceeds, a classical social dilemma arises. Deep reinforcement learning (RL) offers a powerful method to optimize a policy to act as social planner, offering a mechanism that can promote sustainable and efficient management of a common resource.

We present this method in the first study (n≈4k), focused on the sustainable management of a resource throughout a long episode (40 timesteps) in an iterated multiplayer trust game.

The RL mechanism discovers a redistributive policy that leads to a large but also more equal surplus ($z = 3.25$, $p = 0.001$). The RL mechanism outperforms baseline mechanisms by conditioning its generosity on available resources and temporarily sanctioning defectors. Examining the RL policy allows us to develop a similar but explainable mechanism that is more popular among players. Surprisingly, testing the RL mechanism outside of its training regime – having participants play 3 consecutive games instead of 1 – even expands the lead in performance the RL mechanism achieves ($z = 6.08$, $p < 0.001$).

In order to train a mechanism to maximise aggregate return to players, we need to create a simulated version of the economic game, populated with faithful simulations of human participants. To this end, we first trained neural networks to behave like human players. Critically, this neural network model of human behavior makes little prior assumptions about how humans behave in the task.

In a second study ($n \approx 4k$) we relax a key assumption underlying much of mechanism design. Instead of assuming that the goal of the mechanism is to maximize the sum of reward achieved by participants, we let participants vote for the AI policy they prefer. This policy develops its own tradeoff between inequality and maximization of overall reward, while being preferred over the strongest baseline (951/1,744 votes (54.5%), $p < 0.001$).

A third study ($n \approx 1656$) demonstrates how a model can be trained removing another condition, which is access to reasonable baselines during data collection and training. We show how a mechanism can attain a similar policy as in the second study, while starting at random, only playing against itself.

S.02.03 - Who's in Charge? Sense of agency when AI gathers, or acts

Roya Mohammadsadegh¹, Youngbin Kwak¹

¹ *University of Massachusetts Amherst*

Details

Artificial intelligence (AI) is becoming an increasingly common partner in human decision-making, by supporting, guiding, or even fully executing decisions. However, little is known about how different types of AI involvement affect the human experience of control, particularly the sense of agency over outcomes. This question is especially relevant as decision-making often involves not only choosing an outcome but actively gathering costly information and implementing actions based on the information collected.

In this study, participants ($N = 240$; 60 per condition) located a hidden target, based on the gathered information regarding the possible location. While gathering more information made it easier to locate the target, revealing more information involved paying more costs. Most importantly, the task was conducted in collaboration with an AI contributing in either gathering of information or locating of the target, which generated four between-subject conditions: (1) No AI, (2) AI-Gather/Human-Locate, (3) Human-Gather/AI-Locate, and (4) All AI. After each trial, participants rated their sense of agency over the outcome. The AI in this task operated using a probabilistic sampling algorithm that dynamically updated its information-gathering strategy based on prior samples, simulating real-time decision support.

Our results revealed a marked asymmetry in how AI influences perceived control. Participants reported significantly reduced agency when AI performed the gathering of information. In contrast, agency was preserved when participants gathered the information themselves, and the AI located the target. Importantly, this effect was moderated by the cost of information gathering; while increasing sampling cost significantly decreased agency when a human did the information gathering, the effect was notably smaller when the AI performed the gathering. Our findings demonstrate that the division of decision-making steps between humans and AI in information gathering and action execution meaningfully affects the sense of agency, an essential variable in models of decision-making and control.

O.01: Social Learning & Interactions

O.01.01 - Neural dynamics of social evidence accumulation in cooperative interactions of freely moving marmosets

Weikang Shi¹, Olivia Meisner¹, Monika Jadi¹, Anirvan Nandy¹, Steve Chang¹

¹Yale University

Details

Social interactions are inherently complex, requiring outcome evaluations, behavioral adjustments, and coordinated communication. In nonhuman primates, social gaze is a key mean through which individuals gather information about others' intentions and actions. To uncover the neural mechanisms underlying the use of social gaze in cooperation, we studied dyadic cooperative pulling behavior in freely moving common marmosets (*Callithrix jacchus*) using an automated 3D behavior tracking system to define and quantify social gaze events. Previous findings revealed that marmosets flexibly adapt both the gaze-independent and gaze-dependent strategies to support successful cooperation. Building on decision neuroscience frameworks—where saccadic fixations accumulate value information leading to decision outcomes—we hypothesized that social gaze serves as a mechanism for accumulating social evidence prior to cooperative actions. We further predicted that the dorsomedial prefrontal cortex (dmPFC), a region implicated in various social cognition, supports this accumulation process. To test this, we developed a multi-channel wireless neural recording system that allowed us to record from two animals in the naturalistic setting ($n = 460$ neurons in animal 1; $n = 450$ in animal 2). Behaviorally, we observed enhanced social gaze prior to pull actions, particularly in successful trials. At the single-neuron level, dmPFC neurons demonstrated systematic modulation in firing rate slopes as the animals approached pull actions, suggesting a ramping process that tracks accumulated social information. At the population level, principal component (PC) trajectories derived from dmPFC activity exhibited geometric differences corresponding to gaze accumulation: trajectories were longer when social gaze accumulation was higher, and shorter with lower accumulation levels. Comparative analysis across conditions revealed that cooperation trials showed a stronger correlation between PC trajectory length and gaze accumulation than self-reward trials. Moreover, this relationship was most prominent in successful cooperative pulls, underscoring the behavioral relevance of the neural dynamics. These findings parallel evidence accumulation mechanisms observed in value-based and perceptual decision-making, extending them to social decision contexts. Together, our results reveal that the dmPFC encodes accumulated social evidence both at the level of individual neurons and through the collective geometry of neural population trajectories. These findings provide new insights into the neural computation of social decisions in ecologically valid settings and underscore the importance of social gaze in coordinating real-world cooperation.

O.01.02 - Interplay of self and social interests during learning in early adolescence

Cong Wang¹, Natalie Melville¹, Clare Hogan¹, Victoria Tredinnick¹,
Nanda Sankarasubramanian¹, Pearl Chiu¹, Brooks Casas¹

¹Virginia Tech

Details

Objective: Successfully navigating social environments requires individuals to consider how their actions impact both themselves and others, and to dynamically adjust expectations and actions in ways that satisfy social goals. Yet, little is known about how self-interest and social considerations interact to shape learning in early adolescence—a critical developmental period marked by heightened sensitivity to rewards, dynamically changing social preferences, and still-maturing executive control. By combining a carefully designed social learning task with computational modeling and fMRI, we studied the neurocomputational mechanisms—and individual differences therein—through which early adolescents learn action outcomes tied to both their own and others' rewards.

Methods: A total of 135 adolescents (ages 13-14), including 129 fMRI participants, completed a learning task with probabilistic rewards for both themselves and an anonymous social partner. On each trial, participants chose between two fractals, each predominantly associated with one of two possible reward allocations. To examine the potential interplay of personal and social interests in learning, we extend the classic reinforcement learning framework by incorporating established economic theories of social preferences.

Results: Compared with self-regarding learning, learning from outcomes accrued to a social other was weaker overall but varied significantly across individuals. These individual differences were captured by an error-driven learning process incorporating individual-level social preferences ($r = 0.65$, $P < 10^{-15}$), including inequity (self-value relative to other-value) and efficiency (self-value combined with other-value) concerns, supported by a social preference-weighted prediction error encoded in frontoparietal network (FPN) regions (cluster-wise PFWE < 0.05). Critically, functional connectivity of these FPN areas with the amygdala and ventromedial prefrontal cortex—tracking inequity and efficiency signals, respectively—predicted adolescents’ behavioral sensitivity to these social preferences (all $r > 0.24$, $P < 0.01$).

Conclusions: These results indicate that early adolescents engage in social learning, albeit with notable individual variability. This variability likely stems from differences in the development of FPN functioning, which supports the integration of social preferences into ongoing learning. Our findings thus support a neurocomputational mechanism by which early adolescents reconcile multiple—and sometimes competing—social motives during learning, advancing our understanding of social behavior in uncertain environments during a critical developmental stage.

O.01.03 - Humans learn hidden preferences from decisions, response times and eye movements in social interactions

Mrugsen Gopnarayan¹

¹ University of Hamburg

Details

Objectives: Eye movements are intricately coupled with decision-making, serving as a window into the attentional processes of decision-makers. In social interactions, humans can use this coupling to infer others’ hidden preferences. Yet, it remains unclear to what extent access to attentional information improves social learning in complex interactions. Here, we used an interactive bargaining setting to test whether humans can utilize information from another person’s eye movements, in addition to choices and response times (RT), when making social inferences.

Methods: In this preregistered study, 79 pairs of participants (mean age = 24.9, SD ± 6.9 years; 113 female) were assigned the roles of seller and buyer. Pairs were split into an attention and a control group, depending on whether the seller had access to the buyer’s real-time eye movements. Sellers aimed to sell products from 20 categories (e.g., cars), each characterized by 3 attributes (e.g., speed, comfort, safety). For each category, the seller could sequentially offer up to 4 out of 12 options. Buyers received a baseline reward for rejecting all offers but could win additional rewards for accepting high-value offers. We developed a Bayesian belief updating model for the seller to model the seller’s inference process, specifically testing whether sellers offered products that allowed them to reveal buyers’ preferences (“information gain”).

Results: Buyer’s choices, RTs, and eye movements were all predictive of their preferences. They accepted better-than-chance offers, had longer RTs when rejecting high-utility offers, and fixated first on the highest-weighted attribute (high: 55%; medium: 26%; low: 19%). Sellers adjusted their offers more after faster rejections ($B = 2.47$, $SE = 0.21$, $p < .001$). Although sellers in the attention group did not earn more points than the control group ($B = -3.75$, $SE = 2.80$, $p = 0.18$), they utilized first fixations to make relevant offers ($M = 53.03 \pm 4.22$, $p = 0.0164$). Computational modeling confirmed that sellers took not only offer utility but also information gain into account ($t(1092) = -2.41$, $p = 0.0163$).

Conclusions: Our results indicate that not only choices themselves but also decision-process information, such as the speed of decisions and the fixation patterns during decisions contain relevant information in interactive decisions. However, real-time attentional information poses a challenge to be interpreted reliably. Modeling results further showed that sellers made offers not only to maximize immediate utility but also to increase information about the buyer’s preferences, indicating strategic use of offers.

O.01.04 - A Bayesian belief updating account of confirmation bias during advice seeking and integration

Yi Wei¹, Brenna Outten², Lisa Kluehn², John O’Doherty², Caroline Charpentier¹

¹ University of Maryland, ² California Institute of Technology

Details

Objective: People frequently rely on advice from others when making decisions. Yet this process can be biased: individuals may favor their own beliefs and disregard any advice, or specifically favor advice that confirms their beliefs, regardless of accuracy. While both forms of confirmation bias are commonly observed in daily life, their cognitive underpinnings remain unclear. This study offers a novel computational account of confirmation biases related to prior beliefs and confirmatory advice.

Methods: Online participants ($N=539$) were asked to guess the majority bead color in an opaque urn made of blue and yellow beads, based on a random draw of 1 to 3 beads from the urn (prior draw) and advice from one of two advisors.

Unbeknown to participants, one advisor offered more accurate advice, while the other more often confirmed the prior draw. Participants indicated their guess and confidence either before or after advice, and on a third of trials they actively chose which advisor to consult. We modeled advice-seeking and guess decisions using an optimal Bayesian belief-updating framework alongside biased variants that differentially weighted prior and advice information, as well as confirmatory and accurate advice.

Results: Mixed-effects logistic regressions revealed that participants' advice-seeking was driven not only by the advisors' accuracy ($z=9.54$, $p<.001$) but also by their confirmatory tendencies ($z=6.98$, $p<.001$). Majority color guesses were influenced by the prior draw ($z=33.44$, $p<.001$), advice ($z=35.44$, $p<.001$) and an interaction with advisor identity ($z=-2.99$, $p=0.003$) with stronger influence of advice from the accurate advisor. The computational model including both confirmation biases (prior weight, confirmatory advice weight) fit our data best, capturing individual variability in both advice-seeking and integration that the optimal model could not. Model-predicted trial-by-trial belief uncertainty and choice difficulty were also found to explain 42% of the variance in confidence ratings.

Conclusions: Our findings demonstrate that advice valuation involves two separable forms of confirmation bias - favoring prior and confirmatory advice - and that individuals vary systematically in these tendencies. Bayesian modeling of beliefs illuminates both the integration of prior and advice information during decisions and the computational drivers of confidence. By improving our mechanistic understanding of biased belief formation, these results pave the way for investigating links between confirmation bias and real-world belief rigidity, including in mental health and social dysfunction.

O.02: Practical & Clinical Applications

O.02.01 - Revealing beliefs and preferences from neuroimaging data instead of behavior

Stefan Bucher¹, Zih-Yun Yan², Bo Shen³, Peter Dayan⁴, Paul Glimcher³

¹ University of Cambridge, ² New York University, ³ NYU Grossman School of Medicine, ⁴ University of Tübingen

Details

Objective: Neuroeconomics posits that observing neural processes can improve the choice models of the behaviorist revealed preference tradition. While insights about the neural choice process have informed economic choice models, the seamless integration of neural data into economic theory remains elusive. In an attempt to close this gap further, we present an approach to infer beliefs and preferences from measurements of reward prediction errors (RPE; Schultz, Dayan, and Montague, 1997)—differences between obtained and expected rewards which are observable in BOLD activations in the ventral striatum and the ventromedial prefrontal cortex (Bayer and Glimcher, 2005; Rutledge et al., 2010; Niv et al., 2012).

Methods: We develop a theoretical framework formalizing the insight that contrasting the RPEs in response to positive and negative news about a binary prospect can reveal subjective expectations about—and/or valuations of—the possible outcomes, because a high RPE indicates that an outcome was better than expected. We further design an fMRI experiment featuring binary lotteries whose winning odds are revealed only gradually, inducing participants to sequentially update their beliefs. We elicit participants' lottery valuations—in an incentive-compatible manner—at a random stage during this gradual resolution of ambiguity. Our sample size ($N=31$) exceeds the 28 participants necessary to detect a typical BOLD effect size in response to belief updates ($\eta^2=.65$ in Preuschoff et al., 2008; $\alpha=0.05$, $\beta=0.8$).

Results: Participants' behaviorally elicited probability equivalents (the chance of \$100 making them indifferent to a $p\%$ -chance of winning \$X) are well-behaved, increasing linearly in p . Trials with $X=\$100$ reduce to a belief elicitation mechanism (Karni 2009) and reveal that subjective beliefs are perfectly calibrated in the absence of ambiguity and slightly pessimistic in its presence. Trials with $X=\$20$ reveal a coefficient of relative risk aversion of 0.67 ± 0.03 as well as a moderate degree of ambiguity aversion (0.4 ± 0.09).

Neurally, in addition to the well-documented RPE responses to rewards in the vmPFC and ventral striatum, our neuroimaging data show analogous traces of changing reward expectations in response to information—absent any reward—in these regions as well as the cingulate cortex and hippocampus. The resulting activations allow us to infer beliefs, which we then compare with the behaviorally revealed ones.

Conclusion: Our approach extends the revealed preference paradigm to neuroimaging data, promising a path towards inferring subjective beliefs when behavioral elicitation is unreliable or infeasible, including potentially in animal studies.

O.02.03 - Risk taking for reward declines with Parkinson's disease progression

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Details

Dopamine drugs used to treat motor symptoms in Parkinson's disease (PD) are associated with increased risk taking and implicated in impulse control disorders (ICDs), such as pathological gambling and compulsive buying. However, while higher prevalence of ICDs is reported in the PD patients compared to the general population, the majority of patients taking dopaminergic drugs do not report ICDs, illustrating large variability in the effect of dopamine drugs on decision-making. The present study aims to understand the role of dopamine in risky decision-making and to understand when dopamine drugs might contribute to increased risk taking. In this smartphone-based remote study, PD patients (n=110) completed surveys and behavioral tasks in their home environment, alternating between ON and OFF dopamine medication sessions across a 21-day period. No difference in risk taking for reward was observed in Parkinson's patients ON vs. OFF their dopamine medication ($p = 0.367$). However, dopamine medication decreased variability in risk taking for reward within each individual across days ($p = 0.002$). Moreover, we observed that PD patients prescribed higher dosages of levodopa medication took fewer risks for gains overall than those with lower dosages ($p < 0.01$). Using an approach-avoidance computational model, we found that Pavlovian attraction to potential reward previously linked to phasic dopamine, also declined with increasing levodopa in mg/kg, even after accounting for participant age, gender, education, and years since diagnosis. Greater levodopa in mg/kg was associated with greater years of Parkinson's disease, suggesting that dopamine decline resulting from neurodegeneration decreases attraction to reward beyond the influences of healthy aging.

O.02.04 - Memory constraints on decision-making capacity in Alzheimer's Disease: Evidence from open-ended decisions

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Details

While Alzheimer's disease is widely recognized for impairing memory, it remains unclear how these impairments specifically influence decision-making with standard economic paradigms, which typically minimize the role of memory. This knowledge gap limits our understanding of the cognitive mechanisms underlying diminished decision-making capacities in Alzheimer's disease, evidenced by real-world financial errors (Chiong et al., 2014; Nicholas et al., 2021). To address this issue, we build upon our retrieval-constrained valuation framework (Zhang et al., 2021) by introducing a novel paradigm examining open-ended decisions requiring self-generated options, directly assessing the impact of memory deficits on decision quality.

Our paradigm involved two phases: internal menu choices (IMC), where participants made preferential decisions by generating their own options within familiar consumer-goods categories, and external menu choices (EMC), where participants chose from provided options within the same categories. A choice switch between the two phases indicates that the participant likely has failed to retrieve a more preferred option during IMC. Using a sample of 94 elderly participants, including both dementia patients and healthy controls, we observed significantly higher switch rates among participants with Alzheimer's disease compared to both age-matched healthy controls and a dementia comparison group with behavioral variant frontotemporal dementia (bvFTD), who primarily exhibit impaired judgment rather than memory deficits (Chiong et al., 2016). Notably, we identified a behavioral dissociation: bvFTD participants demonstrated fewer IMC-EMC switches but exhibited increased EMC-EMC switches, reflecting preference instability. Therefore, the changes in IMC do not reflect a general cognitive decline in dementia, but represent a specific impairment in Alzheimer's disease, likely attributable to memory deficits.

Furthermore, we identified a robust negative association between memory retrieval capacity—measured via semantic fluency—and IMC-EMC switch rates across diagnostic groups. Using voxel-based morphometry (VBM), we localized structural correlates of the switch rate to the left inferior frontal gyrus ($p < 0.05$, cluster-size corrected), a region strongly implicated in semantic retrieval. Collectively, these findings elucidate the neural and cognitive mechanisms underlying decision-making deficits in Alzheimer's disease, suggesting novel targets for behavioral interventions to improve memory-based decision-making.

O.03: Valuation & Choice

O.03.01 - Whole-brain predictor of preference trained on twenty-two tasks shows distributed coefficients but a localized signal

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Details

Objective: How does the brain represent subjective value, and how can we decode it to predict preference? These questions lie at the heart of neuroeconomics but are difficult to resolve due to conflicting evidence from different analytical approaches. On one hand, there is converging evidence for a localized 'common currency signal' among univariate functional imaging studies. But several studies have shown that univariate evidence may be overturned if the underlying multivariate patterns differ. Furthermore, multivariate studies have decoded preference throughout the whole brain and promise higher prediction performance if these distributed signals can be extracted. A way to test and reconcile these two views is to build a whole-brain decoder of preference that can identify both local and distributed signals. The first key challenge is that the current approach of training a decoder on a single dataset encourages the predictor to exploit task-specific confounds for prediction. The second key challenge is that high-dimensional models are difficult to interpret and validate against prior univariate knowledge.

Methods: We organized a collaborative effort that combines published data across 22 tasks examining the neural correlates of preference. To identify a convergent signal, we employed a whole-brain prediction algorithm that can statistically equate the weight of each task.

Results & Conclusions: We found signals that could predict all 22 tasks in both localized vmPFC and distributed whole-brain activity outside of the vmPFC. Critically, the distributed signals could not be extracted with a predictor trained on a single dataset, which performed worse than predicting simply based on the average vmPFC activity. In contrast, decoders trained across multiple tasks performed the best and even better than those trained specifically for the tested dataset. This shows evidence of both local and distributed signals of preference, but that the latter requires a wide variety of tasks to be identified.

We also introduce a novel approach for interpreting high-dimensional predictors. By mapping the neural correlates of the algorithm's predictions, we identified that the sole consistent correlate of the whole-brain multivariate predictive signal of preference is in vmPFC. This result suggests that 1) distributed signals outside of vmPFC may not have a consistent locus, and 2) many of the prediction weights throughout the brain may function to dampen "noise" rather than to provide additional preference-related signals. These results link our understanding of the high-dimensional multivariate brain decoder of preference with decades of extant research in neuroeconomics.

O.03.02 - Competitors or Opportunities? Mutual exclusivity alters neural and attentional processing of choice alternatives

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Details

Introduction: Decisions form a central bottleneck to most tasks, one that people often experience as costly. We recently showed that this cost is intensified when decision-makers feel as though choosing one option sacrifices others (mutually exclusive), and that this cost can be reduced by framing choices as inclusive (e.g., allowing selection as many as they want, as in buffets). A prediction arising from these findings is that exclusivity may modulate how people perceive the next-best options in a set, such that options that are evaluated as competitors during exclusive choice may be evaluated as potential opportunities for future selection during inclusive choice. To test this prediction, we examined patterns of fixation and neural activity while participants made choices that were either mutually exclusive or inclusive.

Methods: We recorded fMRI and eye-tracking data from participants (N=30) performing a value-based decision making task in which they chose their favorite option from sets of four consumer products. Prior to each choice, participants were informed whether they would later have the opportunity to choose more items from the set (inclusive choice) or not (exclusive choice). We focused our neural and eye tracking analyses only on the first choice of each set.

Results: When participants made exclusive choices, we found that they fixated each item in proportion to its rank and value - fixating the best option most and the worst item least. By contrast, for inclusive choices, they fixated the top two items to a similarly high degree and the bottom two to a similarly low degree - this pattern mirrored our finding that participants later added on average one additional item to their set. Consistent with this boundary between two and three items forming a distinct threshold for their evaluations, when we examined neural activity during inclusive choice in a region of dorsal ACC previously associated with choice anxiety, we found that this activity increased the worse the second-ranked option was and the better the third-ranked option was. This dissociation was absent during exclusive choice.

Discussion: Our work provides the first insight into the influence of mutual exclusivity on the neural and attentional dynamics during decision making. Our findings suggest that exclusivity modulates how people process the next-best items in a set: When only one option can be chosen (exclusive choice), each of the lesser options gets diminishing priority in proportion to its rank. When multiple options can be chosen, participants instead prioritize those items that they plan to select and deprioritize those they plan to discard.

O.03.03 - Two-step value normalization explains intra-valuation adaptation triggered by option unavailability

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Details

Choices are influenced by context changes. Previous studies have largely focused on contextual differences between choices and the mechanistic impacts that accompany these changes. In contrast, it remains unclear whether and how changes in choice-relevant information during the valuation and choice process influence individuals' choices. We propose a two-step value normalization model that offers a potential explanation for how changes in available options during valuation influence decision-making, through a context-adaptive value normalization process. To test our hypothesis, we used an EEG and pupil dilation recording alongside a novel three-option gambling task. During the task, on some trials, one option became unavailable ('sold-out' option) before the choice cue, prompting individuals to make decisions from the remaining two options. Against other normalization models, our proposed two-step value normalization model, which assumes the second-step normalization to be applied between the normalized values of the two available options, best explained individuals' choice patterns across all trials. Consistent with the model's interpretation of the changes in choice-relevant information, second-step normalized value differences were reflected in pupil dilation—a neurophysiological measure known to track subjective values—measured after the sold-out cue, whereas first-step value differences were reflected in pupil dilation both before and after the cue. Moreover, we found that the normalized value of the sold-out option was associated with the single-trial EEG amplitude in the P3 and FT9 channels around 400 ms after the sold-out cue. The neural-level sensitivities were consistent with model-estimated individual differences, such that the neural instantiation of the sold-out option at the P3, followed by the FT9, was associated with the extent to which individuals normalize values at the second step. These results offer a neuromechanistic account of two-step normalized value representations, highlighting their role in adaptive valuation processes triggered by changes in option availability.

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O.03.04 - The dynamics of decisions with self-generated options

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Details

Objective: Decision makers often face scenarios without explicit menus, requiring them to generate options (e.g., choose a lunch spot while at work). Such decisions rely on searching through an internal representation of the option space. How do people make decisions in these cases? Is it a two-stage process in which they first form a consideration set and then choose from it, or a parallel process where they evaluate options as they recall them? We address this question using a multi-session experiment combined with computational modeling, offering quantitative predictions about what people choose, when they choose, and how choices differ across domains and time constraints.

Methods: We employ sequential sampling models, which have been widely used to study menu-based decisions. The two-stage model assumes that options begin to accumulate evidence simultaneously after the choice set is formed, typically favoring the highest-rated option within the set. In contrast, the parallel process assumes that options start accumulating evidence as soon as they're recalled, favoring lower-rated items if they're recalled earlier. To test those models, we conducted a multi-session study. In Session I (N = 250), participants made memory-based choices from 30 familiar categories (e.g., fast food) in time free (tf) and time pressure (tp) conditions. In Session II (N = 200, 7 days later), for each category they recalled as many items as they could and then rated those items.

Results: We found that the parallel-process model provided the best account for choices and response times across categories and conditions. For example, it accurately captures behavioral patterns such as the fact that people choose options that are rated higher (b1) and recalled earlier (b2) (b1(tf) = 0.68; b1(tp) = 0.41; b2(tf) = -2.44; b2(tp) = -3.12, all $p < 10^{-16}$) and also choose those options faster (b1(tf) = -0.07, $p = 10^{-10}$; b1(tp) = -0.05, $p = 10^{-8}$; b2(tf) = 0.10, $p = 10^{-12}$; b2(tp) = 0.06, $p = 10^{-9}$). It also best explains how time pressure increases choice of the earliest recalled items while decreasing choice of the highest rated items. The best model indicates that accessible options benefit not only from a head start but also from an attentional boost.

Conclusion: We provide a quantitative account of decisions involving self-generated menus. Our findings challenge the notion of a static consideration set, and suggest that people evaluate options dynamically, with a consideration set that evolves over time. Our results align with menu-based decisions, indicating that attention plays an important role—even when menus are generated internally.

O.04: Uncertainty & Information

O.04.01 - Representations of the intrinsic value of information in mouse orbitofrontal cortex

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Details

Animals are motivated to acquire knowledge. They often seek information that reduces uncertainty, even if it does not lead to increased external reward and comes at a cost. This implies that information is intrinsically valuable. However, due to its cognitive nature, the neural mechanisms that assign value to information-associated stimuli to guide knowledge seeking are poorly understood. We have therefore developed an information seeking task for mice and used it to investigate neural population representations of information-associated odor stimuli. In this task, mice choose to receive probabilistic water reward in either of two nosepoke ports, which differ only in whether they provide information via odor that reveals the reward amount but cannot be used to increase reward. Mice are cued at trial start by odor in a third port which reward ports are available, such that they learn an association between odor and predicted information. Mice strongly prefer the information port (68% mean preference, $p < 0.001$, $N = 33$). Moreover, mice exchange water to pay for information, preferring the information port even when it decreases their water reward. We fit reinforcement learning parameters to choices between information and water to model the subjective value of information (mean 38% water value exchanged for information, $N = 4$). Thus, like humans and other animals, mice display an economically sub-optimal information bias in their decision making, behaving as if information has intrinsic value. To ask how representations of neutral odor stimuli are transformed by association with information value, we imaged neurons in orbitofrontal cortex (OFC) using miniature microscopes in mice learning the information seeking task ($N = 7$ mice, 1138 cells). Decoding analysis and dimensionality reduction revealed a population representation of predicted information comprising 18% of OFC neurons. The difference between neural activity in anticipation of information vs. no information scaled with the time

animals spent in a state of uncertainty, consistent with the information prediction representation being a scalar value signal. We observed distinct populations of neurons responsive to odors predictive of information and odors predictive of water reward (18% of OFC cells each, 30% of which overlap). Moreover, a latent variable model recapitulated distinct representations of intrinsic information versus extrinsic water value in the low-dimensional dynamics of OFC activity. These data suggest that mice have evolved distinct pathways in OFC that represent the intrinsic value of knowledge and the extrinsic value of water reward.

O.04.02 - Why did we evolve to seek information? Theory of subjective value without instrumental value

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Details

Objective: Why do we want to know the future? We can be strongly motivated to seek information about uncertain future rewards. We often seek this information even when it has no instrumental value for controlling the outcome, suggesting we endow it with subjective value of its own. There has been a recent explosion of research on this preference, called “temporal resolution of uncertainty” in economics and “observing behavior” in psychology. However, the most fundamental question remains unanswered: why? This subjective value without instrumental value seems maladaptive. Yet it is conserved across species, suggesting it evolved for a crucial purpose.

Here we develop a theoretical framework to understand subjective value in light of evolution. We formulate theories that explain information’s subjective value in lab experiments as an evolved estimate of its instrumental value for solving core computational problems organisms face in their natural environments. We use this framework to evaluate extant evolutionary theories of the origin of information seeking: Time Allocation theory, that information improves time allocation for foraging, and Credit Assignment theory, that information improves temporal credit assignment for learning.

Methods: We embody theories with models where optimal Bayesian agents maximize reward rate in naturalistic environments, and derive their instrumental value of information (IVOI model). We measure the subjective value of non-instrumental information in our recent experimental data (SVOIexp; n=521 humans, n=4 monkeys). We compare how IVOI model and SVOIexp are governed by a broad suite of motivational factors (expected reward, measures of reward uncertainty, information and reward timing), quantifying their effects with logistic regression.

Results: We show these theories value information for distinct reasons, yet remarkably, both make a series of similar, specific, correct predictions about SVOIexp. For example, every factor in our suite has matching directional effects on IVOI model in both models, SVOIexp in humans, and SVOIexp in each monkey (n=5 factors; all $\beta > 0.1\sigma$ in humans, > 20 ul juice in monkeys, > 10 ul in models (robust to parameter variation); all $p < 0.01$). We then leverage our framework to prove the theories are dissociable due to their distinct mechanisms, and derive novel factors to do so.

Conclusion: We present a framework for understanding the origin of subjective value. Applying it to information seeking reveals evidence that evolution managed to endow humans and animals with remarkably robust information value computations to simultaneously enhance both time allocation and credit assignment in natural environments.

O.04.03 - Cognitive maps and theta oscillations in medial temporal lobe and prefrontal cortex during risky decision-making

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Details

Neuroeconomic studies propose that decisions utilize a common neural currency, where rewarding things such as juice, money, and social stimuli are encoded using a common neural value code in the brain (Levy & Glimcher 2012). Such value coding has been identified in dorsal anterior cingulate cortex (dACC; Kennerley et al., 2014), orbitofrontal cortex (Kennerley et al., 2014; Padoa-Schioppa et al., 2006, 2008), and ventromedial prefrontal cortex (vmPFC; Chib et al., 2009; Lebreton et al., 2009), among other regions. Our recent work shows that in addition to this brain valuation system, a cognitive mapping system emerges in a risky decision-making task in medial temporal lobe (MTL) and prefrontal cortex (PFC; Orloff et al., 2023; 2024, Neuroeconomics). Given the role of MTL in cognitive mapping and the PFC in both cognitive mapping and value-based decision-making, we examine communication between MTL and PFC in humans undergoing presurgical iEEG monitoring for treatment-refractory epilepsy. In this task, patients made binary choices between shapes, which varied along two continuous dimensions corresponding to reward magnitude and probability. As we previously showed in fMRI, we identify that a grid-like representation (a neural signature of cognitive maps) of decision vectors between options emerges in mPFC during risky decision-making (Fig 1A). Additionally, value information (reward

probability and magnitude) can be decoded (across all contacts including those in MTL and PFC) across subjects after viewing choice options (1B). To examine hypothesized information transfer between MTL and PFC, we computed intertrial phase coherence (phase locking value, PLV) time-locked to the revelation of the second shape (the time point at which we observe decision-value and grid-like representations). We observed strong inter-trial coherence in both MTL and ventral PFC (encompassing vmPFC and OFC) in the theta band immediately following the revelation of the second shape. (Figs 2A and 2B). To test how information is transferred between these regions, we measured phase coherence between these regions in theta band (i.e., phase difference across trials). As hypothesized, and consistent with other studies (Adams et al., 2020; Knudsen & Wallis, 2020), we observed a high PLV between MTL and ventral PFC after presentation of the second shape (Fig 2C). Taken together, this suggests that a cognitive map and value information are present in a risky decision-making task and that theta coupling between MTL and ventral PFC supports information transfer for value-based choices.

0.04.04 - Olfactory modulation of risk taking and emotional evaluation: TAAR ligands and control odors shape reward sensitivity

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Details

Objective: Trace amine-associated receptors (TAARs), particularly TAAR5, are expressed in limbic regions and modulate dopaminergic and serotonergic systems. Animal and human studies suggest TAAR ligands influence affective and defensive behaviors, but their effect on human economic decision-making remains understudied. We examined how TAAR-targeting and control odorants affect risky choice and emotion.

Methods: Ninety-six healthy adults (mean age = 22.4) completed five sessions in a within-subject design, each under a different odor condition: TAAR agonists (trimethylamine, cadaverine), TAAR antagonists (timberol, myrcene), pleasant control (citral), unpleasant control (caproic acid), and no-odor placebo. All participants completed all conditions in pseudorandomized order. In each session, they performed a lottery-based risk task; in one randomly assigned session, they also completed an emotional image evaluation task. Generalized linear mixed-effects models assessed the impact of odorants and stimulus parameters.

Results: All odorants—including placebo—increased the likelihood of choosing the safe option, suggesting a general shift toward risk aversion under olfactory stimulation. Classical economic effects were observed: larger potential gains ($\beta = -0.015$, $p < .001$) and higher win probabilities ($\beta = -9.77$, $p < .001$) reduced safe choices. Odor valence positively predicted safe choices ($\beta = 0.065$, $p < .001$), while odor familiarity had a negative effect ($\beta = -0.029$, $p < .05$).

Interactions between odorants and win probability were not significant, indicating no effect on probability sensitivity. In contrast, interactions with reward magnitude were significant for cadaverine ($\beta = -0.0033$, $p < .001$), citral ($\beta = -0.0047$, $p < .001$), and timberol ($\beta = -0.0051$, $p < .001$). These negative interactions suggest that under these odors, higher potential rewards led to greater risk aversion—pointing to a selective modulation of reward sensitivity by olfactory cues.

In the affective task, emotional valence ratings were shaped by prior outcomes: higher monetary wins attenuated negative affective bias, while longer payment delays increased it ($\beta = -0.018$, $p < .001$), indicating cross-task affective carryover driven by reward context.

Conclusions: Together, these findings show that TAAR-related and control odors influence both risky choice and emotion via limbic-linked modulation of reward sensitivity.

PS.01: Emotion & Choice

PS.01.01 - Affective valence reinforces choice alongside reward

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Details

Objective: Standard RL models assume that behavior is shaped by external rewards, without recognizing a role for affect. Here, we sought to illuminate the role of affect in RL. We hypothesized that affect reinforces choice alongside reward, such that individuals prefer choice options which lead to more positive affect in addition to preferring options which yield greater reward.

Methods: We administered three two-armed bandit tasks with valence self-reports (N1 = 101, N2 = 191, N3 = 421). Though there were differences between tasks (see Abstract Supplement for details of each), their core structure was the same: on each trial, participants chose between two cues and received an outcome (a monetary win or loss). At the end of many trials, participants also rated their affective valence.

We fit computational models that predicted valence ratings using several trial-level variables (e.g., received reward, counterfactual reward). These models yielded estimates of the valence elicited by each cue outcome. We then used RL algorithms to estimate the expected reward Q and expected affect A from each cue on each trial, based on the cue's recent outcomes and the estimated valence elicited by those outcomes, respectively. Q and A values were then used to predict choices.

Results: The models fit valence ratings very well ($R21 = .44$, $R22 = .86$, $R23 = .78$). In all three tasks, we found positive effects of both expected affect A (.20[.06,.35], .42[.29,.55], .51[.39,.64]) and expected reward Q (.71[.55,.89], 1.59[1.36,1.86], .29[.17,.41]) on choice likelihood. Thus, participants preferred cues which had recently led to more positive affect and greater reward, confirming our hypothesis that both affect and reward reinforce choice.

Additionally, we compared the effects of Q and A on choice in the third study, which was designed to provide comparable estimates of these effects. Expected affect had a larger impact on choice than expected reward (.22[.001,.45]), demonstrating the importance of affect to RL.

Conclusion: Standard RL models recognize that external rewards reinforce behavior, but do not identify a role for affect. Here, we show that affect also reinforces behavior, and that its effect on choice can be even greater than that of reward. These results provide important insight into the basic mechanisms of learning and choice, identifying a novel and influential role for affect in RL.

PS.01.02 - Emotional control predicts changes in decision-making under negative affect

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Details

Value based decision-making is known to be affected by emotional states. Different aspects of how individuals experience and handle emotions may affect the extent to which their decision-making is altered by negative emotion.

Objective: The aim of this study is to investigate how individual differences in emotional awareness and control moderate changes in risk and ambiguity preferences due to negative affect.

Methods: Healthy adults completed emotion questionnaires at a baseline visit. In two experimental visits, participants watched a negatively valenced video with fear-, disgust-, or sadness-inducing content or a sham video. Participants then completed a risky decision-making task where they chose between a certain gain/loss of \$5 or playing a lottery where they could win/lose a different amount. Lottery reward, probability, and ambiguity level varied trial-by-trial. Following their choice, they rated their confidence on a 1-4 likert scale. Based on a factor analysis of the questionnaires, resulting latent variables of emotional awareness and control for each participant were used in subsequent analyses. We fit a risk and ambiguity utility model to choice data to derive estimates of individuals' risk tolerance, ambiguity tolerance, and choice stochasticity.

Results: Out of 30 participants who completed the experiment, 17 performed the risky decision-making task immediately after the emotion induction. Negative affect was associated with increased risky lottery choices ($t(16) = 2.15$, $p = 0.047$), particularly in the loss domain, and increased choice stochasticity in the gain domain ($t(16) = -2.31$, $p = 0.028$). We found no effects of negative affect on confidence, and no statistically significant relationships between emotional control and baseline behavior. However, there were significant moderation effects of emotional control when looking at the change in behavior under negative affect. In the gain domain, higher emotional control was significantly related to more willingness to choose the lottery compared to baseline ($r = 0.51$, $p = 0.038$) and increased choice stochasticity ($r = -0.65$, $p = 0.005$). In the loss domain, emotional control was significantly related to a decrease in choice stochasticity ($r = 0.51$, $p = 0.038$). Emotional awareness did not relate to any aspect of changes in behavior.

Conclusion: Our preliminary results show that negative affect reduces risk aversion and worsens choice stochasticity in gains, while making choices in the loss domain more deterministic. They also suggest a role for individual differences in emotional control in moderating these effects. Future work will test the extent to which this relates to psychopathology.

PS.01.03 - Dissociable effects of age, apathy and depression symptoms, and locus coeruleus integrity on cognitive effort-based decision-making

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Details

Choosing how much cognitive effort to expend is critical for everyday decisions. Although there are considerable individual differences in the willingness to engage in cognitive effort, multiple lines of research suggest that there are marked differences in this facet of decision-making in older age and in psychiatric disorders. Nevertheless, there have been no investigations to date that have simultaneously measured the effects of both age and psychiatric-like symptoms on the willingness to engage in cognitive effort, nor have there been studies that examined this construct in middle age. The current study provides an opportunity to test whether age and affective dysregulation (e.g., apathy, depression symptoms) are independently associated with the willingness to engage in cognitive effort. Further, this work helps to provide additional insights into the neural mechanisms that support cognitive effort-based decision-making by incorporating in vivo imaging of the norepinephrine system, a key neuromodulator thought to be involved in the mobilization of cognitive effort. Participants ($N=92$) ages 18-60 completed the Cognitive Effort Discounting paradigm in addition to individual difference questionnaires indexing apathy and depression symptoms. In a subset of these participants ($N=42$), we used ultra-high-field MRI (7T) to measure the integrity of the locus coeruleus, the hub of the brain's norepinephrine system. Multilevel models were used to test for the contribution of apathy and depression symptoms, age, and locus coeruleus integrity on the costs of engaging in cognitive effort. Behavioral analyses suggest that both age and affective dysregulation (apathy, depression symptoms) were independently associated with the willingness to engage in cognitive effort. Specifically, we found that as age increased, the willingness to engage in cognitive effort decreased, $B = -0.004$ $[-0.007, -0.001]$, $p = 0.007$. Moreover, higher levels of both apathy, $B = -0.15$ $[-0.27, -0.04]$, $p = 0.007$, and depression symptoms, $B = -0.07$ $[-0.12, -0.03]$, $p = 0.002$, were associated with reductions in the willingness to engage in cognitive effort. Interestingly, we found that the integrity of the locus coeruleus moderated the associations between both apathy and depression symptoms on the willingness to engage in cognitive effort ($ps < 0.043$), with the strongest effects of apathy and depression symptoms observed in those with higher levels of locus coeruleus integrity. Together, these results suggest that age- and affect-related changes in the willingness to engage in cognitive effort are likely distinct, with the latter subserved by the integrity of the norepinephrine system.

PS.01.04 - The skewed distribution of likes makes social media users less happy

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Details

Objective: On social media platforms, few posts are extremely popular while most posts receive only few likes. Here, we hypothesized that such a positive skew in the distribution of likes reduces the happiness of those users who post. This is because of more frequent disappointments which are not compensated by rare (if larger) positive surprises (compared to a less skewed distribution).

Methods: We recruited 165 self-reported social media users from Prolific (9 exclusions due to failed attention check) to play a social media game. Participants would see a series of 30 pairs of animal photos that we randomly selected from a stimulus set created in a pretest. For each pair, participants had to decide which one of the two photos to post on a fictitious social media platform. They were informed that their posts could receive likes. The number of likes was based on the data of other real participants (i.e., the data from the pretest). After every post, participants would provide

the number of likes they expected to receive before the actual number of likes received was revealed. Every 3 posts, participants indicated how happy they felt on a visual analog scale. We manipulated between subjects whether likes across posts followed a distribution with a positive skew (skewed condition; mean=23.45, sd=9.98, skew =1.14, $p<.001$) or a symmetrical distribution (symmetrical condition; mean=23.49, sd=6.29, skew=-0.02, $p=.566$). We further matched the correlation of feedback to the original likes from the pretest between conditions. All analyses control for the log-transformed number of likes that the participants reported to usually receive for their social media posts, a trial fixed effect and a participant-level random intercept.

Results: As we hypothesized, participants in the skewed condition were less happy ($b=-6.67$, $SE=3.24$, $p<.05$). Next, we investigated the mechanism behind this effect. Participants in the skewed condition more frequently experienced negative prediction errors ($b=0.25$, $SE=1.22$, $p<.05$). Further, the prediction error of the last trial was, in turn, positively associated with happiness ($b=0.10$, $SE=0.02$, $p<.001$). Finally, we estimated a computational model where happiness was a function of recent prediction errors (mean $r^2=0.25$). We found that especially those participants were less happy in the skewed condition, who were more sensitive to feedback (interaction of skewed condition x sensitivity parameter: $b=-24.19$, $SE=5.69$, $p<.001$).

Conclusions: We show that the pervasive positive skew in the distribution of likes across posts makes posting users less happy and explore why.

PS.01.05 - Affective bias in beliefs is action-dependent: evidence and a model

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Details

Our beliefs are often affectively and motivationally biased. For example, we tend to be optimistic, overestimating the likelihood of desirable events. As these types of bias seem pervasive, they may be expected to apply equally to all kinds of beliefs. On the other hand, however, some affective aspects of biased beliefs have been described as action-dependent (e.g. choice-confirmatory processes, cognitive dissonance). Therefore, affective biases may differentially distort beliefs about one's own actions versus external states of the world.

Here we compare an affective bias in belief judgements about one's own choices and imposed choices. We devised a visual discrimination task with belief ratings (probability of the choice being correct from 0 to 100%), where we manipulated monetary incentives and choice agency across four experiments (total $N = 800$). We show that while beliefs are biased by the net value of incentives in Free choices, the effect is attenuated for Observed choices made by the computer (Exp1a: $\beta_{\text{INCENTIVE}} = 3.46$, $t = 8.67$, $p < 0.001$, $\beta_{\text{INCENTIVE:OBSERVED}} = -2.40$, $t = -4.27$, $p < 0.001$; Exp1b: $\beta_{\text{INCENTIVE}} = 3.05$, $t = 5.04$, $p < 0.001$; $\beta_{\text{INCENTIVE:OBSERVED}} = -3.69$, $t = -2.35$, $p = 0.02$; Exp2: $\beta_{\text{INCENTIVE}} = 2.72$, $t = 8.30$, $p < 0.001$; $\beta_{\text{INCENTIVE:OBSERVED}} = -1.48$, $t = -3.21$, $p = 0.002$). Additionally, we tested Replayed choices where participants judged their previous choices after re-watching the stimuli, and Forced choices where the participants were required to press the computer-selected button. In these conditions we observe an incentive effect comparable to that of Observed choices, with no difference between Replayed and Forced (Exp3: $\beta_{\text{INCENTIVE}} = 1.42$, $t = 7.04$, $p < 0.001$; $\beta_{\text{INCENTIVE:FORCED}} = 0.2$, $t = 0.7$, $p = 0.48$).

We then propose a computational mechanism that can account for this attenuation of the incentive effect in the non-free conditions: a confirmatory model that biases evidence towards the actual choice only if it matches a covert decision made when observing the evidence.

PS.01.06 - Reference points, a computational instantiation of reward expectations, predict the severity of major depressive disorder

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Details

Prospect theory, the mathematical theory of decision-making established by Kahneman and Tversky, posits that people decide if a stimulus is rewarding by comparing it to a fluctuating and unconscious benchmark called the reference point. Reinforcers above the reference point are experienced as positive, and those below as negative. Decades of behavioral experiments have shown that a wide range of reward-related behaviors are reference-dependent and that people can appropriately set their reference point based on their expectations about the current environment.

What would happen if the reference-setting mechanisms went awry? If a person were unable to appropriately adapt their

reference point and ended up with a pathologically elevated reference point, then they would experience many objectively positive stimuli as negative. Psychiatrists would term this phenomenon anhedonia: the inability to enjoy previously rewarding experiences. Importantly, anhedonia is one of the defining features of major depressive disorder (MDD), and the presence of this common symptom suggests that a maladaptive response to rewards is a key feature of MDD.

We hypothesized a defining feature of MDD may be a pathologically elevated reference point, leading to lower subjective valuation of all stimuli and therefore a loss of interest in previously rewarding activities. To test this hypothesis, we used a gamified foraging task to assess the reference point in controls ($n=70$) and participants diagnosed with MDD ($n=50$). We found that participants with MDD (vs. controls) showed a systematic 50% elevation of the reference point (t-test, $p < 0.001$). In addition, individual reference points strongly correlated with depression severity as measured by the gold-standard Montgomery-Asberg Depression Rating Scale ($r = 0.71$, $p < 0.001$).

We used a second task to test the hypothesis that the reference point adapts to the reward environment pathologically in patients with MDD, perhaps driving the pathological elevation observed at steady-state. Using this task, we found that when participants were switched to a new reward environment, participants with MDD showed slow or undetectable resetting of their reference point compared to controls (decay parameter significantly different, $p < 0.05$).

Together, these results suggest that anhedonia in depression may reflect a pathology in reference point setting, and they provide the foundation for more objective, neuroeconomics-based measurement of depression.

PS.02: Consumer Behavior & Attention

PS.02.01 - Distributional reinforcement learning in financial markets? Characterizing how shape of distribution impacts learning strategy

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Details

Recent studies suggest that dopamine neurons in the ventral tegmental area implement distributional reinforcement learning (RL) where these neurons convey information about reward distributions. However, behavioral evidence supporting distributional RL remains elusive. To address this question, in this study, we designed a financial investment task where subjects faced different financial portfolios carrying different log-return distributions. Critically, we manipulated the shape of the distributions—heavy-tail versus non-heavy-tail—while controlling their mean and variance so as to examine whether distributional shape could impact learning strategy (standard versus distributional RL). Human participants (22 subjects) encountered two distributions, with each in one block of trials (120 trials per distribution). Subjects were informed the existence of good and bad markets and a 0.1 probability of market shift at any point in time. For each portfolio, the distribution under good and bad markets were mean-shifted and symmetric around 0 return. On each trial, information about the log-return of the portfolio was randomly drawn from the corresponding distribution where return is defined by the ratio of the previous return (V_{t-1}) and the current return (V_t). At the beginning of a block, participants were endowed with the portfolio and reward points transferrable to cash. Each trial consisted of a prediction phase followed by a decision phase. In the prediction phase, participants were asked to predict the return of the portfolio ($(V_t - V_{t-1})/V_{t-1}$) by placing a bar on the return line. A bonus was given when the actual return fell within the confines of the bar. Prior to bar placement, subjects had to determine the size of the bar where the potential bonus decreased with bar size. Information about the current return was then revealed before subjects entered the decision phase to indicate the degree of which she or he would like to buy or sell the portfolio using a probability scale. First, we found that predicted returns were closer between good and bad markets when facing heavy-tail distribution. Second, subjects showed greater variability in bar-size decisions when facing heavy-tail distribution. Third, subjects' buy/sell decisions were more correlated with their predicted return than the actual return of the portfolio irrespective of the distributions. Fourth, about half the subjects' predicted returns were better described by distributional RL than median RL. Finally, 6 out of 22 subjects used different learning strategies when facing different distributions. Together, these results suggested that while distributional shape can impact predictions, humans do not always adopt a distributional RL strategy in uncertain and volatile environments.

PS.02.02 - Neuroforecasting: The impact of hedonic vs. utilitarian Motives

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Details

We systematically compared neuroforecasting accuracy for participants with hedonic or utilitarian motives, evaluating hedonic or utilitarian products. The 'products' consisted of profiles of candidates with whom participants could socialize (hedonic motive) or who could be recruited for a cognitive task (utilitarian motive). The profiles featured three hedonic attributes (attractiveness, sense of humor, and sociability) and three utilitarian attributes (analytical thinking, stress resistance, and persistence). We constructed two pseudo-markets (each N=200) where consumers evaluated the same set of 80 profiles with either hedonic or utilitarian motives, allowing us to isolate the impact of motive while keeping stimulus attributes constant. We then recruited an independent sample (N = 80) to evaluate the same set of profiles in the MRI scanner with either a hedonic or utilitarian motive.

We then assessed how neural responses from the two samples with different motives could forecast each market. We first ran a whole-brain analysis with general linear models to identify regions forecasting market-level preferences. We then took the significant regions as region-of-interest (ROIs) to further investigate differences in forecasting accuracy in the two markets, as well as the moderating roles of motive (hedonic vs. utilitarian) and type of attribute (hedonic vs. utilitarian).

Our analyses highlighted several regions predictive of market preferences: while nucleus accumbens (NAcc) responses predicted the hedonic market, activity in left posterior insula (pINS) forecasted both markets. For pINS, responses to both hedonic and utilitarian attributes could forecast both markets, but the forecasting abilities were moderated by the participants' motive: pINS responses to hedonic attributes were more predictive among participants with a hedonic motive, while pINS responses to utilitarian attributes were more predictive among participants with a utilitarian motive. In contrast, for NAcc, only the responses to hedonic attributes, but not to utilitarian attributes, could forecast the markets. NAcc forecasting ability was also moderated by the participants' motive but in the opposite direction: responses to hedonic attributes were more predictive of the market among participants with a utilitarian motive.

Our results suggest distinct effects of motive on the forecasting ability of NAcc and pINS toward relevant product attributes. Individuals' pINS responses toward motive-congruent attributes forecast market preferences better, while their NAcc responses toward hedonic attributes forecast better if these attributes are irrelevant for current motives.

PS.02.03 - Loss aversion emerges from the interplay of valuation, attention and evidence accumulation

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Details

Objective: Loss aversion—"losses loom larger than gains," is well-documented, yet its underlying mechanisms remain unresolved. Recent research in value-based decision-making highlights the dynamic interplay among value, attention, and evidence accumulation. The attentional drift diffusion model (aDDM) posits attention modulates how value biases evidence accumulation while other studies suggest accumulated evidence guides attention, manifested as more fixation on options with stronger accumulated evidence. Current study investigates how these processes interact to shape loss aversion.

Methods & Results: Using eye-tracking during a gambling task (N = 80), participants chose between a gamble option (with varying gains and losses) and a certain option.

We found that valuation bias contributes to loss aversion. The aDDM with valuation bias best predicted participants' choices and reaction times. This bias was significantly correlated with subjects' behavioral loss aversion tendencies derived from prospect theory ($r = 0.92$, $p < .001$).

Attentional bias also played a significant role on loss aversion. We computed Loss Gaze Proportion (LGP)—gaze proportion on loss vs. gain—as an index of attentional bias on the gamble option. LGP showed a significant correlation with loss aversion ($r = 0.34$, $p = .002$).

Additionally, accumulated evidence guided attention allocation between options. We calculated Gamble Gaze Proportion (GGP)—gaze proportion on the gamble vs. certain option. The aDDM predicts that greater decision thresholds correspond to greater accumulated evidence differences. Accordingly, Δ GGP—defined as GGP difference between the gamble and certain options—at decision onset was positively correlated with decision thresholds ($r = 0.45$, $p < .001$), suggesting a link between accumulated evidence and attention.

To quantify how evidence influences GGP, we computed the Evidence Impact Coefficient (EIC) by simulating evidence accumulation with aDDM and performed mixed linear regression analyses, where GGP at each time bin was predicted by prior-bin accumulated evidence. The regression analyses with valuation bias, LGP, and the interaction between EIC and LGP as predictors against individual loss aversion coefficients showed all predictors were significantly positive (valuation bias: $p < .001$; LGP: $p = .033$; EIC×LGP: $p = .028$), indicating that EIC amplifies the effect of attentional bias on loss aversion.

Conclusions: Loss aversion emerges from valuation and attentional biases, with the impact of attention further amplified by how strongly evidence guides attention between options. These findings offer a more integrated account of the cognitive mechanisms driving loss aversion.

PS.02.04 - Search strategies influence intertemporal choice

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Details

Introduction: In intertemporal choice, comparative searchers, who compare attributes across options, exhibit greater patience than integrative searchers, who integrate features within an option (Reeck et al. 2017; Amasino et al., 2019). However, demonstrations of this effect are often correlational. It is unknown whether these results emerge independently from these sampling patterns or if both are caused by a shared underlying mechanism. Here, we use the drift-diffusion model (DDM) to test whether information sampling patterns alone can generate the differences in intertemporal choice seen in the empirical data.

Objective & Methods. Here, we conducted a series of simulations to explore how patient choices are influenced by the way information is sampled. First, we simulated choices between larger later (LL) and smaller sooner (SS) options using the DDM with either a comparative (Eq. 1) and integrative (Eq. 2) value function.

$$\text{Eq. 1 } V = \delta_A(A_{LL} - A_{SS}) + \delta_D(D_{LL} - D_{SS})$$

$$\text{Eq. 2 } V = \frac{\delta_A A_{LL}}{1 + \delta_D D_{LL}} - \frac{\delta_A A_{SS}}{1 + \delta_D D_{SS}}$$

Next, to account for information sampling patterns, we used an attentional DDM (aDDM) in which unattended attributes receive a discount θ (e.g., Eq. 3 for the comparative model). For each trial, one fixation pattern (comparative or integrative) and fixation times were randomly pulled from the empirical data, and the value signal evolved according to that pattern for that trial.

$$\text{Eq. 3 } V = \delta_A(A_{LL} - \theta_A A_{SS}) + \delta_D \theta_D (D_{LL} - D_{SS})$$

Results. Results indicate that comparative and integrative search predict significantly different choices. For the standard DDMs (Eq. 2-3) that do not use empirical search patterns, surprisingly, integrative DDMs led to more patient choices, the opposite of the empirical findings (logistic regression predicting LL choice from relative slope $\delta_A - \delta_D$ $p < .001$, DDM type $p < .001$, and their interaction $p < .001$). However, incorporating sampling patterns into the aDDM reverses this pattern, with comparative search predicting more patient choices for both DDM value functions (search pattern $p < .001$, DDM type $p < .001$, interaction $p = .0001$). Next steps will test Eq. 2-3 value functions in the empirical data in which choice architecture was used to manipulate search patterns.

Conclusions. Overall, our results demonstrate that search strategies alone influence intertemporal choice, with comparative search promoting greater patience only when empirical search patterns are considered. Importantly, this pattern is only seen when models incorporate empirical search patterns; the standard DDM cannot account for the results seen in the empirical data. These findings demonstrate the importance of search strategies in shaping intertemporal patience.

PS.02.05 - Brain activity reveals how wildlife imagery evokes engagement on social media

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Details

Visual imagery can motivate environmental advocacy and charitable giving, but the mechanisms underlying their broad appeal remain unclear. To understand how images of wildlife species elicit online engagement, we investigated links between behavioral probes, neuroimaging data (n=37), and social media engagement data from National Geographic's Instagram content stream. The account has amassed over 275 million followers as of 2025, highlighting its vast reach and influence. As hypothesized according to an Affect-Integration-Motivation (AIM) framework, activity in brain circuits associated with anticipatory affect and value integration (i.e., the Nucleus Accumbens or NAcc, and Medial Prefrontal Cortex or MPFC) predicted individuals' engagement with and donations to depicted species (56 stimuli). Group brain activity in the value integrative component of this circuit (MPFC) also forecast aggregate engagement on social media (i.e., total number of likes divided by number of current followers). Furthermore, MPFC activity correlated with activity in distinct circuits implicated in face processing (i.e., the Fusiform Face Area or FFA) and mentalizing (i.e., the TemporoParietal Junction or TPJ). Finally, a neurally-inspired model derived from these correlated components (i.e., indexing facial salience and phylogenetic closeness, respectively) was used to forecast image engagement out-of-sample (276 stimuli). These findings not only extend neuroforecasting to a novel online domain, but also theoretically imply that neural data can support the discovery of stimulus features which scaffold new models for forecasting online engagement. These findings also have applied implications for accentuating or optimizing image features to promote support for wildlife.

PS.02.06 - Virtual reality as a research tool for value-based decision making

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We highlight how Extended Reality (XR, which includes Virtual Reality, Augmented Reality, and Mixed Reality) is emerging as a powerful methodological tool for neuroeconomic research. Beyond enhancing ecological validity, XR enables researchers to collect multiple streams of rich physiological and behavioral data, including eye, hand, and facial tracking, as well as spatial positioning, without disrupting naturalistic experiences. We will argue that XR can help advance the field by providing researchers with novel ways to design experiments, manipulate environments, and, most importantly, capture multiple physiological signals of decision processes in real time.

Through the spotlight and a live demonstration, we will showcase examples from our lab using VR to study value-based decision making and spatial navigation. These projects illustrate how immersive tasks can complement and extend insights from classic behavioral paradigms rather than replace them. Finally, we will introduce our efforts to create open tools for experiment design and data analysis. These initiatives aim to make immersive experimentation broadly accessible, supporting the Society's collective goal of building more powerful, precise, and ecologically valid tools for neuroeconomics.

PS.03: Decision Processes

PS.03.01 - Multi-response decision making: Moving beyond single alternative selection in value-based settings

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Details

Objective: Many choices involve selecting multiple items (e.g., grocery shopping). Despite their ubiquity, the cognitive processes underlying these "multi-response" decisions remain understudied. Motivated by sequential sampling theories, we propose that individuals adapt decision strategies to their goals by focusing on task-relevant value comparisons and managing cognitive load. We examine how selection requirements, preference strength, and set size influence the choice process.

Methods: In Study 1, 75 subjects selected 1, 2, or 3 items from sets of 4. In Study 2, 100 subjects selected from larger sets (4, 8, or 12 items). Selection requirements were blocked, with block order randomized. We collected choice data, response times, and process data (eye movements in Study 1; mouse trajectories in Study 2).

Results: Subjects adapted their strategies based on selection requirements. In Study 1, for single-item selections, accuracy was most influenced by the value difference between the best and second-best options ($\beta = 1.04$, $p < .001$). For two-item

selections, the difference between the second-best and third-best option was most predictive ($\beta = 0.79$, $p < .001$), while for three-item selections, the difference between the third-best and worst option was most critical ($\beta = 0.85$, $p < .001$). This pattern replicated in Study 2, with stronger effects in larger sets.

Subjects favored selecting items in rank order, consistent with a sequential sampling approach. The best-to-second-best (1–2) sequence occurred in 60.3% of two-item correct trials, and the sequence (1–2–3) occurred significantly most frequently (31.5%) in three-item correct trials (all contrasts, $ps < .001$). In Study 2, subjects maintained this tendency in 4-item sets, but showed a reduced tendency with larger set sizes.

Subjects responded slower when selecting more items and responded faster when the relevant value difference was largest. In Study 1, where initial selections took significantly longer than subsequent ones, subjects made fewer subsequent when they had spent more time on the initial selection. In Study 2, subjects' initial mouse trajectories were more curved when selecting a single item compared to selecting two or three ($p < .0001$), suggesting less conflict.

Conclusions: Our work provides a comprehensive characterization of multi-response choice, demonstrating that individuals adapt their choice processes. The findings offer empirical support for extending existing sequential sampling models beyond single-item selection by explaining patterns in choice and process data. This lays the groundwork for developing computational models that can predict multi-response decisions.

PS.03.02 - Global reward rate controls transition from value-based to heuristic-based decision-making

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Details

Objective: Local effects of reward on value-based choice are often investigated using simple metrics such as win-stay/lose-switch strategies and by fitting reinforcement learning (RL) models to estimate reward values based on each reward feedback. However, relatively less is known about whether and how the overall reward feedback (reward rate) on a longer timescale affects an animal's choice strategy, potentially creating qualitatively distinct modes of decision making. To address these questions, we re-analyzed three datasets from different species (mice, monkeys, humans) performing similar dynamic foraging tasks.

Methods: Subjects from three different species—mice (Bari et al., 2019), monkeys (Tsutsui et al., 2016) and humans (Rutledge et al., 2009; healthy controls only)—performed similar dynamic foraging tasks, in which they selected between two choice options that provided reward probabilistically. Rewards were baited, and reward probabilities changed between blocks of trials, resembling naturalistic foraging. We developed various RL models incorporating distinct components to explore how global reward rate could influence learning and/or decision-making processes. Our hypothesis was that a higher global reward rate promotes reliance on win-stay/lose-switch heuristics, whereas a lower reward rate leads to more value-based decision making based on RL estimated values.

Results: Fit of data using various RL models provided evidence for the effects of global reward rate on behavior. We found that the model with a competitive interaction between heuristic and value-based strategies, driven by the global reward rate, consistently provided the best fit to choice across all datasets (paired t-test on AIC of the best vs. second-best model; mice: $p = .00622$; monkeys: $p = 2.81e-10$; humans: $p = .000578$). Analysis of the estimated parameters revealed that the coefficients for both explicit win-stay and lose-switch were significantly positive across all datasets ($p < .001$), confirming that the subjects indeed resorted more to win-stay/lose-switch strategy as the overall reward rate increased.

Conclusion: Our findings indicate that the overall reward rate over timescales of many trials plays a key role in modulating decision-making strategies across mammalian species, with higher reward rates promoting a shift from value-based strategies to win-stay/lose-switch heuristics. Overall, our results provide an algorithmic account for how the animals' strategies shift as a function of the overall reward rate and provide testable predictions for underlying neural mechanisms.

PS.03.03 - Neural processing of fairness in social decision-making associated with personality traits

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Details

This study investigates how personality traits are associated with the brain's processing of fairness during social interactions, using the Ultimatum Game (UG) as a framework. We aimed to determine whether distinct personality profiles are associated with neural responses to fair and unfair offers in decision-making contexts.

A total of 29 participants played the role of Responders and were clustered into two groups--proself and prosocial--based on personality traits (HEXACO-60) and emotional states (PANAS, BMIS). The proself group, scoring higher in forgiveness, liveliness, and positive mood, tended to accept unfair offers more often. In contrast, the prosocial group--characterized by conscientiousness and fairness--was more inclined to reject unfair offers. We recorded brain activity using Event-Related Potentials (ERPs) and fast optical imaging (Event-Related Optical Signals--EROS--by Frequency Domain fNIRS) during offer evaluations.

Results revealed distinct temporal and spatial patterns of brain activity between the two groups during the rejection of unfair offers. Proself participants exhibited an earlier peak in the P200 ERP component--occurring approximately 30 milliseconds sooner--and a lower amplitude at the Fz electrode, suggesting a faster but less intense initial neural response to perceived unfairness. Additionally, these individuals showed a larger P300 amplitude at the CPz electrode, which is typically associated with more elaborate and evaluative cognitive processing in later stages of decision-making. Complementing these electrophysiological findings, EROS data indicated that proself individuals had reduced activation in the right frontal cortex, specifically along the border of Brodmann areas 8 and 9, between 200 and 230 milliseconds following rejection. In contrast, prosocial participants demonstrated increased activation in the dorsolateral prefrontal cortex (DLPFC, anterior BA9) between 350 and 400 milliseconds--reflecting a delayed but possibly more controlled cognitive engagement with the fairness violation. Prosocial participants also displayed stronger activation in both ERP and EROS signals in the right temporoparietal junction beginning around 500 milliseconds after rejecting unfair offers. This region is widely associated with perspective-taking and social norm evaluation, underscoring the prosocial group's heightened sensitivity to violations of fairness.

In conclusion, this study highlights how proself and prosocial individuals engage distinct neural circuits across different stages of processing unfairness. By integrating fast optical imaging with electrophysiological methods, we show that social decision-making is deeply influenced by dispositional traits such as forgiveness, liveliness, and conscientiousness.

PS.03.04 - No decision is better than a wrong decision: An incentivized opt-out option can garner self-interest to reduce deception

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Details

Objectives: We take a novel approach to examine whether offering a small monetary incentive to opt out of an opportunity to lie can leverage self-interest to reduce dishonesty and deception. Specifically, we investigate how combining minimal financial incentives with an opt-out option might align individuals' economic motivations with ethical behavior.

Methods: Across four controlled behavioral experiments (N = 1,784), we tested whether a small monetary opt-out could discourage unethical decisions in incentivized deception tasks. In Studies 1–3, participants were presented with the opt-out option after learning the game outcome but before making their decision. In Study 4, the opt-out option was offered before any outcome information was revealed in a game, allowing us to test the effectiveness of the incentivized opt-out option in a risky decision.

Results: Across all studies, a \$2 opt-out significantly reduced dishonesty, even when participants could have earned substantially more by lying. A meta-analysis confirmed the robustness of this effect across the four studies, showing a significant reduction in the likelihood of lying ($d = -0.91$, $SE = .14$, 95% CI [-1.19, -0.64], $Z = -6.56$, $p < .001$).

Conclusion: Our findings highlight a critical tension: while financial incentives often promote performance, they may inadvertently erode honesty. By offering a small economic alternative, organizations may redirect self-interest away from misconduct and toward ethical choices. Rather than restricting behavior, this strategy provides an additional choice that satisfies economic motives while upholding moral standards. This approach does not absolve individuals of ethical responsibility but suggests a promising, low-cost mechanism by which organizations can better align incentives with integrity.

PS.03.05 - Redistributive behavior is governed by distinct moral principles

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Details

Objective: Previous research on redistributive behavior has largely relied on the assumption that moral principles are critically important, informing attitudes towards policies that redistribute resources from the economically advantaged to the economically disadvantaged. However, to date no empirical work has directly addressed these fundamental principles. Across two studies we developed a novel experimental task which enables us to empirically distinguish between different moral principles underlying redistributive decisions. Leveraging behavioral choice, computational modeling, and neuroimaging, we address redistributive decision-making across multiple levels of analysis.

Methods: We performed two experiments using the Redistribution Game – a large online study (Experiment 1; $n = 231$) and an fMRI study (Experiment 2; $n = 50$). In each, participants played a novel incentive-compatible task called the Redistribution Game in which participants first view a distribution of tokens among co-players. Then, participants are allowed to set a redistributive tax rate, which alters the final tokens all players receive. Across trials, we manipulate the number of tokens participants initially receive, allowing for the disentangling of self-interest in redistributive decisions. We also vary the criteria used to distribute tokens, creating different degrees of fairness of the initial inequality. To analyze behavior in the Redistribution Game, we developed a utility model which incorporated Equality (unconditional support of redistribution), Equity (unconditional opposition), and Payout-Maximization (self-interest).

Results: Both experiments demonstrated that each of the three principles was employed by a significant proportion of our sample. Furthermore, the fairness of the pre-existing inequality affected the principle used, with 'unfair' inequality promoting Equality and 'fair' inequality promoting Equity. In Experiment 1, we also found that the moral principles utilized by participants in their redistributive choices intuitively explained views that individuals hold towards real economic policies. In Experiment 2, we found that increased activation in primary visual cortex, secondary visual cortex, and right PCC uniquely distinguished Equality-seekers, while deactivation of the right vmPFC and bilateral dACC uniquely distinguished Equity-seekers.

Conclusion: The current study employed a multi-faceted approach to understanding redistributive choice, demonstrating that preferences for redistribution in a socioeconomic task are governed by substantial heterogeneity, that preferences generalize from the lab to the ballot box, and that there are clear neurobiological correlates of these preferences.

PS.03.06 - Increased subjective costs of control-related effort after eating in bulimia nervosa

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Details

Objective: Because exerting control is cognitively demanding, we must make cost-benefit decisions about whether even trying to exert control is worth the effort. These decisions may play a major role in bulimia nervosa (BN): Individuals with BN often rigidly control their eating between binge-eating episodes, but after eating begins, many endorse thinking, "Now that I have done it, I might as well go all the way." Here, we tested whether starting to eat abnormally influences the subjective effort costs associated with cognitive control in BN.

Methods: Women with and without BN ($N=35$) completed the Cognitive Effort Discounting task in two states: after a 16-h fast and after a standardized meal. The task assesses the discounting of cash offers to complete more demanding levels of an N-back. Steeper discounting indicates higher estimated effort costs. The Eating Disorder Examination assessed BN symptom frequency.

Results: In a fed relative to fasted state, women with BN showed steeper effort discounting than healthy controls (HC; Group $\times$ State $p=0.006$). The effects of food consumption in HC resembled those previously observed with dopamine-releasing pharmacological agents like methylphenidate: eating decreased effort costs in HC. However, women with BN showed slightly elevated costs of cognitive effort after eating. Moreover, women with BN who more steeply discounted cognitive effort in a fed state reported more frequent binge-eating episodes ($p=0.034$).

Conclusions: Results suggest that in BN, an altered effort-cost computation after eating starts may reduce willingness to expend effort on control and leave urges to continue eating unchecked. Interventions that decrease subjective costs and increase the subjective value of cognitive effort, specifically after eating, may prove fruitful for BN.

POSTER SESSION I

PS.01.01 - Affective valence reinforces choice alongside reward

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Details

Objective: Standard RL models assume that behavior is shaped by external rewards, without recognizing a role for affect. Here, we sought to illuminate the role of affect in RL. We hypothesized that affect reinforces choice alongside reward, such that individuals prefer choice options which lead to more positive affect in addition to preferring options which yield greater reward.

Methods: We administered three two-armed bandit tasks with valence self-reports (N1 = 101, N2 = 191, N3 = 421). Though there were differences between tasks (see Abstract Supplement for details of each), their core structure was the same: on each trial, participants chose between two cues and received an outcome (a monetary win or loss). At the end of many trials, participants also rated their affective valence.

We fit computational models that predicted valence ratings using several trial-level variables (e.g., received reward, counterfactual reward). These models yielded estimates of the valence elicited by each cue outcome. We then used RL algorithms to estimate the expected reward Q and expected affect A from each cue on each trial, based on the cue's recent outcomes and the estimated valence elicited by those outcomes, respectively. Q and A values were then used to predict choices.

Results: The models fit valence ratings very well ($R21 = .44$, $R22 = .86$, $R23 = .78$). In all three tasks, we found positive effects of both expected affect A (.20[.06,.35], .42[.29,.55], .51[.39,.64]) and expected reward Q (.71[.55,.89], 1.59[1.36,1.86], .29[.17,.41]) on choice likelihood. Thus, participants preferred cues which had recently led to more positive affect and greater reward, confirming our hypothesis that both affect and reward reinforce choice.

Additionally, we compared the effects of Q and A on choice in the third study, which was designed to provide comparable estimates of these effects. Expected affect had a larger impact on choice than expected reward (.22[.001,.45]), demonstrating the importance of affect to RL.

Conclusion: Standard RL models recognize that external rewards reinforce behavior, but do not identify a role for affect. Here, we show that affect also reinforces behavior, and that its effect on choice can be even greater than that of reward. These results provide important insight into the basic mechanisms of learning and choice, identifying a novel and influential role for affect in RL.

PS.01.02 - Emotional control predicts changes in decision-making under negative affect

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Details

Value based decision-making is known to be affected by emotional states. Different aspects of how individuals experience and handle emotions may affect the extent to which their decision-making is altered by negative emotion.

Objective: The aim of this study is to investigate how individual differences in emotional awareness and control moderate changes in risk and ambiguity preferences due to negative affect.

Methods: Healthy adults completed emotion questionnaires at a baseline visit. In two experimental visits, participants watched a negatively valenced video with fear-, disgust-, or sadness-inducing content or a sham video. Participants then completed a risky decision-making task where they chose between a certain gain/loss of \$5 or playing a lottery where they could win/lose a different amount. Lottery reward, probability, and ambiguity level varied trial-by-trial. Following their choice, they rated their confidence on a 1-4 likert scale. Based on a factor analysis of the questionnaires, resulting latent variables of emotional awareness and control for each participant were used in subsequent analyses. We fit a risk and ambiguity utility model to choice data to derive estimates of individuals' risk tolerance, ambiguity tolerance, and choice stochasticity.

Results: Out of 30 participants who completed the experiment, 17 performed the risky decision-making task immediately after the emotion induction. Negative affect was associated with increased risky lottery choices ($t(16) = 2.15$, $p = 0.047$), particularly in the loss domain, and increased choice stochasticity in the gain domain ($t(16) = -2.31$, $p = 0.028$). We found no effects of negative affect on confidence, and no statistically significant relationships between emotional control and baseline behavior. However, there were significant moderation effects of emotional control when looking at the change in behavior under negative affect. In the gain domain, higher emotional control was significantly related to more willingness to choose the lottery compared to baseline ($r = 0.51$, $p = 0.038$) and increased choice stochasticity ($r = -0.65$, $p = 0.005$). In the loss domain, emotional control was significantly related to a decrease in choice stochasticity ($r = 0.51$, $p = 0.038$). Emotional awareness did not relate to any aspect of changes in behavior.

Conclusion: Our preliminary results show that negative affect reduces risk aversion and worsens choice stochasticity in gains, while making choices in the loss domain more deterministic. They also suggest a role for individual differences in emotional control in moderating these effects. Future work will test the extent to which this relates to psychopathology.

PS.01.03 - Dissociable effects of age, apathy and depression symptoms, and locus coeruleus integrity on cognitive effort-based decision-making

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Details

Choosing how much cognitive effort to expend is critical for everyday decisions. Although there are considerable individual differences in the willingness to engage in cognitive effort, multiple lines of research suggest that there are marked differences in this facet of decision-making in older age and in psychiatric disorders. Nevertheless, there have been no investigations to date that have simultaneously measured the effects of both age and psychiatric-like symptoms on the willingness to engage in cognitive effort, nor have there been studies that examined this construct in middle age. The current study provides an opportunity to test whether age and affective dysregulation (e.g., apathy, depression symptoms) are independently associated with the willingness to engage in cognitive effort. Further, this work helps to provide additional insights into the neural mechanisms that support cognitive effort-based decision-making by incorporating in vivo imaging of the norepinephrine system, a key neuromodulator thought to be involved in the mobilization of cognitive effort. Participants ($N=92$) ages 18-60 completed the Cognitive Effort Discounting paradigm in addition to individual difference questionnaires indexing apathy and depression symptoms. In a subset of these participants ($N=42$), we used ultra-high-field MRI (7T) to measure the integrity of the locus coeruleus, the hub of the brain's norepinephrine system. Multilevel models were used to test for the contribution of apathy and depression symptoms, age, and locus coeruleus integrity on the costs of engaging in cognitive effort. Behavioral analyses suggest that both age and affective dysregulation (apathy, depression symptoms) were independently associated with the willingness to engage in cognitive effort. Specifically, we found that as age increased, the willingness to engage in cognitive effort decreased, $B = -0.004$ [-0.007 , -0.001], $p = 0.007$. Moreover, higher levels of both apathy, $B = -0.15$ [-0.27 , -0.04], $p = 0.007$, and depression symptoms, $B = -0.07$ [-0.12 , -0.03], $p = 0.002$, were associated with reductions in the willingness to engage in cognitive effort. Interestingly, we found that the integrity of the locus coeruleus moderated the associations between both apathy and depression symptoms on the willingness to engage in cognitive effort ($ps < 0.043$), with the strongest effects of apathy and depression symptoms observed in those with higher levels of locus coeruleus integrity. Together, these results suggest that age- and affect-related changes in the willingness to engage in cognitive effort are likely distinct, with the latter subserved by the integrity of the norepinephrine system.

PS.01.04 - The skewed distribution of likes makes social media users less happy

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Details

Objective: On social media platforms, few posts are extremely popular while most posts receive only few likes. Here, we hypothesized that such a positive skew in the distribution of likes reduces the happiness of those users who post. This is because of more frequent disappointments which are not compensated by rare (if larger) positive surprises (compared to a less skewed distribution).

Methods: We recruited 165 self-reported social media users from Prolific (9 exclusions due to failed attention check) to play a social media game. Participants would see a series of 30 pairs of animal photos that we randomly selected from a stimulus set created in a pretest. For each pair, participants had to decide which one of the two photos to post on a fictitious social media platform. They were informed that their posts could receive likes. The number of likes was based on the data of other real participants (i.e., the data from the pretest). After every post, participants would provide the number

of likes they expected to receive before the actual number of likes received was revealed. Every 3 posts, participants indicated how happy they felt on a visual analog scale. We manipulated between subjects whether likes across posts followed a distribution with a positive skew (skewed condition; mean=23.45, sd=9.98, skew =1.14, $p<.001$) or a symmetrical distribution (symmetrical condition; mean=23.49, sd=6.29, skew=-0.02, $p=.566$). We further matched the correlation of feedback to the original likes from the pretest between conditions. All analyses control for the log-transformed number of likes that the participants reported to usually receive for their social media posts, a trial fixed effect and a participant-level random intercept.

Results: As we hypothesized, participants in the skewed condition were less happy ($b=-6.67$, $SE=3.24$, $p<.05$). Next, we investigated the mechanism behind this effect. Participants in the skewed condition more frequently experienced negative prediction errors ($b=0.25$, $SE=1.22$, $p<.05$). Further, the prediction error of the last trial was, in turn, positively associated with happiness ($b=0.10$, $SE=0.02$, $p<.001$). Finally, we estimated a computational model where happiness was a function of recent prediction errors (mean $r^2=0.25$). We found that especially those participants were less happy in the skewed condition, who were more sensitive to feedback (interaction of skewed condition x sensitivity parameter: $b=-24.19$, $SE=5.69$, $p<.001$).

Conclusions: We show that the pervasive positive skew in the distribution of likes across posts makes posting users less happy and explore why.

PS.01.05 - Affective bias in beliefs is action-dependent: evidence and a model

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Details

Our beliefs are often affectively and motivationally biased. For example, we tend to be optimistic, overestimating the likelihood of desirable events. As these types of bias seem pervasive, they may be expected to apply equally to all kinds of beliefs. On the other hand, however, some affective aspects of biased beliefs have been described as action-dependent (e.g. choice-confirmatory processes, cognitive dissonance). Therefore, affective biases may differentially distort beliefs about one's own actions versus external states of the world.

Here we compare an affective bias in belief judgements about one's own choices and imposed choices. We devised a visual discrimination task with belief ratings (probability of the choice being correct from 0 to 100%), where we manipulated monetary incentives and choice agency across four experiments (total $N = 800$). We show that while beliefs are biased by the net value of incentives in Free choices, the effect is attenuated for Observed choices made by the computer (Exp1a: $\beta_{\text{INCENTIVE}} = 3.46$, $t = 8.67$, $p < 0.001$, $\beta_{\text{INCENTIVE:OBSERVED}} = -2.40$, $t = -4.27$, $p < 0.001$; Exp1b: $\beta_{\text{INCENTIVE}} = 3.05$, $t = 5.04$, $p < 0.001$; $\beta_{\text{INCENTIVE:OBSERVED}} = -3.69$, $t = -2.35$, $p = 0.02$; Exp2: $\beta_{\text{INCENTIVE}} = 2.72$, $t = 8.30$, $p < 0.001$; $\beta_{\text{INCENTIVE:OBSERVED}} = -1.48$, $t = -3.21$, $p = 0.002$). Additionally, we tested Replayed choices where participants judged their previous choices after re-watching the stimuli, and Forced choices where the participants were required to press the computer-selected button. In these conditions we observe an incentive effect comparable to that of Observed choices, with no difference between Replayed and Forced (Exp3: $\beta_{\text{INCENTIVE}} = 1.42$, $t = 7.04$, $p < 0.001$; $\beta_{\text{INCENTIVE:FORCED}} = 0.2$, $t = 0.7$, $p = 0.48$).

We then propose a computational mechanism that can account for this attenuation of the incentive effect in the non-free conditions: a confirmatory model that biases evidence towards the actual choice only if it matches a covert decision made when observing the evidence.

PS.01.06 - Reference points, a computational instantiation of reward expectations, predict the severity of major depressive disorder

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Details

Prospect theory, the mathematical theory of decision-making established by Kahneman and Tversky, posits that people decide if a stimulus is rewarding by comparing it to a fluctuating and unconscious benchmark called the reference point. Reinforcers above the reference point are experienced as positive, and those below as negative. Decades of behavioral experiments have shown that a wide range of reward-related behaviors are reference-dependent and that people can appropriately set their reference point based on their expectations about the current environment.

What would happen if the reference-setting mechanisms went awry? If a person were unable to appropriately adapt their

reference point and ended up with a pathologically elevated reference point, then they would experience many objectively positive stimuli as negative. Psychiatrists would term this phenomenon anhedonia: the inability to enjoy previously rewarding experiences. Importantly, anhedonia is one of the defining features of major depressive disorder (MDD), and the presence of this common symptom suggests that a maladaptive response to rewards is a key feature of MDD.

We hypothesized a defining feature of MDD may be a pathologically elevated reference point, leading to lower subjective valuation of all stimuli and therefore a loss of interest in previously rewarding activities. To test this hypothesis, we used a gamified foraging task to assess the reference point in controls ($n=70$) and participants diagnosed with MDD ($n=50$). We found that participants with MDD (vs. controls) showed a systematic 50% elevation of the reference point (t-test, $p < 0.001$). In addition, individual reference points strongly correlated with depression severity as measured by the gold-standard Montgomery-Asberg Depression Rating Scale ($r = 0.71$, $p < 0.001$).

We used a second task to test the hypothesis that the reference point adapts to the reward environment pathologically in patients with MDD, perhaps driving the pathological elevation observed at steady-state. Using this task, we found that when participants were switched to a new reward environment, participants with MDD showed slow or undetectable resetting of their reference point compared to controls (decay parameter significantly different, $p < 0.05$).

Together, these results suggest that anhedonia in depression may reflect a pathology in reference point setting, and they provide the foundation for more objective, neuroeconomics-based measurement of depression.

P1.A.33 - Multimodal neural markers of loss and risk avoidance

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Details

Individual differences in anticipating potential gains versus potential losses have profound implications for health and for wealth. Nevertheless, identifying reliable and valid neurophenotypes remains a significant challenge. Here, we aim to assess the convergence of candidate neurophenotypes across structural and functional neuroimaging modalities. Specifically, we examined whether Anterior Insula (AIns) activity during presentation of negatively skewed gambles prior to choice (previously shown to be associated with risk preference and debt) was associated with AIns activity during anticipation of large ($-\$5$) losses (previously shown to be associated with risk for drug relapse), and whether these functional measures related to the structural coherence of the AIns to Nucleus Accumbens (NAcc) white-matter tract. Lastly, we tested whether AIns activity during both negatively skewed gambles and loss anticipation was associated with real-life cumulative debt.

Healthy participants ($N=72$) were recruited and underwent fMRI scans during two monetarily incentive tasks (Skewed Gambling Task and the Monetary Incentive Delay task), a DWI scan, and completed several questionnaires. As predicted, AIns during anticipation of negatively skewed gambles was robustly correlated with AIns activity during loss anticipation ($R=0.47$, $p=.0003$). We then tested whether AIns activity during loss anticipation in these two tasks was associated with coherence of the white-matter tract connecting the AIns to NAcc, consistent with a structural influence on motivation and behavior. Coherence of this tract was in fact associated with activity of AIns both during anticipation of negatively skewed gambles ($R=0.30$, $p=.022$) and large losses ($R=0.30$, $p=.023$). The convergence of the structure-function association of AIns during both tasks further suggests that these functional and structural markers may index a latent variable relevant to loss avoidance.

Finally, we validated the real-life implication of these markers by finding that both functional markers were negatively associated with the magnitude of debt subjects reported (risk: std $\beta=-2.71$, $p=.007$; loss: std $\beta=-2.53$, $p=.011$), and that this association remained robust after controlling for assets, demographic, self-reported, and behavioral individual differences.

Together, the present findings offer promise for identifying reproducible, multimodal neural markers of loss anticipation and risk avoidance. By bridging individual differences in functional activity, structural connectivity, and consequential decision outcomes, this work lays a foundation for future efforts aimed at clinical translation and targeted interventions.

P1.B.8 - The Jaguar brand without a jaguar in its logo: Computational characterization of brand logo designs toward brand personality

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Details

Motivation. The British automaker Jaguar debuted its new logo recently and the absence of the leaping jaguar surprised many. In marketing, companies may re-design their logos to refresh consumer perceptions as a positioning strategy. Yet, while some brands have successfully achieved their intended images, others experience backlash or failure. This exemplifies the elusive principles for how logos should be designed. Marketing research has shown how certain visual features of logos are linked to perceived traits of brands: angular logos can boost perceived premiumness (Septianto & Paramita, 2021); asymmetric logos make brands feel excited (Luffarelli et al., 2019). However, existing research is limited to discrete cases. The variations in logo design are countless, especially when considering other essential aspects such as color choices (Zhou et al., 2025; Kronberg 2020). While brand logos are designed to reflect brand personalities, it remains unclear how logo designs effectively convey intended brand traits. Drawn on insights from human trait perception research (Stolier, et al., 2018), we propose a dual-process model to explain how consumers perceive brand personalities from logos: brand personalities are derived based on physical features of brand logos and consumers' conceptual knowledge about the brands.

Methods: We presented 110 brand logos currently being used to human crowdworkers (N=293) to assess 5-dimension brand personalities (Geuens et al., 2009). The logos are processed by VGG16, a convolutional neural network pretrained on image recognition, to extract high and low visual features. We quantified brand-related conceptual knowledge using GPT-3 embeddings derived from a corpus of news articles published between 2010-2024. To analyze how these two information sources relate to human judgments, we used the representational similarity analysis (i.e., how similar two brands are in terms of visual features, conceptual associations, or perceived personalities). We applied variance partitioning to determine the unique and shared contributions of visual features and conceptual knowledge to brand personalities evaluated by humans.

Results: The conceptual knowledge uniquely accounted for a larger share of explained variance than visual features for perceptions of activity (84.2%), and responsibility (54.2%) in the full model. Visual features contributed most to simplicity (65.5%), emotionality (53.5%) and aggressiveness (60.8%) and significantly predicted the perceived simplicity ($p < .01$) and emotionality ($p < .05$). Together, visual and conceptual features explained the variance of brand personality perception distinctively, supporting the dual-process model.

P1.B.9 - How consumers decide what attributes to (not) consider

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Details

In many real-world decisions, consumers must first retrieve which attributes matter before evaluating options because decision environments are often unstructured, lacking a standardized or exhaustive set of attributes. Despite the prevalence of this setting, most approaches in multiattribute decision making, like conjoint analysis, ignore the need for attribute set construction. In this study, we offer a systematic investigation into the factors shaping the considered attribute set.

To this end, we examine consumer choices in familiar domains like cars and restaurants, where participants must construct the attribute set from memory. Across various categories, we observe that most participants only recalled a subset of plausible attributes (median forgetting rate 29% to 50%). By combining subjective beliefs about the distributional characteristics of attribute values and the semantic relationship between attributes, we directly contrast two theoretical accounts on why an attribute is not considered: (1) Under rational inattention, an attribute is not considered if the cost of recalling the attribute exceeds its expected informational value, determined by the level of perceived uncertainty about the attribute value; (2) Alternatively, the attribute may simply fail to come to mind, due to memory limitations shaped by factors such as salience or the intrinsic randomness of memory processes. Critically, while the former implies that selective omission of attributes is optimal, the latter predicts negative impact of such omissions on welfare, due to failure to consider attributes that would have been valuable given its cost of recall.

Our data (N=105) provides support for the role of cognitive limitations, rather than rational inattention, in the attribute set construction. Specifically, we find no significant association between value of information and likelihood to be recalled and considered ($p=0.87$), against the core prediction of rational inattention models. Consequently, a majority of subjects failed to recall at least one attribute whose value of information exceeds the minimum information value of recalled attributes.

Moreover, adding semantic relatedness that accounts for the cost of retrieval due to the underlying knowledge structure, outperforms the baseline rational inattention regression, suggesting a crucial role of memory failures (LRT, $p < 0.001$).

Apart from theoretical contributions to the understanding of the cognitive basis of multiattribute decision-making, our results also suggest behavioral interventions aiming at addressing memory limitations (e.g., those focusing on attributes that are hard to come to mind) as an effective strategy for marketers and choice architects to improve decision quality.

P1.B.10 - The brain leads while behavior lags: Neural activity forecasts market demand for vehicles while elicited preferences reflect past demand

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Details

A growing body of evidence for the efficacy of neuroforecasting has demonstrated a dissociation between brain and behavior in predicting future aggregate outcomes. Across multiple domains, brain responses have been shown to outperform behavior in forecasting aggregate, out-of-sample market dynamics. Here, we investigated the temporal dynamics of neuroforecasting in the domain of consumer demand for vehicles, testing the relationship between brain, behavior, and the evolution of the aggregate outcome over time. In 2023, neurotypical participants ($N=40$) viewed an array of contemporaneously available vehicles and rated their desire to learn more about or purchase each model while undergoing fMRI. Imaging and choice data were held as monthly U.S. vehicle sales were measured for the following year; the preceding year's sales figures were also collected. Because neural responses in the nucleus accumbens (NAcc) predicted both individual choice behavior and quarterly changes in market demand, we focused on assessing how this relationship evolves over time. Using hierarchical modeling, we found evidence for a dissociation between brain and behavior. Specifically, NAcc activity forecasted changes in market demand for vehicles in the 12 months following fMRI scanning, while self-reported interest in learning more about vehicles explained demand in the preceding 12 months. Evidence for the NAcc as a leading indicator is consistent with its well-established role in anticipatory affect. On the other hand, the relationship between market dynamics and behavioral data may reflect knowledge about existing preferences that lags behind emerging preferences. These findings are consistent with constructionist accounts of preference that emphasize the role of memory in value-based decision making. These data additionally highlight the importance of using both implicit and explicit preference elicitation methods, since the mode of elicitation may affect not only behavioral responses, but also their utility for predicting subsequent aggregate outcomes.

P1.B.11 - A novel test of the goal-dependent relationships between overall value and response times

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Details

Objective: Humans display flexibility in adapting their choices to align with different decision goals. One possible mechanism underlying this flexibility is the transformation of option values from preference-based to goal-congruent representations. We recently extended the leaky competing accumulator model, a sequential sampling model that predicts choices and response times (RTs), to incorporate this goal-congruent value transformation mechanism. A core prediction of our model is that the relationship between RTs and the overall value (OV) of the available options is modulated by the current decision goal, with faster decisions occurring when choosing between goal-congruent options. While previous research has provided evidence for a linear transformation of values (e.g., reordering values when choosing the best/worst option), our model further predicts that value transformation can be non-monotonic under certain goals, such as choosing the most mediocre or extreme option. The present study aims to empirically test these model predictions across two novel choice goals.

Methods: 46 participants completed our experiment online. In the choice task, on each trial participants chose one product from sets of four, systematically varying in value differences and overall value based on previous ratings. In each of four blocks, participants chose according to a different decision goal: choosing the best, worst, most mediocre, or most extreme option. The order of blocks was counterbalanced.

Results: Regression analyses confirmed our model's prediction that choices are fastest when the overall value of the options is closest to the target for the choice goal. Specifically, replicating previous findings, we found that RTs decreased with increasing OV when the target was to choose the best option ($\beta = -0.08 \pm 0.00$, $p < .001$) and this pattern was reversed in the choose worst condition ($\beta = 0.13 \pm 0.00$, $p < .001$). Importantly, in line with our model predictions, participants responded faster at intermediate OV level when the target was to choose the most mediocre option (positive quadratic effect: $\beta = 0.02 \pm 0.00$, $p = .030$). This U-shape relationship between RTs and OV was reversed in the extremity condition -

responses were fastest when OV was at either end of the rating scale (negative quadratic effect: $\beta = -0.04 \pm 0.00$, $p < .001$).

Conclusion: Our results corroborate the model predictions that the goal of a decision can determine whether the values are transformed linearly or non-linearly. Critically, these findings extend the mechanism of goal-congruent value transformation to wider range of decision goals, suggesting that flexible decision-making relies on goal-dependent value representations.

P1.B.34 - Prior expectations of risk induce risk-preference gradients in decision under risk

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Details

We investigated how prior expectations of risk impact risk preferences. The primary motivation for this inquiry came from theory (Kőszegi and Rabin, henceforth KR) predicting that prior expectations of risk decrease risk aversion. This is accomplished through modeling reference point—essential for the value function in prospect theory—as the decision maker's probabilistic beliefs about future outcomes. To test this prediction, we designed a lottery decision task by implementing a 'reference lottery' such that it was present in every pair of options the subjects faced during the experiment. Two reference lotteries were selected—a high-risk lottery with 10% chance of winning \$330 (USD) and a sure gain of \$33. A between-subjects design was adopted so that half of the subjects experienced the high-risk lottery as the reference (high-risk group) and the other half experienced the sure gain as the reference (no-risk group). Under KR, we hypothesized that subjects in the high-risk group would be less risk averse than the no-risk group. Subjects were not explicitly informed the presence of the reference option. The other lottery—referred to as the varying lottery—present in each pair of options was created by a 4 (outcome level: \$165, \$83, \$47, \$37) $\times$ 4 (probability level: 0.2, 0.4, 0.7, 0.9) table where the diagonal entries were lotteries whose expected value (EV) matched that of the reference lottery. These diagonal entries served to provide a wide dynamic range of risk while EV was controlled for. In addition, in a subset of trials, both groups faced exactly the same pair—a choice between (10%, \$330) and a \$33 sure gain. Sixty subjects participated in the experiment (30 subjects at the time of abstract submission). We reported two preliminary findings, one consistent with KR and one not predicted by KR. First, consistent with KR, in the pair seen by both groups—a choice between (10%, \$330) and \$33 sure gain—subjects in the high-risk group chose the riskier option (10%, \$330) more often (37%) than the no-risk group (26%). Second, in EV-matched pairs with varying degrees of risk, the degree of risk aversion changed systematically with the level of risk carried by the varying lottery. In the high-risk group, subjects went from risk loving to risk averse as the varying lottery moved away from the high-risk reference and toward a sure gain. By contrast, in the no-risk group, subjects went from risk loving to risk averse as the varying lottery moved away from the sure-gain reference and toward risk. Such 'risk-preference gradients' are not predicted by either KR or classical prospect theory and call for further theoretical development on this matter.

P1.C.12 - Arbitrary-based social comparison, trust, and risk

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Details

Objective: Numerous fields have demonstrated that our decisions are guided by social information, and one important piece of social information is social comparison. Previous research has suggested that social status can influence trust, but most prior studies examining the influence of social comparison on trust decisions employed social comparison contexts that are personally meaningful to participants. The current study investigated how interpersonal trust and risk-related decisions are made subsequently in unrelated situations after experiencing arbitrarily manipulated social comparison contexts. In addition, the study directly compared people's behaviors in trust and risk environments under different social positions in a single experimental paradigm.

Methods: Experiment 1 (discovery sample) recruited 302 undergraduate students with raffle tickets as incentives, employing a 3 (Comparison direction: upward, lateral, downward; between-subject) by 2 (Economic game: trust, risk; within-subject) mixed design. Experiment 2 (Validation sample; preregistered) involved 299 participants from Prolific with real money as incentives, using the same design without the lateral condition. Participants completed three tasks: a social comparison induction task, a one-shot Trust Game, and a one-shot Risk Game. The social comparison induction task was always completed first, and the order of the Trust and Risk games was counterbalanced.

Results: Results from both experiments showed no main effect of comparison direction on subsequent trust and risk-related decisions. However, results suggested a significant effect of comparison direction on the reported levels of relative rank (Exp 1: $p = 0.049$; Exp 2: $p = 0.006$) and the amount participants chose to allocate to their counterpart in

the comparison induction task (Exp 1: $p < 0.001$; Exp 2: $p = 0.012$). Additionally, participants treated the trust and risk environments differently, investing more in the trust game (Exp 1: $p < 0.001$; Exp 2: $p = 0.016$). We also observed robust gender differences with females investing less in both games than males (Exp 1: $p < 0.001$; Exp 2: $p < 0.001$).

Conclusions: Participants exposed to arbitrary-based upward social comparisons tended to experience greater feelings of inferiority and higher levels of envy, and they also allocated fewer economic resources to a randomly assigned comparison target. However, the influence of this type of social comparison did not carry over to their trust and risk-related decisions in subsequent unrelated situations. Notably, we found evidence that individuals could distinguish between trusting and risky environments and treated them differently.

P1.C.13 - Individual differences in dynamic belief updating during trust learning

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Details

Objective. Trust involves decisions made under uncertainty whereby outcomes depend on the unobservable intentions of others. Unlike natural risk, this uncertainty is relational and contingent on inferred partner reliability. While normative models assume people update beliefs about others based on outcomes, individuals vary in their strategies and sensitivities - especially in populations with social cognitive difficulties. This study aims to characterize individual differences in trust updating and underlying computational mechanisms.

Methods. We studied this heterogeneity using an online repeated trust game, in which participants (N=334, ages 18–65) acted as trustors allocating portions of an endowment to one of two computer-controlled agents. Investments were multiplied by 4, and reciprocation varied dynamically across time. To isolate learning mechanisms from the influence of social context, agents were either framed as humans (social condition) or slot machines (nonsocial condition), with matched contingencies and volatile changes in trustworthiness. To characterize latent cognitive profiles, we fit multiple classes of models that varied along two axes: policy structure and trustworthiness estimation process. Policies included heuristic (Win-Stay-Lose-Shift, constant investment), softmax action selection and linear proportional adjustments. Trustworthiness estimation models ranged from static expectations (no learning or mentalizing) to Reinforcement Learning (RL; trial-and-error value updating), to Bayesian models (beliefs tracking with uncertainty).

Results. Results showed that participants adapted their investments based on partner reciprocity, but asymmetrically. Monetary losses caused stronger trust changes than gains, resulting in steeper scaling of subsequent sharing following losses. This asymmetry was more pronounced in the social condition, with slower trust recovery following violations by initially trustworthy human partners. Preliminary modeling supports cognitive heterogeneity in trust learning: while RL models fit group-level data well, individual-level variations were best captured by considering multiple policies and trustworthiness estimation algorithms rather than a 'best-model-fits-all' approach.

Conclusions. By examining individual differences in model fit and parameter estimates, our findings highlight unique cognitive signatures of trust learning strategies and policy choices across social contexts. Next steps include testing whether these cognitive profiles map onto traits and symptoms traditionally associated with social dysfunction.

P1.D.14 - ERP markers of individual differences in risk attitudes and choice consistency in decision-making

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Details

This study explores how individual differences in risk attitude and response consistency shape the brain's temporal dynamics during risky decision-making. Fifty-six healthy adults completed 400 trials of a financial choice task, selecting between probabilistic risky options and certain safe alternatives while 64-channel EEG data were recorded. Participants were categorized into behavioral subgroups using hierarchical clustering based on their risk aversion and trial-by-trial choice consistency, resulting in well-defined groups: risk-averse (RA), risk-neutral (RN), and risk-seeking (RS), as well as consistency-based groups (steady-, regularly-, and inconsistent responders).

We focused on stimulus-locked event-related potentials (ERPs) during perception, valuation, and decision phases—specifically the N1, P200, medial frontal negativity (MFN), P300, and late positive potential (LPP). Behavioral analyses confirmed overall risk aversion across the sample, with choice consistency highest in RN individuals. ERP results revealed that RN participants exhibited significantly higher parietal N1 and frontal P200 amplitudes than RA participants, suggesting enhanced attention and more automated evaluation processes. Riskier decisions were also associated with greater P300 amplitude around 350 ms, especially at right parietal sites, implicating P300 in behavioral relevance and

option selection.

LPP amplitude was modulated by both decision and risk level, with distinct late activity patterns in RA vs. RN groups. Specifically, high-risk options evoked greater late positivity in RN individuals but reduced activity in RA participants, suggesting group-specific differences in affective and regulatory processing of risk. RN participants also showed earlier and more robust expected value encoding in P200, while RA individuals exhibited delayed value-related effects in MFN, suggesting differing valuation strategies.

In conclusion, individual variability in risk preferences and choice consistency corresponds to distinct ERP signatures throughout the decision-making process. These findings underscore the relevance of early neural processing stages—particularly in RN individuals—and support the view that choice consistency reflects a more automatic and efficient valuation strategy. This work advances our understanding of the neurocognitive underpinnings of risky decision-making and highlights the importance of incorporating individual behavioral traits in neuroeconomic models.

P1.D.35 - Repeated risk exposure shifts decision preferences toward risk seeking

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Details

Objective: Risk preference is traditionally viewed as a stable trait, underpinning core assumptions in economic and behavioral decision research. Here, we directly test the assumption of stability by examining whether financial risk preferences shift with repetition when learning from feedback is controlled for. We use computational modeling to uncover the features that underlie temporal shifts in risk preferences.

Methods: We used a simplified roulette game where participants bet on one of two items on a picker wheel (NExperiment1 = 74, NReplication = 66). To boost engagement, the items on the wheel varied across 20 trials, and participants were led to believe they were playing alongside another participant. On each trial, participants and the “other player” took turns selecting an item, after which participants chose how much money to bet on their selection, ranging from 1 to 50 bills. To model risky behavior, we conducted a third experiment (NExperiment3 = 49) in which we also varied the win-to-loss ratio between 1.1 and 2.9. The best-fitting model was a Constant Elasticity of Substitution (CES) utility model with three parameters: (i) p , which reflected marginal utility (ii) θ , which assigns a utility weight to the expected gambling rewards and $(1 - \theta)$ to the amount kept, and (iii) β , which captures choice noise. These parameters were allowed to vary over time.

Results: Across all three experiments we found that participants gradually became more risk-seeking (amount of money wagered predicted from trial number: Experiment 1: $\beta = 0.028$, $t(69) = 4.7$, $p < .001$; Replication: $\beta = 0.029$, $t(57) = 4.27$, $p < .001$; Experiment 3: $\beta = 0.03$, $t(45) = 5.09$, $p < .001$). Computational modeling revealed that, across trials, the utility weight assigned to gambles (θ) gradually increased. This led to escalating risky behavior. In contrast, neither marginal utility nor consistency changed over time.

Conclusion: These findings challenge the assumption of stable risk preferences by revealing an escalation of risk-taking with repeated opportunities to take financial risks. Computational modeling revealed that the relative utility weight of a gamble increases with repeated opportunities to gamble. This in turn leads to escalating risk-taking. Future studies may examine if problematic gambling can be explained by faster escalation of risk preference due to changes in the utility function rather than heightened baseline risk preferences.

P1.D.36 - Effort exertion to avoid food and monetary losses across metabolic states

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Details

Background: Humans routinely act to avoid losses, which may be primary (e.g., food) or secondary (e.g., money). Decisions about primary outcomes are often influenced by biological factors (e.g., taste preference, hunger, or satiety), whereas decisions about secondary outcomes are less affected by such states. Motivation to pursue these outcomes is often studied using discounting paradigms, where subjective value is reduced by associated costs like effort or time. Sensitivity to such costs varies and may relate to psychiatric conditions like Binge Eating Disorder (BED).

Objective: This study investigates how individuals with varying binge-eating pathology value food and monetary losses across hunger and satiety using an effort discounting task. We hypothesized that hunger would increase willingness to exert effort to avoid food losses more than monetary losses, and that effort preferences would be stable across domains within individuals.

Methods: We adapted a loss-frame version of the Effort Expenditure for Rewards Task (Treadway et al. 2009, Ruiz et al. 2024) to assess willingness to avoid food and monetary losses under fed and fasted conditions. On each trial, participants chose between a low-effort task, risking a larger loss of the outcome (snack or money), and a high-effort task, risking a smaller loss. Outcome magnitudes and probabilities varied parametrically.

Results: Preliminary group-level results from 16 participants (13 females, aged 27 ± 3 years) showed that hard choices increased with loss probability ($F(2, 120) = 19.80, p < 0.001$) and decreased with loss magnitude ($F(1, 409) = 211.78, p < 0.001$), regardless of domain or metabolic state. Participants chose the hard option more in the monetary (mean = 0.43 ± 0.027) than food (mean = 0.39 ± 0.05) domain, and more when fasted (mean = 0.5 ± 0.03) than fed (mean = 0.45 ± 0.030) ($F(1, 409) = 5.137, p = 0.024$). The effect of metabolic state did not differ by domain ($F(1, 409) = 0.213, p = 0.561$). Effort preferences moderately correlated across domains ($R^2 = 0.65, p = 0.006$).

Conclusions: Participants behave lawfully across states and outcomes in this novel adaptation of the loss-frame effort task. Participants work more to avoid monetary losses when fasted. Willingness to work to avoid losses is moderately stable across domains. Future work in a larger sample will extend this research to the gains domain and to individuals with BED.

P1.E.15 - Spontaneous eye blink rate is linked to risky and impulsive decisions

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Details

Objective: Dopamine is one of the key neurotransmitters involved in both risky and impulsive decisions. Given that previous studies suggested the spontaneous resting-state eye-blink rate (sEBR) to be an indirect marker of striatal dopaminergic activity, the purpose of the present study is to test the hypothesis that sEBR is linked to decision making in risky and impulsive contexts.

Methods: We report the preliminary results of two experiments. In Experiment 1 participants ($n=36$) underwent a five-minute resting-state sEBR measurement via the electrooculogram, followed by a binary choice task with risky and delay discounting questions. In a risky choice task, participants made choices between a more risky and a less risky lottery. In a delay discounting task, they chose between a sooner smaller and a larger later reward with part of the questions involving an immediate reward and another part involving only delayed rewards. The procedure in Experiment 2 ($n=19$) was the same. The risky choice task was modified to involve a choice between a certain outcome and a risky lottery, while the delay discounting task offered a choice between an immediate and a larger delayed reward. We then used the regression analysis to determine the link between the sEBR and the probability to choose a riskier option and a sooner-smaller option.

Results: In risky choices, Experiment 1 showed that higher sEBR was associated with increased sensitivity of participants' choices to the expected value of a riskier option and an increased sensitivity to its standard deviation, indicating participants with higher sEBR were more motivated by the expected reward and more sensitive to its riskiness. In Experiment 2, a similar effect was observed with sEBR being associated with increased sensitivity to the risky reward amount as well as the probability of obtaining it, while at the same time higher probability of selecting a safe option, indicating increased risk avoidance.

In intertemporal choices, Experiment 1 showed that higher sEBR was associated with a higher probability to select a sooner smaller reward but only in trials where the sooner reward was immediate. Experiment 2 revealed that higher sEBR was associated with immediate option preference through the increased sensitivity to time delay.

Conclusions: The results suggest that sEBR is associated with increased impulsivity in a delay discounting task, while its relationship to risky choice is more complex with higher sEBR increasing both reward and risk sensitivity. The latter is in line with the hypothesis that

P1.E.16 - Neuroeconomically dissociable decision-making computations are altered by Shank3 haploinsufficiency

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Details

The mechanisms underlying decision-making encompass distinct information processing computations, which can be differentially perturbed within psychiatric conditions. Autism spectrum disorders (ASDs) are characterized by intellectual

impairments, altered communication and social interactions, and repetitive behaviors or restricted interests. Phelan-McDermid Syndrome is a rare ASD caused by deletions in the SHANK3 gene, which is critical for maintaining functional synapses. Rodent studies have been limited in their ability to model cognition of these patients, often relying on full knockout-mice to yield stronger behavioral phenotypes. This reduces the translational potential of animal studies, as homozygous SHANK3 deletions are extremely rare or non-viable in humans. We aimed to fill this knowledge gap by robustly characterizing complex decision-making behavior of haploinsufficient mice by leveraging the neuroeconomic foraging paradigm, “Restaurant Row,” which has been translated across species. We longitudinally tested 48 C57BL/6J mice (SHANK3+/+ vs SHANK3+/-, male and female) across a changing economic landscape. Mice had 30-min daily to forage for their primary source of food by navigating a maze, weighing opportunities to earn food rewards of varying costs (tone-indicated delays) and subjective value (flavors). We found robust SHANK3+/- phenotypes typified by altered deliberation behaviors during cost-informed decisions that were not explained by overt differences in feeding behavior, motivation, or other types of choices. Fitting our data to a drift-diffusion model revealed striking changes in drift rates, but not decision boundary or bias parameters. These findings highlight variations to evidence accumulation processes during value-based judgements and provide a translational computational framework to understand decision-making mechanisms underlying altered behavior in neurodevelopmental disorders.

P1.E.17 - Trait reward sensitivity and behavioral motivation shape connectivity between the default mode network and the striatum during reward anticipation

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Details

Individuals vary substantially in their responses to rewarding events and their motivation to pursue rewards. The ventral striatum (VS) plays a key role in reward anticipation, and connectivity between the VS and the default mode network (DMN)—a network associated with self-referential and evaluative processes—has been implicated in reward processing. However, the relationship between these neural mechanisms and reward-related individual differences remains unclear. In the present study, we examined how trait reward sensitivity and behavioral motivation shape connectivity between the default mode network (DMN) and the ventral striatum (VS) during reward anticipation. Forty-six participants completed the Monetary Incentive Delay (MID) task while undergoing fMRI, with trial types reflecting varying levels of reward and loss salience. Behavioral measures of motivation were derived from reaction time contrasts between large and neutral trials, and self-reported anhedonia and reward sensitivity were assessed. We found that individuals with higher reward sensitivity exhibited greater striatal connectivity with DMN during reward-salient trials, highlighting the VS's role in incentive processing. However, this relationship was moderated by behavioral motivation. Specifically, in individuals with high behavioral motivation, reward sensitivity was associated with reduced DMN-VS connectivity during reward anticipation. In contrast, for those with lower behavioral motivation, the relationship between reward sensitivity and DMN-VS connectivity was attenuated. These results provide novel insights into the neural correlates of individual differences in reward processing, demonstrating that behavioral motivation is crucial in understanding DMN-striatal interactions during reward anticipation. These findings highlight the importance of considering motivational context when investigating reward-related neural mechanisms.

P1.E.18 - Neural implementation of asynchronous evidence accumulation during intertemporal decision-making

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Details

Objective: Recent research suggests that attribute consideration in the multi-attribute decision-making may be asynchronous, with different attributes engaged to influence the evidence accumulation process at different time onsets—a phenomenon known as attribute latency (onset asynchrony), yet the neural implementation of such a mechanism remains unknown. The current study aims to investigate the neural implementation of asynchronous evidence accumulation during multi-attribute decisions.

Methods & Results: We used magnetoencephalography (MEG) to investigate how the brain implemented the asynchronous attribute evidence accumulation in an intertemporal choice task (N = 40) by systematically varying the amounts of reward and delay between options. Combining computational modeling with multivariate representational similarity analyses (RSA), we demonstrate that a drift-diffusion model (DDM) with attribute latency better explains subjects' choice and reaction time data. More importantly, the attribute latency is closely related to the neural latency signal representing decision attributes. Specifically, we divided participants into high-latency (N = 20) and low-latency

(N = 20) groups according to model-fitted attribute latency parameters and conducted RSA analyses separately for each group. We found that neural representational latency between reward and delay attributes was significantly larger in the high-latency group than in the low-latency group (permutation test: $p = 0.0274$). Furthermore, we developed a subject-based “Behavior-Guided Neural Alignment (BGNA)” method and corroborated this model-neural correlation at the individual level (permutation test: $p = 0.0076$). Finally, our results also revealed that the decision value related neural representational dynamics correlated with accumulated evidence of the drift-diffusion model during the decision process. Specifically, individual peak of representational strength was positively related to model-predicted decision threshold ($r = 0.39$, $p = 0.014$), and the mean build-up rate of the representational strength was positively associated to the model-estimated drift rate ($r = 0.59$, $p < 0.001$). Additionally, source localization analyses revealed that initial processing of attribute values and later option valuation engaged dissociable brain regions.

Conclusion: Taken together, these results provide neural evidence for asynchronous attribute processing in multi-attribute decisions and identify a multivariate neural correlate of the evidence accumulation, advancing the understanding of the neurocomputational mechanisms underlying complex decision-making.

P1.E.37 - Impulsivity, gender, and life outcomes: the role of measurement modality and social perception

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Details

Objective: This study investigates how impulsivity relates to educational attainment and occupational status, whether these associations differ by gender, and how measurement modality influences observed effects.

Methods: A multimethod design was employed to assess impulsivity in a diverse sample of 154 adults aged 16 to 81 years ($M = 45.0$, $SD = 19.0$). Measures included self-report (BIS-11, UPPS), informant-report, behavioral tasks (delay discounting), hormonal assays (testosterone), and neural activation indices. Linear regression models tested associations between impulsivity and life outcomes, with interaction terms to assess gender moderation and modality effects.

Results: Informant-reported impulsivity (BIS-11) was significantly negatively associated with educational attainment ($\beta = -0.66$, $p = .0061$) and occupational status (ISEI; $\beta = -7.35$, $p = .0067$). In contrast, self-reported impulsivity, behavioral, hormonal, and neural measures showed no significant associations. These findings suggest that how others perceive an individual's impulsivity may be more predictive of real-world outcomes than internal self-assessments or task-based indicators. Gender did not moderate these relationships; interaction terms were non-significant and not directionally consistent with hypothesized gendered penalties. Measurement modality did not systematically influence gender effects. However, gender (female) was independently associated with lower occupational Model fit was modest (e.g., $R^2 = 0.16$ for occupational status), indicating that additional factors—such as marital status, financial stability, or parenthood—may mediate these relationships and warrant further investigation.

Conclusions: These findings underscore the importance of social perception in the consequences of impulsivity and challenge assumptions about gendered penalties. They highlight the need for neuroeconomic and personality research to consider how reputational dynamics and measurement modality shape the real-world impact of individual differences. Future work should explore mediating pathways and domain-specific effects to better understand the socioeconomic consequences of impulsivity across contexts.

P1.F.19 - Do piglets use mirror reflections to locate hidden food?

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Details

Background: The ability to use mirror reflections instrumentally is considered indicative of complex, higher-order cognitive functions in animals and has important implications for welfare assessment. In neurobehavioral research, evaluating the cognitive abilities of piglets may also provide valuable insights for translational studies using porcine models. However, whether piglets can meaningfully use mirrors remains a matter of debate. While a classic study reported that mirror-experienced piglets (*Sus scrofa*) could locate hidden food bowls behind obstacles via mirror reflections with shorter reaction times (Broom et al., 2009), subsequent attempts to replicate these findings have been unsuccessful (Gielsing et al., 2014). Given the increasing role of pigs in biomedical research, this study aimed to reassess the capacity of piglets to use mirrors to locate hidden food in a controlled laboratory setting.

Methods: Eighteen piglets were habituated to an experimental environment containing a mirror for a total of 12 hours. Following the design of Broom et al. (2009) and excluding olfactory cues, we observed whether the piglets could correctly

interpret the mirror image to navigate around obstacles and locate the hidden food, or whether they treated the mirror image as a real object and searched behind the mirror for an illusory target.

Results: Among the mirror-familiarized piglets, only two successfully navigated around the obstacle to find the food, while three searched behind the mirror, and ten failed to use the mirror to locate the food. Three piglets showed no interest in the mirror and were excluded from the analysis. A goodness-of-fit chi-square test revealed no significant difference from random choice.

Conclusions: Although a control group was not included in this study, the findings are consistent with the conclusions of Gieling et al. (2014), suggesting that most piglets do not use mirror reflections to locate physical food sources. These results imply that piglets at this developmental stage may not fully comprehend the representational nature of mirror images, which suggest that piglets can't successfully pass the mirror test (Gallup, 1970) and may not yet possess the cognitive functions necessary for instrumental mirror use.

P1.F.20 - Social information creates self-fulfilling prophecies in judgments of pain, vicarious pain, and cognitive effort

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Details

Humans often rely on others' judgments to form their own—avoiding effort and risk while improving accuracy. However, social cues can introduce systematic distortions in how we perceive and learn from experience. For example, when social cues align with one's expectation, they can lead to self-fulfilling prophecies, such as placebo effects, that persist or even grow over time. A pressing question is whether social cues can generate self-fulfilling prophecies—persistent perceptual and learning biases—even when they provide no real information or are never reinforced.

To address this, we conducted a series of experiments (N = 111) across three domains: somatic pain (thermal heat), vicarious pain (observing others in pain), and cognitive effort (mental rotation). On each trial, participants viewed a "social cue"—randomly generated ratings described as prior participants' responses—preceding the delivery of a stimulus at low, medium, or high intensity. The cues were either high or low and not systematically related to stimulus intensity. Despite being uninformative, these cues robustly influenced both expectation and perception: higher cues led to higher expectation and perceptual ratings. Notably, these effects persisted over repeated exposures, even with ongoing feedback.

Using computational modeling and trial-by-trial mediation analyses, we found strong evidence for two interacting mechanisms. (1) Mediation analyses revealed bidirectional effects—expectations created by social cues shaped perception, and perception shaped subsequent expectations. These feedback loops contributed to durable biases over time. (2) Computational modeling revealed that a model with separate learning rates for confirmatory and disconfirmatory trials, plus carryover effects from perception to future expectations, best fit the data across all domains. In this model, learning rates were higher when outcomes matched cue-congruent expectations, corresponding to a confirmation bias in learning.

Therefore, we found that even 'mere suggestions'—social information without grounding in reality—can shape subjective experience and bias learning, despite the presence of actual feedback. Moreover, individuals exhibited consistent susceptibility to social cues across tasks, suggesting a stable cognitive trait. Although the strength of these effects varied, their cross-domain consistency points to a general mechanism by which social beliefs take hold and persist. These findings have broad implications for understanding how socially acquired beliefs can endure in health, education, and policy—even when misaligned with reality.

P1.F.21 - Evidence integration through weighted prediction error: Behavioral evidence and computational model

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Details

Many naturalistic learning tasks involve evaluating and integrating information sampled from stochastic environments. For instance, in foraging tasks, individuals estimate the probability of finding rewards after repeatedly visiting different locations; and bandit tasks involve estimating the average payouts after repeatedly gambling at different slot machines. Although the cognitive processes underlying evidence integration have been widely studied, less attention has been devoted to studying how and why individuals integrate information in different ways. Understanding the neural and

cognitive bases of individual variability in evidence integration can significantly enhance our overall understanding of learning and decision making overall.

In this study, we examined the mechanisms of evidence integration using mathematical and neural network models applied to three different sets of behavioral data. We propose a framework for how agents flexibly incorporate new information into their existing estimates using prediction error weighted by the amount of information previously acquired. We show that this simple model can reproduce a variety of strategies for evidence integration, then implement this model in a biologically plausible neural network that closely resembles well-studied reward-learning systems in the brain. First, we demonstrate individual differences in evidence integration by analyzing human behavioral data from three sequential estimation tasks. We then fit our model to each individual and identify the cognitive parameters that account for the observed heterogeneities.

Our model captures these diverse strategies and can reproduce both the recency bias and optimal strategic integration. Critically, we show how variability within trials, between trials, and across individuals can be linked to biological parameters in our neural network model, including the number of neurons and the pattern of synaptic connectivity. Furthermore, we demonstrate that our simulated neurons replicate activity patterns in rostralateral PFC and dorsal ACC related to prediction error and social weighting.

These results suggest that our framework and its neural network implementation reveal plausible, flexible, and resource-efficient mechanisms for evidence integration. Specifically, humans may rely on weighted error-driven learning, rather than more resource-intensive operations such as Bayesian inference, when making estimates about sequences of data.

P1.F.38 - Emotion regulation and age are associated with trustee identity-related decision bias in the trust game

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Details

Objective: Social decisions, such as trusting another with money, are complex processes influenced by social context (e.g., trustee identity), emotion regulation strategies, and age. While prior research has examined trust decisions (e.g., percentage of decisions to trust), how these factors collectively shape the underlying cognitive process of decision making is less known. Understanding this interplay has critical theoretical and practical implications, from refining cognitive models to informing interventions against maladaptive decisions like falling prey to impersonation scams. Therefore, we used a Drift Diffusion Model (DDM, Ratcliff, 1978) in a modified Trust Game to examine how trustee identity, emotion regulation, and age interact to influence the key cognitive components in decision making.

Methods: The data used in our study were obtained from the social and nonsocial reward processing study conducted by Smith et al. (2024, Data in Brief). Our sample included 129 adults (Mage = 43.5 (18.1); 59.7% female, 37.2% male, 3% non-binary; 45.0% non-white, 55.0% white) who completed a modified Trust Game and self-report measures of emotion regulation of the self and others (Niven et al., 2011). In each trial of the game, participants decided how much to invest in a trustee who was either their friend or a matched stranger. We used DDM to test the interactive effects of trustee identity, emotion regulation strategy, and age on key cognitive components of the decision process (drift rate, boundary separation, non-decision time, and bias). In our preliminary analyses, we first fitted a DDM model for each participant separately to estimate participant-level trustee identity effects on DDM components. Second, we used these participant-level estimates of trustee identity effects to determine if such effects were associated with emotion regulation strategies and age.

Results: Our analysis revealed a three-way interaction between trustee identity, emotion regulation, and age ($\beta = -.18$, $\eta^2 = .04$, $p = 0.02$). While participants generally favored friends over strangers, this bias diminished as their tendency to make others feel better increased. Crucially, age amplified this effect: the emotion regulation-related decrease in friend bias was more pronounced in older adults compared to younger adults.

Conclusion: Our findings revealed the interplay between social context of trustee identity, individual emotion regulation strategy, and age in decision bias in the Trust Game. Such findings may provide explanations for the vulnerability of older people to impersonation scams.

P1.F.39 - Investigating how the diversity of experienced interpersonal trauma influences social trust learning

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Details

Evaluating and reevaluating who is trustworthy is an essential social cognitive capacity in humans and its impairment can have devastating consequences. Interpersonal trauma (IpT; i.e., trauma caused intentionally by another individual), particularly when experienced in childhood, can cause a lasting sense of betrayal and has been shown to negatively affect a wide range of psychological processes related to social trust. However, much of this research has focused on self-report and/or has been limited in scope to a single type of trauma. Here, we used a model-based approach to investigate how the cumulative diversity of experienced IpT (which we term IpT load) is related to variation in social learning and decision-making (LDM).

Across 2 blocks, 418 prolific participants (203m, 211f, 4o; 18-52yo; post-exclusion N=365) learned about 6 partners' in a multishot trust game (22 rounds/partner, 3 partners/block). Each round, participants decided how many points (1-5; self-paced) to send to their partner, which then quadrupled in the transaction. Participants then saw whether their partner "shared" back half of the proceeds or "kept" them all. Partners had varying share response contingencies (share% = 80%, 65%, 35%, and 20%), which shifted once (by bias towards share/keep, level of certainty, or both; i.e. 35%→80%) between rounds 8 and 14. Points served as raffle tickets for a \$50 bonus. In a matched nonsocial condition, participants learned about 6 lotteries. In addition, each participant's IpT load was assessed using a modified version of the Lifetime Events Checklist (LEC-5) that additionally asked the age the trauma was first experienced, and whether it was experienced once, or repeatedly. These data were collected as part of a larger battery of surveys and tasks.

Participants were split into those who had experienced IpT, and those who had not. IpT load was calculated as the sum of experienced IpT types. Social and non-social learning data were fit separately with a modified rescorla-wagner update rule with three parameters: initial prediction (P0), learning rate (LR), and outcome bias (D). In those that had experienced IpT, we found that IpT load was negatively correlated with social LRs ($p=0.005$) after controlling for non-social LRs and demographic variation (age, race, ethnicity, and birthsex). This effect was limited to participants who had experienced at least one IpT during childhood ($p=0.002$), compared to those who had only experienced IpT in adulthood ($p=0.668$). These data provide evidence for a sensitive period during which IpT can shape social LDM as well as a dose-response-like relationship between IpT load and social learning rates.

P1.G.22 - Fatigue increases self-reported decision difficulty and revealed risk and ambiguity aversion more in women than men

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Details

Most decisions, such as what to invest in, where to spend one's holiday, or whether to adopt a novel medical treatment, involve risk or ambiguity. We make such decisions not only when we are rested but also when we are tired and exhausted. In an increasingly uncertain world with an increasingly fatigued population, understanding the interplay between fatigue and decision-making under uncertainty becomes ever more important but currently remains limited. While it is relatively well established that men are more risk tolerant than women, it remains unknown whether and how fatigue moderates this sex difference.

Here, participants (N = 204) made a series of incentivised decisions before and after experimentally induced cognitive fatigue. Decisions involved choosing between a risky or an ambiguous option with the potential for larger monetary reward and a safe but smaller option. Each participant performed the experiment twice, once with induction of high levels of fatigue and once with induction of lower fatigue levels. After each completion of the decision task, participants rated on a visual analogue scale how confident they felt about their choices and how hard they found them.

Regardless of sex, mixed effects models suggest that with higher levels of self-reported fatigue, participants were less confident in their choices (standardised coefficient = -0.17; $p = .04$) and found it harder to make decisions (standardised coefficient = 0.20; $p = .04$). Regardless of fatigue, women tended to choose the safe option more often than men in both risky and ambiguous decision contexts (standardised coefficient ≥ 0.44 , $p < .01$), replicating previous research. Moreover, women perceived decisions on average to be moderately difficult but harder than men (standardised coefficient = 0.53; $p < .001$). Importantly, high fatigue affected women more than men in terms of how hard they found the decisions (three-way interaction sex $\times$ pre vs. post fatigue induction $\times$ weak vs. strong fatigue induction: standardised coefficient = 0.54; $p = .02$), and women were more likely to choose the safe option under higher levels of fatigue in both decision

contexts (four-way interaction sex $\times$ time (pre vs. post fatigue) $\times$ fatigue level (weak vs. strong) $\times$ self-reported fatigue: standardised coefficient ≥ 0.31 ; $p \leq .03$).

These findings suggest that fatigue affects decisions under uncertainty in a sex-dependent manner and highlight the importance of examining individual decision mechanisms and subjective experiences in a state-dependent fashion. This may not only refine theoretical models but also inform personalised strategies to support adaptive behaviour and well-being under fatigue.

P1.G.40 - Cognitive and neural underpinnings of altered numerical cognition and risky choice in dyscalculia

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Details

Developmental dyscalculia (DD) is a learning disorder marked by impairments in numerical and mathematical cognition. Despite its high prevalence and mental health impact, its cognitive origins and everyday implications for financial decision making remain poorly understood. We test competing theories on the cognitive basis of DD, proposing deficits in either number perception or the maintenance of numerical information in working memory.

We recruited 33 adolescents with DD and 33 age- and gender-matched controls (15–23 years, 28 females per group). Participants underwent a comprehensive behavioral and neural battery, including anatomical and fMRI scans during a magnitude comparison task, a risky choice task, cognitive tests, and questionnaires. We modeled behavior from the magnitude task using a Bayesian perceptual choice model to isolate cognitive components.

Model fits revealed that dyscalculics were significantly worse than controls at retaining numerical information in working memory ($p=0.004$), and relied more on directly accessible on-screen information when deciding ($p=0.019$). Supporting these findings, fMRI data showed no group differences in numerical encoding precision ($p=0.88$) in the parietal magnitude system (using numerical population receptive field modeling). However, gradient-based connectivity analyses revealed weaker integration within this region ($p=0.002$) and greater segregation between visual and parietal-attention networks in DD, potentially reflecting impaired visuospatial working memory. Intriguingly, also the data of the risky choice task suggested that attentional processes influence economic behavior differently in DD (stronger stake-size effect, $p=0.022$).

These findings clarify the cognitive impairments underlying DD, supporting (visuo-spatial) working memory accounts over perceptual deficits. They provide novel insights into the neural mechanisms of DD and its broader impact on everyday financial decisions under uncertainty.

P1.H.23 - Experimental habit formation using smartphone applications: Challenges in inducing devaluation with extended training

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Details

Objective: understanding habit formation in humans is a fundamental challenge, due to constraints of laboratory-based studies. This study investigated whether prolonged, engagement with a gamified smartphone task could induce habitual behavior.

Methods: we developed a web-based application. Participants responded to red or blue cars on the screen by pressing buttons. Habit formation was evaluated using three features: automaticity, assessed via dual-task performance with a counting task; inflexibility, measured by performance following unexpected task alterations; and insensitivity to outcome devaluation, assessed by removing rewards for one response and measuring persistence. Across five pilot experiments ($n = 27-43$ per study; total $N = 177$), participants were randomly assigned to either short training (ST) or extended training (ET) groups. Experimental features e.g. stimuli speed, reinforcement, were iteratively refined across versions.

Results: a linear mixed-effects model revealed a significant effect of training duration on automaticity, as greater accuracy was found on the dual-task measure in the ET group compared to the ST group ($\beta = -0.039$, $p < .001$). Some experiments also showed shorter response times in the ET group, suggesting increased behavioral efficiency. Exploratory analyses revealed group-dependent relationships between self-reported and behavioral automaticity. Self-reports predicted performance only in the ST group, suggesting these measures may be less informative once performance plateaus ($B = 0.017$, $p = .010$). Neither the inflexibility nor the devaluation tests differentiated between groups consistently. Bayesian analyses supported the null hypothesis for outcome insensitivity ($BF_{01} = 4.073$), indicating no robust differences between the groups.

Conclusions: our findings highlight challenges of inducing measurable habitual behavior in humans, even with prolonged training in situ. They question the sensitivity of traditional outcome devaluation protocols in capturing stimulus–response learning. Thus, there is a need for methodologies that target core features of habit, beyond reward-driven learning. Further development is necessary to induce and measure habit formation using smartphone-based paradigms. All data and code are available on the SchonbergLab GitHub to support transparency and replication.

P1.H.41 - Behavioral signatures of rotational transfer learning in a spatial predictive inference task

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Details

Humans can transfer relational knowledge from past experiences (e.g., milk and eggs are often adjacent in grocery stores) to guide behavior in novel contexts (e.g., navigating a new grocery store). Theoretical accounts suggest that such generalization is supported by a cognitive map, which might be transformed (rotated or stretched) to best match the current situation. However, this idea has not been thoroughly tested behaviorally, nor is it clear whether people are capable of such transformation in complex environments where the number of cognitive anchors (ie. items at the grocery store) exceeds working memory capacity and there exist multiple cognitive maps to choose from. Here, we examine behavioral signatures of rotational transfer using a spatial predictive inference task. In the task, participants predicted the locations of colored targets, with spatial layouts fixed within each latent state. A given latent state would persist for several presentations of each color before either being rotated or replaced with another one. Participants were informed that state transitions (i.e., changes in target-location associations) could occur, but not when or how the new layout related to the previous one. Study 1 (N = 96) employed a between-subjects design to compare transfer learning when target rotations were spatially coordinated (N = 57) as a coherent map versus independently rotated for each color (N = 39). Following unsigned state transitions, prediction errors decreased rapidly and were significantly lower in the coordinated condition. Moreover, angular error distributions in the coordinated condition deviated from uniformity, while those in the independent condition did not, suggesting that participants leveraged preserved spatial relationships to transfer knowledge after coherent rotations. Study 2 (N = 20) increased task complexity by using eight (rather than four) colored targets. Consistent with Study 1, error reduced rapidly after state transitions. Study 3 (N = 41) tested whether participants could learn and rotate multiple spatial layouts. Each latent state was a rotated version of one of two prototype maps (each with four colored targets). Again, participants adapted quickly following state changes. Together, these findings suggest that humans can infer and apply structured spatial relationships—without explicit instruction—to support adaptive behavior in novel contexts. This transfer learning effect is robust and can be detected even in scenarios with the number of items exceeding memory capacity and multiple spatial maps. Future work will focus on developing cognitive models to uncover the mechanisms underlying rotational transfer learning.

P1.H.42 - Do causal expectations shape associative learning signals beyond experience?

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Details

Do neural prediction-error signals reflect causal knowledge, or merely statistical associations? Classic reward learning theories posit that prediction errors summate across stimuli. This account explains conditioned inhibition (CI), a hallmark of associative learning, wherein a stimulus comes to predict the absence of reward when paired with a reward-predictive cue (Rescorla 1969). CI arises naturally from stimulus-based prediction-error learning models, which update expectations based on the summed associative strengths of individual cues (Tobler et al., 2003). However, such models assume that learning occurs at the level of observable stimuli, not at the level of latent causes that generate outcomes. If the brain instead tracks independent causes of reward and inhibition, cue combinations may not simply summate. While stimulus-based models can learn such interactions through experience, it remains unknown whether striatal prediction-error signals reflect this causal structure from the outset. We test whether key regions of the reward learning system are sensitive to latent causal knowledge presented through instructions, or whether they only respond to the observed information of the average reward history.

We designed a two-phase conditioning paradigm that builds on traditional CI protocols but incorporates a causal environment. In Phase 1, participants learned simple cue–outcome associations: animals (monkeys, camels) predict high reward, plants (vines, ivy) predict no reward, and a control cue (palm tree) predicts medium reward. Before Phase 2, we introduced a mechanistic framework -delivered through instructions and illustrations- that explained both the individual cue–outcome relationships and the interactions between cues in compound settings. In Phase 2, participants encountered compound cues, but outcomes are unobserved. Based on past reward history, such compounds should average to

medium reward; under the causal model, however, some cue combinations predicted high reward (e.g., monkey+vines) while others predicted reward omission (e.g., monkey+ivy).

Behaviorally, participants reliably acquired the single-cue associations during Phase 1 (N=36). In Phase 2, their trial-wise reward expectations aligned more closely with the causal model than with associative predictions based on past reward history. Responses on a final open-ended quiz further confirmed that participants incorporated the causal framework introduced in the instructions. Ongoing fMRI data collection will test whether striatal responses at cue onset reflect expectations derived from the latent causal structure, rather than from direct associative experience.

P1.H.43 - Neural mechanisms underlying valence bias in reinforcement learning and episodic memory across development

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Details

Individuals learn differently from positive and negative outcomes. Such valence biases in reinforcement learning (RL) shift across development and also yield corresponding biases in what is retained in episodic memory. In the present fMRI study, we investigate the neural mechanisms underlying the impact of valence bias on memory, and how such processes change with age.

Sixty-eight participants aged 8-25 (target N = 120) completed an RL task in an MRI scanner. Participants had to learn through trial and error the values and probabilities associated with five deterministic or probabilistic “point machines”. Images of trial-unique exemplars from three distinct categories were paired with probabilistic wins, probabilistic non-wins, or deterministic outcomes respectively and memory for these images was probed in a surprise recognition test.

To measure valence bias, we fit participants’ choices with an RL model and computed an asymmetry index (AI) reflecting biases in their learning rates for positive and negative prediction errors (i.e., PE+ and PE-). Consistent with prior research, we found that individuals with more positive AI were more likely to remember the objects presented on PE+ trials, compared to those who with more negative AI. A univariate analysis revealed that increased activity in both hippocampus and amygdala during outcome presentation predicted successful recognition memory, suggesting a role episodic encoding. Further, increases in hippocampal resting-state connectivity with the ventral temporal cortical ROI associated with the probabilistic non-win category from pre- to post- learning in participants with more negative AI was selectively associated with enhanced memory for the PE- exemplars, which may reflect prioritized consolidation of these memories during post-encoding rest. Together, these preliminary findings provide mechanistic insight into how valence bias during RL shapes memory-related neural processes. Ongoing work will examine whether AI predicts valencespecific neural activation during learning and biased offline memory reactivation during postencoding rest, as well as potential age-related changes in these neural processes. Collectively this work provides important insights into how individual differences in learning computations shape the prioritization of valued outcomes in memory across development.

P1.I. 24 - Optimal Utility: Maximizing expected value by picking a curved utility function

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Details

Pascal introduced the first framework for human decision-making, arguing that humans maximize long-term average returns. Bernoulli later introduced risk sensitivity, proposing that humans maximize a transformation of value now called utility. By the 1970s, it was clear human choices were not consistently pursuing even the most byzantine utility functions. In response, Kahneman and Tversky laid the foundation for predictive theories that abandoned consistency and fixed utility functions in favor of non-stationary multi-parameter descriptive models.

Why would biological choosers evolve to be inconsistent and non-stationary? In this project, we employ a new approach to explain the why. We use a mixture of proof-based (for simple environments), analytic (for complex binary choice problems) and Montecarlo (for any problem) approaches to ask: 1) What is the average yield of a given utility function to a chooser with a specific internal noise in a well-defined environment? 2) What utility function maximizes average earnings conditional on her internal noise and environment?

We show that for a noisy chooser, expected earnings maximization cannot be achieved using a perfectly linear utility function as Pascal had proposed. When representational precision is constrained, sigmoidal, convex, and concave utility functions can all be optimal, depending on the distributional structure of the environment.

We also quantify the expected gains in earnings that would result from relaxing the resource constraint in the brain and

compare these gains with the biological costs of noise reduction. This allows us to calculate the optimal level of noise in the representation of value, under different cost functions—thus endogenizing both the utility function and the choosers' noise term. We illustrate how the choice environment affects the optimal (costly) allocation of additional cognitive resources to valuation.

Under these representational assumptions, many puzzling phenomena become easily explainable. The K&T sigmoidal value function, Bernoulli's concave, and Pascal's linear utility function all emerge as rational strategies required of choosers who face different environments with varying degrees of precision. Our approach has important implications for revealed preference theory and what we can infer from observed choices. We propose that, rather than "revealed preference theory," a more accurate description of a rational theory of human decision making may be "revealed decision-environment theory." If our theory is correct, then one could predict the utility (and hence choice structure) of any chooser for any given environment fully understood by the chooser (a significant constraint). This opens avenues for further exploration.

P1.I. 25 - The unique neural circuits underlying top-down and bottom-up motivated self-control during nutritional decision making.

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Details

Objective: Studies of dietary food choice show that individuals tend to naturally weigh tastiness over healthiness, leading to unhealthy eating (Hare et al., 2011). While top-down cognitive regulation can promote healthier choices, neural data suggests this strategy has little effect on how the ventromedial prefrontal cortex (vmPFC) represents tastiness and healthiness (Hutcherson 2012; Tusche & Hutcherson, 2018). This failure to shift vmPFC value representations might be why top-down regulation feels difficult and so often fails in the real world. We speculated that vmPFC value representations might be more strongly influenced by manipulations that lead people to intrinsically value healthiness more. For example, research suggests that the physiological state of satiation may motivate participants to naturally balance their relative weighting of taste and health. We build upon this in the current study, where we use fMRI to investigate whether these different forms of motivated self-control use similar or different neural circuits. More specifically, we hypothesized that bottom-up, physiological motivations may be more effective than top-down regulation in changing how the vmPFC weighs taste and health information or represents overall value.

Methods: Hungry participants (current n = 21 out of target 50) attended two separate sessions. They first rated the tastiness and healthiness of different foods before completing a dietary choice task while undergoing fMRI. On each trial they chose between a displayed food or neutral food. Top-down motivations were manipulated in different blocks by instructing participants to either choose naturally or to focus on the food's healthiness. Bottom-up motivations were manipulated between sessions by presenting choices while either hungry or just after gorging on a buffet of junk food.

Results & Conclusions: Behavioral analyses indicate that both satiation and cognitive regulation increased the influence of healthiness on participants' choices and reduced the influence of tastiness. However, preliminary univariate fMRI analyses suggest that these similar behavioral outcomes relied on different neural circuits. Although vmPFC response correlated with choices, this correlation weakened under satiation. Additional analyses at an uncorrected threshold suggested that satiation increased vmPFC sensitivity to healthiness and decreased sensitivity to tastiness. Conversely, cognitive regulation had no significant effect on vmPFC representations of overall value, or of tastiness and healthiness. These preliminary results suggest that bottom-up and top-down motivations may alter behavior through different neural mechanisms.

P1.I. 26 - Prior preferences interfere with the associative learning of food values

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Details

Background: Cognitive flexibility, vital for environmental adaptation, is often probed with monetary assignment to neutral cues. Food valuation reflects strong, diverse preferences beyond nutritional content that motivate food choices. Prior work suggests intrinsic food values can be changed, yet little is known about the flexibility of associative learning processes that drive such change.

Objective: To characterize the behavioral mechanism by which food value priors influence associative learning.

Methods: In a novel probabilistic reversal-learning task, participants (n=279) repeatedly predicted stimuli-coupled outcomes. The task utilized 4 food stimuli pre-rated by each participant as being (a) strongly disliked, (b) disliked,

(c) liked, and (d) strongly liked. Reward distribution associations alternated between “Congruent” blocks, where disliked items (a, b) were mainly paired with negative outcomes (“punishments”) and liked items (c, d) with positive outcomes (“rewards”), and “Incongruent” blocks, where this was reversed. Participants’ reversal learning was compared across block types. Four reinforcement learning models addressing initial conditions, state-switching, block identity beliefs, and participant heterogeneity were fitted to behavior.

Results: Initial block identity had a significant main effect on learning quality ($F(1,554)=8.17$, $p=0.004$). Participants who started in a Congruent block, where food-value priors were reinforced, tracked changing stimulus values less efficiently, exhibiting lower prediction accuracy on Incongruent than Congruent trials ($p<.001$). Regardless of starting block, participants better predicted outcomes for reward- than punishment-associated foods ($ps<.0001$). Preliminary model comparison indicated that a policy-based model consistently outperformed valuation-based models across all participants, suggesting prioritization of environmental cues, or state-inference, over the updating of intrinsic food valuations. However, for Congruent-start participants, policy adherence model accuracy was lower than that of valuation-based models.

Conclusions: These findings suggest cognitive inflexibility is evident when primed by food-value associations aligned with priors. Preliminary model-based results hint at a mechanism by which such priming may lead participants to rely less on external cues and more on intrinsic values when navigating changing environments. Additionally, better prediction accuracy for reward- than punishment-associated foods suggests highlighting rewarding aspects of food, like health benefits, may more effectively influence food-based learning than information about potential harm, like health consequences.

P1.I.44 - Cultural influence on use of explore-exploit strategies: A case of independence vs. interdependence

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Details

Cultural backgrounds influence people’s self-construals. Independence and interdependence self-construals lead people to distinct cognitive styles. This study investigates the difference in using explore-exploit decision-making strategies in an uncertain and resource-limited environment among European American and Asian cultural backgrounds.

Task Design: We used the Grids Task where 227 participants (win version: 39 Asians and 73 European Americans, loss version: 35 Asians and 72 European Americans) accumulated points across 16 distinct grids. Each grid consists of an 11×11 matrix, totaling 121 cells. Every cell contains a numerical value, but at the start of each grid, the value from one cell is revealed as a hint. The values of the remaining cells are hidden and can only be uncovered by clicking on them with the mouse. Each click reveals the number in that cell and adds the corresponding amount of points to the participant’s total. By calculating the Manhattan Distance from each clicked cell to the previous cell, we compare the tendency for using exploration strategies between European American and Asian participants in the win (maximize gains) and loss (minimize losses) version of the task.

Analysis & Results: We used a linear regression model to determine whether Manhattan Distance was predicted by culture (Asians vs. European Americans) and task version (win vs. loss). We found a significant interaction effect between task version and culture, as well as a main effect of task version. For Asian participants, Manhattan Distance was higher in the win version than the loss version, whereas for European American participants, Manhattan Distance was higher in the loss version than the win version.

The Self Construal scale measured participants’ independent and interdependent self-construal. Interdependent self-construal was marginally higher in Asians than in European Americans, whereas independent self-construal did not have significant differences. Interdependent self-construal was also negatively correlated with Manhattan Distance in loss version.

Discussion: Both the regression model and the analysis of self-construal scores show significant culture effects. Asians have a stronger exploration tendency under the win domain, while European Americans have a stronger exploration tendency under the loss domain. These results are in line with previous works of cultural psychology study suggesting that Asians and European Americans have different cognitive styles, extending it to explore-exploit decisions. Further analyses will determine the mechanisms driving these cultural effects, including how interdependence contributes to exploration.

P1.I.45 - Neural adaptations in multialternative perceptual decisions

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Details

It is widely accepted that simple perceptual decisions unfold as a process of evidence accumulation. Neural signals resembling accumulation dynamics have been reported across multiple species and paradigms, and in humans include effector-selective mu/beta (8-30 Hz) activity over motor cortex and a centroparietal positivity (CPP), which both build at an evidence-dependent rate and peak at response. The critical question of how decision mechanisms are reconfigured based on the number of choice alternatives has been examined in monkey neurophysiology using a direction discrimination task with either two or four possible response options. Behavioral and physiological measures supported the general accumulation-to-bound framework. Moreover, relevant neural activity began at a lower level on four-option trials but peaked at a common level across trial types. The authors interpreted this larger excursion as the decision system tuning itself to require more evidence before committing to a response. The study also reported a slower rise in firing rates with four options but a similar firing rate at the time of response. We sought to examine similar mechanisms in EEG signatures of decision formation in humans. Participants viewed clouds of independently moving dots and reported the principal motion direction. Before each trial, a cue indicated whether there would be two or four directions as possible responses. The proportion of dots moving coherently was either low or high, independent of the number of options. Responses were faster and more accurate on trials with greater coherence or fewer response options. In the EEG data, we found a CPP signal with a greater rate of increase for high versus low coherence and two versus four options, in line with previous results. Critically, mu/beta motor preparation signals for two- or four-option trials began to diverge just after the condition cue, reaching a significantly greater desynchronization for two-option trials by evidence onset time ($p = .019$, paired t-test). Motor preparation for both trial types, however, reached a comparable level at response. Similar to the previous study, these combined results reflect how the parameters of evidence accumulation are tuned according to the context of the current decision.

P1.J.27 - A systematic empirical comparison of active inference and reinforcement learning models in accounting for decision-making under uncertainty

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Details

Reinforcement Learning (RL) and Active Inference (AInf) are related computational frameworks for modeling learning and choice under uncertainty. However, differences in how they account for human behavior on established decision tasks remain unclear. To address this, participants from two samples (US: $N = 152$; Taiwan: $N = 66$) were asked to complete a three-armed bandit task and several affective measures. In one sample, the task further manipulated gain/loss frame and reward magnitude. Choice data were used to fit several complexity-matched RL and AInf models in order to: 1) perform model comparison; 2) examine relationships between parameters of complexity-matched models; and 3) compare external validity of the best-fit models by examining task manipulation effects on parameter estimates and associations with affective measures. Bayesian model comparison favored AInf models in both samples (US: $\text{pxp} = 1.0$; Taiwan: $\text{pxp} = 0.910$). However, RL and AInf models showed similar accuracy in predicting participant choices. Correlations in parameter estimates between models suggested both explained behavior in overlapping but partially distinct ways. Only AInf parameters were sensitive to task conditions of frame and magnitude manipulations (respectively: learning rates from losses: $p = 0.003$; information bonus: $p = 0.04$), while both models showed similar effect size associations with affective measures ($p < 0.05$). These results suggest that RL and AInf have similar levels of explanatory power with respect to behavior on this task. Yet, they provide partially distinct explanations and may offer complimentary insights. Future research will be necessary to extend this work to other tasks and populations. Toward this end, we provide an open-source toolbox with this article including accessible code for each RL and AInf model variant for future adaptation.

P1.J.28 - Computational measures of metacognition for risk and their relation to emotional monitoring and control

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Details

Background Awareness of one's emotions and the quality of one's decisions guides behavior. Metacognitive monitoring of decision-making and emotional state monitoring are examples of different kinds of awareness, but the extent to

which these traits are similar is not yet fully understood. Here, we employ a recently developed computational model of confidence to evaluate how metacognition for risky decision-making relates to emotional awareness and control.

Methods 69 adults completed a confidence and decision-making under uncertainty task. Participants chose between a monetary gain or loss of \$5 with 100% probability versus a lottery to win or lose a different amount (or nothing). The lottery amounts, probabilities, and ambiguity levels (0% for risk trials) varied trial-by-trial. After making their choice, participants rated their confidence that they chose what they preferred. We sequentially fit a utility model to the task choices and the CASANDRE model of confidence to high versus low confidence ratings, using Maximum Likelihood Estimation with PyTorch. CASANDRE returned individual parameters for meta-uncertainty, a computational measure of metacognitive ability, and confidence criterion.

Participants completed the Interoceptive Accuracy Questionnaire, Trait Meta-Mood Scale, Toronto Alexithymia Scale, Mindful Attention Awareness Scale, General Self-Efficacy Questionnaire, Emotion Regulation Questionnaire, and the Ego-Resiliency Questionnaire. Confirmatory factor analysis (CFA) compared a one- versus two-factor model containing all questionnaire scores as factors.

Results The 2-factor CFA explained more variance and out-performed the 1-factor CFA based on scree plot, comparative index, and AIC measures. Factor loadings for factor 1 predominantly represented emotional awareness and monitoring; factor 2 loadings corresponded to emotional regulation and control. We found no significant associations between metacognitive ability and CFA factors. Factor 1 (Emotional Awareness) exhibited a trending but negative association with the metacognitive ability parameter ($\rho = -0.22$, $p = 0.064$) while factor 2 (Emotional Control) was not associated with metacognition ($\rho = 0.15$, $p = 0.212$).

Conclusions Our results indicate that emotional awareness is a separable construct from emotional control. Surprisingly, higher self-reported emotional awareness seemed marginally related to worse metacognitive ability for risky decision-making, perhaps suggesting that attention to internal states versus cognition are two opposing aspects of awareness. Follow-up studies will attempt to replicate this result in a larger online sample.

P1.J.29 - Flexible motivation in major depression: Symptom dimensions relate to diminished responses to food craving cues

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Details

Motivational difficulties in major depressive disorder (MDD) may reflect symptom variability specific to goal-directed behavior (anhedonia, apathy) rather than global mechanisms underlying diagnostic status. To test this, we used cue-induced craving—a potent, real-world motivational state that narrows and focuses decision making toward what is being craved—as a means to stress test the reward system and probe individual differences in motivational flexibility in MDD. Across two studies, using a similar task administered either at-home (N=52 MDD, N=27 non-psychiatric comparisons) or in-lab (N=28 MDD, N=35 comparisons), participants repeatedly rated their mood, and for five snacks presented in varying quantities, reported their desire and willingness-to-pay bids to consume them (realized via auction and indexing momentary subjective value). Mid-task, each underwent a brief multisensory craving induction targeting one sweet or savory snack from the set. In the at-home study, the snack set was mailed to participants beforehand; during the task, they completed the induction with the assigned snack on camera, and were required to return all items (except any won in the auction) to receive their bonus. Snacks were chosen to vary along multiple attribute dimensions, enabling assessment of both targeted and spillover effects of the induction. At-home participants also completed a detailed clinical battery to assess MDD symptom dimensions. As expected, MDD participants reported lower overall mood than comparisons (at-home: $t = -2.12$, $p = 0.04$; in-lab: $t = -3.72$, $p < 0.001$), with mood declining over the task in both groups (at-home: $t = -4.79$, $p < 0.001$; in-lab: $t = -5.49$, $p < 0.001$). Across both studies, the craving induction robustly increased desire (at-home: $t = 4.07$, $p < 0.001$; in-lab: $t = 2.98$, $p = 0.004$) and subjective value for the target snack (at-home: $t = 2.74$, $p = 0.01$; in-lab: $t = 2.62$, $p = 0.01$), with no significant differences between diagnostic groups (at-home: $p > 0.17$; in-lab: $p > 0.56$). Both groups also showed similar spillover effects, bidding more for snacks that shared attributes with the target item (at-home: $t = 2.56$, $p = 0.01$; in-lab: $t = 2.63$, $p = 0.01$). Consistent with our hypotheses, reduced craving response (desire following induction) related to greater behavioral apathy and cognitive function symptoms of MDD (at-home: $t > 2.54$, $p < 0.02$). These findings reveal consistent null effects of MDD diagnosis across experimental contexts, suggesting that reward sensitivity and motivational flexibility are better captured by symptom-specific dimensions tied to goal-directed behavior.

P1.J.46 - Beyond reward: Goal distance as a driver of momentary well-being

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Details

Objective: Well-being is a central aspect of human experience. One dominant view is that momentary happiness reflects recent reward prediction errors—that is, positive surprises in reward should increase mood. This framework implicitly assumes that more reward is always better. However, whether an outcome is rewarding often depends on the current state and goal. In this study, we ask whether mood tracks proximity to a goal rather than absolute reward, and whether it is also influenced by overlearned preferences for larger rewards.

Methods: We developed a novel decision-making task in which outcomes accumulate over blocks of trials toward a defined goal. If participants exceeded the goal, a penalty mechanism subtracted twice the excess from their total earnings (e.g., reaching 50 when the goal is 40 yields a net wealth of 30). On each trial, participants chose between two buttons: one that typically yielded positive rewards and one that typically yielded negative rewards. In half the blocks, participants started below the goal; in the other half, above it. Every three trials, participants rated their current happiness on a continuous scale.

Results: Participants ($n = 32$) chose the high-reward option more frequently when their wealth was below the goal (mean choice proportion = 0.59 ± 0.02) than when it was above the goal (0.48 ± 0.03 ; $\Delta = 0.12$, $t(31) = 4.1$, $p < 0.001$), effectively minimizing goal distance across trials (effect of trial number on goal distance: $\beta = -0.6 \pm 0.04$, $t = 13$, $p < 0.001$). On average, goal distance was lower when starting below the goal compared to starting above ($\Delta = -3.7 \pm 1.5$, $t = -2.5$, $p = 0.016$), suggesting that participants prioritized reducing goal distance but were partially biased towards obtaining larger rewards, presumably out of habit. Critically, happiness ratings were sensitive to goal distance: happiness increased as participants approached the goal from below ($\beta = 1.6 \pm 0.16$, $t(26) = 10$, $p < 10^{-7}$) and decreased when exceeding it ($\beta = -0.98 \pm 0.20$, $t = -4.9$, $p < 0.001$). Happiness was more sensitive to goal distance in the habitual state, when more reward is better, than in the goal-based state when more rewards is worse ($\Delta = 0.6 \pm 0.3$, $p < 0.05$), suggesting that habitual tendencies also influence mood.

Conclusions: These findings suggest that happiness reflects proximity to goals more than absolute reward, but that habitual responses still influence both mood and choice. Happiness may serve as a signal of progress toward goals, shaped by but not reducible to simple reward maximization.

P1.K.30 - Visual attention and consumer choice: An eye-tracking study on food packaging design

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Details

Objective: This study examines how visual attention patterns influence consumer preferences in packaging design. Cognitive psychology suggests prolonged attention to design elements affects final choices. Eye-tracking objectively captures fixation patterns, revealing decision-making processes. Despite neuromarketing advances, links between eye movements and verbalized preferences remain unclear. Our experiment analyzed eye-movement metrics alongside verbal justifications for packaging choices. Participants evaluated identical food products with alternative packaging designs. Results connect quantitative fixation data with qualitative choice motivations.

Methods: The study involved 27 participants of both genders. The experimental design included the presentation of 30 stimulus images, each containing three alternative packaging options for the same type of food product. During the selection process, the total number of participant fixations and average fixation duration were recorded, along with verbal descriptions of their choices.

Results: Verbal descriptions of the choices were categorized into five consumer choice factors: (1) packaging appearance, (2) brand, (3) prior experience with the product, (4) emotions, and (5) pricing considerations. Data analysis was conducted using a generalized linear mixed regression model with a binomial error distribution and a logit function.

The analysis of fixed effects revealed that total fixation duration per trial had the strongest influence on the dependent variable (consumer decision: 1 – chosen, 0 – not chosen), with $\beta = 0.242$, $SE = 0.012$, $z = 19.727$, $p < 0.001$. The number of fixations (total fixations) also showed a significant positive effect ($\beta = 0.007$, $SE = 0.001$, $z = 6.290$, $p < 0.001$).

A general linear model (GLM) with repeated measures, including the within-subject factor of consumer choice, revealed a significant effect on average fixation duration ($F = 3.738$, $p = .007$). Pairwise comparisons showed that fixation duration was significantly longer for packages associated with prior experience (factor 3) compared to packaging appearance

(factor 1) (272.16 ms vs. 249.68 ms, $p = .002$), and compared to brand (factor 2) (272.16 ms vs. 251.15 ms, $p = .044$).

Conclusion: The findings indicate that the likelihood of purchasing decisions is significantly influenced by both the total number and duration of fixations. Verbal justifications for consumer choices could be grouped into five key factors. The longest fixation durations were observed for packaging associated with prior personal experience, indicating that familiarity plays a crucial role in visual attention and decision-making.

P1.K.31 - A neuroscience approach to analyzing the effectiveness of safety signage in areas at risk of shark attacks

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Details

Introduction: Safety signage through warning signs is the main means of risk communication with societal impact. Challenges persist in creating signage that effectively attracts attention and drives behavioral change. Tourism, urbanization, and environmental degradation have intensified in coastal areas, and together with climate change, have increased the presence of sharks in densely populated regions, raising the number of human-shark interactions (Afonso et al., 2024). In this scenario, effective risk communication is vital (Pepin-Neff e Wynter, 2021), and signage is especially relevant due to its visual and textual features, which influence users' attention and behavior (Ma et al., 2018).

Objective: This study aimed to investigate how the characteristics of risk signage influence individuals' attention and perception, directly impacting its communicative effectiveness based on psychophysiological data.

Method: A neuroscience experiment was conducted with 63 participants, in which safety signs with controlled visual and textual stimuli were presented. Participants' visual behavior was recorded using eye-tracking technology, with descriptive analysis focused on time to first fixation (TFF) and total fixation duration (TFD). A generalized mixed model (GMM) using pupil diameter as a metric was applied to assess the effects of information quantity on the signs, supplemented by a post-experiment questionnaire.

Results: Signs present in real-environment images performed best in TFF and TFD metrics, indicating a greater ability to attract and maintain observers' attention. Textual elements were consistently the first to be visualized and the ones that concentrated the longest fixation time throughout the exposure. GMM revealed that signs with a moderate amount of content achieved the best results, suggesting an effective balance between informational load and perceptual clarity. Questionnaire results corroborated these findings.

Conclusion: The visual and textual structure of signage directly influences its effectiveness. Signs with a moderate amount of content, presented in real-world contexts, enhanced both visual engagement and rapid risk identification, significantly contributing to user safety and the effectiveness of risk communication in coastal environments.

P1.K.47 - The effects of across-trial lottery-outcome variance on gaze and choice

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Details

Objective: There is an established link between how long people look at option attributes and how much they weight those attributes in their choices (Yang & Krajbich, 2023). But what drives attention to different attributes? It is thought that people allocate their limited cognitive resources to maximize information gain. Thus, according to several prominent theories, decision-makers should focus on reducing their uncertainty about high-variance (i.e., salient) attributes. This may lead them to overweight those salient attributes (Bordalo et al., 2012). Prior research has examined salience in static, within-choice contexts, where uncertainty aversion may counteract the hypothesized effect. Here, we investigated whether across-trial variability in gamble attributes could influence gaze and, consequently, risky choice.

Method: Participants made a series of 300 choices about whether to accept or reject a three-outcome equiprobable gamble. From one choice to the next, the outcomes were drawn from distributions with different variances. In the treatment group, the three outcome distributions had low ($sd=4$), medium ($sd=28.4$), or high ($sd=40$) variance. By contrast, the control group experienced the same set of gambles, but with half of the low-variance outcomes swapped with half of the high-variance outcomes, making it so that each outcome distribution had the same medium variance.

We measured choices, response times and visual attention using an Eyelink 1000 Plus eye-tracker.

Results: Contrary to predictions, treatment group participants fixated more on low-variance outcomes and weighted them

more heavily in their choices compared to the control group. Treatment group participants also accepted more risky gambles ($\beta = 0.868$, $SE = .408$, $z = 2.129$, $p = .033$). A significant interaction revealed increased weighting of low-variance outcomes in the treatment group, ($\beta = 4.189$, $SE = 1.759$, $z = 2.382$, $p = .017$), whereas the interaction for high-variance outcomes was marginal ($\beta = 2.045$, $SE = 1.056$, $z = 1.933$, $p = .053$). Eye-tracking data largely mirrored choice results: treatment group participants fixated longer on low-variance outcomes compared to the medium- and high-variance ones ($ps < .001$).

Conclusion: We used eye-tracking to investigate how gaze patterns relate to across-trial variance and risky choice. Our findings suggest that attribute salience is not solely determined by immediate, within-choice contrasts, but can also be shaped by how attributes vary across time. Surprisingly, people allocate more attention to, and put more weight on, lower variance outcomes.

P1.K.48 - Rational evidence accumulation under cognitive resource constraints

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Details

In both perceptual and economic decision making, the brain often needs to integrate sequential information under cognitive resource constraints. In this study, we investigate how evidence accumulation is shaped by a resource-rational trade-off between performance and cognitive effort, and how temporal irregularities affect this process.

In a series of visual estimation experiments, subjects ($N = 8$) observed 8 sequentially presented stimulus samples placed on a circle whose angular positions were drawn from a Gaussian distribution with unknown mean. Their task was to estimate this underlying generative mean. Subjects received trial-by-trial feedback and a performance-based financial bonus. To test the effect of temporal irregularity, we introduced a temporal break of 1750ms after the 4th sample to the otherwise regularly paced sequence in half of the trials. In two follow-up experiments, break duration (150-1750ms) and break position (after the 2nd, 4th, or 6th sample) varied across trials respectively. We used circular regression to estimate the influence of each sample on participants' final estimates.

Subjects showed stable individual differences (primacy or recency), which remained across the no-break and all break conditions, suggesting distinct strategies for optimizing performance. In addition, subjects showed a robust "peak-after-break" effect: the first sample after a break received significantly higher weight than the one before it. This effect was more pronounced with longer break duration and later break position in the sequence.

We propose a normative Bayesian model under the information bottleneck framework, in which the encoding and memory precisions are determined by an active, resource-rational process that optimally balances the benefit of accurate estimation against the cost of encoding and memory effort throughout the accumulation process. The model predicts high encoding precision for the first sample after the break ("peak-after-break") as new information effectively reduces uncertainty following memory degradation during the break. The model accurately predicts behavioral patterns across different break durations and positions and accounts for individual differences in temporal weighting by allowing different cost-benefit trade-off factors in encoding and memory.

Our results suggest that evidence accumulation is governed by a dynamic process that continuously balances an optimal trade-off between cost and benefit. This framework bridges perceptual decision making and economic theories of bounded rationality, offering a unified account of how cognitive effort is allocated in response to environmental structure.

P1.L.32 - Cultural diversity in System 2 thinking

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Details

Objective: This study proposes a methodological framework for investigating cultural variations in System 2 thinking to inform culture-specific cognitive modeling in AI. We use Japanese and Polish cognitive styles as illustrative examples of alternatives to the North American analytic model currently dominant in AI development.

Methods: Our methodology integrates: (1) Cross-cultural cognitive literature analysis; (2) Meta-analytic framework for comparing neural activation patterns during reasoning tasks; (3) Integration of multi-loop learning theory with neuro-economics to develop computational models for culture-specific cognition. This approach parameterizes cognitive styles along dimensions of holistic/analytic processing, self-construal, ethical frameworks, and learning mechanisms.

Results: The framework yields: (1) A structured approach to identify culturally-specific reasoning patterns and their

neural correlates; (2) Computational formulations exemplified by models of context-weighted relational processing and dialectical reasoning; (3) A dataset construction protocol with historical text, contemporary discourse, and oral tradition layers; (4) Evaluation metrics including Thought-Property Preservation Score, Cultural Authenticity Score, and Historical Relevance Index. These enable future empirical validation and computational implementation of diverse reasoning styles.

Conclusions: This approach establishes a pathway for capturing diverse cultural cognition patterns in AI systems, moving beyond the current monocultural paradigm of rationality. The framework's significance lies in: (1) Creating neuroeconomic models that formalize culture-specific decision processes; (2) Providing metrics that recognize alternative manifestations of rationality; (3) Establishing a roadmap for capturing cultural learning processes within multi-loop frameworks. With empirical validation studies planned for next year, this research contributes to developing pluralistic AI cognition that better reflects global human thought while countering technological cognitive colonialism.

POSTER SESSION II

PS.02.01 - Distributional reinforcement learning in financial markets? Characterizing how shape of distribution impacts learning strategy

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Details

Recent studies suggest that dopamine neurons in the ventral tegmental area implement distributional reinforcement learning (RL) where these neurons convey information about reward distributions. However, behavioral evidence supporting distributional RL remains elusive. To address this question, in this study, we designed a financial investment task where subjects faced different financial portfolios carrying different log-return distributions. Critically, we manipulated the shape of the distributions—heavy-tail versus non-heavy-tail—while controlling their mean and variance so as to examine whether distributional shape could impact learning strategy (standard versus distributional RL). Human participants (22 subjects) encountered two distributions, with each in one block of trials (120 trials per distribution). Subjects were informed the existence of good and bad markets and a 0.1 probability of market shift at any point in time. For each portfolio, the distribution under good and bad markets were mean-shifted and symmetric around 0 return. On each trial, information about the log-return of the portfolio was randomly drawn from the corresponding distribution where return is defined by the ratio of the previous return (V_{t-1}) and the current return (V_t). At the beginning of a block, participants were endowed with the portfolio and reward points transferrable to cash. Each trial consisted of a prediction phase followed by a decision phase. In the prediction phase, participants were asked to predict the return of the portfolio ($(V_t - V_{t-1})/V_{t-1}$) by placing a bar on the return line. A bonus was given when the actual return fell within the confines of the bar. Prior to bar placement, subjects had to determine the size of the bar where the potential bonus decreased with bar size. Information about the current return was then revealed before subjects entered the decision phase to indicate the degree of which she or he would like to buy or sell the portfolio using a probability scale. First, we found that predicted returns were closer between good and bad markets when facing heavy-tail distribution. Second, subjects showed greater variability in bar-size decisions when facing heavy-tail distribution. Third, subjects' buy/sell decisions were more correlated with their predicted return than the actual return of the portfolio irrespective of the distributions. Fourth, about half the subjects' predicted returns were better described by distributional RL than median RL. Finally, 6 out of 22 subjects used different learning strategies when facing different distributions. Together, these results suggested that while distributional shape can impact predictions, humans do not always adopt a distributional RL strategy in uncertain and volatile environments.

PS.02.02 - Neuroforecasting: The impact of hedonic vs. utilitarian motives

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Details

We systematically compared neuroforecasting accuracy for participants with hedonic or utilitarian motives, evaluating hedonic or utilitarian products. The 'products' consisted of profiles of candidates with whom participants could socialize (hedonic motive) or who could be recruited for a cognitive task (utilitarian motive). The profiles featured three hedonic attributes (attractiveness, sense of humor, and sociability) and three utilitarian attributes (analytical thinking, stress resistance, and persistence). We constructed two pseudo-markets (each $N=200$) where consumers evaluated the same set of 80 profiles with either hedonic or utilitarian motives, allowing us to isolate the impact of motive while keeping stimulus attributes constant. We then recruited an independent sample ($N = 80$) to evaluate the same set of profiles in the MRI

scanner with either a hedonic or utilitarian motive.

We then assessed how neural responses from the two samples with different motives could forecast each market. We first ran a whole-brain analysis with general linear models to identify regions forecasting market-level preferences. We then took the significant regions as region-of-interest (ROIs) to further investigate differences in forecasting accuracy in the two markets, as well as the moderating roles of motive (hedonic vs. utilitarian) and type of attribute (hedonic vs. utilitarian).

Our analyses highlighted several regions predictive of market preferences: while nucleus accumbens (NAcc) responses predicted the hedonic market, activity in left posterior insula (pINS) forecasted both markets. For pINS, responses to both hedonic and utilitarian attributes could forecast both markets, but the forecasting abilities were moderated by the participants' motive: pINS responses to hedonic attributes were more predictive among participants with a hedonic motive, while pINS responses to utilitarian attributes were more predictive among participants with a utilitarian motive. In contrast, for NAcc, only the responses to hedonic attributes, but not to utilitarian attributes, could forecast the markets. NAcc forecasting ability was also moderated by the participants' motive but in the opposite direction: responses to hedonic attributes were more predictive of the market among participants with a utilitarian motive.

Our results suggest distinct effects of motive on the forecasting ability of NAcc and pINS toward relevant product attributes. Individuals' pINS responses toward motive-congruent attributes forecast market preferences better, while their NAcc responses toward hedonic attributes forecast better if these attributes are irrelevant for current motives.

PS.02.03 - Loss aversion emerges from the interplay of valuation, attention and evidence accumulation

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Details

Objective: Loss aversion—"losses loom larger than gains," is well-documented, yet its underlying mechanisms remain unresolved. Recent research in value-based decision-making highlights the dynamic interplay among value, attention, and evidence accumulation. The attentional drift diffusion model (aDDM) posits attention modulates how value biases evidence accumulation while other studies suggest accumulated evidence guides attention, manifested as more fixation on options with stronger accumulated evidence. Current study investigates how these processes interact to shape loss aversion.

Methods & Results: Using eye-tracking during a gambling task (N =80), participants chose between a gamble option (with varying gains and losses) and a certain option.

We found that valuation bias contributes to loss aversion. The aDDM with valuation bias best predicted participants' choices and reaction times. This bias was significantly correlated with subjects' behavioral loss aversion tendencies derived from prospect theory ($r = 0.92$, $p < .001$).

Attentional bias also played a significant role on loss aversion. We computed Loss Gaze Proportion (LGP)—gaze proportion on loss vs. gain—as an index of attentional bias on the gamble option. LGP showed a significant correlation with loss aversion ($r = 0.34$, $p = .002$).

Additionally, accumulated evidence guided attention allocation between options. We calculated Gamble Gaze Proportion (GGP)—gaze proportion on the gamble vs. certain option. The aDDM predicts that greater decision thresholds correspond to greater accumulated evidence differences. Accordingly, Δ GGP—defined as GGP difference between the gamble and certain options—at decision onset was positively correlated with decision thresholds ($r = 0.45$, $p < .001$), suggesting a link between accumulated evidence and attention.

To quantify how evidence influences GGP, we computed the Evidence Impact Coefficient (EIC) by simulating evidence accumulation with aDDM and performed mixed linear regression analyses, where GGP at each time bin was predicted by prior-bin accumulated evidence. The regression analyses with valuation bias, LGP, and the interaction between EIC and LGP as predictors against individual loss aversion coefficients showed all predictors were significantly positive (valuation bias: $p < .001$; LGP: $p = .033$; EIC $\times$ LGP: $p = .028$), indicating that EIC amplifies the effect of attentional bias on loss aversion.

Conclusions: Loss aversion emerges from valuation and attentional biases, with the impact of attention further amplified by how strongly evidence guides attention between options. These findings offer a more integrated account of the cognitive mechanisms driving loss aversion.

PS.02.04 - Search strategies influence intertemporal choice

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Details

Introduction: In intertemporal choice, comparative searchers, who compare attributes across options, exhibit greater patience than integrative searchers, who integrate features within an option (Reeck et al. 2017; Amasino et al., 2019). However, demonstrations of this effect are often correlational. It is unknown whether these results emerge independently from these sampling patterns or if both are caused by a shared underlying mechanism. Here, we use the drift-diffusion model (DDM) to test whether information sampling patterns alone can generate the differences in intertemporal choice seen in the empirical data.

Objective & Methods: Here, we conducted a series of simulations to explore how patient choices are influenced by the way information is sampled. First, we simulated choices between larger later (LL) and smaller sooner (SS) options using the DDM with either a comparative (Eq. 1) and integrative (Eq. 2) value function.

$$\text{Eq. 1 } V = \delta_A(A_{LL} - A_{SS}) + \delta_D(D_{LL} - D_{SS})$$

$$\text{Eq. 2 } V = \frac{\delta_A A_{LL}}{1 + \delta_D D_{LL}} - \frac{\delta_A A_{SS}}{1 + \delta_D D_{SS}}$$

Next, to account for information sampling patterns, we used an attentional DDM (aDDM) in which unattended attributes receive a discount θ (e.g., Eq. 3 for the comparative model). For each trial, one fixation pattern (comparative or integrative) and fixation times were randomly pulled from the empirical data, and the value signal evolved according to that pattern for that trial.

$$\text{Eq. 3 } V = \delta_A(A_{LL} - \theta_A A_{SS}) + \delta_D \theta_D (D_{LL} - D_{SS})$$

Results: Results indicate that comparative and integrative search predict significantly different choices. For the standard DDMs (Eq. 2-3) that do not use empirical search patterns, surprisingly, integrative DDMs led to more patient choices, the opposite of the empirical findings (logistic regression predicting LL choice from relative slope $\delta_A - \delta_D$ $p < .001$, DDM type $p < .001$, and their interaction $p < .001$). However, incorporating sampling patterns into the aDDM reverses this pattern, with comparative search predicting more patient choices for both DDM value functions (search pattern $p < .001$, DDM type $p < .001$, interaction $p = .0001$). Next steps will test Eq. 2-3 value functions in the empirical data in which choice architecture was used to manipulate search patterns.

Conclusions: Overall, our results demonstrate that search strategies alone influence intertemporal choice, with comparative search promoting greater patience only when empirical search patterns are considered. Importantly, this pattern is only seen when models incorporate empirical search patterns; the standard DDM cannot account for the results seen in the empirical data. These findings demonstrate the importance of search strategies in shaping intertemporal patience.

PS.02.05 - Brain activity reveals how wildlife imagery evokes engagement on social media

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Details

Visual imagery can motivate environmental advocacy and charitable giving, but the mechanisms underlying their broad appeal remain unclear. To understand how images of wildlife species elicit online engagement, we investigated links between behavioral probes, neuroimaging data ($n=37$), and social media engagement data from National Geographic's Instagram content stream. The account has amassed over 275 million followers as of 2025, highlighting its vast reach and influence. As hypothesized according to an Affect-Integration-Motivation (AIM) framework, activity in brain circuits associated with anticipatory affect and value integration (i.e., the Nucleus Accumbens or NAcc, and Medial Prefrontal Cortex or MPFC) predicted individuals' engagement with and donations to depicted species (56 stimuli). Group brain activity in the value integrative component of this circuit (MPFC) also forecast aggregate engagement on social media (i.e., total number of likes divided by number of current followers). Furthermore, MPFC activity correlated with activity in distinct circuits implicated in face processing (i.e., the Fusiform Face Area or FFA) and mentalizing (i.e., the TemporoParietal Junction or TPJ). Finally, a neurally-inspired model derived from these correlated components

(i.e., indexing facial salience and phylogenetic closeness, respectively) was used to forecast image engagement out-of-sample (276 stimuli). These findings not only extend neuroforecasting to a novel online domain, but also theoretically imply that neural data can support the discovery of stimulus features which scaffold new models for forecasting online engagement. These findings also have applied implications for accentuating or optimizing image features to promote support for wildlife.

P2.A.6 - Worry now, pay later – anxiety and stress increase buy now / pay later usage

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Details

Objective: Buy now, pay later (BNPL) is an increasingly popular payment option for a range of transactions. People acquire items immediately, but spread payments out, typically in four bi-weekly installments. BNPL has no fees or interest charges (if paid on time) but can create complex debt and increase overall spending (Di Maggio et al., 2022; deHaan et al. 2024.) So its usage can harm the segment of users who find it most attractive- those already stressed by financial precarity. Motivated by this concern, in four pre-registered experiments we examine how “worry” influences BNPL choices for discretionary purchases.

In Study 1, in-lab participants (N=378, MAge=20.4) reported agreement with statements that they felt more anxiety and more stress in the current month. These were correlated in all studies ($p < .001$) and averaged into a worry composite. Participants imagined purchasing a bath towel set, selecting paying the \$260 cost now or making four payments of \$65 every two weeks. Worry significantly predicted BNPL ($b = .204$, $p < .005$) even when controlling for perceptions of the expensiveness ($b = .536$, $p < .01$) and necessity ($b = -.140$, $p = .035$) of the towels.

Study 2 replicated this in an older sample (Prolific; N=970, MAge=37.9) for a range of items. BNPL election was significantly dependent on worry levels ($b = .10$, $p < .001$) despite controls for expensiveness ($b = .08$, $p = .171$) and necessity ($b = .08$, $p = .021$). In Study 3 (N=629, MAge=22.85), worry also increased BNPL use ($b = .14$, $p = .043$) for items at a lower \$100 price point (with controls for expensiveness and necessity).

In our experiments, participants are making payment choices, not purchase ones, suggesting layaway as an interesting contrast to BNPL. Both plans allow deferred costs, but the item is received at first payment in BNPL and at last payment in layaway. So in Study 4, participants (N=623, MAge=23.60) chose between paying up front and a randomly assigned deferred payment option (BNPL/layaway). They also rated their general difficulty with affordability of desired items at time of purchase. Deferral was similarly likely across BNPL (19%) and layaway (15%, $X^2(1) = 1.71$, $p = .19$). Including worry ($b = .18$; $p = .027$) and affordability ($b = .28$, $p < .001$) in the same model showed that both predicted BNPL. In contrast, only affordability ($b = .19$, $p = .018$) was significant for layaway (worry: $p = .928$).

Conclusion: Increased worry predicts an increased likelihood of electing BNPL (but not other forms of payment deferral) across a range of purchase decisions. Since economic concerns are a key driver of anxiety and stress, our findings raise the policy issue of a reinforcing cycle between financial precarity, worry, and BNPL usage.

P2.A.38 - Combining neuroimaging and physiological measures to study arousal-uncertainty links during market bubbles

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Details

Objective: Financial markets experience speculative bubbles unexplained by classical theories. Emotions and interoceptive signals appear crucial in investment decisions, yet remain unclear when measured in isolation. This study integrates Smith et al.'s (2014) neuroimaging with Bossaerts et al.'s (2024) physiological approaches to explore whether multimodal measurement reveals mechanisms missed by isolated approaches. We hypothesize that fMRI activation in reward regions (Nucleus Accumbens, Anterior Insula) and peripheral arousal (EDA, HR) may jointly inform financial performance.

Methods: Participants (N=195, 68 female, mean age: 24.43 ± 4) completed a real-time interactive trading simulation with monetary incentives. All completed interoceptive (MAIA-2), risk preference (Holt-Laury), and demographic questionnaires. Data acquisition included: fMRI imaging for a subsample ($n=20$), EDA+ECG for $n=86$, wearable EEG in $n=40$. fMRI analysis followed ROI extraction and peak-alignment from prior studies; EDA/ECG features were extracted in phase-locked windows around key events. Both measures were time-locked to identical market events, enabling event-synchronized brain-peripheral integration.

Results: Electrodermal analysis revealed robust arousal-uncertainty relationships (Cohen's $d=1.91$, $p=0.0052$ for price change tertiles; $d>1.3$, $p<0.03$ across volatility/range; 9/12 results survive FDR correction). These large effects span all temporal windows across multiple uncertainty definitions. No direct association between EDA and trading performance. Replicating Smith et al.'s approach, right nAcc activation did not predict investment returns (low tercile: 0.108, high: 0.0697, $t=0.95$, $p=0.35$); similar for left nAcc ($t=0.71$, $p=0.48$). Consistent with their findings, right anterior insula showed differential activation patterns in high vs low performers around market crashes; mixed-model analysis revealed a significant wallet-by-bubble interaction (estimate = -0.162, $t = -5.11$, $p<0.001$), with a cross-over pattern confirming robust modulation by performance during bubbles, though some effects remain trends. Additional questionnaire, ECG, cross-modal and Heartbeat Evoked Potentials (HEP) analyses are ongoing.

Conclusions: Peripheral arousal signals market uncertainty while fMRI reveals performance-specific bubble mechanisms, demonstrating complementary brain-body information. Ongoing analyses will extract additional ROIs, explore whole-brain signals and integrate multimodal measures. Preliminary results demonstrate distinct yet complementary roles for peripheral and neural measures, with direct integration analyses ongoing to establish full multimodal benefits.

P2.B.7 - Frame by frame: Cognitive dynamics underlying consumers' short video watching behavior

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Details

Short videos have emerged as a dominant medium in digital marketing, offering immersive and dynamic experiences that significantly influence consumer decision-making. However, the cognitive processes underlying short-video watching remain largely unexplored, particularly due to the rapid, frame-by-frame variation in visual and auditory stimuli. To address this gap, we propose a frame-by-frame drift diffusion model (ffDDM) that integrates principles from sequential sampling theories and dual-process cognition. Unlike conventional models that assume a constant drift rate, the ffDDM allows the drift rate to vary dynamically in response to situational cues (e.g., human faces, captions, color features) embedded in each video frame. Using a large-scale field dataset ($N=72,000$) from a leading e-commerce platform, we estimate and compare the ffDDM against several benchmark models, including the standard DDM, the homogeneous heuristic DDM, and mixed-effects logit and probit models. Our results show that the ffDDM consistently outperforms these alternatives in both in-sample fit and out-of-sample predictions. Furthermore, the ffDDM reveals significant influences of peripheral cues on consumer behavior—effects that conventional models fail to capture. These findings highlight the value of modeling consumers' dynamic cognitive responses to video content and offer actionable insights for marketers aiming to optimize short-video design in marketing contexts.

P2.B.8 - Neuroforecasting box-office demand for movies

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Details

Objectives: Despite the ubiquity of digital media, movies remain a popular pastime. In today's saturated content landscape, understanding what drives audience engagement is key to forecasting box office (BO) success. Traditional measures like surveys often miss underlying affective drivers. This study tested whether neural responses in regions tied to anticipated reward (NAcc), aversion (AI_{ns}), and integrated value (MPFC) could predict both individual desire to watch (DtW) and aggregate BO performance by comparing various models.

Methods: Two samples ($n = 27$; $n = 15$) watched 32 trailers (16 comedy, 16 horror) while being scanned by fMRI. After each trailer, subjects rated DtW, valence, and arousal. BO revenue for all 32 films was collected via BO Mojo. During analysis, 24 released movies were used for modeling, and 8 unreleased films held out for validation.

Results: For individual prediction, self-reported positive arousal (PA) predicted DtW across genres ($t = 22.00$, $p < .001$); negative arousal (NA) was negatively associated with DtW for horrors ($t = -5.35$, $p < .001$). NAcc responses at trailer onset predicted PA ($r = .092$, $p < .01$) and DtW ($r = 0.10$, $p < .01$), but AI_{ns} responses at trailer offset predicted NA ($r = 0.12$, $p < .001$) and desire not to watch ($r = 0.09$, $p < .01$).

Aggregately, onset NAcc responses forecasted log-transformed BO returns overall ($r = .54$, $p < .001$), whereas onset MPFC responses forecast the revenue for horrors only ($r = .60$, $p < .05$). A multivariate model including activation at onset NAcc ($t = 3.53$, $p < .01$), offset AI_{ns} ($t = -1.91$, $p = .073$), and middle-phase MPFC significantly outperformed a permuted null distribution ($n = 1,000$) across RMSE ($p < .05$), MAE ($p < .01$), and adjusted R^2 ($p < .001$), indicating that its performance on unreleased films was unlikely by chance.

Further, dynamic spatial InterSubject Correlation (ISC) in NAcc was positively associated with its predictive strength for PA ($r = .86$, $p < .001$) and DtW ($r = .71$, $p < .01$), and forecasts of BO returns ($r = .52$, $p < .05$). Alns ISC was similarly associated with its predictive strength for NA ($r = .56$, $p < .05$), but negatively associated with BO returns forecasts ($r = -.71$, $p < .01$). These findings show that time-resolved neural synchrony in NAcc and Alns modulates the predictive strength of the regions for individual and aggregate demand.

Conclusions: The model's predictive success on unreleased movies confirms its generalizability. Findings show that affective mechanisms not only drive individual choices but can forecast market demand. The observed link between neural synchrony and predictive power suggests that collective gain anticipation with variable individual aversion can enhance forecasting.

P2.B.9 - Interpretable visual features for demand neuroforecasting

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Details

Recent advances in marketing and machine learning have enhanced demand estimation by incorporating image data, while neuroforecasting research has demonstrated that neural activity in the nucleus accumbens (NAcc) of a small sample can predict market-level outcomes. However, both fields stop short of explaining why these approaches are effective. To address this gap, we use machine learning to generate hypotheses about the psychological and visual mechanisms that underlie the predictive power of neural signals in consumer demand.

Drawing on the neural random utility model, we propose that early affective brain activity reflects a common utility component shared across consumers. Then, we use a generative machine learning approach to identify visual features in vehicle images that correlate with this neural activity, making the features interpretable through human evaluation (see Figure 1).

Our two-part methodology begins by training a custom variational autoencoder to extract latent features from vehicle images. See Figure 2 for network architecture. We use regularized regression to identify features most correlated with NAcc activation, measured in 45 participants viewing 52 unique vehicles in an fMRI scanner. We then use latent space traversals to manipulate individual features in generated images and ask online observers to describe what visual aspects are changing, thus assigning interpretation to these features.

In the second part, we use these interpretable visual features to design improved survey instruments. Rather than relying on traditional stated preferences, we focus questions on attributes that drive neural responses—those aligned with the common utility component—hypothesizing that this will yield forecasts that better predict market behavior.

By integrating methods from machine learning, neuroscience, and marketing, our framework enhances both theory and practice in demand forecasting. It increases prediction accuracy and interpretability while potentially reducing the need for repeated fMRI studies. Once trained, the model can rapidly generate insights for new products, offering a scalable and efficient tool for understanding consumer choice. This research deepens our understanding of shared utility representations and how neural data can improve market predictions.

P2.B.39 - Value pattern formation and retrieval during hedonic experience and decision-making: Relevance to anhedonia and advertising

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Details

Objective: Value-based decision making involves the initial assignment of value to positive experiences and the retrieval of value at the time of decision. It has been challenging to study the interaction of these processes with standard experimental approaches. We designed a novel fMRI task to investigate the temporal dynamics of value representation: how it emerges during hedonic experience and returns during financial decision-making. We further tested whether these processes could account for anhedonia in schizophrenia.

Methods: Twenty healthy controls ($n=5$ female, aged 30 ± 9) and 24 individuals with schizophrenia ($n=5$ female, aged 39 ± 9) with moderate negative symptoms participated in a novel fMRI task in which they experienced pleasurable stimuli (movie trailer advertisements) and made financial decisions (willingness-to-pay, WTP using a Becker-DeGroot-Marschak procedure) to win a copy of the advertised movies.

Subject-level support vector regression with 5-fold cross validation decoded brain activity patterns in value regions

(ventromedial prefrontal cortex and ventral striatum) during hedonic experience (trailer viewing) to predict WTP. Expression of value patterns was calculated throughout the experiment to observe the dynamics of their emergence during trailer viewing and reinstatement during financial decision-making.

Results: In the healthy group, brain activity patterns during trailer viewing predicted WTP during the subsequent auction procedure ($t_{19}=3.98$, $p=0.0004$, 1-sample t-test). Even though these WTP patterns were trained on the trailer period, they returned during the auction period on high bid trials ($t_{18}=5.49$, $p=0.00003$). In the schizophrenia group, these patterns were less predictive of WTP compared to controls ($t_{42}=2.65$, $p=0.011$, 2-sample t-test) and were less effectively retrieved during the auction (group $\times$ bid condition interaction: $F_{1,36}=10.2$, $p=0.003$). Anhedonia symptoms of schizophrenia correlated to impaired WTP-modulation of value patterns during the auction (SANS Anhedonia global: $t_{22}=-2.63$, $p=0.015$, linear regression).

Conclusions: Our findings suggest that value representation occurs during hedonic experience, it resembles that seen during subsequent financial decisions, and can predict these decisions. Schizophrenia patients showed impaired retrieval of value patterns that correlated to anhedonia, consistent with evidence of a value representation deficit in schizophrenia. Our experimental paradigm may help elucidate the link between hedonic experience and reward seeking, for instance in the context of advertising and psychopathology.

P2.C.10 - Rewiring risk: Enhancing coordination with brain stimulation

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Details

Coordination problems are widespread in economic and social interactions, where individuals must align actions to achieve mutually beneficial outcomes. One of the most prominent coordination games is the Stag Hunt, where subjects can choose either the risky action that, if taken jointly, results in the highest (efficient) outcome, or the safe action that secures them a small payoff regardless of the other's decision. Over countless experiments, researchers have found a large pervasiveness of coordination failures in this type of game (Devetag & Ortmann 2007) but it is still not clear what causes these coordination failures. This project uses a novel brain stimulation technique (tSMS) to causally test the role of certain idiosyncratic traits in coordination.

We address two key questions: (1) What is the effect of stimulating the left dorsolateral prefrontal cortex (DLPFC) on the evolution of coordination? (2) What contributes to coordination failures in the Stag Hunt? To explore this, we examine four potential mechanisms: risk aversion, cognitive ability, reciprocity, and patience.

We conducted two experiments at the Hospital Nacional de Paraplégicos in Toledo, Spain. We use transcranial static magnetic field stimulation (tSMS), a new non-invasive brain stimulation technique that uses a strong compact magnet to temporarily modulate brain excitability. In the first experiment, 60 healthy subjects were randomly assigned to either a tSMS group, where stimulation targeted the left DLPFC, or a sham group (control). Before stimulation, we measured baseline preferences (risk, time, social) and cognitive ability. Participants then played ten rounds of the Stag Hunt with the same partner.

In the second experiment (52 subjects), we replicated the procedure but focused on identifying the channel through which tSMS influenced coordination. The key difference is that we measured preferences and cognitive ability after stimulation to understand which traits were being modulated by the tSMS. We also included variations of the game to evaluate if the effects generalized across different payoff structures.

In both experiments, subjects who received tSMS stimulation on the left DLPFC achieved significantly higher coordination rates. In the second experiment, we found that the treated group showed a substantially higher willingness to take risks (measured through lottery choices), while no significant differences emerged in patience, reciprocity, or cognitive ability. These findings suggest that tSMS increases coordination by modulating risk preferences. In sum, this study provides evidence that risk attitudes are a key determinant of coordination success and demonstrates the potential of tSMS as a tool for understanding the neural basis of economic behavior.

P2.D. 11 - Context-dependent aversion to conflicting information

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Details

Objective: An understudied type of uncertainty arises when decision-makers face two conflicting sources of information—for example, if one medical opinion suggests that a treatment is likely to be effective, and a second suggests it will not. In

this study, we investigated how decision-makers treat such uncertainty. Specifically, we examined whether conflict-based uncertainty is treated differently from ambiguity, where there is agreement on the range of success likelihoods.

Methods: We designed a two-part behavioral task completed by 237 online participants, in which uncertain monetary lotteries were framed as either ambiguous (e.g., “the chance of winning is between 25% and 75%”) or conflicting (e.g., “one source says 25%, another says 75%”). In the first part, participants chose between certain and uncertain options (e.g., “Would you rather receive \$5 for sure, or participate in a lottery offering \$21, where the success rate is 25% according to one source and 75% according to another?”). In the second part, participants chose between identical conflicting and ambiguous lotteries that differed only in framing (e.g., “Would you rather participate in a lottery offering \$120, where, according to one source, the success chance is 10%, and according to another, 90%; or in a second lottery where both sources agree that the success chance ranges between 10% and 90%”).

Results: In the first part of the task, when conflict and ambiguity were separately contrasted with certainty, participants exhibited similar levels of aversion to both (conflict chosen in $46.9\% \pm 1.7\%$ of the trials, vs. ambiguity in $42.7\% \pm 1.7\%$). However, in the second part of the task, when the two types of uncertainty were directly contrasted, attitudes reversed sharply, showing strong aversion to conflict (chosen in only $22.7\% \pm 1.7\%$ of trials, $p < .001$). This reversal occurred in 82.7% of participants, suggesting a context-sensitive perception of conflict.

Conclusions: These results suggest that, in the absence of direct comparison, conflict may be interpreted as ambiguity. It is only when conflict is explicitly contrasted with ambiguity that its aversive nature becomes evident. These findings have implications for real-world settings, such as medical decision-making and uncertainty communication. Future studies may explore the neural mechanisms underlying the processing of conflict-based uncertainty, potentially revealing distinct computational and affective processing routes for different types of uncertainty.

P2.D. 12 - Comparing the incomparable: Modeling values of qualitative outcomes

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Details

Background: Everyday decisions often involve choosing between qualitatively distinct options, such as going out for a meal or seeing a movie, that lack a shared metric. In prior work (Korem et al 2025), we developed the estimated value model, which inferred values from ordinal outcomes based on observed choices in a forced-choice lottery. Here, we extend the model to estimate value distributions and risk attitudes from choice behavior, without assuming a specific functional form or transitivity. This proof-of-concept simulation study implements a fully Bayesian framework to recover values and uncertainty attitudes across categories.

Method: We simulated responses in a forced-choice lottery task, where each outcome was defined by a normally distributed subjective value (mean and standard deviation). A grid search varied sample sizes (10–110), the distance between outcomes mean (0.1–1.0), and standard deviation around each value (0.5–1.0). For each condition, we generated participant-level choices and applied our model to infer item-specific value distributions and individual risk attitudes. To test generalizability, we simulated choices between three items (a, b, c), trained the model on two pairwise comparisons (a–b and a–c), and evaluated its ability to predict the third (b–c).

Results: The model accurately recovered simulated value ratios even under substantial noise. With >80 simulated participants, correlations between true and recovered values exceeded $r > .9$ for trained item pairs and $r > .8$ for the untrained pairwise comparison. Risk attitudes were also reliably recovered at the individual level ($r > .6$). The Bayesian framework allowed full posterior estimation of uncertainty in both item values and participant-level parameters.

Conclusions: This approach offers a flexible and generalizable framework for estimating subjective value and risk sensitivity across qualitatively distinct options. By inferring value distributions from observed choices, without requiring transitive consistency or prespecified utility functions, this method allows researchers to quantify preferences in ecologically valid domains where direct valuation is infeasible. The model is broadly applicable to consumer behavior, intertemporal choice, and affective decision-making research.

P2.D. 13 - Flexible behavior with dynamic valuation via range normalization in uncertain, changing reward contexts

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Details

In naturalistic settings—from deciding between different snacks or between job offers—the potential reward outcomes from one's choices can vary significantly from moment to moment, requiring a high degree of flexibility in decision making. However, commonly used models of choice under uncertainty (e.g., Prospect Theory) cannot effectively capture such flexibility, as they assume that the reward probability and magnitude of each choice option (or nonlinear functions of them) are multiplied to form subjective values, which are then compared to make a choice. In the case where choice options have drastically different reward magnitudes from trial to trial, only the nonlinearity of utility function can allow for flexibility, but to a very limited extent. Therefore, we hypothesized that additional mechanisms must be involved, including range normalization, which rescales the reward magnitudes on a trial-by-trial basis relative to the range of available options. To reveal these mechanisms, we designed an experiment in which human participants (N=65) performed a probabilistic reward learning task, where the range of reward magnitudes on each trial was between 1 and 20, or between 1 and 200. We used various model-free and model-based approaches to analyze and fit participants' choice data. Using logistic regression, we found that reward probability and magnitude were combined additively to determine choice. Furthermore, participants dynamically adjusted their sensitivity to reward magnitudes based on the magnitude range in each trial, while their sensitivity to reward probability remained constant. By applying Bayesian model selection to the fit of reinforcement learning models, we found the best-fitting model additively combines reward probabilities and magnitudes and performs range normalization of reward magnitudes (protected exceedance probability > 0.999). These mechanisms allowed participants to fine tune their sensitivity to reward magnitudes across a wide range of contexts, without disregarding information about reward probabilities. Overall, our results suggest that human decision making under uncertainty relies on flexible, context-sensitive evaluation mechanisms, rather than on the rigid computation of subjective values.

P2.D. 14 - Agency increases risk-taking in experience-based decisions

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Details

The experience-description gap captures a systematic difference in choice behavior based on how individuals learn about a lottery's payoff distribution (Barron & Erev, 2003; Hertwig et al., 2004). When individuals decide from description, they tend to be more risk averse than when they decide from experience at least for gains with sizable probabilities. A difference between the two decision formats is agency. For example, in a paradigmatic implementation, decisions from experience require repeated sampling, which can be terminated anytime. The extent to which agency—here defined as (a) the number of actions taken or (b) the ability to terminate information acquisition at will—contributes to the experience-description gap remains unclear. Given that higher perceived control, which is related to agency, facilitates risk taking (Langer, 1975), we propose that agency in experience-based decisions enhances perceived control. We hypothesize that agency promotes risk tolerance in the gain domain relative to conditions without agency. To test this, participants (N = 150) made decisions from experience under two conditions. In the free termination condition, participants freely sampled outcomes and chose when to stop. In the forced termination condition, participants were drew the same number of samples in the same sequence as the free condition, but without control over when to stop. Participants also completed a set of decisions from description, allowing us to quantify the gap. We predicted that participants in the free termination condition would exhibit greater risk-seeking behavior, evident through (A) reduced underweighting of small probabilities, (B) higher risk tolerance (as measured by alpha values in the CRRA function), or (C) both. Our findings support hypothesis B: participants in the free termination condition showed higher risk tolerance, with greater alpha values in the CRRA function compared to both the forced termination ($\Delta\alpha = 0.09$) and described conditions ($\Delta\alpha = 0.07$). Participants reported feeling significantly more in control and more confident in their decisions for the free than the forced termination condition (Δ agency rating = 6.61, $p = .004$; Δ confidence rating = 5.72, $p = .005$). Differences in subjective agency ratings predicted corresponding differences in risk-taking ($r = .20$, $p = .014$) only in the free termination condition. The findings suggest that perceived control, provided by the ability to decide when to stop sampling, mediates experience-based decisions. Overall, they highlight the role of agency in risk-taking and provide an agency-based explanation for the experience-description gap.

P2.D.37 - Behavioral signatures in response to bimodal and unimodal reward distributions

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Details

Both humans and animals possess the ability to extract statistical regularities from the environments so as to navigate, adapt, and survive. However, little is known about how humans infer and respond to a rich array of properties associated with distributions beyond basic statistics such as the mean and variance of a sample. Inspired by emerging real-life scenarios such as the more frequent encounters of extreme weather in modern days, we investigated how people respond to bimodal reward distributions and compared them with responses to unimodal distributions. In a lottery decision task, subjects chose between two lotteries on each trial. She or he can face a choice between a bimodal distribution (40%, 0 point; 20%, 500 points; 40%, 1000 points) and unimodal distribution (25%, 0 point; 50%, 500 points; 25%, 1000 points), a choice between bimodal distribution and a sure gain (ranging from 0 to 1000 in increments of 100), or a choice between unimodal distribution and a sure gain. Subjects had complete knowledge about the distributions and received feedback on how many points they won after each choice. We found substantial individual differences—some subjects almost always chose the bimodal distribution, some always chose unimodal, and some in between. Such individual tendencies were marginally correlated with the certainty equivalent of each distribution and individual subjects' experience with unimodal distributions. Further, subjects were more likely to choose the riskier option after receiving 1000 points from a bimodal distribution than from a unimodal one. By contrast, they tended to choose the riskier option more frequently after receiving 0 points from a unimodal distribution than from a bimodal one. Together, these results suggest that preferences for bimodal over unimodal distributions may be experience-dependent and that risk preferences are not only dependent on recent experiences but knowledge about the particular distribution they come from.

P2.D.40 - Resisting social impression updating: Motivation to reduce uncertainty inflates reliance on weak explanations for others' trait-inconsistent behavior

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Details

People rely on their impressions of others' traits to guide predictions about their behavior. When someone acts in a way that contradicts those expectations, it introduces cognitive uncertainty in the form of a credit assignment problem: does the behavior reflect a need to update the underlying trait belief (e.g., she's not as friendly as I thought), or can it be explained by a transient situational factor (e.g., she was distracted by the news she just received)? Resolving this ambiguity involves weighing the relative plausibility of trait- versus state-based explanations. In this study, we examined how people respond to trait-inconsistent behavior when provided with situational explanations that vary in perceived informativeness. Across two experiments (total N=495), participants made generosity judgments about an individual, for whom they received a relevant trait information (agreeableness), both before and after they observed their trait-inconsistent sharing behavior. While observing sharing behavior, participants were provided with a situational cue that was either informative (happiness) or uninformative (physical discomfort or time of day) for predicting generosity. Despite recognizing some situational cues as uninformative for the behavior in isolation, participants were more likely to treat them as explanatory in the presence of expectancy-violating behavior, suggesting a motivated shift in explanatory weighting that preserves prior beliefs. This effect was stronger among individuals with higher intolerance of uncertainty, consistent with a greater subjective need to maintain predictability in the face of uncertainty. These findings suggest that impression updating is shaped not only by normative inference but also by the motivational dynamics of uncertainty reduction, indicating that people flexibly reinterpret information to preserve the coherence of their impressions when social predictions are violated.

P2.E.15 - Developing a neuroeconomic approach to study altruistic decision-making in mice

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Details

Understanding the psychological and neural mechanisms underlying prosocial decision-making can shed light on interpersonal dysfunctions observed in nearly all neuropsychiatric disorders. Prosocial behaviors include those that aim to benefit another. Specifically, altruistic behaviors benefit another at a cost to oneself. Recent studies have reported a variety of prosocial behaviors in rodents, from comforting and helping behaviors to prosocial allocation of resources. To date, the neural computations underlying cost-benefit decision processes when considering the needs of another remains underexplored in rodent models.

To investigate this, I conceptualized and developed a novel social paradigm in mice based on principles of behavioral economics and foraging theory. In this task, an “actor” mouse forages for food rewards at four spatially distinct zones (“restaurants”). The actor has the opportunity to feed both itself and a “recipient” mouse in the center of the arena. These mice are cohoused dyads (n = 6 dyads) where, in task, they are separated by an opaque or mesh divider (n = 3 dyads per divider group) in order to assess the effects of social access on prosocial choice. Mice were able to forage for two different flavors in order to introduce an element of subject value. Two of the four restaurants feed both mice; the other two restaurants feed only the actor.

Preliminary results revealed that mice with social access in the mesh divider group shifted preferences toward less preferred flavors compared to their opaque divider counterparts. Upon closer look, this was due to an adjustment in foraging strategies: actor mice with social access detracted time investments away from their preferred flavor that fed only themselves, reallocated toward earning more rewards of their less preferred flavor that instead fed both mice. We then measured choice reaction times in each restaurant’s T-shaped intersection from offer onset until the actor made either a skip or enter decision. Compared to the opaque group, actor mice in the mesh group displayed slower reaction times when deciding to skip offers, particularly in less preferred restaurants that feed both mice. Differences in these reaction time metrics, which can capture elements of choice conflict, indicate mice in the mesh group are spending more time deliberating in a restaurant-specific manner. Together, these data highlight that both social access and subjective value influence foraging decisions that involve the consideration of the needs of others. These results suggest mice modulate their behavior to benefit a conspecific, with ongoing efforts to identify the neuroeconomic mediators of this effect.

P2.E.16 - The ventral tegmental area and dorsal raphe nucleus control neuroeconomically dissociable decision-making algorithms

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Details

How the brain makes choices depends on multiple decision-making systems. This includes separable circuits in the brain as well as different roles multiple neuromodulators play in aspects of motivated behavior. Here, we interrogated how multiple regions and neurotransmitter systems, including dopamine and serotonin, contribute to fundamentally distinct types of choices in mice tested on our neuroeconomic foraging paradigm, “Restaurant Row.” On this task, mice have a limited time budget to forage for food by investing in rewards of varying costs (delays, 1-30 s signaled by tone pitch) and subjective value (unique flavors). Each trial was divided into two stages: mice made deliberative accept vs. reject decisions in the offer zone followed by secondary re-evaluative stay vs. quit decisions in the wait zone. This study consisted of two cohorts. First, we characterized the behavior of 40 outbred Swiss Webster mice. After 60 days of testing, mice were time-sacrificed during task engagement in order to perform whole-brain tissue clearing and staining of 275 regions for cFos expression, an activity-dependent biomarker of recent cell activity. This allowed us to capture a snapshot of brain-wide activation patterns compared to a control group of an additional 10 brains that were not engaged on the task prior to tissue extraction. We found a striking restructuring of brain-wide network activation patterns that depended on neuroeconomic task engagement and differentially recruited the ventral tegmental area (VTA) and dorsal raphe nucleus (DRN). In a second cohort of 44 mice, we transfected either the VTA or DRN with adeno-associated viruses expressing either hM3Dq (excitatory, N=11/11), hM4Di (inhibitory, N=10/8), or no chemogenetic receptors (N=4) driven by the synapsin promoter in order to bidirectionally manipulate neural activity in neurons when administered clozapine-N-oxide vs. saline via intraperitoneal injection. We found a shift in willingness to accept offers in the offer zone or willingness to wait out delays in the wait zone that depended on (i) the brain region targeted, (ii) the chemogenetic receptor expressed, and (iii) the subjective value of the flavor in pursuit. On-going efforts are currently characterizing recordings of downstream dopamine and serotonin release using dual-color fiber photometry across 6 brain regions, including the medial prefrontal cortex, orbitofrontal cortex, nucleus accumbens, amygdala, lateral dorsal tegmental area, and interpeduncular nucleus - regions based on our whole-brain screen are implicated in functionally distinct but connected roles with VTA vs. DRN during different aspects of neuroeconomic decision-making.

P2.E.41 - The impact of temporal discounting on precommitment decisions to avoid future self-control costs

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Details

Objective: Theoretical accounts have proposed that delay discounting may be related to prospective self-control strategies such as precommitment. We previously demonstrated that a precommitment-based willingness-to-pay task can be employed to behaviorally measure the subjective cost of self-control. Here, we test whether discount rates are associated with differences in the cost of self-control.

Methods: Healthy dieters ($n = 81$) completed a precommitment task. They first completed a 'bidding' phase, during which they were presented with images of snack foods (selected from a pre-task ratings) that varied on level of temptation (low, medium, high), quantity (small, medium, large), and exposure times (1–60 mins). During this phase, they reported the maximum amount (from a study endowment) they would be willing to pay to avoid the food on that trial. One trial was randomly chosen for realization. Participants could increase their chances of avoiding future exposure to the food by bidding a higher amount on each trial. They also completed a battery of cognitive tasks, including an intertemporal choice (ITC) task for which they made binary choices between pairs of sooner, smaller and larger, later monetary rewards. To quantify delay discounting, we used two measures: (1) the logit-transformed choice probability for the immediate option, and (2) the discount parameter from a hyperbolic discounting model fit. We analyzed the bids from the precommitment task to calculate subject-specific bid means, and performed multiple linear regression of the bids with temptation, quantity, time, and trial number as the regressors for each participant.

Results: We found that task variables modulated self-control costs, with a significant and positive effect of temptation, quantity, and time on bids; the effect of temptation was the strongest. Furthermore, the cost of self-control was related to discounting behavior, with a significant positive correlation between (logit-transformed) choice probabilities and average bids across the subjects ($r = 0.28$, $p_{uncorrected} = 0.014$, $df = 78$).

Conclusion: Our results indicate that a greater preference for immediate rewards is associated with higher precommitment (larger bids) to avoid situations that require self-control. Our results also show that precommitment decisions, presumably reflecting the estimated cost of self-control, are higher when the rewards are highly tempting or of larger quantity, or when self-control is to be exercised for longer. In ongoing work, we are using cost of control models to gain mechanistic insights into how delay discounting and other cognitive factors might affect this form of control.

P2.E.42 - Validating an abridged training protocol to capture the emergence of neuroeconomic decision-making strategies in mice

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Details

Training rodents to perform complex decision-making tasks can take several months. Longitudinal studies such as these are labor and resource intensive, limiting the ability to investigate the progression from naive to expert levels of task performance. This makes it difficult to capture the development of decision-making strategies using in vivo recordings of neural activity. Given the advent of recording methods that can track large populations of single neurons across days, we aimed to establish an approach that could interrogate the neurobiology underlying the formation of complex decision-making strategies in a reasonable timeframe. To address this challenge, we validated an abridged protocol for the neuroeconomic foraging task, Restaurant Row. This task has been used to study processes underlying value-based decision-making across species and models of neuropsychiatric diseases. Notably, our protocol reduced the longitudinal training timeline in mice from over 70 days to under 10 days. On this task, mice have a limited time budget each day to forage for their primary source of food. Mice learned to navigate a square maze in one direction, encountering multiple competing offers for food rewards in serial order. Offers varied in cost (delays ranging from 1–30 s associated with tone pitch) and subjective value (four unique flavors located in spatially separated "restaurants"). Each restaurant contained a T-shaped "offer zone" where mice made initial accept vs. reject decisions based on cued offer costs that, if accepted, advanced to a cued countdown in a separate "wait zone." Here, rather than progressing through stages of training with costs escalating across weeks as done previously, mice were immediately exposed to the final stage of testing on day 1. We tested commonly used strains of mice (C57, CD1, and Swiss Webster) on different session lengths (30 vs. 60 min). We found that all mice were able to acquire the basic structure of the task, learning to increase laps run in the correct direction and total earnings within the first few days of testing. We also found mice learned to use auditory information in the offer zone to skip expensive (high-pitch) offers, a strategy that significantly emerged by day 10 only in C57 and Swiss

Webster mice (approximating performance observed by day 70 in our classic protocols). Our results demonstrate that mice are capable of making cost-informed choices on Restaurant Row within a 10-day timeline. These efforts support the feasibility of experiments aimed at characterizing activity of the same population of cells over a condensed period within which mice develop deliberative decision-making strategies.

P2.F.17 - The Prominent Deck B Phenomenon in the elderly - A study using clinical Iowa gambling task

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Details

Background: The Iowa Gambling Task (IGT) is a widely used neuropsychological test for assessing decision-making abilities. The clinical version of IGT (cIGT) has been specifically developed to evaluate decision-making deficits in older adults. However, whether older adults consistently perform worse than younger adults on the IGT remains a subject of debate. Studies conducted by the Iowa research team suggest that older adults exhibit significantly poorer performance than younger adults. In contrast, MacPherson et al. using the IGT, found no significant performance differences between the two groups. Furthermore, Tsai largely supported MacPherson et al.'s findings through a two-phase validation of the original IGT. Notably, they identified the "Prominent Deck B (PDB) Phenomenon", wherein both older and younger adults exhibited a preference for Deck B due to a short-sighted decision-making pattern driven by gain-loss frequency (GLF) rather than expected value (EV).

Methods: This study aimed to examine whether older adults perform worse on the cIGT compared to younger adults. A total of 84 participants (42 older adults and 42 younger adults) completed the cIGT, and the Beck Depression Inventory-II (BDI-II).

Results: No significant differences were observed in overall cIGT performance between older and younger adults. Both groups exhibited the "Prominent Deck B Phenomenon". Behavioral analyses suggest that older adults adopt a more conservative decision-making strategy, whereas both groups exhibit a short-sighted decision-making pattern.

Conclusion: Our results indicate that older adults didn't perform worse on the cIGT than younger adults. Moreover, both groups were more influenced by GLF rather than EV, suggesting that decision-making behavior is primarily driven by immediate feedback. Notably, older adults demonstrated a more dispersed selection pattern, avoiding strong biases toward immediate rewards, which may indicate a more cautious decision-making style.

P2.F.18 - Social responsiveness buffers internalizing symptoms from social isolation

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Details

Objective: Social isolation is related to internalizing symptoms, but substantial individual differences exist in this relationship. Little is known about what leads to such variable susceptibility to the negative effects of social isolation. Previous studies showed that patients with depression were coupled with impaired social responsiveness—an ability to adapt flexible social behaviors according to the environment. Therefore, we propose that social responsiveness in an iterated economic exchange may be a candidate factor that modulates the relationship between social isolation and internalizing symptoms.

Methods: 57 participants completed well-established scales assessing social isolation (UCLA Loneliness Scale) and internalizing symptoms (Mood and Anxiety Symptom Questionnaire, Beck's Depression Inventory). Participants then played a 10-round iterative trust game as the investor, while an anonymous counterpart played as the trustee. In each round, participants invested a portion of an initial endowment in the trustee, which was then reciprocated by the trustee's repayment or not. We proposed a belief-learning model to capture social learning processes in the trust game, assuming participants learned the trustworthiness of others by updating the expectation of repayment. Social responsiveness was operationalized as the extent to which investments were associated with learned trustworthiness.

Results: Participants' investments were significantly predicted by trustee's last round repayments ($\beta = 0.29$, $SE = 0.06$, $t = 4.97$, $p < .001$), showing an adaptive social strategy in the trust game. Importantly, there was a significant interaction between social isolation and model-estimated social responsiveness in predicting both mood and anxiety symptoms ($\beta = -1.89$, $SE = 0.85$, $t = -2.21$, $p = .032$) and depression score ($\beta = -1.29$, $SE = 0.55$, $t = -2.35$, $p = .022$). Specifically, individual with higher social responsiveness were more resilient to social isolation and thus suffered fewer internalizing symptoms.

Conclusions: Our data showed that model-estimated social responsiveness attenuates the negative relationship between

social isolation and internalizing symptoms. This finding suggests a buffering role of social responsiveness against the negative effects of social isolation, contributing to potential interventions aimed at enhancing resilience in the face of social isolation.

P2.F.19 - Delayed source information determines biased retrospective valuation during observational learning

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Details

Social polarization fosters selective exposure and echo chambers, as individuals gravitate toward information that aligns with their preexisting views or ingroup perspectives. Although interventions to reduce biased exposure have been proposed, their effectiveness has been inconsistent. To address this gap, we need to understand how group membership shapes observational learning—learning by observing others' actions and their outcomes. Prior work shows that individuals trust ingroup sources more than outgroup sources. Yet it is unclear whether, upon learning a source's group identity, individuals simply ignore outgroup information or initially learn from all sources and then retrospectively adjust the value of outgroup-derived information. To examine this question, we recruited 124 participants spanning liberal, moderate, and conservative partisanship—populations known to be strongly influenced by group cues in the real world—into a novel observational learning paradigm. In this task, participants first predicted and observed a demonstrator's choice and outcome without knowing the demonstrator's group identity, which was predetermined as ingroup or outgroup based on a minimal group paradigm and revealed afterward. This delayed disclosure of group membership allowed us to rule out the possibility of reduced attention to outgroup members and instead test whether individuals re-evaluate previously acquired information based on group identity. Using computational modeling and formal model comparison, we found that participants increased the value of an option more when the demonstrator's choice aligned with their initial prediction and was rewarded, and decreased it more when the choice did not align and was not rewarded. These positive and negative valuation biases were further amplified for ingroup and outgroup demonstrators, respectively. Moreover, individual variability in this group bias was explained by political partisanship and mediated by gray matter volume in the amygdala, a brain region often linked to social categorization, such that conservatives with larger amygdala volumes showed a stronger influence of group identity on valuation. These findings reveal a computational mechanism by which group membership shapes learning from others, demonstrating that social identity can both enhance and diminish the integration of observed information. Together, our results highlight the importance of accounting for group-based biases when designing interventions aimed at promoting more balanced information processing in socially polarized environments.

P2.F.20 - Validity of affective computing in assessing emotion–decision links: Evidence from prosocial behavior

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Details

This study aimed to evaluate how affective computing (AC) measures of emotional state correspond with traditional emotion assessment methods—namely, facial electromyography (EMG) and self-report—in the context of decision-making, and to determine whether facial EMG electrodes affect the accuracy of AC-based emotion recognition, using donation decisions as an example where emotions play a crucial role.

Two groups of participants (N = 41 and N = 45) made monetary donations to support homeless pets after viewing 32 photographs of dogs designed to elicit various emotions. During image presentation, facial expressions were recorded using FaceReader (FR). For Group 1, facial EMG was also recorded from the corrugator supercilii and zygomaticus major muscles via 4-mm surface electrodes. After each image, participants could donate from a pre-received reward. Subsequently, participants rated their emotions using 9-point valence/arousal scales.

Donation amounts and self-reported (SR) valence and arousal were statistically equivalent across both groups (TOST, all p s < .05, all p s > .05 for difference tests), confirming comparable emotional and behavioral responses. In contrast, FR measures differed significantly between groups (all p s > .05 for TOST, most p s < .05 for difference tests), indicating that FR recognition may be sensitive to the presence of EMG recording equipment.

Across both groups, negative emotions were consistently linked to higher donations. Corrugator EMG strongly correlated with donations in both Group 1 ($r = .87$, $p < .001$) and Group 2 ($r = .87$, $p < .001$), and zygomaticus EMG showed negative correlations (Group 1: $r = -.56$, $p < .001$; Group 2: $r = -.46$, $p = .009$). SR valence also negatively correlated with donations in both groups ($r = -.84$ to $-.94$, all p s < .001). FR valence similarly showed negative correlations with donations

(Group 1: $r = -.58$; Group 2: $r = -.80$, both $p < .001$), but was weaker in Group 1, indicating reduced recognition accuracy. FR happiness negatively correlated with donations in both groups, with a stronger effect observed in Group 2 ($r = -.77$) compared to Group 1 ($r = -.56$), both $p < .001$. Notably, FR sadness predicted donations only in Group 2 ($r = .51$, $p = .003$), further supporting the disruptive effect of EMG electrodes.

These results demonstrate that affective computing yields emotion–decision correlations comparable to EMG and self-report when facial data is unobstructed. However, the presence of EMG electrodes significantly reduces AC performance, a critical consideration for multimodal emotion research.

P2.F.43 - Individuals prefer repairable relationships and trust perception impacts decision to repair

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Details

Objective: When a relationship appears to decline, individuals often face the decision to leave the relationship or repair it. Those having clinical conditions involving interpersonal hypersensitivity or paranoia often leave a benign relationship prematurely, not repairing relationship ruptures, which are often associated with felt loneliness. We designed a novel social decision-making task where participants chose to leave or repair relationships that were perceived to decline. We examined how participants' tendency to trust others may be associated with this decision.

Methods: Participants ($N=28$; $M = 52.61$, $SD = 19.14$) completed a novel social decision-making task either online from home or in-lab. Participants were told that the goal was to accrue as many credits as possible. During the task, participants were matched with a series of computerized partners. Each partner, for a maximum of 30 trials, shared a proportion of credits with the participants. The shared proportion (but not the absolute amount) followed a decay rate, so the more trials the participant stayed with the partner, the lower the proportion received. In each trial, the participant had the option to "leave" this partner and wait for 8s to be matched with a new partner. There was a 50% chance that the participant was matched with a partner who also presented a "give" option at each trial, in addition to the "leave" option. By choosing "give," the participant could share credits with the partner to potentially increase the proportion received in a few subsequent trials. This task consisted of five blocks of nine minutes each. Besides this task, participants also completed an in-lab trust task where they rated the perceived trustworthiness of 64 photos. Participants' mean trust ratings were used to quantify their trusting tendencies.

Results: Participants stayed for more trials with partners who presented a "give" option than those who only allowed leaving ($p < .001$). With partners who only presented the "leave" option, participants stayed for longer with partners whose sharing proportion declined slower ($p < .001$). With partners who presented the "give" option, participants' stay time was predicted by both the sharing decay rate and their trusting tendencies: Only the more trusting (+1 SD) participants stayed for longer with partners with a slower share-decay rate. When presented with the "give" option, participants also showed a tendency to stay longer with partners who became more generous after the participant chose to give ($p=.054$).

Conclusions: This study provides preliminary evidence on how individual differences, such as tendencies to trust, may affect interpersonal decision-making and social wellbeing.

P2.F.44 - Own-age bias in trust perception of older adults

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Details

Study's objective: The goal of this project is to determine the extent to which older adults show an own-age bias in trustworthiness judgments and behavior. Understanding who older adults trust is important because older adults have increased susceptibility to financial scams and, recent evidence suggests that susceptibility to financial fraud may be further exacerbated by age-related disorders such as Alzheimer's disease, with early victimization predicting later diagnosis.

Methods used: First, we compared older adults' ($N = 71$; ages 65-83) ratings of trustworthiness of young ($N = 6$), middle-aged ($N = 6$), and older ($N = 6$) adult faces. We hypothesized that if older adults show an own-age bias in trustworthiness judgments, they will rate the older adult faces as being more trustworthy compared to young adult and middle-aged adult faces. Second, using an economic trust game, we compared trust behavior—that is, the amount shared with the same young, middle-aged, and older adult partners. If older adults show an own-age bias, we hypothesize

that older adults will share more money with older, compared to younger and middle-aged, adult partners.

Results obtained: We ran two linear models to determine whether trustworthiness ratings and sharing amounts differ depending on the age group of the model. As predicted, the linear analysis of trustworthiness judgements revealed statistically significant differences in how participants rated older and middle-aged adults ($B = -0.44$, $p < .001$), and older and young adults ($B = -0.64$, $p < .001$). Similarly, the linear analysis for economic trust game offers produced statistically significant results with the older and middle-aged adults ($B = -0.45$, $p = 0.032$), but not for the older and younger adults, $p > .05$.

Conclusions: These findings support the idea that older adults likely have an own-age bias when both making trust judgments and acting on those judgments. Collectively, these results suggest that older adults may be more likely to fall victim to fraudulent scams that are perpetuated by their peers.

P2.F.52 - Association of social information use with transdiagnostic symptom dimensions

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Details

Objectives: Humans use social information to guide their individual decisions to improve decision accuracy and reduce potential risk. Aberrant social information use has been identified as a characteristic of many mental health disorders. However, given the inherently complex and overlapping symptomatology of mental disorders, the specific symptom dimensions underlying the altered use of social information remain poorly understood.

Methods: In an online experiment, we recruited 294 participants from the general population in the U.S. They completed the BEAST (Berlin Estimate Adjustment Task), a simple and incentive-compatible task to measure individuals' tendency to utilize social information, and subsequently completed a set of psychiatric questionnaires. We employed factor analyses to identify transdiagnostic symptom dimensions and conducted a linear regression model to investigate their associations with social information use.

Results: People placed less weight on social information compared to their own estimates ($t(293) = -9.25$, $p < 0.001$), consistent with previous findings. Factor analysis of the psychiatric questionnaires revealed three underlying transdiagnostic dimensions: 'Social Anxiety-Social Fear', 'Depression-Anxiety', 'Borderline-Paranoid'. Moreover, we found the transdiagnostic dimension of psychiatric symptoms related to Depression-Anxiety showed a negative association with the extent of social information use ($b = -0.246$, $t(282) = -3.538$, $p < 0.001$), while the loadings on the Borderline-Paranoid dimension was positively associated with the degree of social information use ($b = 0.143$, $t(282) = 2.327$, $p = 0.021$).

Conclusions: Our results support the role of social information use as a transdiagnostic feature spanning multiple psychiatric disorders. Furthermore, these findings emphasize the strength of transdiagnostic approaches in revealing aberrant social information processing beyond what is captured by categorical diagnoses.

P2.G.21 - Degradation in structural connectivity reflects memory retrieval and decision-making performance across aging

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Details

As the global population ages, it is increasingly important to understand how healthy aging affects memory and decision-making, which are key for maintaining quality of life in older adulthood. In this study, 82 adults aged 25–80 completed a consumer-choice task that varied in memory and task demand. Participants chose between pairs of similarly rated consumer goods, with product ratings displayed either simultaneously (no-memory decision) or sequentially with a delay (memory decision). Each product's rating was shown using one or two rows of stars on a five-star scale. Behavioral results showed age-related decline in memory-dependent decision trials, such that older adults chose more suboptimal products when they maintained product information for a delay before making a choice. In a simultaneous choice condition that did not require memory, older adults were disproportionately affected by increased demand (two-rows of ratings), suggesting that increased perceptual processing demands also contributed to age-related suboptimal decisions. Diffusion tensor imaging was used to construct individual structural connectomes based on the average fractional anisotropy along streamlines connecting gray matter regions. The task demand-related reduction in decision quality in the no-memory simultaneous choice condition was correlated with connectivity between prefrontal regions (ventromedial and dorsolateral cortex), medial temporal lobe (MTL), inferior frontal gyrus, orbital gyrus, and inferior parietal lobe while

controlling for age ($N = 82$; $\beta = -0.287$, $z = -2.031$, $p = 0.042$). In contrast to the no-memory condition, which applied to all age groups, the relationships between brain structure and memory-related task performance were strongest in older adults. In older participants ($N = 33$, ages 60-80), there was a significant interaction between age and the integrity of MTL to early visual cortex (EVC) connections on memory-related reduction in choice quality ($\beta = 0.457$, $z = 2.430$, $p = 0.015$). This suggests that MTL-EVC degradation may hinder integration of perceptual information into the memory network for older adults. These findings point to a potential age-related vulnerability in neural networks supporting perception, value integration, and executive control, even absent memory demands. Together, these results highlight that memory and decision-making are not isolated processes but dynamically interact through shared and distinct neural systems. By identifying specific structural pathways that both support memory-related decision making and are vulnerable to age-related disconnection, this study provides a potential target for early detection and intervention.

P2.G.22 - Distinct food attribute representations emerge across binge-type eating disorders

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Details

Objective: Eating disorder pathology is characterized by alterations in value representations, with individuals exhibiting abnormal reward processing for food versus non-food stimuli and disrupted choice patterns that maintain compulsive eating behaviors. Although bulimia nervosa (BN) and binge-eating disorder (BED) are the most common eating disorders, how individuals with these binge-type eating disorders mentally organize nutritional attributes remains underexplored. We examined how individuals with BN and BED rate foods based on health and taste domains along four objective nutritional properties: fat content, calories, protein, and carbohydrates. We hypothesized that individuals with eating disorders would show disrupted alignment between their mental organization and objective nutritional classifications.

Methods: 70 healthy controls (HC), 34 with BN, and 19 individuals with BED rated 76 food items on perceived healthiness from unhealthy to healthy and tastiness from bad to good. Using computational modeling, we constructed mental representations for each diagnostic group and food attribute by clustering foods based on associations derived from correlations in their ratings. We then compared these data-driven clusters to objective nutritional groupings using techniques that assess clustering adequacy.

Results: Clustering consistency analyses revealed that HC showed a strong alignment between their mental organization of foods and the foods' actual nutritional properties, with their clusters closely matching objective classifications, indicating a prioritization of nutritional content as the primary grouping principle. In contrast, the mental representation of individuals with BED exhibited disrupted organizational patterns with minimal consistency with nutritional information, particularly when evaluating tastiness. Those with BN showed intermediate patterns between HC and BED groups. These differences were most prominent for fat and calorie classifications, with protein and carbohydrate categories showing similar but less marked effects across groups.

Conclusions: These findings suggest that healthy individuals mentally organize foods based on objective nutritional properties, whereas individuals with eating disorders—particularly BED—show disrupted clustering based on nutritional content. This divergence may reduce their sensitivity to the subtle differences in foods, potentially perpetuating maladaptive eating behaviors. These results highlight a novel mechanism underlying abnormal reward processing in eating disorders, and targeting these representational distortions could improve intervention strategies for treatment-resistant symptoms.

P2.G.36 - How do people maintain false beliefs? Modeling anchoring biases during learning and inference

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Details

People sometimes maintain false beliefs despite contradictory evidence, explaining it away by integrating it into complex frameworks that protect their core assumptions. We refer to this process as explanatory anchoring bias. Unlike confirmation bias or standard belief-updating models, this mechanism involves modifying auxiliary beliefs, rather than selectively regulating attention to evidence supporting the false belief. An explanatory anchoring bias better reflects real-life naturalistic conditions, where multiple, interrelated information sources shape belief formation, and may better account for clinical observations, such as the persistence of false beliefs in delusions.

Here, we developed a new task and computational model to capture this bias. Agents learn the value of three stimuli at the same time in a four-phase task. Phase 1 introduces a potentially false assumption through a single unambiguous piece of evidence about one stimulus, by drawing from a distributional extreme. Phase 2 involves inference about

individual stimulus values by providing ambiguous summed stimulus information (total value of all stimuli), which can drive the formation of internally consistent beliefs. Phase 3 presents disambiguating evidence about individual stimuli which could correct the false initial assumptions if integrated with previous knowledge. Phase 4 returns to the ambiguous sum trials (as in Phase 2) to assess the persistence of initial assumptions.

Computational modeling revealed qualitatively distinct behaviors between Bayesian and reinforcement learning (RL)-inspired agents. Critically, Bayesian agents quickly corrected biased estimates after receiving disambiguating evidence, while RL agents showed delayed correction and a higher error, consistent with higher explanatory anchoring bias.

We are currently piloting a version of this task to test whether people update beliefs more like Bayesian or RL agents, and to explore individual differences in these mechanisms.

This approach offers a new computational framework for studying belief persistence, especially in clinical contexts where false beliefs are maladaptively maintained. Understanding explanatory anchoring bias may inform targeted interventions for persistent dysfunctional beliefs.

P2.G.45 - How we learn what to believe and who to trust: Understanding joint updating using Bayesian inference

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Details

In everyday life, people update their beliefs to navigate a changing world, like forming opinions on a new policy. While research has shed light on how humans update beliefs about decision-relevant quantities (value, location) in simplified tasks, it is unclear whether the same mechanisms apply to real-world topics, where beliefs are often strong and supported by overarching belief systems that filter relevant information. For example, we often revise beliefs about current events based on news sources. This requires not only forming and updating opinions (Is this policy good?) but also judging the credibility of information sources (Can I trust this outlet?). Thus, people must simultaneously update beliefs about both the topic at hand and the source itself. Here, we investigate the cognitive and computational mechanisms that support complex real-world belief-updating. To do so, we developed a model that jointly updates beliefs about a topic and its source using Bayesian inference. Simulations yielded a key prediction: when a source provides information aligning with prior beliefs, its perceived credibility increases, regardless of its true reliability. This heightened credibility, in turn, amplifies belief-updating from that source. We tested these two core predictions in human data: (H1) people will judge sources as more credible when information aligns with their prior beliefs, and (H2) this increased perceived credibility will amplify belief updating. We tested this in a novel 'news-based inference' task, tracking participants' (N=180) changing beliefs about real-world topics and source credibility. We manipulated source reliability (high: 10% misinformation vs. low: 50%) and alignment (information aligned with participants' views 75%, 50%, or 25% of the time) in a between-subjects design. Preliminary results supported H1 in high-credibility conditions: participants rated sources as more credible when information aligned with their beliefs, akin to a confirmation bias. In low-credibility conditions, we observed a U-shaped pattern: sources with moderate alignment (50%) were rated as more credible than those with high or low alignment. This may reflect a strategy where moderate agreement signals balanced reporting when the source shows obvious signs of low credibility. Moreover, supporting H2, across both conditions, higher perceived credibility boosted stronger belief shifts. Together, our results suggest that humans update beliefs by integrating both content and source trustworthiness—they lean into confirmation bias when sources seem credible and show adaptive skepticism when they do not. This potentially highlights a nuanced mechanism for real-world belief-updating.

P2.G.46 - Neural mechanisms of diminished loss aversion in presymptomatic gene carriers for frontotemporal dementia

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Details

Frontotemporal dementia (FTD) is the most common neurodegenerative cause of dementia before age 60 and is marked by impaired decision making, with disastrous consequences for patients and families. 20-30% of FTD is caused by autosomal dominant mutations. In gene carriers, neuroanatomic and fluid biomarker changes are detectable a decade or more prior to disease onset, though measurable neuropsychological changes generally do not precede symptomatic disease.

In prior neuroeconomic research, symptomatic FTD is marked by diminished loss aversion and FTD targets frontal/limbic circuits central to the evaluation of outcomes. We hypothesized that diminished loss aversion would be an early marker of impairment in presymptomatic gene carriers, and that this would be reflected also in diminished neural loss aversion,

a neurocomputational correlate of loss aversion behavior.

31 mutation carriers and 24 noncarriers performed a Loss Aversion task inside the scanner. Participants chose to accept or reject 102 potential mixed gambles with equal probabilities of winning or losing varying quantities of money. Each subject's behavioral loss aversion was characterized using logistic regression and calculated as $\lambda = -\beta_{\text{loss}}/\beta_{\text{gain}}$. In a functional MRI analysis, we identified regions in which neural activity both increased with anticipated gains and decreased with losses, using the conjunction of statistical maps from two regressors modeling parametric modulations of task activity by the size of the potential gain and potential loss in each trial. Across this group map of value-responsive brain regions each participant's neural loss aversion was calculated as the (negative) slope of the loss response minus the slope of the gain response. Linear regression models were used to assess the influence of gene mutation on λ and neural loss aversion; the association between these two parameters was assessed with Kendall's rank correlation.

Regions in bilateral anterior insula, dorsal striatum and dorsomedial prefrontal cortex were modulated by both gains and losses, consistent with earlier studies in healthy subjects. Mutation carriers had significantly lower loss aversion (mean $\lambda = 1.29$ and 1.83 , $p = 0.027$) and lower neural loss aversion, but this result was not statistically significant (mean 0.01 and 0.037 , $p = 0.13$). There was a significant association between λ and neural loss aversion for the whole group ($\tau = 0.339$, $p < 0.001$) and for noncarriers ($\tau = 0.352$, $p = 0.026$). For mutation carriers alone the association was not significant ($\tau = 0.235$, $p = 0.069$).

Alterations in neuroeconomic measures of decision-making may be presymptomatic indicators of early neural change in genetic FTD.

P2.G.51 - Developmental changes in functional connectivity and its association with mental health and cognition

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Details

Objective: Functional brain connectomes are linked to cognition and mental health in adults. Fewer studies explore these associations longitudinally in children. Here, we test how brain connectivity changes across time, predicts mental health and cognition, and how brain connectivity-outcome associations change across development.

Methods: We ran nested cross-validated partial least squares (PLS) models to predict mental health and cognition using functional connectivity (FC) in the ABCD cohort at the baseline (age 9-10y), 2-years-, and 4-years-follow-up waves. We created cognitive and mental health outcome measures from 5 cognitive tasks and, separately, 15 scales of parent-rated child behavior checklist and youth-rated brief problem monitoring questionnaires via a principal component (PC) analysis. Each outcome (3 mental health PCs and 1 cognitive PC) was predicted separately using the FC features and sex as predictors. When comparing across waves, we always restrict the sample to participants that were measured at both time points. We also tested if the covariance structure among 338 cortical-cortical and cortical-subcortical FC features and the segregation index of each cortical network significantly changed along the 2-year intervals.

Results: Concurrent FC patterns explained significant variability in children's mental health (1-8%) and cognitive ability (7-10%) at all three waves. However, the covariance space of these FC patterns changed significantly as children developed across assessment waves. In addition, models trained on data at a given longitudinal wave showed mixed accuracy patterns for future or past waves. E.g., both cognition and a mental health outcome measure representing the degree of internalizing versus externalizing behaviors were predicted better when using wave 1 weights to predict wave 3 scores, but worse using wave 3 weights to predict wave 1 scores. Interestingly, cognition was predicted less accurately in both the past and future waves when using models trained on wave 2 data. Several FC edges' association strengths with cognition or mental health significantly changed across waves, including the cingulo-opercular network, the sensorimotor network and cortico-subcortical connections. The segregation indexes for these networks also changed between waves (e.g., cingulo-opercular increased, sensorimotor network decreased). **Conclusion:** We demonstrate age-related variation in FC signatures and their predictive importance during childhood/adolescence for mental health and cognition, with important implications for understanding brain development and applying brain-based predictive models at different developmental stages.

P2.H.23 - Dopamine influences risk preference through learning, not utility curvature

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Details

Objective: Risk preference can emerge from distinct cognitive mechanisms depending on the nature of outcome uncertainty. We aimed to dissociate utility-based and learning-based influences on risky decision-making and identify which mechanism mediates dopamine's effect on risk preference

Methods and Results: We designed two parallel tasks where mice chose between a risky (lottery) and a certain (surebet) option on each trial. In the cued task, lottery offers are explicitly signalled, reflecting stationary stochasticity ($n = 10$); while in the uncued task, lottery offers are unsignaled and change in blocks, introducing volatility ($n = 12$). Using Cohen's partial pseudo- R^2 to quantify the relative contribution of different factors, we found that the current trial's offer ($\Delta EV = EV_{\text{lottery}} - EV_{\text{surebet}}$) drove choices more in the cued task (cued: 0.94, uncued: 0.77, $t(15.5) = 4.19$, $p = 0.0007$), while the previous trial's outcome (win/lose the lottery) dominated in the uncued task (cued: 0.09, uncued: 0.65, $t(14.8) = -7.81$, $p < 1e-5$), with strong win-stay/lose-switch effects. This suggests in stationary stochastic environments like the cued task, utility curvature is more important for guiding choice, whereas in volatile environments like the uncued task, learning from recent outcomes also affects choice.

Pharmacological manipulation with the dopamine D2/3R agonist pramipexole (PPX) selectively increased lottery choices in the uncued task by asymmetrically reducing outcome sensitivity (a large decrease in lose-switch), but minimally affected the cued task ($\Delta \text{outcome-effect}$: cued = 0.04 ± 0.05 SE, $n = 8$; uncued = -0.28 ± 0.06 SE, $n = 6$). These results suggest that dopamine modulates risk preference through value learning, rather than utility-based evaluation. Surprisingly, dopamine release in the nucleus accumbens, measured via dLight1 fiber photometry, tracked reward outcomes in mice doing either task (cued: $n = 2$, uncued: $n = 1$, ongoing data collection). This implies that in the cued task, while prediction error signals are intact, their influence on behavior is gated. Ongoing work using optogenetic manipulations, neural recordings, and computational models integrating reinforcement learning and expected utility theory aims to mechanistically explain how learning can be behaviorally decoupled from dopamine signals.

Conclusions: Together, these findings outline distinct cognitive and neural mechanisms underlying risky decision-making and better characterize the contribution of dopamine. This may help with developing differential diagnoses for maladaptive risk-related behaviors like pathological gambling.

P2.H.24 - Latent saliency of feature combinations modulates reinforcement learning strategies in multi-feature environments

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Details

When learning the value of novel items, people often generalize from the values of their constituent features, allowing rapid estimates without exhaustive sampling. As observed in visual attention driven by bottom-up perceptual processes, items composed exclusively of highly salient features—those at the extremes of the value spectrum—may attract disproportionately more attention than others. Previous studies, however, largely assumed that feature- and item-level values are independent, and that learners tend to be biased toward tracking each item's value, unless under limited cognitive resources, both because task demands often require precise item-level estimates and because feature information is typically only weakly informative. Here, we examined whether and how the saliency of an item's features influences item-level value learning, testing a potential nonlinear interplay between feature- and item-level information. We used a novel probabilistic reward learning task in which 135 participants (62 females; age=18-39) were asked to learn the reward contingencies of nine items, each composed of two identifiable feature types (3 animals X 3 colors), with only one feature type being, on average, predictive of reward. Feature sets were personalized using two brief choice tasks, one for each feature dimension, to identify each participant's most, moderately, and least preferred features. We hypothesized that items composed solely of the most or least preferred feature pairs would become subjectively salient and be tracked more sensitively than other, non-salient items. To quantify the impact of item saliency on individuals' reliance on feature- versus item-based learning in valuation, we constructed a reinforcement learning model in which feature- and item-based learning were implemented as complementary, coexisting strategies. Model-based analysis revealed that participants generally relied more on item-based learning than on feature-based learning (salient: $t(134)=8.55$, $p<0.001$; non-salient: $t(134)=6.56$, $p<0.001$). Crucially, reliance on feature-based learning was significantly lower for salient items than for non-salient items ($t(134)=4.37$, $p<0.001$). These findings suggest that when a feature combination is particularly salient, individuals are more likely to treat it as a unified item, thus becoming less likely

to rely on its constituent features during learning. Overall, our results provide novel evidence that the latent saliency of feature combinations modulates the balance between feature- and item-based learning, highlighting the role of pre-existing preferences in shaping reinforcement learning strategies in multi-dimensional environments.

P2.H.25 - Context-appropriate guidance of valuation by episodic temporal recency

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Details

Objective: The subjective value of delayed or temporally extended outcomes can be guided in a context-dependent manner by estimates of temporal recency. For instance, the predicted value of a perishable good, such as milk, can decrease as a function of time since it was stored. For other goods, value could increase with time (e.g., pickles) or follow a non-monotonic function (e.g., avocados). Mechanistically, the medial temporal lobe has been implicated in tracking recency and is thought to interact with cortical valuation systems to support memory-guided decisions. Here, we present a behavioral test of people's ability to acquire and generalize context-appropriate patterns of recency-dependent value.

Methods: Participants encountered a series of boxes tagged by visually unique items in intermixed "encounter" and "decision" trials. In decision trials, participants chose whether to open a box they previously encountered at a lag of 4–20 items ago. An "accept" decision yielded a lag-dependent reward, whereas a "reject" decision yielded a fixed baseline reward.

Hypotheses, exclusion criteria, and sample size were pre-registered. Each participant was randomly assigned to one of three conditions (n=50 per condition) in which the function that mapped lag to value was rising, falling, or non-monotonic. We fit participant-specific logistic regression models to accept/reject decisions as a function of the condition-specific ground-truth expected reward value of the item presented on each decision trial.

Results: Positive regression coefficients indicated that participants successfully calibrated to each of the three environments. Wilcoxon signed-rank tests showed that coefficients for ground-truth expected reward were greater than zero in the rising-value condition (mean=1.95, SD=.93, W=1271, p<.001), the falling-value condition (mean=2.04, SD=.98, W=1266, p<.001) and the non-monotonic condition (mean=.33, SD=.61, W=978, p<.001). Performance was significantly lower in the non-monotonic condition than in the other two conditions (Mann-Whitney U=2269, 2253; p<.001), which did not differ from one another (U=1167, p=.570).

Conclusions: Our results demonstrate that humans can use adaptive temporal inference to evaluate novel prospects. The paradigm offers a foundation for investigating putative roles of MTL and cortical brain systems in flexibly navigating contexts in which temporal information carries information relevant to valuation. Comparatively less successful performance in the non-monotonic condition raises follow-up questions as to whether performance was constrained by stubborn monotonic priors or by limited resolution of temporal representations.

P2.H.26 - Discretization: Theory and experiment

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Details

We introduce an ex-ante model of discretization where the decision maker partitions the state space into discrete categories given their prior subjective belief, the stakes, and the cost of accruing information. Our theory endogenizes how finely decision makers partition the state space, including the frequency of each category and associated decision rules. In a motivating example, we characterize the optimal partition under a uniform prior with cost of accruing information as Shannon entropy. This characterization allows us to test several key hypotheses of the theory with a set of experiments. In the first study, subjects explicitly choose the number of categories given varying levels of stakes and costs. In the second study, subjects reveal how many categories they implement through a perceptual matching task. Across both studies, we find evidence that we can classify subjects as discretizers, questioning whether the classical approach is a good approximation of behavior.

P2.I. 27 - A supply and demand approach to information processing in decision-making

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Details

Value-based decisions are driven by subjective estimates of value for each available option, but recent work has shown that subjective feelings of certainty about those value estimates also influence choice behavior. Cognitive and computational theories have proposed that decision-makers process information about choice options in order to reduce their uncertainty about their value estimates before choosing an option. One theory specifically proposes that value estimates are refined during deliberation, which results in more certain – and sometimes revised – value estimates after the choice relative to before. Here we examine the idea that choice options hold different levels of familiarity for decision-makers, and that familiarity can influence the degree to which certainty gain or value revision occurs. Our working hypothesis is that not only will people have a greater desire to increase their certainty when they are more unsure about option values to begin with, but they will also have a greater ability to increase their certainty when they are more familiar with the choice options. We examined data from a previously-published study ($n = 41$) – along with an unpublished dataset from that same study – in which participants rated value and certainty about snack foods both before and after choosing their preferred options from pairs. Our analyses were based on mixed effects regressions. Our results show that both certainty gain and value revision are decreasing functions of initial certainty – which we classify as a demand effect – and increasing functions of familiarity – which we classify as a supply effect. Together, these results provide support for our supply and demand approach to the processing of information during decision-making. This offers a proof of concept to guide future research and in particular computational models for optimal attention and value updating during decisions.

P2.I. 28 - Subliminal face attractiveness is processed in anterior ventral striatum and ventromedial prefrontal cortex

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Details

Studies have shown that the subjective values (SVs) of consciously perceived objects are automatically computed in the anterior ventral striatum (aVS) and ventromedial prefrontal cortex (vmPFC) without need for explicit evaluation. Here we examined whether SVs are computed automatically without conscious awareness. In an fMRI experiment, participants ($n=29$) performed a delayed match-to-sample task, reporting face identity (match or non-match) and their perceptual awareness of the face (no experience or vague-to-clear experience). There were three presentation conditions: a face suppressed from awareness with continuous flash suppression (CFS) ($n=144$), a clearly visible face without suppression ($n=72$), or no face behind the CFS (baseline) ($n=45$). After scanning, participants rated the attractiveness for each of the twelve faces on a scale from 1–10 as a measure of SVs. Behaviorally, when faces were seen, task performance (d') exceeded chance ($p<.001$, one-tailed) and reaction times were faster than baseline ($p=.003$, two-tailed). When faces were reported as unseen, performance did not exceed chance ($p=.180$, one-tailed), but reaction times were slower than baseline ($p<.015$, two-tailed), suggesting a subliminal memory trace. Neurally, both seen ($p<.001$, one-tailed) and unseen ($p=.045$, one-tailed) faces elicited increased BOLD signal in the fusiform face area (FFA) relative to baseline. Critically, there was a positive linear relationship between subjective attractiveness ratings and BOLD signal in both aVS ($p=.0045$, one-tailed) and vmPFC ($p=.018$, one-tailed) for unseen faces. For seen faces, a similar relationship was found in vmPFC ($p=.016$, one-tailed) but not in aVS ($p=.288$, one-tailed). Moreover, mean BOLD signal change in FFA positively correlated with parametric estimates in aVS ($r=.43$, $p=.011$, one-tailed) and vmPFC ($r=.57$, $p=.001$, one-tailed) for unseen faces, linking stronger subliminal face processing in FFA to stronger SV processing in aVS and vmPFC. Implicit SV processing for seen faces was weaker than anticipated, possibly due to task-related signals confounding the value-related signals. In conclusion, we demonstrate that SVs can be computed automatically in aVS and vmPFC without conscious awareness, suggesting a mechanism through which subliminal information can influence our value-based preferences, with implications for theories of consciousness.

P2.I. 29 - A mathematical model of lab bubble-related asset-buying: Successfully playing a dividend hot-potato game boosted earnings

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Details

Objective: Excessive demand is defined as demand that promotes disequilibria in asset or goods markets and drives prices above fundamental values (e.g., an asset-price bubble [Haracz, 2022]). Neuroimaging studies are elucidating the neuroeconomics of asset-price bubbles. In a lab asset-market study, a market-level excessive demand measure, calculated from summed subject-level desired share holdings, outperformed other demand proxies in explaining asset-price changes (Haracz, 2024). This result yields the question of what motivates subjects' desired share holdings. The present lab asset-market study answers this question.

Methods: In a classic lab asset-market design, 9 experiments each included 9 subjects. Experiments included 15 2.5-minute periods of trading an asset with a dividend-based fundamental value that declined across periods. To capture desired holdings, the end of each Period 1-14 was followed by a survey that elicited each subject's number of asset shares that they want to hold at the end of the next period.

Results: Potential motivating factors for holding shares were analyzed with a regression equation of the form $DS_{i,t+1} - S_{i,t}$ (i.e., subject i 's desired change in share holdings, calculated as the desired number of shares in upcoming Period $t+1$ minus the number of shares held in the current Period t) = $b_0 + b_1(\text{Variable 1}) + b_2(\text{Variable 2}) \dots + b_7(\text{Variable 7})$, where $b_x > 0$ is the coefficient for a potential explanatory variable x : Variable 1 (price trend [i.e., momentum]) = $(avePt-1 - avePt-2)/avePt-2$; Variable 2 (asset price deviation from fundamental value) = $(avePt-1 - FVt)/FVt$; Variable 3 (number of shares held) = $S_{i,t}$; Variable 4 (prior period's excess bids) = $B_{i,t-1} - O_{i,t-1}$; Variable 5 (forecasted price trend) = $(FavePi,t - avePt-1)/avePt-1$; Variable 6 (change in holdings) = $S_{i,t} - S_{i,t-1}$; Variable 7 (purchasing power given last period's average price) = $C_{i,t}/avePt-1$; where FVt is each share's dividend-based fundamental value in Period t , $FavePi,t$ is subject i 's survey-elicited forecast of the average price for Period t , and $C_{i,t}$ is subject i 's amount of cash in Period t . This model explained 27.4% of the variance in subjects' desired change in share holdings. A model with $S_{i,t}$ as the only variable explained 21.0% of this variance.

Conclusions: Subjects' number of shares held was best able to explain the desired change in holdings for the next period. This explanatory variable's negative sign means that subjects tended to hold dividend-yielding shares for a limited time before selling. Subjects ending up without shares earned more than those left with shares ($p = 0.0035$), suggesting a winning strategy of playing dividend hot potato.

P2.I. 30 - A reframed view of human model-free learning emphasizing automatic,implicit, outcome-irrelevant processes

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Details

Objective: Human learners must solve the credit assignment problem by identifying which aspects of their behavior are responsible for a given outcome. Under conditions with clear instructions and structured environments, studies have shown that people can rely on internal cognitive models to guide learning, casting doubt on the relevance of model-free, trial-and-error learning in humans (Monsell, 2017). Some have even argued that model-free processes may not operate in humans when sufficient prior knowledge is available (Feher da Silva & Hare, 2020, 2023). Here, we challenge that view and provide evidence that model-free learning is robust, automatic, outcome-irrelevant, and implicit.

Methods & Results: We present data from four studies showing that humans cannot fully inhibit credit assignment to action features that are explicitly known to be irrelevant for predicting outcomes. In Study 1 ($N=178$), participants completed a multi-armed bandit task choosing between card pairs (e.g., A vs. B or C vs. D), with card positions randomized on each trial. Despite clear instructions about the irrelevance of spatial location, participants were more likely to repeat the same side after a rewarded trial (51%) than after an unrewarded one (45%; posterior median = .23, HDI95% [.12, .34]; probability of direction $\approx 100\%$).

Study 2 ($N=504$) replicated this effect using narrative-based instructions and extended training across three sessions. Reanalysis of data from Feher da Silva et al. (2023) revealed similar outcome-irrelevant effects that had not been previously reported.

In Study 3 ($N=186$), we introduced a dual-task paradigm that varied working memory load across trials. Computational modeling showed that higher cognitive load led to increased outcome-irrelevant learning.

Study 4 (N=198) examined individual differences and found that outcome-irrelevant learning was negatively correlated with working memory capacity, but unrelated to self-reported motivation, and occurred without explicit awareness.

Conclusions: Model-free outcome-irrelevant learning persists even when instructions are explicit, experience is extensive, and motivation is high. This tendency increases under cognitive load and is linked to limited working memory capacity, suggesting constraints on humans' ability to suppress irrelevant learning processes. Simulations further show that while suboptimal in stable environments, this form of learning may promote faster adaptation in dynamic contexts. Our findings suggest that model-free learning is a deeply ingrained mechanism that may serve adaptive purposes under uncertainty.

P2.1.47 - Image size affects valuation in food and risky choice

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Details

Background: Throughout human evolution, environmental visual cues have influenced how humans perceive value, such as the color of a fruit indicating ripeness. In our modern world, physical properties are often independent of value. For example, the size of a food item in an advertisement does not necessarily reflect the amount of food. However, recent research suggests that image size affects visual memory with larger images better remembered during naturalistic encoding (Masarwa et al., 2022). Here we hypothesized that image size also affects perceived value and tested this in behavioral experiments in two domains: food and risky choice.

Methods: In Experiment 1, 27 healthy adult participants passively viewed AI-generated food images displayed in one of two sizes, small or large. Subsequently, the same images were shown again, along with new images, all presented in medium size. Participants were asked to indicate whether they saw the image before, and to provide an estimate for their willingness-to-pay (WTP) for the item, along with their confidence in the estimate. In Experiment 2, 26 participants completed a risky decision-making task, in which they chose between a safe option with a guaranteed reward and a risky option with a probabilistic reward and the same expected value. Probability information was conveyed in both numerical and graphic form with reward amounts displayed numerically. Stimulus size was manipulated in three conditions: both options presented at the same size, the risky option larger, or the safe option larger. Image content was fully counterbalanced across size condition.

Results: In Experiment 1, participants remembered larger images ($66 \pm 3\%$ SEM) better than smaller images ($55 \pm 3\%$; $p = .001$). Participants were also willing to pay more for images first viewed as large ($\$2.02 \pm .15$) compared to those viewed as small ($\$1.95 \pm .15$; $p = .07$). Interestingly, confidence in WTP was higher for small ($80.93 \pm 3\%$) compared to large ($76.42 \pm 3\%$) images ($p = .0002$). In Experiment 2, participants chose the risky option more frequently when presented as the larger stimulus ($20.1\% \pm 4\%$) compared to when it was presented as the smaller stimulus ($17.2 \pm 4\%$; $p = .008$).

Conclusion: Our preliminary findings demonstrate how task irrelevant visual features, image size on the screen, affects valuation and memory. If replicated, this finding has practical implications for visual paradigms in neuroscience, where the manner of stimulus presentation may bias valuation.

P2.1.48 - Communicating the economic impact of NIH funding cuts changes attitudes and motivates action

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Details

Background: In the U.S., current and proposed cuts to federal science funding will have negative consequences for research, healthcare, and local economies. Drawing on theories from behavioral science and neuroeconomics, we tested hypotheses about optimal ways to communicate the estimated impacts of funding cuts to aid policy-relevant decision making.

Methods: In two preregistered online experiments (Study 1: N=2893, Study 2: N=2449), we tested theory-driven interventions that communicated economic losses associated with NIH funding cuts. We recruited representative samples of U.S. adults, balanced by political ideology, age, and gender. Interventions were compared with a Control condition, in which participants read unrelated text.

Objective: We aimed to test whether text, quiz, and map-based interventions influenced approval, knowledge, and perceived impact of funding cuts, as well as intentions to take action to oppose the cuts by contacting congressional representatives, speaking to others, and sharing information. We selected and compared these interventions to test

predictions about the role of active engagement, prediction error, and self-relevance in attitude change and decision making.

Results: In both studies, the interventions decreased approval of funding cuts ($d=0.22-0.33$), increased self-reported knowledge ($d=0.42-0.62$), led to more negative perceived local impact ($d=0.30-0.35$), and increased action intentions ($d=0.31-0.37$). All interventions were effective at changing attitudes, but interventions with active engagement (quizzes and interactive maps) were more effective at motivating action. The interventions were effective across the political spectrum, and there were no significant backfire effects (i.e., no Control vs. Intervention effects in the opposite direction; no interactions with political ideology). Among participants who were initially unsure about the funding cuts, 46% disapproved post-intervention. Among participants who initially approved of the cuts, 26% disapproved post-intervention. We created a public website to scale these interventions (<https://scienceimpacts.org/>); analysis of naturalistic user data revealed converging evidence of effectiveness.

Conclusion: We demonstrated that scalable online interventions that communicated the economic impact of NIH funding cuts reliably changed attitudes and motivated action to oppose funding cuts. Our results complement prior evidence that elaborative information processing and perceived self-relevance influence persuasion and decision making. To facilitate informed science policy decisions, we recommend using interactive tools to emphasize self-relevant, local economic impact.

P2.J.31 - Neural signatures of the spill-over effect of emotions on the processing of ads: An EEG study

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Details

Consumers often encounter emotionally charged stimuli before making purchasing decisions, yet the neural mechanisms through which these emotional contexts influence subsequent choices remain underexplored. This study investigates the spill-over effect of contextual emotions on the processing of advertisements using electroencephalography (EEG).

Participants ($N = 36$) viewed validated emotional video clips (eliciting disgust, fear, happiness, and sadness, respectively) interspersed with emotionally neutral commercials (Figure 1). EEG was continuously recorded, and data were decomposed into spectral features (1–128 Hz) across 64 electrodes. Using contrast-based analyses and cluster permutation testing, we identified unique spectral signatures for each discrete emotion, consistent with prior literature (e.g., increased temporal gamma activity for disgust).

Critically, these emotion-specific neural fingerprints partially re-emerged during the viewing of subsequent commercials, despite their neutral content, providing neural evidence for emotional spill-over from context to ad processing (Figure 2). A machine learning classifier trained to decode emotional states from EEG during emotional video viewing achieved 65% accuracy (vs. 25% chance). When applied to the commercials, the classifier predicted the emotional context with 37% accuracy, demonstrating residual emotion-related neural patterns during ad exposure (Table 1).

Preliminary analyses reveal important behavioral downstream effects of this spill-over. Specifically, ads that were classified (via EEG patterns) as evoking sadness were associated with significantly lower brand recall ($p < 0.05$) and ad recall ($p < 0.001$). In contrast, happiness-related patterns during ad viewing showed a marginally positive effect on ad recall ($p < 0.06$). No significant memory effects were observed for fear or disgust, suggesting that not all emotions exert the same downstream effects.

These findings highlight that emotional neural states induced by prior stimuli can persist and shape how subsequent, unrelated content is processed and remembered. At the same time, this shows the possibility to decode neural traces of specific emotions from the activity associated with unrelated stimuli. From both a neuroeconomic and marketing perspective, this study underscores the importance of managing the emotional context, as it may unconsciously modulate consumer attention, memory, and evaluation, thus offering practical implications for optimizing ad effectiveness in emotionally rich environments.

P2.J.32 - Separable neural representation of momentary positive and negative arousal

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Details

For decades, scientists have been interested in the neural correlates of momentary affect. Recent studies have highlighted the role of two regions implicated in incentive processing: the Nucleus Accumbens (NAcc) and the Anterior Insula (AIns) (Rutledge et al., 2014; Knutson et al., 2014). However, the spatial separability of positive and negative valence in the

brain remains largely unexplored, as does the question of whether these neural activities are the antecedents or the consequence of experienced affect.

We conducted two concurrent fMRI-pupillometry studies (N = 30 and N = 32, respectively) where participants completed a modified Monetary Incentive Delay task with affective probes. On each trial, participants were probed about their current valence and arousal either during reward anticipation or after reward feedback. Positive Arousal (PA) and Negative Arousal (NA) scores were derived from the ratings. Using General Linear Models with parametric regressors of PA and NA, we found spatially separable neural correlates of both forms of arousal. In both studies, PA was mainly associated with activity in the NAcc, whereas NA was mainly associated with activity in the AIns. These results were corroborated by a data-driven machine learning approach using a support vector regression with recursive feature elimination.

We then explored the temporal dynamics of the neural representation of PA and NA. Both NAcc and AIns activities exhibited strongest correlations with respective valenced arousal approximately 2-4 seconds prior to the affective probes, during the incentive processing phase, but diminished during the self-report period. Notably, our pupillometry data, which has a much higher temporal resolution than BOLD signal, revealed a similar temporal association pattern in which pupil diameter was most associated with self-reported affect 1-2 seconds before the onset of affective probes, and decreased throughout self-report. This convergence of methods indicates that the observed temporal lag between neural activity and affective ratings was not merely a byproduct of the low temporal resolution of fMRI. Finally, using openly available neurotransmitter maps, we demonstrated that the spatial separation of PA and NA parallels the distinct neurochemical targets involved.

To conclude, our findings showed temporally orchestrated, spatially separable neural representation of positive and negative arousal. Affect-relevant neural activity precedes self-report, suggesting that it predicts, rather than react to, affective self-report. Future research will examine the generalizability of these findings to more naturalistic paradigms.

P2.J.33 - Influence of affective state on context-sensitive valuation in methamphetamine use disorder

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Details

Introduction: Drugs are supraphysiological reinforcers thought to co-opt value-based decisions by overshadowing other rewards. This is thought to induce biased context-based reward value representations, hindering appropriate non-drug-related choices. In previous work (Gueguen et al., 2024), we showed that context-sensitive valuation is reduced in opioid addiction, especially during early abstinence, and is associated with negative affective states. Here, we extend this work to Methamphetamine Use Disorder (MUD), a growing public health crisis with no approved medication, high relapse rates, and an urgent need for effective behavioral interventions. Using a behavioral intervention to reduce negative affective states, we assess the causal influence of affective and clinical states on contextual valuation in early abstinent individuals with MUD.

Methods: 48 participants in active treatment for MUD performed a validated contextual reinforcement learning task (cRL, Molinaro & Collins, 2022) before and after undergoing a behavioral interventional aiming at improving their affective state through recalling neutral and positive non-drug-related autobiographical memories. PRE- and POST-intervention questionnaires assessed affective and clinical state (positive and negative affect with PANAS-X, PROMIS-banks for depression and anxiety, withdrawal for amphetamine and stimulants, VAS craving). In the cRL task, participants learn to associate cues with rewards from two trinary contexts, each with a low (L), middle (M), and high (H) value cue. The task plays on context during learning to [1] increase the subjective value of M1 and [2] decrease the subjective value of M2. Context sensitivity leads to a choice bias (M1 preferred to M2) during testing, and an explicit valuation bias (M1 valued higher than M2).

Results: Participants learned to choose the best symbols in all trial types, both PRE- and POST-intervention. Participants showed a choice bias ($p < 0.05^*$) during both PRE- and POST-intervention sessions, and a valuation bias ($p < 0.03^*$), which was even stronger POST vs PRE intervention (3-way Anova; $p < 0.01^{**}$). In parallel, participants reported a reduction of their negative affect, withdrawal, and craving for stimulants POST vs PRE intervention. Computational modeling and comparison are underway.

Discussion: Individuals with MUD exhibit context-sensitive valuation, even more after reporting a reduced negative affective state following the recall of autobiographical memories. This highlights the possibility to use affect-based behavioral interventions to causally reduce drug biases in value-based decision-making in addiction.

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P2.J.49 - The intrinsic value of control

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Details

Objective: Traditional models view cognitive control as inherently costly, creating a paradox: why do people willingly engage in new effortful activities without immediate external rewards? A possibility is that mental effort is intrinsically rewarding when it leads to learning progress, potentially offsetting effort costs. We tested whether (H1) task enjoyment is greater in controllable environments, where cognitive control can be deployed to improve performance, than non-controllable ones where performance is predefined; and this especially when (H2) experiencing learning progress.

Methods: We quantified learning progress in a novel task where participants searched in a grid of stimuli for a target defined by a combination of specific features. We manipulated task difficulty (varying the number of relevant features) and controllability (free vs. imposed selections).

Results: Results from a pilot study (n=18) and preregistered experiment (n=52) confirmed that (H1) enjoyment was significantly higher in controllable rather than non-controllable conditions ($\beta = -17.51$, $p < .001$), and (H2) learning progress positively predicted enjoyment primarily under controllable conditions (interaction: $\beta = -1.14$, $p = .032$).

Conclusion: These findings demonstrate that cognitive control, required in controllable but not uncontrollable conditions, can be intrinsically rewarding when leading to learning progress. This challenges traditional models by showing that effort can become rewarding under specific conditions of controllability and improvement.

P2.K.34 - A Novel form of confirmation bias in learning driven by value-based attention

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Details

Successful reward prediction hinges on learning from multiple, often conflicting cues. This process can be simplified by prioritizing learning from certain cues over others. We hypothesized that value-based attention facilitates this process by enhancing learning from cues that are more predictive of reward. To test this, we combined a multi-cue reward learning task with eye-tracking and computational modeling.

Participants (n=73) completed a variant of the weather prediction task in which they learned to predict one of two weather outcomes based on different combinations of four visual cues on each trial. One outcome was more common (the more rewarding option) overall, while each cue provided different amounts of evidence about the correct outcome. We developed multiple computational models to fit choice data and link them to gaze data, aiming to identify mechanisms of attentional influence on behavior.

Gaze data revealed that participants not only preferentially attended to cues supporting the more rewarding option, but also to the option itself. These attentional patterns mirrored biases in subjective weights of individual cues on choice. Fit of choice data showed that participants' behavior was most consistent with attention systematically influencing the learning of cue-outcome associations. Crucially, learning was modulated by the parallel deployment of attention to presented cues and the chosen option, based on reward outcome. On rewarded trials, learning rates were higher for cues that supported the chosen option (choice-congruent), whereas on unrewarded trials, learning was stronger for cues that contradicted the chosen option (choice-incongruent). Moreover, we found that cue-choice confirmation bias was correlated with overt attention: participants dwelled longer on choice-congruent cues when rewarded and on choice-incongruent cues when not. The dwell time on each cue predicted its learning rate, suggesting value-driven attention directly shapes reward learning by influencing cue-outcome updating.

Our results thus reveal a novel form of confirmation bias, extending confirmation bias about chosen and unchosen options (the tendency to favor learning from reward feedback that supports existing choices/beliefs) to individual cues that are used to make decisions. This enables differential learning of various sources of information based on their compatibility with choice. We conclude that value-based attention can provide a neural mechanism for this novel form of confirmation bias that can mitigate the challenges of learning in naturalistic settings.

P2.K.50 - The role of attention in integrating private and social information during simple decisions.

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Details

Objective: Individuals often rely on a combination of personal and social information to inform decisions, such as how to vote in an election or whether to buy a new product. We use eye-tracking paradigm in a real-time social decision-making task to investigate how attention mediates the integration of personal beliefs and peer influence during these types of decisions.

Methods: We collected pilot data from 70 online participants using a single-player adaptation of a real-time information cascade task previously developed in our lab. Participants have to infer a hidden weather state (Sun or Rain) based on two information sources: (1) a noisy but informative private signal about the weather, and (2) a live feed of their neighbors' evolving choices. Each trial lasted 12 seconds, during which participants could revise their choices multiple times and were incentivized for both accuracy and speed. In the current study, we retained the same task structure, but participants played alone, receiving social information drawn from one group in the earlier study. Throughout the task, we tracked participants' gaze using WebGazer to capture their attentional dynamics.

Results: We found that people use both personal and social information to make decisions. Subjects were more likely to choose Sun when their private information indicated Sun and more of their neighbors chose Sun. Regression results suggest that the more subjects looked at personal information, the more likely their choices were consistent with personal information. We fitted a drift-diffusion model and found that how much people weighed personal over social information was correlated with how often they fixated on personal over social information ($r = 0.56$, $p < 0.001$). To further examine the role of attention in the decision process, we fitted an attentional drift-diffusion model, which successfully accounted for both subjects' choices and their response times.

Conclusions: Preliminary results suggest that attention plays a significant role in guiding the integration of personal and social sources of information in basic decision making. Furthermore, the results show that the effect of visual attention in these simple decisions is well-captured by simple extensions of the aDDM.

P2.L.35 - An inexpensive method to measure latent toxoplasmosis and its behavioral consequences

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Details

An estimated 2.4 billion humans are affected by the protozoan *Toxoplasma gondii*, which causes one of the most common infections influencing human behavior and cognition. The infection and its effects are severely underresearched, because the diagnosis is costly and time-intensive, preventing widespread testing, in particular in less-than-wealthy regions. Psychological methods such as response time analysis could circumvent these problems and facilitate more intensive research. We propose a psychological diagnostic method for latent toxoplasmosis using response times, hence enabling large-scale tests of psychological, psychiatric, and behavioral effects. A clinical trial ($N=119$) showed that the method is sensitive (92%) and specific (97%) compared to testing for *Toxoplasma* IgG Antibodies ($p < 0.0001$, $\kappa=0.85$). A representative UK survey ($N=2020$) using this method confirmed previously-hypothesized behavioral effects and uncovered previously-unknown effects of latent toxoplasmosis infections which are relevant and pervasive, both psychologically (increase in risky behaviors, depression, anxiety, and stress) and economically (decrease in yearly income of 2,500 GBP; decrease in employment of 11%).

POSTER SESSION III

PS.03.01 - Multi-response decision making: Moving beyond single alternative selection in value-based settings

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Details

Objective: Many choices involve selecting multiple items (e.g., grocery shopping). Despite their ubiquity, the cognitive processes underlying these “multi-response” decisions remain understudied. Motivated by sequential sampling theories, we propose that individuals adapt decision strategies to their goals by focusing on task-relevant value comparisons and managing cognitive load. We examine how selection requirements, preference strength, and set size influence the choice process.

Methods: In Study 1, 75 subjects selected 1, 2, or 3 items from sets of 4. In Study 2, 100 subjects selected from larger sets (4, 8, or 12 items). Selection requirements were blocked, with block order randomized. We collected choice data, response times, and process data (eye movements in Study 1; mouse trajectories in Study 2).

Results: Subjects adapted their strategies based on selection requirements. In Study 1, for single-item selections, accuracy was most influenced by the value difference between the best and second-best options ($\beta = 1.04$, $p < .001$). For two-item selections, the difference between the second-best and third-best option was most predictive ($\beta = 0.79$, $p < .001$), while for three-item selections, the difference between the third-best and worst option was most critical ($\beta = 0.85$, $p < .001$). This pattern replicated in Study 2, with stronger effects in larger sets.

Subjects favored selecting items in rank order, consistent with a sequential sampling approach. The best-to-second-best (1–2) sequence occurred in 60.3% of two-item correct trials, and the sequence (1–2–3) occurred significantly most frequently (31.5%) in three-item correct trials (all contrasts, $ps < .001$). In Study 2, subjects maintained this tendency in 4-item sets, but showed a reduced tendency with larger set sizes.

Subjects responded slower when selecting more items and responded faster when the relevant value difference was largest. In Study 1, where initial selections took significantly longer than subsequent ones, subjects made fewer subsequent when they had spent more time on the initial selection. In Study 2, subjects’ initial mouse trajectories were more curved when selecting a single item compared to selecting two or three ($p < .0001$), suggesting less conflict.

Conclusions: Our work provides a comprehensive characterization of multi-response choice, demonstrating that individuals adapt their choice processes. The findings offer empirical support for extending existing sequential sampling models beyond single-item selection by explaining patterns in choice and process data. This lays the groundwork for developing computational models that can predict multi-response decisions.

PS.03.02 - Global reward rate controls transition from value-based to heuristic-based decision-making

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Details

Objective: Local effects of reward on value-based choice are often investigated using simple metrics such as win-stay/lose-switch strategies and by fitting reinforcement learning (RL) models to estimate reward values based on each reward feedback. However, relatively less is known about whether and how the overall reward feedback (reward rate) on a longer timescale affects an animal’s choice strategy, potentially creating qualitatively distinct modes of decision making. To address these questions, we re-analyzed three datasets from different species (mice, monkeys, humans) performing similar dynamic foraging tasks.

Methods: Subjects from three different species—mice (Bari et al., 2019), monkeys (Tsutsui et al., 2016) and humans (Rutledge et al., 2009; healthy controls only)—performed similar dynamic foraging tasks, in which they selected between two choice options that provided reward probabilistically. Rewards were baited, and reward probabilities changed between blocks of trials, resembling naturalistic foraging. We developed various RL models incorporating distinct components to explore how global reward rate could influence learning and/or decision-making processes. Our hypothesis was that a higher global reward rate promotes reliance on win-stay/lose-switch heuristics, whereas a lower reward rate leads to more value-based decision making based on RL estimated values.

Results: Fit of data using various RL models provided evidence for the effects of global reward rate on behavior. We found

that the model with a competitive interaction between heuristic and value-based strategies, driven by the global reward rate, consistently provided the best fit to choice across all datasets (paired t-test on AIC of the best vs. second-best model; mice: $p = .00622$; monkeys: $p = 2.81e-10$; humans: $p = .000578$). Analysis of the estimated parameters revealed that the coefficients for both explicit win-stay and lose-switch were significantly positive across all datasets ($p < .001$), confirming that the subjects indeed resorted more to win-stay/lose-switch strategy as the overall reward rate increased.

Conclusion: Our findings indicate that the overall reward rate over timescales of many trials plays a key role in modulating decision-making strategies across mammalian species, with higher reward rates promoting a shift from value-based strategies to win-stay/lose-switch heuristics. Overall, our results provide an algorithmic account for how the animals' strategies shift as a function of the overall reward rate and provide testable predictions for underlying neural mechanisms.

PS.03.03 - Neural processing of fairness in social decision-making associated with personality traits

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Details

This study investigates how personality traits are associated with the brain's processing of fairness during social interactions, using the Ultimatum Game (UG) as a framework. We aimed to determine whether distinct personality profiles are associated with neural responses to fair and unfair offers in decision-making contexts.

A total of 29 participants played the role of Responders and were clustered into two groups--proself and prosocial--based on personality traits (HEXACO-60) and emotional states (PANAS, BMIS). The proself group, scoring higher in forgiveness, liveliness, and positive mood, tended to accept unfair offers more often. In contrast, the prosocial group--characterized by conscientiousness and fairness--was more inclined to reject unfair offers. We recorded brain activity using Event-Related Potentials (ERPs) and fast optical imaging (Event-Related Optical Signals--EROS--by Frequency Domain fNIRS) during offer evaluations.

Results revealed distinct temporal and spatial patterns of brain activity between the two groups during the rejection of unfair offers. Proself participants exhibited an earlier peak in the P200 ERP component--occurring approximately 30 milliseconds sooner--and a lower amplitude at the Fz electrode, suggesting a faster but less intense initial neural response to perceived unfairness. Additionally, these individuals showed a larger P300 amplitude at the CPz electrode, which is typically associated with more elaborate and evaluative cognitive processing in later stages of decision-making. Complementing these electrophysiological findings, EROS data indicated that proself individuals had reduced activation in the right frontal cortex, specifically along the border of Brodmann areas 8 and 9, between 200 and 230 milliseconds following rejection. In contrast, prosocial participants demonstrated increased activation in the dorsolateral prefrontal cortex (DLPFC, anterior BA9) between 350 and 400 milliseconds--reflecting a delayed but possibly more controlled cognitive engagement with the fairness violation. Prosocial participants also displayed stronger activation in both ERP and EROS signals in the right temporoparietal junction beginning around 500 milliseconds after rejecting unfair offers. This region is widely associated with perspective-taking and social norm evaluation, underscoring the prosocial group's heightened sensitivity to violations of fairness.

In conclusion, this study highlights how proself and prosocial individuals engage distinct neural circuits across different stages of processing unfairness. By integrating fast optical imaging with electrophysiological methods, we show that social decision-making is deeply influenced by dispositional traits such as forgiveness, liveliness, and conscientiousness.

PS.03.04 - No decision is better than a wrong decision: An incentivized opt-out option can harness self-interest to reduce deception

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Details

Objectives: We take a novel approach to examine whether offering a small monetary incentive to opt out of an opportunity to lie can leverage self-interest to reduce dishonesty and deception. Specifically, we investigate how combining minimal financial incentives with an opt-out option might align individuals' economic motivations with ethical behavior.

Methods: Across four controlled behavioral experiments ($N = 1,784$), we tested whether a small monetary opt-out could discourage unethical decisions in incentivized deception tasks. In Studies 1–3, participants were presented with the opt-out option after learning the game outcome but before making their decision. In Study 4, the opt-out option was offered before any outcome information was revealed in a game, allowing us to test the effectiveness of the incentivized

opt-out option in a risky decision.

Results: Across all studies, a \$2 opt-out significantly reduced dishonesty, even when participants could have earned substantially more by lying. A meta-analysis confirmed the robustness of this effect across the four studies, showing a significant reduction in the likelihood of lying ($d = -0.91$, $SE = .14$, 95% CI $[-1.19, -0.64]$, $Z = -6.56$, $p < .001$).

Conclusion: Our findings highlight a critical tension: while financial incentives often promote performance, they may inadvertently erode honesty. By offering a small economic alternative, organizations may redirect self-interest away from misconduct and toward ethical choices. Rather than restricting behavior, this strategy provides an additional choice that satisfies economic motives while upholding moral standards. This approach does not absolve individuals of ethical responsibility but suggests a promising, low-cost mechanism by which organizations can better align incentives with integrity.

PS.03.05 - Redistributive behavior is governed by distinct moral principles

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Details

Objective: Previous research on redistributive behavior has largely relied on the assumption that moral principles are critically important, informing attitudes towards policies that redistribute resources from the economically advantaged to the economically disadvantaged. However, to date no empirical work has directly addressed these fundamental principles. Across two studies we developed a novel experimental task which enables us to empirically distinguish between different moral principles underlying redistributive decisions. Leveraging behavioral choice, computational modeling, and neuroimaging, we address redistributive decision-making across multiple levels of analysis.

Methods: We performed two experiments using the Redistribution Game – a large online study (Experiment 1; $n = 231$) and an fMRI study (Experiment 2; $n = 50$). In each, participants played a novel incentive-compatible task called the Redistribution Game in which participants first view a distribution of tokens among co-players. Then, participants are allowed to set a redistributive tax rate, which alters the final tokens all players receive. Across trials, we manipulate the number of tokens participants initially receive, allowing for the disentangling of self-interest in redistributive decisions. We also vary the criteria used to distribute tokens, creating different degrees of fairness of the initial inequality. To analyze behavior in the Redistribution Game, we developed a utility model which incorporated Equality (unconditional support of redistribution), Equity (unconditional opposition), and Payout-Maximization (self-interest).

Results: Both experiments demonstrated that each of the three principles was employed by a significant proportion of our sample. Furthermore, the fairness of the pre-existing inequality affected the principle used, with 'unfair' inequality promoting Equality and 'fair' inequality promoting Equity. In Experiment 1, we also found that the moral principles utilized by participants in their redistributive choices intuitively explained views that individuals hold towards real economic policies. In Experiment 2, we found that increased activation in primary visual cortex, secondary visual cortex, and right PCC uniquely distinguished Equality-seekers, while deactivation of the right vmPFC and bilateral dACC uniquely distinguished Equity-seekers.

Conclusion: The current study employed a multi-faceted approach to understanding redistributive choice, demonstrating that preferences for redistribution in a socioeconomic task are governed by substantial heterogeneity, that preferences generalize from the lab to the ballot box, and that there are clear neurobiological correlates of these preferences.

PS.03.06 - Increased subjective costs of control-related effort after eating in bulimia nervosa

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Details

Objective: Because exerting control is cognitively demanding, we must make cost-benefit decisions about whether even trying to exert control is worth the effort. These decisions may play a major role in bulimia nervosa (BN): Individuals with BN often rigidly control their eating between binge-eating episodes, but after eating begins, many endorse thinking, "Now that I have done it, I might as well go all the way." Here, we tested whether starting to eat abnormally influences the subjective effort costs associated with cognitive control in BN.

Methods: Women with and without BN ($N=35$) completed the Cognitive Effort Discounting task in two states: after a 16-h fast and after a standardized meal. The task assesses the discounting of cash offers to complete more demanding levels of an N-back. Steeper discounting indicates higher estimated effort costs. The Eating Disorder Examination assessed BN symptom frequency.

Results: In a fed relative to fasted state, women with BN showed steeper effort discounting than healthy controls (HC; Group x State $p=0.006$). The effects of food consumption in HC resembled those previously observed with dopamine-releasing pharmacological agents like methylphenidate: eating decreased effort costs in HC. However, women with BN showed slightly elevated costs of cognitive effort after eating. Moreover, women with BN who more steeply discounted cognitive effort in a fed state reported more frequent binge-eating episodes ($p=0.034$).

Conclusions: Results suggest that in BN, an altered effort-cost computation after eating starts may reduce willingness to expend effort on control and leave urges to continue eating unchecked. Interventions that decrease subjective costs and increase the subjective value of cognitive effort, specifically after eating, may prove fruitful for BN.

P3.B.7 - Asynchronous development of loss aversion

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Details

Loss aversion—stronger distaste for losses than appetite for equivalent gains—is one of the most widespread biases in human decision making, with real-world impacts on finance, trading, insurance, marketing, and healthcare. We recently proposed a conceptual and computational evidence-accumulation framework that decomposed loss aversion into a response bias to avoid choice that might incur losses and a valuation bias that magnifies information about losses over gains (Sheng, et al., 2020, PNAS). Despite the prevalence and impact of loss aversion in adults, little is known about its development and the respective age-related variations of response bias and valuation bias. To address this gap, we examined decisions to accept or reject gambles of equal odds to win and lose money in 5th (N=109), 8th (N=115) and 11th grade (N=112) graders, with three-grade separation both between the former two grades and between the latter two grades. By fitting the observed choices and response times to a drift diffusion model (DDM), we quantified response bias (defined as the inclination of the starting point toward the rejection boundary) and valuation bias (defined as the log transformed ratio of loss weight vs. gain weight) for each individual. We found response bias and valuation bias showed distinct developmental trajectories across childhood. Response bias increased from 5th grade ($M\pm SD=-0.011\pm 0.061$) through 8th grade ($M\pm SD=0.024\pm 0.060$; $t(222)=4.37$, $p<0.001$; Cohen's $d=0.578$) but subsequently plateaued in 11th graders ($M\pm SD=0.029\pm 0.071$; $t(225)=0.50$, $p=0.617$; Cohen's $D=0.076$). Regression analysis of individual differences confirmed that the difference in response bias between 11th and 8th graders was smaller than the difference between 8th and 5th graders ($B=-0.031$, $SE=0.015$, $p=0.039$). By contrast, valuation bias was flat from 5th ($M\pm SD=0.12\pm 0.30$) through 8th grade ($M\pm SD=0.14\pm 0.31$; $t(222)=0.64$, $p=0.524$; Cohen's $D=0.066$) and then increased in 11th graders ($M\pm SD=0.34\pm 0.38$; $t(225)=4.20$, $p<0.001$; Cohen's $D=0.577$). Regression analysis across individuals confirmed that the difference of valuation bias between 11th and 8th graders was larger than the difference between 8th and 5th graders ($B=0.17$, $SE=0.08$, $p=0.030$). These results suggest that a response bias of avoiding losses emerges and increases in magnitude primarily during early adolescence. By contrast, a valuation bias of amplifying losses increases in magnitude primarily during late adolescence. Together, these findings implicate asynchronous development of the cognitive mechanisms underpinning loss aversion as children mature into adults, potentially reflecting asynchronous maturation of distinct biological mechanisms identified in prior research (Wang, et al., iScience, 2024; Sheng, et al., 2020, PNAS).

P3.B.8 - Informationsearch shapes consumer patience: A novel process-informed model for intertemporal choice

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Details

Time preferences, deciding between consuming now or later, underlie numerous important behaviors. Examples include deciding to buy a new car rather than saving for retirement, studying for an exam instead of streaming television, or deciding to buy a more expensive but energy-efficient appliance to lower future utility bills. There have been two key approaches to understanding intertemporal choices. The first builds on a long tradition of computational models that attempt to calculate the utility of different options and predict choices. Examples include non-linear discounting of value over time (e.g., Samuelson, 1937, Ainslie, 1975, Laibson, 1997) as well as models that attempt to capture psychological comparisons that might shape decisions (e.g., Read et al., 2013; Marzilli Ericson et al., 2015). The second is a growing interest in using process tracing methods – including decision times, mouse tracking, or eye tracking – to elucidate the psychological mechanisms underlying decisions and improve predictions of choice.

The present paper builds upon these developments to carve out the specific role of dynamic search patterns in intertemporal choices. We develop a computational model to incorporate information about search patterns for predicting choice. This model is then applied to eight datasets to examine the relationship between search processes and consumer choices. The results show that our modeling approach outperforms existing models that consider only

looking time, highlighting the importance of considering search directions for accurate predictions. Additionally, our model demonstrates how guiding search patterns can shape consumer choices across various domains, providing valuable insights for marketing managers and policymakers aiming to influence decision-making and behavior.

We investigate three different types of consumer decisions with time-value tradeoffs through five original process tracing experiments and three reanalyzed datasets.

This research makes three main contributions. First, it generalizes the relationship between search and patience across a range of different types of consumer choices, including decisions about shipping times for purchases and environmentally-friendly products. Second, it develops a novel computational model to predict patience using information about search directions. Finally, we reveal that search strategies have a causal relationship with patience, such that altering search changes decisions. These findings have numerous ramifications for both academic theory as well as policies that promote consumer welfare.

P3.B.9 - At what cost?: Social value-based purchase decisions in Liberals and Conservatives

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Details

Objective: Using an embodied-choice approach and building on previous mouse-tracking literature demonstrating that cursor movements reliably encode the deliberation process, we created a novel mouse-tracking paradigm for purchase decision deliberation. Additionally, we intend to understand if individual differences in political orientation manifest as differences in reach trajectories while participants process the product information.

Methods: We created a novel, Buy/Don't Buy mouse-tracking paradigm where participants (N = 291) make purchase decisions based on a product's price and the brand's eco-friendly or humane labor rating. Participants are assigned to either Ethics Rating (experimental condition, N = 144) or a Customer Rating, (control condition, N = 147). Price and product rating (either ethics or consumer evaluation) was sequentially revealed as participants moved the mouse from the bottom center of the screen towards the decision targets located on the top corners of the screen. Half the trials presented only price and the other half presented both price and product ratings.

Preliminary Results: Initial choice analysis demonstrate that within Conservatives, there is no between-subjects main effect of Rating Condition, suggesting their purchase decision did not change based on the product rating type. There is no main effect of, or interaction with, Rating Presence, reflecting that their choices were not impacted by the presence of product ratings. In Liberals, there is a main effect of Rating Condition indicating more items are bought in the Ethics condition; as well as a three-way interaction of Price (expensive vs. inexpensive), Rating Presence and Rating Condition. Based on unpacking of this three-way interaction, we found that in the Ethical condition, more items are picked when the rating appears early and the price appears late, compared to when the price appears first and the ethical rating appears closer to the decision horizon. In the Customer condition, more items are picked when no rating is present, and items are picked more when the price appears closer to the decision horizon.

Conclusions: This novel task design mimics a real-world decision environment to provide insights into the deliberation process, role of action costs in decision development, and the interaction of price and indicators of social value. Our preliminary results demonstrate significant differences in purchase decisions across conservatives and liberals, indicating underlying differences in deliberation. Future analysis will investigate the mouse movement trajectories to reveal these differences in deliberation process based on their political orientations.

P3.B.10 - Characterising the computational complexity of optimal choice via Fitness Landscape Analysis

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Details

Human decision-making often requires solving optimisation problems, which can differ greatly in their computational complexity. However, there is currently no general framework that precisely characterises the computational hardness of these problems or explains how this hardness affects human decision quality.

In this study, we address this gap by introducing general, task-independent complexity metrics derived from Fitness Landscape Analysis (FLA), a method from operations research. We assess the usefulness of these metrics through a series of online experiments in which participants attempt to solve instances of the knapsack optimisation problem. The computational hardness of each instance is measured and varied using FLA.

First, we developed a predictive model to estimate human accuracy on the knapsack task using a set of established FLA metrics. We hypothesised that these metrics, which have previously been shown to influence the performance of local search algorithms, would also predict human performance. We trained this model using existing data from human participants ($n = 148$), aggregating the FLA metrics with machine learning techniques to predict accuracy. This approach allowed us to rank the difficulty of each knapsack problem instance based solely on computational hardness features.

We then tested the model in two new online experiments ($n_1 = 26$; $n_2 = 22$), where we systematically varied instance hardness according to the model's predictions. Our results show that computational hardness, as defined by our model, has a significant effect on both accuracy (p value < 0.001) and time-on-task (p value < 0.001) in both experiments, even though the model was not explicitly trained to predict time-on-task. Across all datasets, the model's out-of-sample predictions explained a substantial proportion of the variance in average human performance across instances (Pearson $r = 0.71$, $p < 0.001$).

These findings demonstrate that FLA-based hardness metrics account for a significant share of the differences in human decision quality, suggesting that FLA offers a promising framework for understanding the intrinsic complexity of cognitive tasks. Our results provide new insights into the limits of human information processing and offer a practical modelling tool to improve existing models of decision-making. Additionally, this approach could inform policymakers by providing a way to categorise decisions based on computational hardness, helping to predict when individuals may need additional support or when consumer products might require regulation to ensure they remain manageable for users.

P3.B.11 - Neural basis of disgust mitigation in sustainable food choices

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Details

Objective: Disgust is often regarded as a defensive emotion that evolved to protect organisms by prompting withdrawal and rejection through a negatively valenced, visceral response to cue of potential contamination. However, disgust can also maladaptively influence dietary choices in consumers even with a lack of objective risk. Many sustainable, cost-effective, and safe solutions such as produce irrigated using recycled water, are rejected due to a perceived risk stemming from stigma of such sources. Studies have found that consumers tend to disproportionately overweight the salient attributes (i.e., disgust here) in multi-attribute decisions. Here, we aimed to examine (a) if shifting attention to positive elements of stigmatized sources through a behavioral intervention could modulate the relative weight of disgust in decision values of the choices; and (b) whether the intervention could subsequently alter affective neural responses (e.g., in insula or OFC) and this difference correlates with the behavior change.

Methods: 51 adults underwent fMRI while they made a series of binary choices involving tradeoffs for three food products. 17 distinct tradeoffs were constructed that varied between price and stigmatized attributes, i.e., type of irrigation (recycled vs. traditional) for produce and protein types (crickets vs. soy) for protein bars. Before completing a second round, participants were randomly assigned to a treatment group ($N = 26$) that viewed a short video emphasizing the safety and societal benefits of recycled water, or a control group ($N = 25$) that viewed a neutral nature scene.

Results: Pre- and post-treatment decision rounds were compared using a difference-in-difference model estimated using OLS to find that participants exposed to the treatment video were significantly more likely to choose recycled-water produce when cheaper ($\Delta = -12\%$, $p = .001$). Tradeoffs were modeled into 6 regressors in the GLM for whole-brain fMRI exploratory analysis that revealed significant clusters in disgust-related regions of interest (insula, OFC) for recycled-water produce vs. traditional foods. Pre vs. post-treatment significant contrasts were observed in several prefrontal regions linked to executive decision subregions, including MFG, SFG, angular and supramarginal gyri ($p \leq .007$).

Conclusion: These findings suggest that behavioral messaging can reduce the influence of disgust on decision-making not by attenuating the neurophysiological reactions of disgust itself, but from reweighting its importance in their decisions. This reframing approach supports a low-cost, scalable strategy to promote consumer adoption of stigmatized but sustainable products without requiring material and perceptual change in the products.

P3.C.12 - Simulating Human and AI Decision-Making under uncertainty in the Clinical Iowa Gambling Task via Q-Learning

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Details

With the rapid advancement of large language models (LLMs) in reasoning and learning, integrating reinforcement learning techniques to simulate human decision-making has become increasingly feasible. This study presents the first integration of the Q-learning algorithm with Anthropic's Claude Sonnet model to simulate behavior in the Clinical Iowa Gambling Task (cIGT), aiming to construct models that represent both a "highly rational agent" and actual human performance.

Q-learning, which accumulates action values through trial-and-error learning, is well-suited for tasks involving risk, delayed feedback, and ambiguous information such as the IGT. We conducted a grid search across three parameters—learning rate (LR), discount factor (DF), and exploration rate (ER)—resulting in 1,210 parameter combinations. Model performance was evaluated using mean squared deviation (MSD) against behavioral data from 114 human participants, as well as against the rational benchmark defined as maximizing net score $[(C + D) - (A + B)]$.

Results revealed that the best-fitting model for human-like behavior was characterized by LR = 0.7-0.9 and ER = 0.7-0.9, while the most rational agent was best captured with LR = 0.1-0.5 and ER = 0.1-0.3. The DF parameter showed no consistent trend across models, suggesting limited influence in this decision context. Overall, LR and ER emerged as the key modulators of decision performance.

This study offers two main contributions: (1) the development of a Q-learning model capable of highly rational behavior in the cIGT, akin to an "AlphaGo for IGT"; and (2) empirical validation that human decision-making under uncertainty tends to favor short-term gains and high exploration, diverging from the rational agent model.

In conclusion, the integration of LLMs with reinforcement learning provides a promising framework for simulating human decision-making processes and offers theoretical insights relevant to psychology, neuroeconomics, and AI ethics.

P3.D. 13 - Modeling internal and external sources of uncertainty in risky decision making

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Details

Human decision-making is inherently variable and uncertain—the subjective value of a good fluctuates over time. Recent theories explain such variability by a Bayesian model, where observers infer option value based on noisy internal representations. Central to this framework is that decision makers represent not only a point estimate of the value but also its uncertainty, which guides inference. Yet, direct evidence that people track such uncertainty during valuation remains scarce. Moreover, uncertainty can stem not only from internal noise but also from external factors, such as the lottery risk. How people integrate these distinct sources of uncertainty remains unknown.

To investigate these questions, we develop a computational model to explain decision uncertainty measured by a modified willingness to pay (WTP) task for risky decisions. On each trial, participants reported the minimum and maximum WTP amounts for a lottery involving two outcomes, each with 50% probability. The difference between the two amounts—the WTP range—provided an explicit readout of uncertainty, with wider ranges reflecting greater uncertainty. The midpoint of the range was taken as the WTP. For a lottery $[q_1, v_1, q_2, v_2]$, the model assumes that each outcome, v_1 and v_2 , elicits noisy responses, r_1 and r_2 , where $r_i \sim N(v_i, \sigma_i^2)$. The model allowed the measurement (encoding) noise σ_i^2 to increase with the outcome v_i . The decision maker infers the value of each outcome through Bayesian inference and computes posterior distribution $p(v_i | r_i)$ that considers both the likelihood $p(r_i | v_i)$ and $p(v_0)$, the prior distribution. To incorporate the probabilities of two outcomes, the decision makers combined the two posteriors as a mixture distribution $q_1 * p(v_1 | r_1) + q_2 * p(v_2 | r_2)$. The model thus tracks internal uncertainty in the form of noise in Bayesian inference and external uncertainty, the outcome risk here, through a weighted mixture of posteriors. The WTP range corresponds to the confidence interval computed as the mean of the mixture distribution plus/minus the standard deviation of the mixture distribution.

Our model captures three signatures in the data: (1) WTP ranges increased with expected value, reflecting the increment of the internal encoding noise with the outcomes. (2) WTP ranges widened with the difference between the two outcomes, due to greater separation between two posteriors that formed the mixture distribution. (3) Participants reported wider WTP ranges for lotteries with higher WTP variability. To sum, our results show that decision makers can track trial-wise uncertainty in valuation, and provide a computational account on how internal and external sources of uncertainty are integrated in risky decision-making.

P3.D. 14 - Distorted probability weighting in decisions under uncertainty reflects boundary repulsions in cognitive noise

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Details

Probability weighting—the tendency to overweight small probabilities and underweight large ones—is a hallmark of risky decision-making and central to Prospect Theory. Yet despite its descriptive success, its mechanistic basis remains poorly understood. Though traditionally viewed as a bias unique to risk, similar distortions occur in perceptual judgments (e.g., overestimation of small visual proportions, underestimation of large ones) and under partial ambiguity (e.g., ambiguity-seeking for low probabilities, aversion for high). These parallels suggest a common cognitive origin rooted in how the brain represents probabilities.

We propose that these distortions arise from noisy inference of bounded quantities like probabilities (always between 0 and 1). Cognitive noise is repelled from boundaries, producing the classic distortion pattern. These boundary repulsions can emerge from two normative principles of cognitive inference: Bayesian optimal decoding with bounded priors (truncating the posterior) and resource-rational efficient coding under limited capacity (skewing the likelihood). Both principles explain probability distortions as a general consequence of bounded noisy inference—not as phenomenon specific to risk.

We tested this proposal in three pre-registered within-subject experiments, manipulating cognitive noise (via fraction complexity) and probability boundaries (via range instructions) across both perceptual estimation ($n = 59$) and risky choice ($n = 70, 71$). All pre-registered hypotheses were strongly confirmed (all $p < 0.001$). As predicted, increasing noise amplified distortions, and introducing contextual boundaries reshaped the weighting function, producing sharp “jumps” in responses above and below boundaries. Crucially, we also observed joint reductions in response variability near both natural and induced boundaries.

These behavioral signatures (distortion–variability coupling and boundary sensitivity) are not explained by existing models of noisy inference that assume fixed priors, log-odds transforms, or anchored response functions. None of these accounts predict both weighting distortions and variability dips arising jointly from boundary manipulations. Importantly, our account also extends to ambiguity, which can be understood as noisy inference under stimulus uncertainty. In this case, stimulus noise has a similar role as cognitive noise in producing boundary repulsions. In other words, risk may be a special case of ambiguity with no stimulus noise. Pilot results of choices under partial ambiguity show similar boundary-driven effects, and a pre-registered experiment is underway. Our framework thus offers a unified, normative explanation of probability distortions across perception, risk, and ambiguity.

P3.D.35 - Perceptual account of variable loss attitudes in mixed gambles

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Details

Loss aversion is a central bias in behavioral economics, captured with a steeper value function for losses within Prospect Theory (Kahneman & Tversky, 1979, 1992). Yet, empirical evidence shows that the loss aversion degree varies with experimental context (Rakow et al., 2020), a finding that preference-based models struggle to fully explain. Here, we test the novel hypothesis that loss aversion—and its context sensitivity—partly originates from a perceptual bias rooted in noisy neural coding (Woodford, 2020).

To explore this, we analyzed the link between loss aversion and decision noise using psychophysical and Bayesian inference models across 6 open datasets (Tom et al., 2007; Botvinik-Nezer et al., 2019; Zhao et al., 2020) and a newly collected dataset (total $n=324$). In all studies, participants decided whether to accept or reject 50/50 mixed gambles.

The psychophysical probit model separates choice variability (slope) from bias (intercept). Prior research shows that greater internal noise increases systematic biases in perceptual tasks (Petzschnner et al., 2015; Xiang et al., 2021). Similarly, in 5 out of our 7 datasets, greater choice noise was linked to larger shifts from loss neutrality—both stronger loss aversion ($r = .16-.36$, $p < .05$) and gain seeking ($r = -.39$ to $-.37$, $p < .05$).

To explore the mechanism behind this noise-bias link, we used a Bayesian inference noisy cognition model. The studies have shown that greater perceptual noise increases central tendency biases, modulated by prior beliefs (Khaw et al., 2021; Garcia-Barreto et al., 2023). Our model tested whether loss aversion reflects differential precision in representing gains vs. losses or differing prior beliefs. Simulations showed that the model reproduces the range of value functions characterizing loss aversion. Model comparisons revealed that the Bayesian inference model explained the data as well as—or better than—Prospect Theory with encoding noise and prior beliefs.

Across all datasets, higher encoding noise for both payoffs related to stronger loss aversion ($r = .28, p < .00$; losses: $r = .25, p < .001$) and gain-seeking (gains: $r = -.26, p < .05$; losses: $r = -.26, p < .05$). More extreme prior beliefs about the losses size were linked to greater loss aversion, while higher prior beliefs about gains related to gain seeking ($r = -.44, p < .001$).

In sum, our results consistently link shifts from loss neutrality to increased decision noise (and more extreme prior beliefs) across varied contexts. These findings support the view that loss aversion is partly driven by noisy neural coding, with strong loss aversion emerging from lower encoding precision and heightened prior beliefs about losses.

P3.D.36 - Is ambiguity aversion generalized? Examining the effects of ambiguity across probabilistic, temporal and effort discounting

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Details

Objective: Ambiguity aversion is commonly examined in studies of risky decision making. People tend to avoid gambles with vague probabilities, compared to those with clearly defined risks. However, less work has examined how ambiguity impacts choices with other types of decision costs (e.g., temporal and effort discounting). By extension, it is unclear if ambiguity aversion is a generalized construct, or if it differs based on decision costs (i.e., domain-specific). In an ongoing study, we examined whether a person's aversion to ambiguity is consistently expressed across different decision costs. We predicted that ambiguity aversion is domain-specific, such that within-subject correlations of ambiguity aversion across different decision costs would yield weak to no associations.

Methods: Adult participants ($N = 62$, ages 25 – 85) completed three two-choice discounting tasks for hypothetical monetary gains, which differed by decision cost type: risk probabilities, time delays, and cognitive effort levels. In each task, they completed 126 trials by indicating their preference between a small cost-small gain option and a large cost-large gain option, where the cost is task-dependent (risk, time delay or cognitive effort). Ambiguity was presented in half of the trials by masking the exact costs required to achieve the larger cost-gains, effectively presenting a range of potential costs. Computational modeling was used to estimate participants' ambiguity preferences in each of the three tasks, using a modified hyperbolic discounting function for calculating an option's subjective value. A model that assumes ambiguity has a separate impact from decision cost on subjective value provided the best fit to our data across the majority of tasks and participants.

Results: We ran three within-subject complete pairwise correlations between the estimated latent parameter for ambiguity preferences. Partial correlations were obtained, controlling for participants' age, sex, years of education, and income bracket. Across our sample, there were no significant correlations between ambiguity preferences across the three different task paradigms: EFFORT-PROBABILITY ($r = 0.23$, $p = .166$, $n = 42$), EFFORT-TIME ($r = 0.23$, $p = .171$, $n = 41$), and PROBABILITY-TIME ($r = 0.26$, $p = .116$, $n = 42$).

Conclusions: The findings suggest that ambiguity aversion may not be generalized across different decision costs. A person who shows a high ambiguity aversion in risk-taking may not do so for other cost domains, such as ambiguous time delays or effort levels. This may have implications on the reliability of making inferences and assumptions using cross-domain comparisons of ambiguity aversion.

P3.E.15 - Sugar liking as an indicator of reward sensitivity in delay discounting and risk-taking tasks

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Details

Objective: Reward sensitivity – the tendency to seek out and enjoy rewarding stimuli. It has been linked to impulsive decision-making, such as preferring smaller immediate over larger delayed rewards. Previous work suggested that the link between reward sensitivity and impulsivity may be influenced by individual risk preferences, given that time delays often carry uncertainty. In this study, we examine how reward sensitivity, measured via sweet taste preference, relates to both impulsivity and risk aversion using data from two independent samples.

Methods: Participants ($n_1=49$, $n_2=65$) completed behavioral tasks assessing delay discounting, risk aversion, and reward sensitivity. Reward sensitivity was measured using the Kampov-Polevoy sweet-liking test, which categorizes participants into sweet-likers and sweet-dislikers based on their ratings of sucrose solutions. Delay discounting (impulsivity) was assessed via binary choices between immediate and delayed monetary rewards, and risk preferences were measured using a lottery choice task. Regression analyses tested whether sweet-liking preferences predicted intertemporal and

risky choices and whether risk preferences moderated these links.

In the first sample, task order varied: some participants completed the sweet-liking test before the risk and impulsivity tasks. This introduced a potential confound, as exposure to sweet tastes might have temporarily altered participants' decision making. To address this, in the second sample, all participants completed the risk and impulsivity tasks before the sweet-liking test, ensuring that measures of reward sensitivity could not influence earlier decision-making.

Results: Across both samples, sweet-likers consistently showed greater sensitivity to time delay: they were more likely than sweet-dislikers to choose immediate rewards as delay increased. In the second sample, sweet-likers also showed increased sensitivity to the amount of immediate rewards, suggesting stronger valuation of short-term gains. The first sample showed that risk aversion accounted for the impulsive behavior: when risk preferences were included in the model, the effect of sweet-liking on impulsivity disappeared. However, this result was not replicated in the second sample: risk preferences did not significantly mediate the relationship between sweet-liking and impulsivity.

Conclusions: These findings support a robust link between sweet taste preference and impulsive choice behavior, particularly heightened sensitivity to both time delay and immediate reward. However, the role of risk aversion as a mediating factor appears inconsistent. This inconsistency raises questions about the underlying mechanisms linking reward sensitivity and decision-making.

P3.E.16 - A novel approach to characterize foraging decisions underlying social interactions in mice

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Details

Historically, rodent tasks designed to study the rewarding properties of food and drugs have been instrumental for accessing the neural underpinnings of motivated behaviors. New efforts have repurposed such tasks to explore appetitive social interactions. These approaches have opened doors for integrating behavioral economics with rodent social neuroscience, allowing for the dissociation of computationally distinct decision-making processes along many dimensions of value in a social setting. To this end, I have adapted the food-based neuroeconomic task, "Restaurant Row", into a social decision-making task in which mice forage for social interactions rather than food rewards. In this task, isolated mice have 20 minutes to forage for their sole source of social contact with four conspecifics who vary in subjective value (social identity based on familiarity and tube test-determined rank). Cost to access social interactions with each conspecific vary in the form of cued delays across trials and task phases. Thus, mice must learn to optimize social decision-making strategies amidst a changing economic landscape. My pilot data validated task feasibility under several experimental conditions, including social vs. non-social stimuli, different mouse strains, degrees of sensory contact, social novelty vs. familiarity, housing status, and social hierarchy. Mice discriminate social from non-social (object) targets, as well as novel from familiar social targets, as a function of cued offer costs and more so when physical access to targets is allowed. Further, singly-housed CD1 mice earn more interactions than both C57 and Swiss Webster mice while maintaining stable task engagement across time and different cost epochs. To probe the effects of agentive, reciprocal task engagement on dynamic social behavior, we permitted some mice to forage for the same conspecifics who then on a subsequent session foraged for them in return, while restricting this ability in other mice who instead served only as actors or targets. Actor-target relationships revealed subordinate mice over-selected dominant mice who in turn reciprocally under-selected subordinate mice, a pattern that was not observed with intermediate mice and which may depend on reciprocal access. These findings suggest that identity-related differences in reciprocal interactions reveal important neuroeconomic signatures of social choice that could drive the development of long-term relationships. By strengthening our understanding of long-term social memory, familiarity, and hierarchy dynamics, this approach will help dissect mechanisms of social decision-making that may be altered in psychiatric disorders.

P3.E.17 - Impulsivity during heightened negative affect through value-based decision-making and ecological momentary assessment

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Details

Study's objective: Impulsivity is a common feature across psychiatric disorders that is often considered to be goal-incongruent and value-free [1]. Prior computational studies used delay discounting and risky decision-making paradigms to study impulsivity, [2] but their associations with psychological measures of impulsivity were weak and replication attempts failed [3]. These lab-based tasks also failed to predict impulsive behaviors in real life [4]. We recently proposed a new model of affect-driven impulsivity (ADI) predicting that heightened negative affect (NA)

reduces exploratory behavior and increases overgeneralization of familiar, previously reinforced actions—a preference for exploitation over exploration [5]. This study empirically tests that prediction by linking lab-based measures of decision-making with real-world impulsive behaviors.

Methods: 110 participants (77 met criteria for borderline personality disorder) completed a 21-day smartphone protocol and a spatiotemporal learning task (the “clock task”). We used computational modeling and multilevel structural equation modeling to examine whether explore-exploit decision-making indices moderated the relationship between momentary increases (i.e., within-person fluctuations) in NA and impulsive behaviors (IB) and suicidal ideation (SI) reported in daily life.

Result: We found that experiencing SI during heightened NA in daily life was related to reduced exploration ($\beta = 0.17$, $SE = 0.07$) and a stronger tendency to select familiar high-value options ($\beta = 0.47$, $SE = 0.09$) following negative feedback on the lab-based learning task. In contrast, momentary NA-IB coupling was not captured by lab behavior. Instead, among individuals with high average NA, greater sensitivity to immediate feedback—reflected in larger response shifts following negative feedback ($\beta = -0.14$, $SE = 0.06$)—and reduced integration of global value—evidenced by weaker exploitation, particularly when the maximum known value was high ($\beta = -0.34$, $SE = 0.06$)—predicted greater real-world IB.

Conclusion: These findings suggest that different mechanisms may underlie internalizing (e.g., SI) and externalizing (e.g., IB) reactions to heightened NA. SI may reflect risk-averse, conservative decision strategies under distress, while IB may reflect hypersensitivity to immediate feedback, possibly shaped by adaptations to early environmental unpredictability. By highlighting the role of emotion in shaping decision strategies, our findings counter prevailing models of ADI that focus on risky choices and outcome devaluation, revealing instead context-sensitive and adaptive (though sometimes maladaptive) patterns of behavior.

P3.E.18 - Modelling uncertainty around subjective values of choice attributes increases analysis sensitivity

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Details

Objectives: Self-reported estimates of subjective values (i.e., ratings on a Likert or continuous scale) are used extensively to test the theories of human decision making. In such studies, rating precision is generally neglected and study outcomes (e.g., self-control in food choice) are defined using the reported values. We model uncertainty around self-reported subjective values for two choice attributes, and propose study outcome measures that combine observed choices and these uncertain values.

Methods: Based on a hypothetical two-attribute choice free from any biases (beyond the choice attributes), we postulate true attribute rating differences that produce a simple rule. That is, assuming no difference in the first attribute, if item A is rated higher than B on the second attribute, item A is chosen. Then, we assume a bivariate normal distribution of true attribute rating differences with its conditional probabilities reflecting this rule and fitted to binary choices either with or without intended conflict between attributes (based on self-reports). In this way we estimate the bivariate normal parameters from self-reported attribute ratings of many products combined with binary choices between these products. Using food choices as an example with healthiness and tastiness as choice attributes, we calculate the probabilities of the following outcomes: self-control (choosing a healthier and less tasty food item over a less healthy and tastier one), choice-attribute consistency (choosing a healthier and tastier food item over less healthy and less tasty one), healthier choice, and tastier choice. See Fig 1.

To check our method, we used data from an experiment ($N = 50$) that tested the effect of increased working memory load on food choices. Participants rated the tastiness and healthiness of many food items. We tailored a unique series of 90 choices for each participant (60 and 30 choices with and without intended conflict, respectively), which were made twice in the low and high load conditions. Multilevel mixed-effect regression was used to study the load effect on the probabilities of interest.

Results: We found that increased load reduced choice-attribute consistency ($z = -2.92$, $p < 0.001$), but not self-control. However, self-control in the lab was associated with self-reported unhealthy snack consumption outside the lab ($z = -4.08$, $p = 0.003$). Simple binary measures could not detect these significant two results nor a load effect on self-control.

Conclusions: Our method may be more sensitive in detecting effects of interest compared to binary measures when outcomes are defined from imprecise subjective value ratings rather than the unknown true values.

P3.E.37 - Computational mechanisms of information-seeking in anticipation of aversive outcomes

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Details

Study objective: Anticipation of future aversive experiences is a core feature of psychiatric conditions, including anxiety and depression. Previous studies on altered negative anticipation have relied primarily on passive paradigms such as Pavlovian conditioning, limiting mechanistic insights into how anticipatory feelings drive complex behaviors, such as decision-making. We introduce a novel framework combining computational modeling, decision-making behavior, and neuroimaging to address this gap. Our model is grounded on the behavioral economic theory of anticipatory utility (AU) (Loewenstein, 1987). Unlike standard RL models, the AU model proposes that the anticipation of future rewards has an inherent value in addition to the experience of the outcome itself. While this model explains well-documented preferences for seeking early information about future rewards (Iigaya et al., 2016, 2020), it remains untested for punishment-related information seeking.

Methods: We applied this model to a newly developed information-seeking task about potential punishments in online (N = 56) and in-person (N = 37) behavior studies. Participants completed self-report transdiagnostic symptoms questionnaires. Physiological signals (pupil dilation and heart rate) were collected while participants performed the in-person task. In a different population (N = 34), participants completed an fMRI version of the task, and neuromelanin-sensitive MRI (Cassidy et al., 2019) was acquired for each one of the subjects.

Results: Contrary to the naive prediction from the AU model, we observed many subjects seeking information about future punishments, especially under longer anticipation conditions. However, participants reported that they reframed the anticipation of avoiding punishments as a positively valued experience. We show in the model that this value reframing makes the task mathematically equivalent to a reward information-seeking task, capturing the preference for advanced information. Individual differences in the strength of reframing were associated with self-reported personality traits, such as anhedonia and anxiety. Physiological signals reflected the impact of punishment-related information in the anticipatory process. Additionally, participants' anticipatory information-seeking could be linked to their neuromelanin-sensitive MRI index of dopamine function in midbrain nuclei.

Conclusions: Our results offer a new perspective on negative anticipation as a complex process that involves value reframing. Individual variation in reframing could offer novel insights into the anticipation in healthy populations and alterations to this process in psychiatric conditions.

P3.E.38 - Allais paradox and the temporal resolution of uncertainty in decision under risk

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Details

We investigated whether and how the timing of uncertainty resolution impacts risk preferences. Despite growing works on information-seeking preferences, it remains unclear how knowing information in advance would impact our attitudes toward risk in decision making. To examine this question, we focused on the Allais paradox and asked how the timing of uncertainty resolution might impact this well-established phenomenon. Using the common-ratio design, in a lottery decision task, we systematically manipulated the timing of resolution such that one lottery would be resolved now, whereas the other would be resolved at a later date (7, 30, 60, 120 days from now). To control for temporal discounting, the timing of reward delivery was the same and set at the date of the later-resolved option regardless of choice. In other words, subjects could choose the lottery where they would learn about whether they won the lottery now, but the timing of reward delivery (in the case of winning the lottery) would be the same as the other, later-resolved option. We found that, at the group level, delay in uncertainty resolution significantly reduced the subjective value of an option across different levels of risk and expected value. When examining the Allais paradox, we found that it was present across different combinations of information delay. However, the size of the paradox did not change with information delay. Further, we found that individual subjects' sensitivity to information delay did not correlate significantly with temporal discounting in a standard intertemporal choice task performed in a separate session. Together, these results suggest that information-seeking preferences may be dissociable from both risk preferences and time preferences.

P3.F.19 - Exploring gain-loss sensitivity in piglets using the Scrofa Soochow Gambling Task

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Details

Background: Decision-making under uncertainty is fundamental in both humans and animals. The Iowa Gambling Task (IGT) shows that healthy adults tend to favor options with better long-term outcomes, unlike those with medial prefrontal cortex damage, who prefer immediate but poorer long-term rewards—highlighting the frontal cortex's role.

However, expected value (EV) may not fully explain human behavior. Chiu et al. (2008) proposed gain-loss frequency (GLF) as a better predictor and developed the Soochow Gambling Task (SGT), where people often chose more frequent small rewards despite lower EV—challenging EV-based rationality.

To test if such tendencies appear in species with immature frontal cortices, we designed the Scrofa Soochow Gambling Task (SSGT) to see if piglets (*Sus scrofa*) show GLF sensitivity when EV and GLF diverge.

Methods: Eight 6-week-old weaned piglets were food-deprived for 8 hours. Following Proctor et al. (2014), Option A provided high-frequency, low-magnitude rewards (GLF+: 3 small gains [~2.7 g], 1 omission [no food, 1 min.]); Option B offered low-frequency, high-magnitude rewards (GLF-: 3 omissions [no food, 1 min.], 1 large gain [~8 g]). Both options had equal EV. Choices were administered via Tuya Smart-controlled feeders. Each piglet completed 12 trials; all choices and omissions were recorded.

The task environment, including waiting and choice areas, followed Murphy et al. (2015). Adaptation steps—device familiarization, task learning, and timing—were also modeled on their protocol.

Results & Discussion: Piglets chose Option A 38 times, Option B 44 times; 14 trials had no choice. A chi-square test showed no significant preference or deviation from chance. The GLF effect may have been reduced due to using omissions rather than actual losses as punishment.

Piglets appeared to be exploring under ambiguity, lacking consistent preferences. While no GLF-driven pattern emerged, the findings highlight the potential role of frontal cortex maturity in developing reward-based strategies. Future studies should extend testing to examine whether GLF sensitivity appears with experience and whether it reflects evolved or cortically mediated behavior.

P3.F.20 - Do people predict others' decisions by repeated sampling of simulated outcomes?

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Details

There is substantial evidence that humans engage their own decision-making mechanisms when predicting choices of others. According to one account, such predictions are implemented by the observer running a single simulation of the other person's decision process in their mind and selecting the simulation outcome as the choice option.

Here, we postulate that observers could reduce uncertainty and increase prediction accuracy by simulating the decision between the same two options multiple times, sampling the outcomes and then selecting the option corresponding to the most frequent outcome. A computational simulation exercise reveals this to be particularly beneficial for decisions with a medium strength of preference: the higher the number of sampled simulated outcomes, the more deterministically the preferred option gets chosen (thus pushing the observer from a probability-matching to a utility-maximizing strategy), which increases accuracy over multiple predictions. Additionally, with sampling more simulated outcomes, repeated predicted decisions should become less stochastic, and we would expect the implementation costs to result in higher response time.

We developed a behavioural decision study employing the modified dictator game paradigm, aimed at testing whether we can identify these behavioural indicators of sampling multiple simulation outcomes when participants predict other's choices. We first estimated participants' social preference and other drift diffusion model parameters to precisely generate a set of option pairs with medium/high strength of preference and then, across two experimental stages, asked participants to choose for themselves and to make predictions for another (artificial) decision-maker on these option pairs. We further employed a between-subjects manipulation: in one experimental condition, the other decision-maker's social preference was identical to the participant, and in another condition it was set to differ by a constant value. At the conference, we expect to present data from this study (N = 65 participants in each condition), along with analyses based on the Drift-Diffusion model and a "sampling-of-decision-outcomes" model of choice. These findings will shed light on potential differences between the mechanisms involved in making choices for ourselves and predicting the choices of others.

P3.F.39 - Beliefs about others' preferences modulate social conformity

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Details

People tend to follow others' choices. It has been suggested that individuals assign additional value to options chosen by others, which contributes to their increased tendency to conform. Since each choice made by others serves as a form of social information, the perceived usefulness or credibility of that information may vary depending on its source. However, the mechanisms via which individuals use their knowledge about others to interpret and assign value to observed social information remain unknown. Here, we developed a novel gambling task, completed by thirty-seven participants, where they made a series of choices between a safe and a risky option either on their own or after observing the choices of two other players. Critically, before presenting the others' choices on the 'Social' trials, we provided partial information about the two other players by indicating which group they were selected from, among five groups varying in risk preference from extremely risk-averse to extremely risk-seeking. Participants' gamble choices on the Social trials revealed varying levels of conformity depending on the risk preference group of others, suggesting that this information modulated the influence of others' choices on participants' own decisions. To directly investigate the mechanisms underlying this modulatory influence, we constructed a computational model incorporating three hypotheses; i) individuals update their beliefs about others' preferences on each trial based on observed choices; ii) updates to risk preferences for one group of others generalize to other groups; and most importantly, iii) the social value assigned to an observed choice is determined by the discrepancy between the individual's belief and the observed choice (i.e., action prediction error, APE). By using a grid-search and behavioral simulation, we estimated individual-level model parameters that best explain participants' behavioral choices. As hypothesized, individuals' sensitivity to APE, despite individual variability in the estimated free parameter, was positively correlated with the extent to which they conformed to others' choices. These findings suggest that individuals rely on their belief about others' preferences to assess the informational value of observed choices in guiding their own decisions. Our data provide mechanistic insight into how the source of social information modulates its value as a key determinant in decision-making processes.

P3.G.21 - Bayesian decision-making across tasks and time

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Details

Introduction: From looking for a pet cat to playing catch with friends, people make decisions all the time. In most decision contexts, at least two categories of information are available: prior information, which refers to previous experiences in similar situations, and likelihood information, which refers to the current sensory input. Past experience playing with a particular friend may combine with momentary information about their current energy levels to inform our decision of how far we may need to run to catch their ball. How do we use both of these categories of information to make decisions, and to what extent may this generalize between contexts (i.e., searching vs. catching a ball)? While evidence from both sensorimotor and perceptual domains supports qualitatively Bayesian-like decision-making, less is understood about its stability and generalizability. Is a Bayesian-optimal searcher also a Bayesian-optimal catcher?

Objectives: Here, we applied Bayesian Decision Theory to assess the stability of individual differences within and across tasks in how prior and likelihood are used.

Methods: The same set of participants (N=105) conducted two tasks, a coin-catching sensorimotor task and a visual search task, twice, roughly two weeks apart. In the coin-catching task, participants inferred a coin's hidden location from splash patterns (sensory input) and the thrower's past accuracy (prior). In the visual search task, participants indicated whether a target was present or absent in a display with hidden items, requiring them to consider both visible cues and prior prevalence rates.

Results: Results showed that, at a group level, participants showed qualitatively Bayesian-like behavior. At the individual level, some measures had good test-retest reliability within a task, such as the sensory weight in the coin-catching task (ICC [3,1] = 0.66, $p < 10^{-13}$) and accuracy in visual search (ICC [3,1] = 0.6, $p < 10^{-9}$). However, the test-retest reliability of sensitivity to changes in prior and likelihood uncertainty differed between tasks and was poorly or not correlated across tasks, signaling that differential Bayesian-weighting may not be domain-general.

Conclusions: Altogether, this study gives concrete suggestions of which measures within these tasks should - and should not - be used to compare populations and potentially serve as biomarkers. Furthermore, it suggests that while certain measures may be reliable within-tasks and could potentially serve as individual-differences measures, it casts doubts on the generalizability of individual Bayesian behavior across tasks.

P3.G.22 - Developing a neuroeconomically informed and biologically constrained regret inventory

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Details

Regret is a poorly understood emotion that may contribute to nearly every mental illness. Regret describes a form of counterfactual thinking where one recognizes alternative decisions could have led to better outcomes. Despite being widely accepted that regret can be detrimental to emotional well-being, no description appears in the DSM nor is pathognomonic for any disorder. Further, little is known about what aspects of regret if any carry utility worth preserving to restore healthy emotional processing and adaptive coping, even if evoking cognitive dissonance. Although psychologists, economists, and neuroscientists have been working toward understanding regret, this has historically occurred outside of a unified framework without a shared lexicon rooted in underlying neurobiology. Currently, there are limited clinical tools that move beyond plain language to describe regret. We propose the concept of a Neuroeconomic Regret Inventory (NRI) inspired by cross-species research efforts to resolve attributes of regret into discretely measurable computational units. The NRI characterizes multiple, orthogonal dimensions of regret. Question items examine cognitive domains derived from neuroeconomic principles, including aspects of reinforcement learning, foraging theory, and temporal discounting. Here, we collected data from 350 subjects online via the Prolific platform. We found subjects could complete the 115-item NRI survey in approximately 15 min. We found that overall, subjects ranked regret related to relationships as the most important life category compared to finance, health, career, and legal decisions. Interestingly, relationship regret-related decisions was the only category that interacted with sex and age. Across the 115 NRI items, questions elicited a wide distribution of responses that scored with varying direction and magnitude. This included within each of the 6 major themes of question items: general questions, regret recognition and registration, feeling and affect, mental operations, reactions and responses, and lastly, anticipation avoidance and learning. Our vision is that this tool could provide improved neuroeconomic language to be leveraged in multiple settings, e.g., structured interviews to guide psychotherapy strategies and inform computational models of task-based behavior and physiology. By enhancing the diagnostic nosology of psychiatric disorders through a description of one's decision narrative, we can develop more effective treatments based on a richer understanding of the psychological mechanisms mediating the perception and influence of one's prior actions.

P3.G.34 - Cognition is the invisible hand: How response times drive allocational efficiency in markets

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Details

What drives stability and efficiency in free markets? Economists have long debated this question, but few have considered the role of the brain. This project proposes a novel neuro-cognitive hypothesis:

Cognition is the “invisible hand”.

Specifically, the time it takes for producers and consumers to make offers acts as a natural matching mechanism that promotes the most beneficial trades. In continuous double auctions, buyers and sellers submit offers until they are matched for a transaction, after which they leave the market. Theoretically, prices stabilize at the competitive equilibrium when the highest-value buyers are the most likely to match with the lowest-cost sellers.

Sequential sampling models (SSMs) from neuroscience describe how individuals accumulate evidence before committing to a decision. A key prediction of these models is that faster decisions occur when evidence strongly favors one option. Applied to markets, this suggests that the quickest traders at any price will often be the lowest-cost sellers and the highest-value buyers. Coincidentally, these are also the individuals most likely to strike a deal, as they have a wider range of prices at which they are willing to compromise. Thus, efficient market-clearing may emerge naturally from decision timing.

We explore this idea using theory, experimental data, and simulations. First, we prove that in a first-come, first-serve market where participants exhibit SSM-like decision-time patterns, price and quantity converge to competitive equilibrium as the number of traders increases.

Second, we analyze over 100 double auctions from Ikica et al. (2023). These markets show a clear pattern: the fastest offers tend to come from those with the most to gain, which aligns with SSM predictions.

Third, we simulate market dynamics using SSMs and compare them to the canonical zero-intelligence (ZI) trader model. Our model reproduces observed convergence patterns in continuous time. In contrast, ZI traders would need to submit

new offers every half second to achieve similar results. We also show asymmetric time pressure (e.g. only on buyers) can shift the bulk of trading surplus to the opposing side.

These findings suggest that decision timing, rooted in basic cognitive mechanisms, can serve as an “invisible hand” that drives market efficiency. By linking neuro-cognitive processes to aggregate outcomes, we offer a novel explanation for why double auctions reliably reach equilibrium—and show how cognitive constraints (like time pressure) shape market dynamics. More broadly, we highlight the promise of integrating neuroscience into economic theory.

P3.G.40 - Exploring the relationship between objective and subjective skills, socioeconomic status, and risky decision making

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Details

Objective: This exploratory study leverages existing data to explore the relationship between objective and subjective graph literacy, numeracy, socioeconomic status (SES) and risky decision making. Understanding graphs and numbers is essential for navigating everyday decisions, from managing finances to interpreting health risks. Socioeconomic disparities may limit opportunities to develop these skills, yet the relationships between SES and both graph literacy and numeracy remain unclear. Here, we examine how these constructs relate to both objective and subjective SES and whether they relate to decision making.

Method: Using datasets from two adult lifespan ($N = 78$; $N = 119$; 25-85) studies, we explored correlations between graph literacy, numeracy, socioeconomic status, and gambling acceptance rate. Objective graph literacy (OGL) was assessed with the Short Graph Literacy scale, subjective graph literacy (SGL) with the Subjective Graph Literacy scale, objective numeracy (ON) with the Berlin Numeracy Test, and subjective numeracy (SN) with the Subjective Numeracy scale. SES was assessed as objective (income and education composite) and subjective (self-perceived rank in country and community composite). Acceptance rate was calculated as the proportion of gambles accepted.

Results: We explored the relationships between four individual difference measures (OGL, SGL, ON, SN) with two measures of SES (objective and subjective) across two studies. Sixteen Pearson's correlations were run (4 measures $\times$ 2 SES variables $\times$ 2 studies; Bonferroni correction $\alpha = .0031$).

In study 1, only subjective numeracy was significantly related to objective SES, $r(76) = .365$, $p = .001$. In study 2, only subjective numeracy was significantly related to objective SES ($r(117) = .329$, $p < .001$) and subjective SES ($r(117) = .298$, $p < .001$).

We also explored the relationships between the four individual difference measures and gambling acceptance rate. Eight Pearson's correlations were run (4 measures $\times$ 2 studies; Bonferroni correction $\alpha = .00625$). None of the measures showed a significant relationship with acceptance rate.

Conclusions: Although objective skills are often assumed to be shaped by SES, this exploratory work shows they are SES-independent. Rather, it's people's perceptions of their numerical skills that are tied to SES. These self-perceptions may impact the decisions people make, potentially reinforcing SES disparities not by objective skill gaps, but by psychological barriers. Graph literacy and numeracy were not related to gambling acceptance rate, indicating that neither numerical/graphical skills nor self-perceptions were related to risky financial decision making.

P3.H.23 - The Prominent Deck B Phenomenon in Schizophrenia: Insights from Clinical and Reversed Clinical Iowa Gambling Tasks

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Details

Objective: Schizophrenia (SZ) is a chronic psychiatric disorder characterized by deficits in cognitive and emotional processing, which impair daily decision-making and negatively impact psychosocial functioning, treatment adherence, and financial management. The Iowa Gambling Task (IGT) has been widely used to evaluate decision-making under dynamic uncertainty, simulating real-life choices. Its clinical version (cIGT) claims applicability across 13 psychiatric disorders. However, debate remains over whether expected value (EV) or gain-loss frequency (GLF) better differentiates performance between individuals with SZ and healthy controls (HC). This study is the first to examine SZ-related decision-making using both a two-stage cIGT and a reversed clinical version (rcIGT), focusing on EV and GLF scores, decision strategies, and the presence of the Prominent Deck B (PDB) phenomenon.

Methods: A total of 69 individuals with SZ and 73 HCs participated. The study comprised two parts:

Study 1: Participants (32 SZ, 38 HC) completed a two-stage cIGT. Analyses included EV and GLF scores, deck selections, learning curves, decision strategies, and the PDB phenomenon. Post-task assessments included a brief interview, the Positive and Negative Syndrome Scale (PANSS), and the self-rated Personal and Social Performance Scale (SRG-PSP).

Study 2: A separate cohort (37 SZ, 35 HC) completed a two-stage rIGT. The same variables were analyzed, with particular attention to the mirrored PDB phenomenon. Post-task assessments mirrored those used in Study 1.

Results: In the cIGT, no significant group differences were found in net scores or GLF indices. Similarly, most EV and GLF measures in the rIGT failed to distinguish between groups, however, SZ participants showed a significant decline in net scores in the second stage of the rIGT. Learning curves were comparable across groups. In the rIGT, SZ participants exhibited higher win-shift/lose-shift rates and lower win-stay/lose-stay rates than HCs. The PDB phenomenon was observed in both groups in the cIGT, and the mirrored PDB phenomenon emerged in the rIGT.

Conclusions: Across both tasks, most EV and GLF metrics did not differentiate SZ and HC decision patterns. However, the consistent emergence of PDB and mirrored PDB phenomena suggests that GLF plays a dominant role in guiding decision-making in both groups. These findings support those of Wilder et al. (1998) and Xu et al. (2021), underscoring the need to reconsider the current design of the cIGT. The rIGT, with increased trial numbers and strategy-based analyses, may offer greater clinical sensitivity in detecting SZ-specific decision impairments and improving assessment utility.

P3.H.24 - Entorhinal cortex signals when to generalise in a novel environment

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Details

No two situations are identical. This poses a key challenge when attempting to generalise our experience from one situation to another. How do we distinguish the elements that are the same across situations from those that are different? One hypothesis is that the medial temporal lobe (MTL) meets this challenge through changes in representational similarity, with increased neural similarity when information can be generalised. We tested this hypothesis in a functional magnetic resonance imaging study. Forty people were trained to report behavioural sequences based on an underlying graph structure to obtain rewards. People then made decisions in a new environment where some but not all elements of the previous graph structure were maintained. Behavioural results showed that participants distinguished shared and unshared sequence elements in the novel environment. Accuracy was significantly higher in blocks where transitions were shared across environments, compared to those where transitions differed (Mgen=68.91% vs. Mnon-gen=61.23%, Mdiff=7.68%, SDdiff=17.56, permutation test: $p=0.009$). This boost in accuracy was especially pronounced during the first half of scanning in the novel environment (Mgen=55.72% vs. Mnon-gen=44.08%, Mdiff=11.64%, SDdiff=20.68, permutation test: $p=0.004$). Throughout this early phase, neural patterns in the entorhinal cortex (EC) showed a corresponding differentiation between the shared and unshared elements across environments. Neural patterns representing starting locations in the familiar and novel environments were significantly more similar in the EC on trials where sequences could be generalised from prior experience, compared to trials with new sequential transitions (mean $\beta_{\text{gen}}=0.026$, $\text{SD}_{\text{gen}}=0.066$, mean $\beta_{\text{non-gen}}=0.010$, $\text{SD}_{\text{non-gen}}=0.102$, Mdiff=0.016, SDdiff=0.102, permutation test: $p=0.018$). This neural signalling was further associated with decision performance in the novel environment. A larger neural distinction in the EC between trials where sequences could and could not be generalised predicted increased performance on trials where prior sequence knowledge could be reused ($\beta=1.97$, $p=0.026$). The results from this experiment suggest that during early exposure to novel environments, entorhinal cortex may signal moments where formerly acquired knowledge can be generalised for effective decision-making.

P3.H.41 - Inferring the time-dependent value of novel items

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Details

Objective: The value of prospective outcomes can appreciate or depreciate with the passage of time. Different types of outcomes undergo different profiles of time-dependent change, and human and nonhuman decision makers can account for such changes in a context-appropriate fashion. The medial temporal lobe represents contextual and temporal information and is thought to interact with cortical valuation circuits during memory-guided decisions. Here, we report

preliminary results from a study investigating brain responses associated with inferring the time-dependent value of novel decision prospects.

Methods: Human participants encountered a series of visually unique items and were periodically offered a choice to accept or decline a previously encountered item. Decisions occurred in two environments marked by unique background images. In a “rising-value” environment, the reward for accepting an item increased with the lag since its previous occurrence; in a “falling-value” environment, it did the opposite. Pre-trained participants completed 4 fMRI sessions, each with two 10-min runs per environment.

We adopted a dual-echo fMRI protocol to improve signal quality in inferior regions of medial PFC and medial temporal lobe while maintaining high nominal spatial resolution (2 mm isotropic) and temporal resolution (TR 1.475 s).

By design, the rising and falling value conditions jointly dissociated expected reward value from recency and task difficulty. Univariate analyses modeled effects of expected value, log-transformed lag, and response time. Multivariate analyses trained subject-level support vector classifiers on accept/reject decisions and tested on a held-out session. Decoder confidence scores were used in follow-up univariate analyses to examine the neural information that supported classification performance.

Results: Whole-brain univariate analyses revealed clusters positively associated with expected value in left ventral striatum and bilateral occipital lobe ($t(13) > 3.019$, $p < 0.01$ uncorrected, 20-voxel cluster threshold). Temporal lag correlated positively with signal in regions including retrosplenial and parahippocampal cortex. Accept/reject decoding was significantly above chance (median=0.54, Wilcoxon signed-rank $p < 0.001$). Decoder confidence scores correlated positively with signal in bilateral ventral striatum, bilateral occipital lobe, and cerebellum.

Conclusion: Our results indicate that humans can flexibly adapt to environmental structures characterized by different patterns of dynamic change in reward value. Ventral striatal activity tracked the context-dependent value of novel items inferred using memory-based temporal information.

P3.H.42 - Whole-scalp subjective value representation reflects adaptive value encoding

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Details

Objective: Humans often learn and encode value in a context-dependent manner (Palminteri & Lebreton, 2021). Whilst there are many advantages to this, it can also lead to sub-optimal behaviour (Klein et al., 2017). We recently demonstrated that humans switch between context-dependent and context-independent mechanisms based on the local learning environment: choosing an independent mechanism when a dependent mechanism is sub-optimal (Juechems et al., 2022). Are neural value codes consistent with adaptive value encoding?

Methods: As in previous work, we implicitly manipulated participants' expectations about whether option values learned within local contexts would need to be subsequently compared across contexts ('crossed', $N=40$) or not ('uncrossed', $N=40$). Participants first learned about 6 real-valued options, presented in 3 fixed pairs. Following learning, and whilst EEG was recorded, participants completed a 1-back task (without feedback), simply observing sequentially presented stimuli (and only infrequently making decisions). In addition, we recorded EEG prior to learning (to measure visual encoding), and measured value encoding independently from the EEG task (using behavioural tasks).

Results: We replicated adaptive value encoding; the behaviour in the crossed group was more consistent with context-independent encoding than that in the uncrossed group. For each time-point and participant, we correlated neural RDMs with individual participants' subjective value RDMs derived from the independent behavioural task. In both groups, a subjective value code emerged ~360 ms after stimulus onset. This code was distinct, and largely independent, from a stimulus identity code (emerging at ~100 ms). Using participant-wise temporal ROIs, we interrogated the subjective neural value code using model-based value RDMs, which were derived from fitting reinforcement-learning models. The neural code in the crossed group was more consistent with context-independence, compared to the uncrossed group, thus providing neural evidence of adaptive encoding. However, the evidence for context-dependence was comparably weak. We demonstrate that this is partly due to individual variability (many participants do not default to context-dependence), but also due to context-dependent models being comparatively less good at capturing variation in the neural data.

Conclusion: The neural representation of value decoded at whole-scalp level is consistent with adaptive value encoding.

**P3.H.43 - Seeking information from compassionate code:
AI compassion increases information seeking but not learning**

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Details

Objective: Humans turn to AI systems (LLMs) daily for information. How does AI's tone influence our desire to seek information and ability to process it? Theory suggests we are more likely to want information when we expect it to improve our understanding and mood (Sharot & Sunstein, 2020). Those factors may also be associated with how well we learn information. Because an AI's tone (particularly social-emotional tone) may impact humans' subjective understanding and mood, it may in turn impact information seeking and learning. We examine if and how AI's perceived tone affects humans' tendency to seek and learn from information.

Methods: 206 subjects completed a multiple-choice exam before and after receiving feedback from an AI system (GPT4o). They reported their mood and subjective understanding before and after receiving feedback and indicated whether they wanted more information about the topic. Feedback was generated multiple times per question using the prompt: "I think the correct answer to the question below is {answer}. Is this correct?". The responses varied in tone but were always accurate. Subjects thus received different feedback and rated their perception of it on empathy, politeness, helpfulness, bluntness, and confrontational tone.

Results: After interacting with the AI, subjects improved on the exam ($t(205)=7.64$, $p<.001$) and indicated they wanted to learn more ($t(205)=5.51$, $p<.001$). Dimensionality reduction analysis of the ratings produced a component explaining 32% of variability. This component, which we labelled "perceived compassion", had high weights on empathy, politeness, helpfulness; a negative weight on bluntness; and zero weight on confrontation. Importantly, we found that greater perceived compassion was related to greater information seeking ($\beta=11.25$, $p<.001$), improved mood ($\beta=2.10$, $p=.05$) and enhanced feeling of understanding ($\beta=9.30$, $p<.001$). In contrast, it was not associated with changes in exam scores ($\beta=0.01$, $p=.31$, $R^2=.01$). The increase in information seeking was mediated by improved mood (ACME=1.38, $p=.036$) and subjective understanding (ACME=3.05, $p<.001$).

Conclusion: Compassionate AI increased information seeking by enhancing mood and a feeling of understanding, but not learning per-se. This demonstrates a dissociation between factors that increase information seeking (and subjective understanding) and those that increase objective learning. Understanding this dissociation is important for theoretical models of learning and for developing AI that not only engages people but also facilitates accurate learning.

P3.I. 25 - Behavioral Study to investigate a Decision Support System in a Multi-Attribute context

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Details

Several decisions task involve multiple items in a multi-attribute decision-making approach. In order to support Decision-Makers (DMs) to solve these tasks several methods have been proposed in literature. These methods support DMs to deal with their bounded rationality considering their preferences to conduct decision processes. This kind of decision task is named value-based decision-making since involve choices guided by DMs idiosyncratic preferences (Glimcher 2014). The FITradeoff Method (De Almeida et al., 2016) is a multi-attribute method constructed for value-based decision-making.

Objective: The objective of this study has been to investigate the cognitive load of Decision-Makers when they use the FITradeoff Method. In special, this study focusses on investigating the holistic evaluation of items during the FITradeoff decision process. Hence, the main objective has been to investigate how DMs compare alternatives in a value-based decision problem using graphical and tabular visualizations.

Methodology: An experiment has been conducted using an experimental version of the FITradeoff Decision Support System. Through the experiment, participants were asked to solve their own decision-making problems. The sample has been composed of 86 graduate and postgraduate students of multi-attribute classes. The experiment has been performed in Neuroscience for Information and Decision Laboratory, and has been supported by two neuroscience tools, namely a 32-channel EEG and Eye-Tracking.

Results: Using these tools, analyses have been done with pupil dilatation and fixations. Also, Alpha, Theta, and Beta bands have been investigated. As result it has been observed that participants presented higher fixations in holistic evaluation process. In addition, they preferred to perform holistic evaluation using bar graphs and tables. Concerning brain activity,

it has been suggested that participants had cognitive effort and attention during the experiment.

Conclusion: Based on the results, several transformations have been made to the FITradeoff DSS to improve multi-attribute tasks. This DSS is available in web at www.fitradeoff.org.

P3.I. 26 - Pupil-linked arousal tracks previous choices and experienced values in decision-making under risk

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Details

The brain's arousal system, as indexed by pupil dilation, is thought to support behavioral flexibility by signaling uncertainty or prediction errors during cognitive tasks. However, its role in decision-making under risk—where individuals evaluate probabilistic gains and losses to guide their choices—remains underexplored. Sheng et al. (2020) found that in participants with a bias toward rejecting gambles, accepting a gamble was associated with larger pupil dilation, suggesting effort to overcome a response bias. Using the NARPS dataset (behavioral data: N=108; pupil data: N=54), we investigate pupil-linked arousal in two conditions of a mixed gambles task, where acceptance rates vary widely across individuals.

To obtain more reliable estimates of subjective value (SV), we first show that modeling choices using Cumulative Prospect Theory to predict ordinal accept/reject ratings (CPT-ordinal) yields better parameter recovery and explains more variance in response times than traditional binary choice models. Using these SV estimates, we analyzed pupil responses with linear mixed-effects models. We corroborate that larger pupil dilation was associated with choices that deviated from participants' default response tendencies, whether accepting or rejecting. Furthermore, pupil responses tracked the absolute magnitude of change in subjective value between consecutive trials, a potential proxy for prediction error relative to the immediately preceding option. To test if these pupil-linked signals actively shape the decision process, we fit Diffusion Decision Models (DDMs) with pupil-based regressors modulating core parameters (e.g., drift rate, starting point, rate of collapsing bounds). However, these models did not outperform a standard DDM, suggesting that in this context, arousal may track but not directly drive decision formation.

Together, these findings refine our understanding of arousal's role in value-based decision-making, highlighting its function in tracking the dynamics of experienced values and previous choice that may support future adaptive behavior.

P3.I.44 - Ventromedial prefrontal cortex resting state activation mediates the effect of body composition on eating behavioral change awareness

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Details

Communication based approaches such as motivational interviewing can foster behavioral change awareness. Recent evidence from our group suggests that such approaches can also apply to dietary decision making, but the strength of the awareness can vary across participants. In this study we hypothesized that the intrinsic functional organization of the brain at rest should be a source for inter-individual differences in importance of change awareness.

Seventy participants (56 females, 14 males, Age = 35.0 ± 1.6) rated how important it is for them to change their eating habits during a motivational interviewing session. One week later they underwent resting state functional magnetic resonance imaging to assess intrinsic brain activity.

Analysis revealed that participants' ratings of the importance to change their dietary habits were positively correlated with their body mass index (BMI; $R = 0.51$, $p < 0.001$, $n = 65$). Both BMI and importance to change ratings positively moderated resting state activation of the ventromedial prefrontal cortex (vmPFC) within the default mode network (DMNvmPFC: $RBMI = 0.4$, $Rimportance = 0.4$; $pFWE < 0.05$).

Crucially, the resting state activation of the vmPFC, that during a prior task-based fMRI session activated in response to food stimulus value ($MNI = [0\ 38\ -6]$), formally mediated the link between BMI and importance to change ($ab = 0.03$, $SE = 0.01$, $p = 0.048$, $c = 0.12$, $SE = 0.03$, $p < 0.001$, $c' = 0.09$, $SE = 0.03$, $p = 0.001$).

These findings provide evidence that the effect of body composition on importance for change awareness is explained by the intrinsic functional organization of the vmPFC associated with food preference formation, and its connectivity to brain regions associated with self-referential processing and valuation.

P3.I.45 - Validating predictions of a flexible decision-making model for varying decision goals and choice set properties

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Details

Introduction: To better capture the flexibility of everyday decisions, we recently proposed a new dynamic decision model that adjusts evidence accumulation as a function of goal-relevant features (e.g., perceptual vs. value-based); the criterion options are compared against (e.g., best vs. worst); and whether options are competing (choice) vs. integrated over (appraisal). Here, we validate two untested predictions of this model: (1) that increasing the size of a choice set will differently impact choice behavior depending on whether the participant's goal was to choose among options vs. appraise the set as a whole; and (2) that the effect of appraisal vs. choice, and of inverting one's criterion (most vs. least preferred item), should be mirrored when reallocating attention to perceptual features of the same stimuli.

Methods: Participants rated a series of consumer products based on their liking and (in Studies 2-3) their perceived real-world size. These ratings were used to generate option sets that varied in average and relative value. In Study 1, option sets varied in size (3-6 items) while participants (N=76) were asked to (a) choose the most liked product or (b) appraise the set as a whole. In Study 2, participants (N=33) appraised four-item sets for overall liking or real-world size. In Study 3, participants (N=20) instead made choices based on (a) the value vs. size of the items and (b) the max vs. min of the set (i.e., best, worst, largest, smallest).

Results: Study 1 replicated past findings that appraisal and choice response time (RT) depended differently on option value: choice RT decreased with overall value (OV) and appraisal RT demonstrated an inverse U-shaped pattern (fastest for low and high value sets, slowest for moderate value). As predicted by our model, we found that the influence of OV on RT varied with set size when participants were choosing ($p=0.02$) but not when they were appraising ($p=0.99$). Study 2 showed that the inverse U-shaped influence of OV on appraisal RT generalized to perceptual choice, with appraisals being fastest when items were overall small or large, and slowest when items were moderately sized ($p=0.001$). Study 3 showed that participants were faster to choose the best option out of a high-OV set ($p<0.01$) and the worst option out of a low-OV set ($p<0.01$). This reversal was mirrored in perceptual choice, with faster responses when choosing the largest of a set of large items ($p<0.03$) or the smallest of a set of small items ($p<0.01$).

Conclusions: Our behavioral results provide strong evidence that supports our proposed flexible decision making mechanism, and open the door to examining associated neural mechanisms.

P3.J.27 - Humans remap value when making risky economic decisions under different goals

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Details

Goal-directed decision making is a fundamental part of human behavior. While previous work has explored how different values across multiple attributes are differentially weighted to reach a decision under different goals (Von Winterfeldt & Fischer, 1975), little is known about how the human valuation process itself is influenced by goals. We abstracted away from attributes by using numerical points. We tested participants (total $n=499$) with a risky decision-making task that alternated between explicit goals to either 1) maximize points or 2) minimize points in either 1) blocked or 2) dynamically switching designs. Participants made choices between safe and risky options in trials that featured 1) only potential gains, 2) potential gains and losses or 3) only potential losses. Outcomes were displayed after each choice. On average, 82% of participants earned more for the maximize goal than the minimize goal ($p < 0.001$), showing that participants successfully oriented to the goal. We tested how this goal orientation was achieved by comparing two models based on prospect theory: 1) a "do-opposite" model in which potential gains and losses were transformed into utilities in the same way for both goals, with a "do opposite" heuristic applied at the decision stage for the minimize goal; or 2) a "value-remap" model in which the decision stage was unaffected but value transformation was goal-congruent such that computational parameters influencing utilities for gains for the maximize goal apply to utilities for losses for the minimize goal. Using model comparison, we found that the "value-remap" model fit better for 80% of participants. Furthermore, we found that the distance between the goal-aligned risk aversion parameters (i.e., α_{gain} for gains in maximize and α_{loss} for losses in minimize) was lower than the points-aligned parameters (i.e., α_{gain} for gains in maximize and α_{gain} for gains in minimize) for block and dynamic designs (both $p < 0.01$). Our results suggest that the best way to predict how someone will choose when trying to lose points when only losses are available is knowing how they choose when they are trying to gain points when only gains are available. Overall, we find evidence that humans flexibly and dynamically remap values according to current goals.

P3.J.28 - Counterfactual outcomes influence feelings of regret more than behavioural adaptation

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Details

Regret is a negative emotion triggered by counterfactual thinking, a process of comparing reality to hypothetical alternatives (e.g., "Had I taken the umbrella, I wouldn't have gotten wet"). While prior research has largely focused on how regret affects behavioural adaptation, the way people psychologically experience regret remains unclear. Some theories suggest that regret arises from directly comparing an actual outcome and a better outcome that would have resulted from a different choice (a counterfactual outcome). Others argue that regret is sensitive to the likelihood of counterfactuals and better characterised by counterfactual prediction errors that depend on the probability of counterfactual outcomes. We tested these different theories across 2 studies.

Participants (N=296) completed a risky decision-making task involving choices between a safe and a risky option. In both studies, participants received feedback on the outcome of both chosen and unchosen options (counterfactual outcome) and periodically rated their momentary happiness. In study 2, we introduced a learning context using a between subject design: the risky option either had a 70% chance (high-win) or a 30% chance of winning (low-win) and participants could learn this through experienced and counterfactual feedback.

In both studies, we found that happiness was higher when risky choices resulted in a win compared to a loss (all $p < .001$, all $r > .63$). Happiness was also significantly lower when the counterfactual risky choice would have won versus lost in study 1 and the high-win condition of study 2 (both $p < .001$, $r = .26$ and $.47$) but was insensitive to counterfactual outcome in the low-win condition ($p = .59$, $r = 0.08$). In study 2, participants chose risky options more in the high-win than low-win condition ($p < .001$, $r = .45$). However, in both studies, counterfactual outcomes did not affect subsequent choices (all $p > .13$, all $r < .15$), despite the value of counterfactual information for learning win probabilities. A computational model integrating Bayesian learning of win probability and separate influences of positive (relief) and negative (regret) counterfactual comparisons on happiness provided the best fit for both studies. This model outperformed models based on counterfactual prediction errors, models with no learning of the win probability of the risky choice, and models that did not distinguish between the effects of positive and negative counterfactual information.

These findings strengthen our existing understanding of how regret is psychologically experienced and highlight the dissociable impact of counterfactual information on subject feelings of regret and subsequent behaviour.

P3.J.29 - When to seek help: Neural correlates of decision-making in social emotion regulation

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Details

When individuals experience distress, they often seek social support to regulate their emotions—a process known as interpersonal emotion regulation (ER). The affective determinants guiding interpersonal ER remain underexplored. This fMRI study investigated the neural foundations of stimulus intensity during interpersonal versus intrapersonal ER. Notably, we also examined three key phases of regulation: anticipation, selection, and implementation.

40 participants completed a standard ER task featuring 3 conditions: (1) Decrease Alone (intrapersonal ER), where participants used reappraisal on their own (e.g., by distancing themselves or imagining the situation as unreal); (2) Decrease Support (interpersonal ER), where participants used reappraisal statements provided by the experimenter; and (3) Control, in which participants responded naturally to negative images. The event-related design included an anticipation phase including intensity cues [2s] (high, medium, low), followed by a selection phase between intrapersonal and interpersonal ER [4s] (with balancing constraints to equalize selections), a regulation instruction [3s], an implementation phase [4s] (in which an aversive image was presented), and post-regulation ratings to indicate the current emotional state [4s]. The fMRI task consisted of 126 trials (42 per condition) and 21 trials per experimental run. Trials were randomized within each run. The experimental session consisted of 6 runs. fMRI data were collected using a 3.0 T Magnetom Prisma MRI scanner (Siemens, Erlangen, Germany) and a 64-channel head coil. A high-resolution 3D T1-weighted dataset was acquired for each subject, followed by functional images using a T2*-weighted, gradient-echo echo planar imaging (EPI) pulse sequence recording sections oriented parallel to the anterior and posterior commissure at a resolution of 2.5×2.5×2.5 mm³.

Behaviorally, participants showed a tendency to choose interpersonal ER more often with high-intensity stimuli. However, social support did not significantly enhance the effectiveness of regulation. fMRI results revealed that, during the selection phase, both interpersonal ER vs. Control and interpersonal vs. intrapersonal ER elicited greater activation

in the ventromedial and dorsolateral prefrontal cortex, and bilateral parietal cortex. These regions are associated with value-based decision-making and cognitive control, suggesting increased engagement when choosing to involve others in ER.

These findings underscore the critical role of decision-making in emotion regulation, revealing that the choice to involve others is not only shaped by emotional intensity but also engages distinct neural pathways.

P3.J.47 - Large language models reveal accelerated abstract processing during social interpretation in trait internalizing symptoms

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Details

Study's objective: Research on interpretation biases in internalizing symptoms has focused on emotional valence (i.e., negativity bias), leaving fundamental information-processing mechanisms underexplored. Guided by dual-coding theory (Kousta et al., 2011; Paivio, 1991), we examined how the balance between concrete, perceptual detail and abstract, conceptual elaboration shapes social interpretation in adults with varying levels of trait internalizing symptoms.

Methods: A confirmatory sample of 170 U.S. participants wrote interpretations of 24 ambiguous social images (12 negative, 12 non-negative) presented with gradually decreasing blur (Stage 1=80% blur, Stage 2=20%, Stage 3=0%). Large Language Model (LLM; GPT-4.1) analyses were used to compute emotional valence and the proportion of abstract versus concrete language in each response. As pre-registered (<https://osf.io/rz8pf>), trait internalizing symptoms were derived via principal component analysis, and multilevel models revealed two key findings.

Results: First, higher trait internalizing symptoms correlated with more negative interpretations ($p=.001$). This pattern was stronger for negative than non-negative scenarios ($p=.009$), replicating previous negativity-bias effects. Second, individuals high in trait internalizing symptoms showed a steeper increase in abstract language disproportionate to perceptual concreteness from Stage 1 to Stage 2 ($p=.002$), indicating earlier engagement in conceptual processing as visual ambiguity declined. The result held even when accounting for word counts and negativity scores.

Conclusions: These results extend valence-based theories by demonstrating that trait internalizing symptoms are associated with accelerated abstraction during social interpretation. LLM-derived linguistic indices provide a scalable, automated method for capturing dual-coding dynamics in natural language, offering new avenues for elucidating latent cognitive processing patterns in psychopathology.

P3.K.30 - Brains Predicting Award-Wining Ads: A neuromarketing analysis predicting the Effie Awards

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Details

Introduction: There is a lot of interest for neuromarketing; using eye-tracking and EEG for marketing applications. Companies that offer these services, collect (neuro)physiological data during TV ad exposure and advise to improve these commercials before they are launched. Despite great public interest, the academic literature on this topic remains relatively scarce. In particular, research linking these metrics to marketing-relevant outcomes on a population-level is scarce, and there is a need to validate these methods.

Recent research suggests that neural synchrony is the most predictive for ad effectiveness, but other metrics such as frontal alpha asymmetry (i.e., approach/avoidance) and power in different frequency bands of the EEG data are also used. In this project, we investigate which neuroscientific metrics are most strongly related to marketing-relevant outcomes.

Methods: In collaboration with Unravel Research, we have access to a large and rich dataset of commercials tested with neuromarketing methods (EEG, Eye-Tracking). This dataset includes approximately 1000 ads that were tested from 2019 up to 2025. EEG and eye-tracking data was collected using the ABM B-Alert X10 and the Tobii X3-120. The total dataset includes over 1,000 participants, with ca. 20 participants per stimulus, making it one of the largest studies on neuromarketing to date. Moreover, the variety of stimuli (e.g., brands, visuals) and participants (e.g., age, gender) provides generalizability.

We will investigate the predictive validity of this data for marketing-relevant outcomes by making use of the Effie Awards, which is a prize for effective marketing communication based on objective metrics, such as brand building or behavior change– depending on the brand category. We combine these two rich datasets to investigate the differences between award-winning commercials and non-award-winning commercials.

Preliminary results: Initial pilot data suggests that award winning ads stand out in terms of how much attention they attract, as well as different neuromarketing metrics of viewer engagement. Data analysis is still ongoing and more will be completed before the conference in October. Using a larger dataset, we will attempt to predict award winning ads based on this data. In addition, we will investigate which ad features are associated with the neuromarketing metrics and awards.

Conclusions: Our project is one of the few to link neuromarketing metrics to real marketing outcomes at such a massive scale and investigate the validity of these methods. Finally, our results provide practical insights for marketers to optimize advertising.

P3.K.48 - Fixation-evoked potentials reveal bayesian belief updating processes in multi-attribute choice

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Details

Introduction: Whether it be buying a new phone or finding the right hotel, many decisions problems require integrating information from multiple attributes in order to identify the best option. Our recently proposed theory of Multi-Attribute Search & Choice (MASC, Gluth et al., 2024) assumes this process follows a hierarchical Bayesian belief updating scheme. Specifically, posterior beliefs about the value of attributes, and in turn the options themselves, are iteratively updated through samples obtained from fixations. When one option is deemed sufficiently superior to all alternatives, a choice is made.

Methods: In this combined EEG and eye-tracking study, we explored whether the process of belief updating proposed by MASC is predictive of the EEG signal in terms of fixation-evoked potentials (FEPs). Participants (N = 50) completed a multi-attribute choice task in which they chose between two smartphones on the basis of star ratings for three attributes (battery capacity, screen size and storage space). We fitted MASC to the eye-tracking data using choice, number of fixations, choice and the distribution of attention across items to guide parameter estimation. By simulating the model with the best fitting parameters, we derived predictions of the strength of belief updating at each fixation. Using linear deconvolution modeling, we were able to assess the effect of these model-derived estimates, while also controlling for overlapping activity evoked by successive fixations and confounds such as saccade amplitude and fixation number.

Results: Our findings demonstrate that MASC not only captures key patterns in the behavioral data, such as the distribution of attention to attributes based on their importance, but also provides meaningful predictions at the neural level. Specifically, regression analyses using threshold-free cluster enhancement to correct for multiple comparisons revealed that the predicted strength of belief updates positively modulated activity in posterior electrodes. This result was driven by two separable dynamics, a P3-like FEP from 250-400ms post fixation onset as well as a late positivity-like modulation between 400-800ms, both at the level of individual attributes and options.

Conclusion: Our results provide converging behavioral and neural evidence that multi-attribute decision making involves dynamic, fixation-driven updating consistent with Bayesian inference as formalized by MASC. Consistent with previous work establishing the P3 as a belief updating signal, we show that model-predicted belief updates are reflected in FEPs with comparable timing and topology.

P3.L.31 - Perfect markets and other illusions

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Details

Objective: Use economic policy to test the effectiveness of heuristics vs. optimization in managing real-world electric systems.

Method: In the 1990s, many states experimented with deregulation of electric utilities, replacing utility monopoly supply with open competitive markets for electricity. Under regulation, utilities used a variety of engineering heuristics to operate their electric systems, but these were not optimal. States brought in economists and other experts to try to design perfect markets that could optimize the electricity systems. The results provide a test of the relative merits of optimization theory vs. engineering heuristics in dealing with real-world problems.

Results: California passed legislation (unanimously) in 1996 to replace utility-owned supply with a “spot” market for electricity, in which power was bought and sold daily. The utilities sold their old plants to independent owners, retaining only the transmission and distribution lines (which were considered “natural monopolies”). Market prices came in below regulated rates until 2000, when a severe drought reduced hydroelectric supplies and forced reliance on old fossil-fueled plants. However, the old plants had not been properly maintained and most broke. California suffered from

rolling blackouts for 2 years and reverted to long-term contracts to obtain new supply. Its governor was recalled and the move towards electric competition came to a screeching halt nationwide.

Texas deregulated its electricity market from 1995 to 1999, also relying on a spot market. To ensure reliability, Texas relied on “shortage pricing”, in which energy prices were allowed to reach \$3000 per MWh (about 100 times the normal price) in the event of shortages. Nevertheless, in February 2011 almost 200 power plants suffered outages due to a severe cold snap, leading to rolling blackouts. The Texas market operators responded by increasing shortage prices to \$9000 per MWh to increase incentives for reliability. But in February 2021, another cold snap caused the outage of 40% of Texas power plants, with consumer costs of around \$100 Billion. As before, plant owners had skimmed on maintenance, and the shortage prices ended up benefiting suppliers financially (consumer bills that month totaled \$50 billion, more than the total annual bills for 2020).

Conclusions: “Optimal” spot markets failed to ensure reliability, and states were forced to return to traditional heuristics to keep the lights on. The theory of spot markets relied on numerous simplifying assumptions which effectively ignored real-world problems. The optimality of “perfect” spot markets proved to be an illusion.

P3.L.32 - Neuroforecasting versus backcasting changes in aggregate demand for vehicles

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Details

Objective: Changes in demand for vehicles using alternative fuel sources has led to a proliferation of new vehicle models and types. Continuous market records also raise the possibility of examining which kinds of data can forecast versus backcast changes in demand. In two studies, we sought to examine whether brain activity could predict individuals’ desire to learn more about and purchase vehicles (Erk et al., 2002), as well as to forecast versus backcast changes in demand for vehicles out-of-sample in the US (Knutson & Genevsky, 2018).

Method: Two cohorts of subjects interested in purchasing a vehicle in the next three years were scanned at the same time point, May/June, in two consecutive years, 2022 (n=13) and 2023 (n=40). Subjects participated in a vehicle rating task as their brain activity was monitored using Functional Magnetic Resonance Imaging (fMRI). During task trials, subjects first saw a centrally presented image of the vehicle and its’ name (2 sec), followed by its fuel source (2 sec), followed by scales on which they could indicate their interest to learn more about and desire to purchase (4 sec each). Individual analyses sought to predict rated desire to know more about each vehicle based on Volume of Interest data from the Nucleus Accumbens (NAcc), Medial Prefrontal Cortex (MPFC), and the Anterior Insula (AIns) (Samanez-Larkin and Knutson, 2015). Aggregate analyses sought to use Signal-to-noise ratio (SNR) of VOI data over the sample to forecast versus backcast change in demand for units sold over 2022 and 2023 versus the previous year (indexed with data from goodcarbadcar.com).

Results: In both samples, subjects’ initial NAcc (but not MPFC and AIns) response to vehicles predicted wanting to know more about and purchase those vehicles ($p < .001$). SNR of NAcc response to vehicles also forecast the slope (but not average) in market demand of units sold in both years (2022 $p < .0001$; 2023 $p = 0.019$). While average behavioral desire ratings did not forecast sales slope in the corresponding year, it did backcast sales slope in previous years, although NAcc response did not.

Conclusions: Initial NAcc responses to vehicles predicted individuals’ desire to learn more about and purchase them. Further, sampled NAcc responses to vehicles (but not behavioral ratings) replicably forecast changes in demand for those vehicles in the United States. Conversely, behavioral ratings backcast changes in demand for vehicle in previous years, but NAcc responses to vehicles did not. Thus, brain activity adds value to conventional measures for forecasting consumer demand for new vehicles, while behavioral ratings remain useful for backcasting.