11th Annual Interdisciplinary Symposium on Decision Neuroscience

June 10th and 11th, 2021

C.T. Bauer College of Business
University of Houston

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AGENDA

ALL TIMES ARE IN EASTERN DAYLIGHT TIME (EDT)

Thursday, June 10th

9:40 am	**Welcome and Opening Remarks** • **Angelika Dimoka, Professor, University of Houston** • **Paul Pavlou, Dean, Bauer College of Business, University of Houston**
10:00 am	**Session 1: Memory and Decision Making** *Chaired by:* Angelika Dimoka
10:00 am	**Stefano Palminteri** Context-Dependence Induces False Memories of Economic Values: A Test Across Three Decision-Making Modalities and Four Preference Elicitation Methods
10:25 am	**Karolina M. Lempert** Aging Effects on Memory-Guided Social Decision-Making
10:50 am	**Achiel Fenneman** Episodic Decision-Making via a Process of Cascading Episodic Sampling (CASES)
11:15 am	**BREAK**

11:25 am	**Session 2: Motivated Attention, Part 1** *Chaired by:* Nikki Sullivan
11:25 am	**Colin F. Camerer** Neural Autopilot Theory of Habits
11:50 am	**Clarice Zhao** A Neuro-Autopilot Theory of Habit: Evidence from Canned Tuna
12:15 pm	**Zachary Wojtowicz** Boredom and Flow: An Opportunity Cost Theory of Attention-Directing Motivational States
12:40 pm	**MEAL**

2:00 pm	**PANEL: Decision Neuroscience: Humble Beginnings, Current State, Future Endeavors**
	
	Moderator: Angelika Dimoka
	Panelists:
	  • **Colin F. Camerer, CALTECH**
	  • **Paul W. Glimcher, NYU**
	  • **Elizabeth A. Phelps, HARVARD**
	  • **Michael L. Platt, WHARTON**

3:05 pm	**BREAK**
3:25 pm	**Session 3: Preferences Over Uncertainty: From Lab to Opiates** *Chaired by:* Hilke Plassmann
3:25 pm	**Paul W. Glimcher** From Neureconomics to the Clinic: Using Measures of Ambiguity Aversion to Predict and Avert Opiod Use
3:50 pm	**Uma R. Karmarkar** Neural Representation of Information Value During Ambiguous Decision-Making
4:15 pm	**Elizabeth Beard** Parallel Mechanisms Underly Learning from Description and Experience
4:40 pm	**VIRTUAL SOCIAL GATHERING**

Friday, June 11th

10:00 am	**Session 4: Self vs Other, Part 1** *Chaired by:* Hilke Plassmann
10:00 am:	**Sebastian Speer** The Effect of Stress on Intuitive (Dis)Honesty
10:25 am	**Arkady Konovalov** Neural Dynamics Underlying Strategic Decisions
10:50 am	**Wanting Chen** Neural Sex-Based Difference in Fairness Norm Compliance
11:15 am	**BREAK**
11:25 am	**Session 5: Self vs. Other, Part 2** *Chaired by:* Nikki Sullivan
11:25 am	**Michael L. Platt** Neural Evidence for Brands as Extensions of the Self
11:50 am	**Sangil Lee** Challenges in fMRI-based Lie Detection: Heterogeneous Neural Correlates
12:15 pm	**DATA BLITZ** *Chaired by:* Nikki Sullivan **Click here for the list of presentations**
12:40 pm	**MEAL**
1:40 pm	**Session 6: Motivated Attention, Part 2** *Chaired by:* Ryan Webb
1:40 pm	**Blair Shevlin** Evaluating the Evidence for Preference-Based Attentional Capture in Binary Choice
2:05 pm	**Antonio Rangel** Fixation Patterns in Simple Choice Reflect Optimal Information Sampling
2:30 pm	**BREAK**

2:40 pm	**Session 7: Adaptation and Misperception** *Chaired by:* Ryan Webb
2:40 pm	**Jennifer S. Trueblood** Leveraging Cognitive and Neural Network Models to Understand and Improve Medical Image Decision-making
3:05 pm	**Liz Izakson** Not Only Contrast: An Assimilation Effect of Context on Value-Based Decisions
3:30 pm	**Mel W. Khaw** Oversampling of Minority Categories Drives Misperceptions of Group Compositions
3:55 pm	**BREAK**
4:05 pm	**Session 8: Choice in the Multiverse (i.e. things > 3)** *Chaired by:* Angelika Dimoka
4:05 pm	**Anita Tusche** Predicting Sales of New Consumer Products with fMRI, Survey, and Market Data
4:30 pm	**Wenjia Joyce Zhao** Attentional Dynamics in Complex Value-Based Choice
4:55 pm	**Stephanie M. Smith** Consumers Undervalue Multi-Option Alternatives in Two-Stage Choice
5:20 pm	**Closing Remarks**

Session 1: Memory and Decision Making

Thursday, June 10th at 10:00 am

Chair: Angelika Dimoka

Context-Dependence Induces False Memories of Economic Values: A Test Across Three Decision-Making Modalities and Four Preference Elicitation Methods

      Magdaléna Soukupová, Ecole Normale Supérieure (Paris)
      Basile Garcia, Ecole Normale Supérieure (Paris)
    *Stefano Palminteri, Ecole Normale Supérieure (Paris)

Aging Effects on Memory-Guided Social Decision-Making

    *Karolina M. Lempert, University of Pennsylvania
      Michael S. Cohen, University of Pennsylvania
      Kameron A. MacNear, University of Illinois – Urbana-Champaign
      Frances M. Reckers, University of Pennsylvania
      Laura Zaneski, University of Pennsylvania
      David A. Wolk, Hospital of the University of Pennsylvania
      Joseph W. Kable, University of Pennsylvania

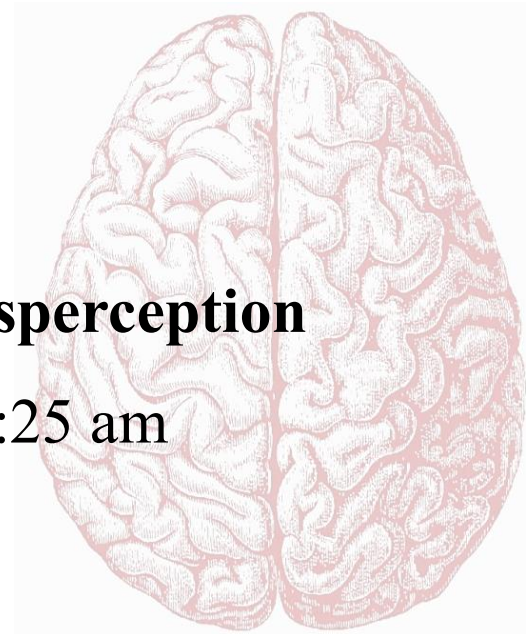**Episodic Decision-Making via a Process of Cascading Episodic Sampling (CASES)**

    *Achiel Fenneman, Radboud University Nijmegen
      Alan G. Sanfey, Radboud University Nijmegen

Session 2: Adaptation and Misperception

Thursday, June 10th at 11:25 am

Chair: Nikki Sullivan

Neural Autopilot Theory of Habits
*Colin F. Camerer, California Institute of Technology
Peter Landry, University of Toronto
Ryan Webb, University of Toronto

A Neuro-Autopilot Theory of Habit: Evidence from Canned Tuna
Colin Camerer, California Institution of Technology
Peter Landry, University of Toronto
Matthew Osborne, University of Toronto
Ryan Webb, University of Toronto
*Clarice Zhao, University of Toronto

Boredom and Flow: An Opportunity Cost Theory of Attention-Directing Motivational States
*Zachary Wojtowicz, Carnegie Mellon University
Nick Chater, University of Warwick
George Loewenstein, Carnegie Mellon University

Session 3: Preferences Over Uncertainty: From Lab to Opiates

Thursday, June 10th at 3:25 pm

Chair: Hilke Plassmann

From Neureconomics to the Clinic: Using Measures of Ambiguity Aversion to Predict and Avert Opiod Use

*Paul W. Glimcher, PhD, NYU Grossman School of Medicine
Anna Konova, PhD, Rutgers Brain Health Institute
] Silvia Lopez-Guzman, MD PhD, National Institute of Mental Health
John Rotrosen, MD, NYU Grossman School of Medicine
Alexandra Mellis, PhD, US Centers for Disease Control

Neural Representation of Information Value During Ambiguous Decision-Making

*Uma R. Karmarkar, University of California, San Diego
Shengxuan Ye, Whale
Vaida Rimeikyte, University of Pennsylvania
Erik Kastman, SeedLinked
Joshua W. Buckholtz, Harvard University

Parallel Mechanisms Underly Learning from Description and Experience

*Elizabeth Beard, Temple University
Jason Chein, Temple University
Vinod Venkatraman, Temple University

Session 4: Self vs Other, Part 1

Friday, June 11th at 10:00 am

Chair: Hilke Plassmann

The Effect of Stress on Intuitive (Dis)Honesty
　　　*Sebastian Speer, Erasmus University
　　　Maarten Boksem, Erasmus University
　　　Ale Smidts, Erasmus University
　　　Ana Martinovici, Erasmus University

Neural Dynamics Underlying Strategic Decisions
　　　*Arkady Konovalov, University of Zurich
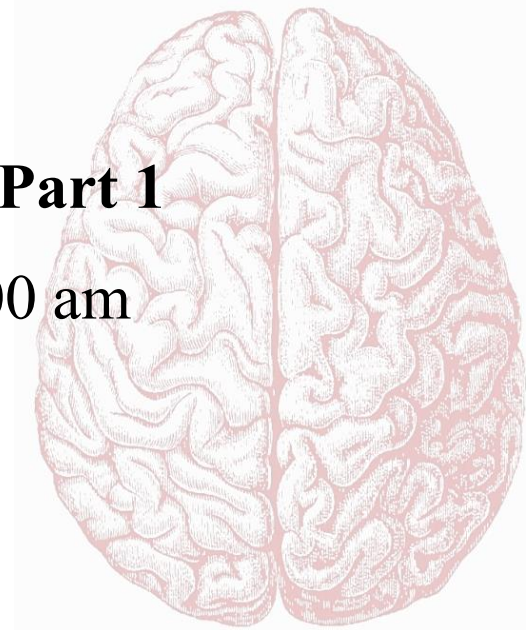　　　Jie Hu, University of Zurich
　　　Christian C. Ruff, University of Zurich

Neural Sex-Based Difference in Fairness Norm Compliance
　　　*Wanting Chen, Southwest University, Chongqing, China
　　　Ofir Turel, University of Southern California, Los Angeles
　　　Qinghua He, Southwest University, Chongqing, China

Session 5: Self vs. Other, Part 2

Friday, June 11th at 11:25 am

Chair: Nikki Sullivan

Neural Evidence for Brands as Extensions of the Self
    ***Michael L. Platt, University of Pennsylvania**
    Feng Sheng, Zhejiang University

Challenges in fMRI-based Lie Detection: Heterogeneous Neural Correlates
    *Sangil Lee, University of California, Berkeley
    Lusha Zhu, Peking University
    Pearl Chiu, Virginia Tech
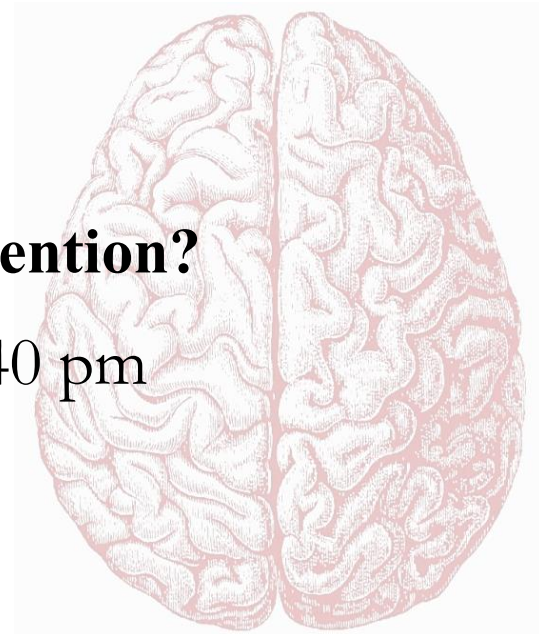   Brooks King-Casas, Virginia Tech
    Andrew S. Kayser, University of California, San Francisco
    Ming Hsu, University of California, Berkeley

Session 6: Motivated Attention?

Friday, June 11th at 1:40 pm

Chair: Ryan Webb

Evaluating the Evidence for Preference-Based Attentional Capture in Binary Choice

    Xiaozhi Yang, The Ohio State University
    *Blair Shevlin, The Ohio State University
    Ian Krajbich, The Ohio State University

Fixation Patterns in Simple Choice Reflect Optimal Information Sampling

    *Antonio Rangel, California Institute of Technology
    Frederick Callaway, Princeton University
    Thomas L. Griffiths, Princeton University

Session 7: Adaptation and Misperception

Friday, June 11th at 2:40 pm

Chair: Ryan Webb

Leveraging Cognitive and Neural Network Models to Understand and Improve Medical Image Decision-making

> ***Jennifer S. Trueblood, Vanderbilt University**
> William R. Holmes, Vanderbilt University
> Eeshan Hasan, Vanderbilt University
> Quentin Eichbaum, Vanderbilt University Medical Center
> Adam C. Seegmiller, Vanderbilt University Medical Center
> Charles Stratton, Vanderbilt University Medical Center

Not Only Contrast: An Assimilation Effect of Context on Value-Based Decisions

> ***Liz Izakson, Tel Aviv University**
> Adam Hakim, Tel Aviv University
> Ryan Webb, University of Toronto
> Dino J Levy, Tel Aviv University

Oversampling of Minority Categories Drives Misperceptions of Group Compositions

> ***Mel W. Khaw, Duke University**
> Rachel Kranton, Duke University
> Scott Huettel, Duke University

Session 8: Choice in the Multiverse (i.e. things > 3)

Friday, June 11th at 4:05 pm

Chair: Angelika Dimoka

Predicting Sales of New Consumer Products with fMRI, Survey, and Market Data
  *Anita Tusche, Queen's University
  Marton Varga, INSEAD
  Paulo Albuquerque, INSEAD
  Nadine Gier, Heinrich Heine University
  Bernd Weber, Rheinische Friedrich-Wilhelms-University of Bonn
  Hilke Plassmann, INSEAD

Attentional Dynamics in Complex Value-Based Choice
  *Wenjia Joyce Zhao, The Ohio State University
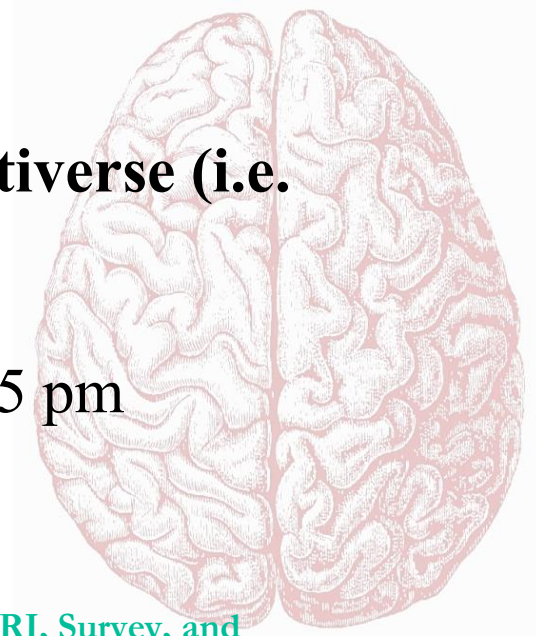 Armin Thomas, Stanford University
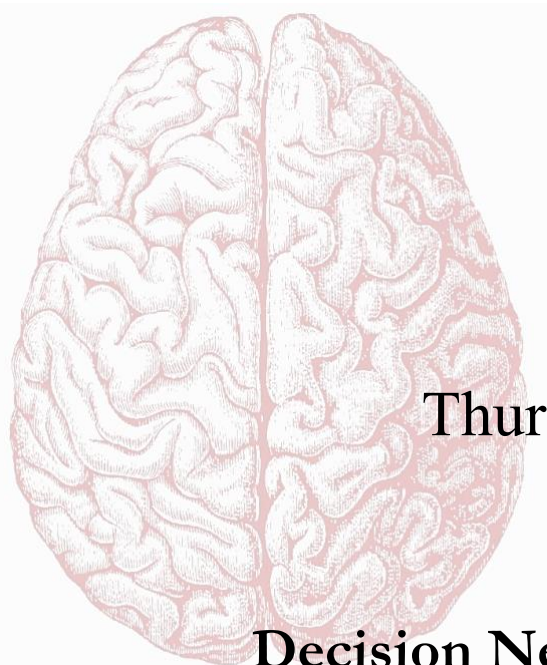 Sudeep Bhatia, University of Pennsylvania
  Ian Krajbich, The Ohio State University

Consumers Undervalue Multi-Option Alternatives in Two-Stage Choice
  *Stephanie M. Smith, UCLA
  Stephen A. Spiller, UCLA

Panel Session

Thursday, June 10th at 2:00 pm

Decision Neuroscience: Humble Beginnings, Current State, Future Endeavors

Moderator: Angelika Dimoka

Panelists:
   • **Colin F. Camerer, CALTECH**
   • **Paul W. Glimcher, NYU**
   • **Elizabeth A. Phelps, HARVARD**
   • **Michael L. Platt, WHARTON**

Description: In this panel session, we bring together experts in the field of decision neuroscience, who were among the first to experience the humble beginnings of this interdisciplinary area. We will discuss the past successes, the current state, emerging challenges, and a look forward toward the next decade of research in this burgeoning field. Panelists will be asked to give their informed opinions about the future of decision neuroscience and the major areas that the field should pursue to remain relevant and leading edge.
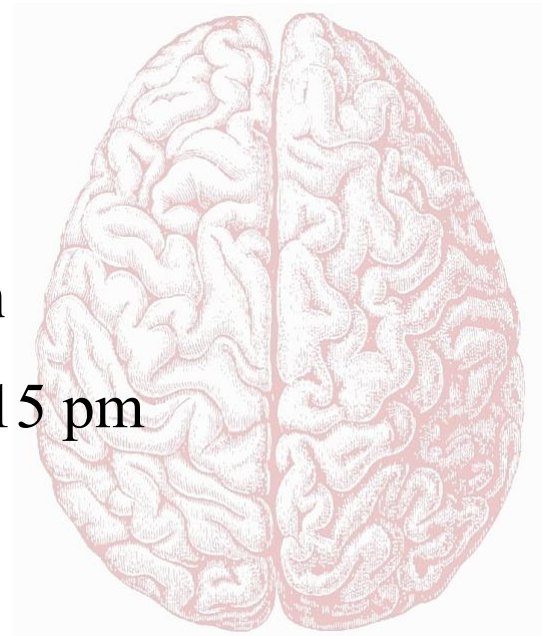
DataBlitz Session

Friday, June 11th at 12:15 pm

Chair: Nikki Sullivan

1. **Fair Shares and Selective Attention**

   *Dianna Amasino, University of Amsterdam
   Davide Pace, University of Amsterdam, Tinbergen Institute
   Joël van der Weele, University of Amsterdam, Tinbergen Institute

2. **Visuospatial Working Memory Modulates the Influence of Visual Attention on Binary Choice**

   *Simone D'Ambrogio, University of Padua
   Massimiliano Pastore, University of Padua

3. **Decomposing Healthy Eating Decisions into Predispositions and Evaluations**

   *Nitisha Desai, The Ohio State University
   Ian Krajbich, The Ohio State University

4. **Perception Differences Between Designers and Consumers Towards Product Design**

   Junjie Zhang, China Academy of Art
   *Lin He, Zhejiang University
   Wenhuan Yu, Zhejiang University
   Tao Liu, Zhejiang University

5. **Some Work and Some Play: The Labor-Leisure Tradeoff Under a Limited Time Budget**

   *****Yue Hu, Heinrich-Heine University Düsseldorf**
   Felix Jan Nitsch, Heinrich-Heine University Düsseldorf
   Aiqing Ling, UCD Michael Smurfit Graduate Business School
   Tobias Kalenscher, Heinrich-Heine University Düsseldorf

6. **All You Can Choose: The Influence of Choice Exclusivity on The Process and Experience of Decision-Making**

   *****Xiamin Leng,** Brown University
   Romy Frömer, Brown University
   Thomas Summe, Brown University
   Amitai Shenhav, Brown University

7. **Emotions and Decision-making: Is Somatic Feedback (Equally) Indispensable for Decisions under Uncertainty**
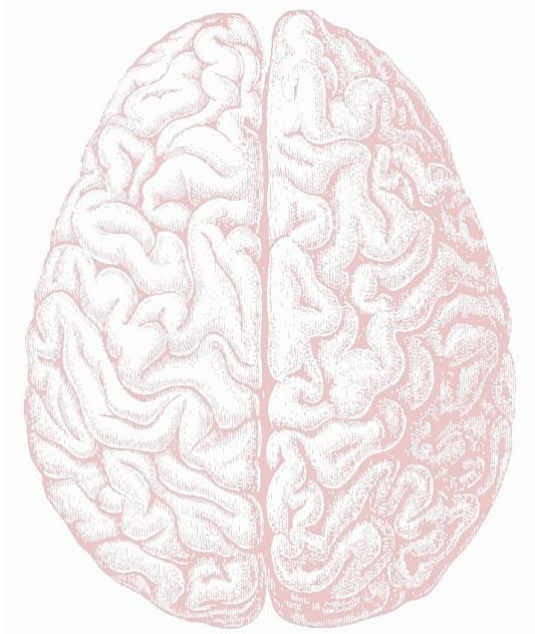
   *****Varsha Singh, Indian Institute of Technology (IIT)**
   Shambhovi Mitra, Indian Spinal Injuries Centre (ISIC)

8. **Webcam-Based Online Eye-Tracking for Behavioral Research**

   *****Xiaozhi Yang, The Ohio State University**
   Ian Krajbich, The Ohio State University

Abstracts for Session Presentations

UNIVERSITY of HOUSTON

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Conference Presenter: Dianna Amasino

Authors
1st Author: Dianna Amasino
2nd Author: Davide Pace
3rd Author: Joël van der Weele

Affiliations
1st Author: University of Amsterdam, Amsterdam School of Economics
2nd Author: University of Amsterdam, Amsterdam School of Economics, Tinbergen Institute
3rd Author: University of Amsterdam, Amsterdam School of Economics, Tinbergen Institute

TITLE: Fair Shares and Selective Attention

ABSTRACT:
Fairness views vary widely and often serve to justify economic privilege. Previous research has found self-serving biases in divisions: workers randomly assigned a higher pay rate keep more joint earnings regardless of effort (Konow, 2000). Here, we investigate the role of visual attention in such biases. We explore whether a random advantage in pay rate influences information-seeking of merit (task performance) vs. outcome (pay rate x task performance) information, where outcome information supports the lucky high-pay participants keeping more for themselves. Further, we restrict the time spent on merit vs. luck to examine the causal impact of attention on allocation biases. Participants (N=600) and recipients (N=900) completed real-effort tasks to produce a surplus. Then, participants were randomly assigned a high (Advantaged) or low (Disadvantaged) pay rate per correct answer. Next, they were paired with opposite pay-rate recipients and divided their jointly-produced surplus. Before making their allocation decisions, participants could reveal merit and outcome information in MouselabWEB. In the "Free Focus" experiment they had 6 s to reveal any information, whereas in the "Constrained Focus" experiment, we imposed time limits (0.8 s maximum) on merit or outcome information, pushing participants to focus on the less-constrained information. Advantaged participants allocated significantly more (~10%) of the surplus to themselves than did Disadvantaged participants. With Free Focus, information-seeking by Advantaged and Disadvantaged participants diverged over time, with Advantaged looking less at merit. With Constrained Focus, participants with a merit focus looked more at merit and gave ~3% less of the surplus to the Advantaged members than those with an outcome focus, a difference driven primarily by Advantaged participants. These findings extend work on self-serving biases in allocations to include the role of attention. Our attention data reveals that Advantaged participants paid less attention to true merit and increasingly sought outcome information that justified keeping more for themselves. Moreover, we find a causal effect of attention: exogenously focusing attention on merit instead of outcome information significantly reduced the self-serving biases of Advantaged participants.

Conference Presenter: Elizabeth Beard

Authors
1st Author: Elizabeth Beard
2nd Author: Jason Chein
3rd Author: Vinod Venkatraman

Affiliations
1st Author: Center for Applied Research in Decision Making, Department of Psychology, Temple University
2nd Author: Control and Adaptive Behavior Lab, Department of Psychology, Temple University
3rd Author: Center for Applied Research in Decision Making, Fox School of Business, Temple University

TITLE: Parallel Mechanisms Underly Learning from Description and Experience

ABSTRACT:
The Description-Experience (D-E) Gap reveals that risk preferences can change as a function of whether the same information is described or learned from experience. The neural mechanisms underlying this effect remain largely unknown and might play a key role in explaining differences between the non-human primate and human literatures, which largely use experience and description-based tasks respectively. The current study aims to elucidate neural processes associated with decisions from description (DFD) and experience (DFE). 24 young adults completed a novel, within-subject risky-choice paradigm while undergoing fMRI. In description-based trials, participants were provided explicit information about each option's probability distribution and the corresponding outcomes. To match working memory constraints, we presented these components sequentially rather than simultaneously as is common in these tasks. In experience-based trials, participants were instructed to 'sample' each option so they could learn the respective probability distributions and outcomes. In both formats, participants had between 15-18s for this "acquisition" phase followed by 3s as part of a "think" phase, where they could assimilate all information before indicating their choice. Consistent with previous research, we found greater risk taking in DFE than DFD ($ß = 0.68$, $p < .01$). Participants were more likely to underweight rare unfavorable outcomes in DFE and overweight rare favorable outcomes in DFD, suggesting participants placed emphasis on different components in DFE and DFD. Preliminary fMRI analyses reveal stronger activation in neural regions associated with working memory and deliberation during the acquisition phase for DFD, suggesting participants were integrating information as it was being acquired. However, we found greater activation in similar networks for DFE than DFD during the "think" phase, suggesting that they waited for all information to be learned before integrating them. These findings suggest that similar mechanisms affiliated with memory and deliberation may be at work, but across different timepoints. Therefore, we contend that the D-E gap may be related to differences in the salience of different choice components when they are integrated across DFD and DFE.

Conference Presenter: Colin F. Camerer

Authors
1st Author: Colin F. Camerer
2nd Author: Peter Landry
3rd Author: Ryan Webb

Affiliations
1st Author: Division of Humanities and Social Sciences, California Institute of Technology
2nd Author: Rotman School of Management, University of Toronto
3rd Author: Rotman School of Management, University of Toronto

TITLE: Neural Autopilot Theory of Habits

ABSTRACT:
A neural autopilot theory uses familiar elements about choice values from reward prediction error (RPE) and learning about "reward reliability" (unsigned RPE). It is used to derive results for a simple two-person consumer choice, about price elasticities. Some applications to consumer choice and social media use are sketched.

Conference Presenter: Wanting Chen

Authors
1st Author: Wanting Chen
2nd Author: Ofir Turel
3rd Author: Qinghua He

Affiliations
1st Author: Faculty of Psychology, Southwest University, Chongqing, China
2nd Author: Brain and Creativity Institute and Department of Psychology, University of Southern California, Los Angeles, CA, United States
3rd Author: Faculty of Psychology, Southwest University, Chongqing, China

TITLE: Neural Sex-Based Difference in Fairness Norm Compliance

ABSTRACT:
Background: Humans often comply with fairness norms, either voluntarily, or through external threats, such as sanctions. For example, buying a green product, wearing a mask, or dividing a bonus among employees can be guided, in part, by reflections of what society views as fair to all, the rewards of complying, or the expected penalties of not complying with social fairness norms.
The literature has demonstrated that there is a unique neural activity for voluntary, sanction-based compliance, and non-compliance with fairness norms. Nevertheless, it overlooked potential sex-based differences. Biological sex can be a salient factor in this context, given sex-based differences in functions of brain regions involved in social compliance and decision-making.
This study seeks to bridge this gap and identify how fairness norms engage neural mechanisms and affect decision-making in males vs. females, under different fairness norm compliance conditions.

Methods: 27 women and 28 men underwent fMRI scanning while holding the role of proposer in a two-person money distribution game. The game had three blocks for all participants in the following order: voluntary (no explicit sanctions for unfair behavior), punishment (explicit monetary sanctions for unfair behavior), and voluntary post-sanctions (voluntary condition after punishment condition).

Results: Fairness compliance was higher in the punishment than in the voluntary condition. After punishment, voluntary fairness compliance decreased significantly. Compared to females, males showed stronger activation in TPJ, precuneus, PCC, OFC and mid temporal cortex while in the voluntary fairness compliance condition. This neural difference disappeared in the voluntary post-punishment condition. In addition, females showed stronger activation in TPJ, precuneus, PCC, inferior frontal cortex and vmPFC in the voluntary post-punishment condition compared to in the voluntary condition. Generalized psychophysiological interaction analysis was employed to compare changes in rDLPFC connectivity among the different conditions. We found stronger connectivity between rDLPFC and right dorsal anterior insula in voluntary compliance for males but not for females. Females presented the same connectivity difference between voluntary post-punishment and voluntary conditions.

Conclusion: The findings imply that for females, voluntary fairness compliance may be motivated intrinsically, and for males, fairness norm compliance is more pragmatic. Punishment feedback caused females to adjust their norm compliance process. These results can serve as a basis for informing marketing specialists and policy makers.

Conference Presenter: Simone D'Ambrogio

Authors
1st Author: Simone D'Ambrogio
2nd Author: Massimiliano Pastore

Affiliations
1st Author: Department of Developmental Psychology and Socialisation, University of Padua, Padova, Italy
2nd Author: Department of Developmental Psychology and Socialisation, University of Padua, Padova, Italy

TITLE: Visuospatial Working Memory Modulates the Influence of Visual Attention on Binary Choice

ABSTRACT:
Recent studies have revealed a plausible link between visual attention and decision making (e.i. attentional bias): fixating an alternative longer leads to increased probability of choosing it. However, the cognitive mechanisms that underlie this link remain elusive. Here, we aim to evaluate whether higher demand of visuospatial working memory is associated with higher attentional bias using psychophysics, eye-tracking, and computational modeling.

We conducted an online experiment adopting a web-based eye-tracking application (WebGazer) to record participants' eye movements. Fifty-seven adults (35 women; mean $\pm$ sd age, 31 ± 10) successfully completed the task. Each participant performed seventy-two choices between two random-dot kinematogram (RDK) stimuli. Participants were instructed to choose the alternative with the highest value. The value of each RDK stimulus was determined by three dots' perceptual features: number, color and direction. We manipulated the visuospatial working memory load within-subject, by changing the number of perceptual features unshared between the two alternatives (e.i. 1 vs 2 vs 3-unshared-attributes).

We estimated the effect of visuospatial working memory on the attentional bias with a hierarchical attentional drift diffusion model (HaDDM). In line with our prediction, we found a higher attentional bias in the 3-unshare-attributes condition compared to the 1-unshared-attribute condition (mean difference = 0.11, 95% highest posterior density interval (HDI95) = [-0.07, 0.29]). However, we found no evidence of an attentional bias difference between the 2-unshared-attributes condition and the 1-unshared-attributes condition (mean difference = -0.01, HDI95 = [-0.16, 0.15]).

These findings improve our understanding of the cognitive mechanisms underlying the influence of visual attention on decision making. Furthermore, our results suggest directions for future investigations on the interaction between visuospatial working memory, visual attention and decision making.

Conference Presenter: Nitisha Desai

Authors
1st Author: Nitisha Desai
2nd Author: Ian Krajbich

Affiliations
1st Author: Department of Psychology, The Ohio State University
2nd Author: Department of Psychology, Department of Economics, The Ohio State University

TITLE: Decomposing Healthy Eating Decisions into Predispositions and Evaluations

ABSTRACT:
When making decisions, people are influenced by the context of the decisions, in addition to the features of the choice options. Context can be shaped by prior information, the framing of the choice options, or experience with related decisions. Here we investigate how context interacts with features of the options to ultimately determine choice.

In our experiment, subjects (n=91) first rated how much they liked various foods. They then made real choices between a healthy and unhealthy food in two virtual "stores". In one store, the healthy foods were higher rated than the unhealthy foods (healthy context); in the other, the unhealthy foods were higher rated (unhealthy context). To understand how context influences choice, we used drift-diffusion modeling to parse choices into distinct components: the predisposition (a biased starting point in the decision process) and the evaluation of the options (drift rate).

We predicted that manipulating the context would impact predisposition, but not evaluation. We also expected predispositions to increase in response to experience within the choice context, but evaluations to remain unchanged.

Our results confirmed that subjects exhibited predispositions toward healthy in the healthy context (0.043 (95% HDI = 0.029, 0.058)) and toward unhealthy in the unhealthy context (–0.038 (–0.052, –0.023)). The diffusion modelling also revealed a slight evaluation bias favoring the healthy category in both stores (healthy store: 0.190 (-0.053, 0.426); unhealthy store: 0.333 (0.092, 0.582)). That is, foods categorized as healthy were evaluated as better simply due to this label. In contrast to the predisposition, the evaluation bias did not credibly change with context.

We also found that predispositions produced significant choice biases: in a choice between two equally liked foods, subjects chose the healthy option more in the healthy store (57.3%, p = 0.009) and the unhealthy option more in the unhealthy store (55.3%, p = 0.037).

Lastly, as subjects spent more time in each store, their predispositions magnified (healthy store: 0.0016 (0.0011, 0.0021) per trial; unhealthy store: -0.0039 (-0.0044, -0.0033) per trial). The evaluation bias, on the other hand, remained constant over time in both stores (healthy store: 0.00076 (-0.00020, 0.0017) per trial; unhealthy store: -0.0011 (-0.0022, 0.00003) per trial).

Our work shows, by changing the choice context, predispositions toward healthy and unhealthy foods are easily manipulated, but people's favorable evaluation of healthy foods persists. Moreover, changes in predisposition occur over very short periods of time, highlighting the malleability of people's predispositions.

Conference Presenter: Achiel Fenneman

Authors
1st Author: Achiel Fenneman
2nd Author: Alan G. Sanfey

Affiliations
1st Author: Faculty of Management Sciences, Radboud University Nijmegen; Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen
2nd Author: Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen

TITLE: Episodic Decision-Making via a Process of Cascading Episodic Sampling (CASES)

ABSTRACT:
Decisions in daily life are not accompanied with a list of available options and their expected outcomes, forcing us to rely on our previous experiences to inform our decisions. But exactly how do we do so leverage our previous experiences to novel problems? Daily life is rich in features, yet decisions made in daily life are both unique (each experience is encountered exactly once) and sparse (each experience contains only a small set of all features encountered in daily life). These properties prevent us from relying on statistically learned decision values.

Instead, we have to rely on our episodic memories to determine which actions are available to us – and which of these are most attractive. But how do we determine which memories to rely upon? This is a non-trivial problem, as our store of memories is vast and a top-down memory-by-memory search poses an unrealistic computational burden. While previous theories and recent findings in neuroscience provide clues on how to formulate a cognitively plausible model of memory-based decision-making, no single computationally realistic model exists that simultaneously describes which memories are evaluated, through which process they are evaluated and how these evaluated memories are translated into a single selected action.

In this paper we summarize recent findings in memory and decision-neuroscience and build upon them to construct a formal model of episodic decision-making. Here we argue that the structure of memories in the medial temporal lobe allows a bottom-up cascading spread of memory activations: the activation of a memory results in a simultaneous feed-forward and feed-back process. The feed-forward process provides evidence to positively or negatively bias the action previously associated to this memory. If this process does not result in sufficient evidence to warrant a decision, then a feed-back pattern-completing process reinstates the features that make up the activated memories. These reinstated features then activate an additional set of memories, trigging the next feed-forward and feed-back processes, until a decision has been reached. We formalize this process in a model of Cascading Episodic Sampling (CASES), and show that this non-random sampling process is robust to large number of stored memories, providing a faster decision speed as the number of memories increases. This model parsimoniously captures, and expands upon, a range of key findings and previous models in the topic of memory-based decision-making.

Conference Presenter: Paul W. Glimcher

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TITLE: From Neureconomics to the Clinic: Using Measures of Ambiguity Aversion to Predict and Avert Opiod Use

ABSTRACT:
A wealth of neurobiological data suggests that nearly all human decisions rely on a single common representation of option value. In individual's preferences over risk, ambiguity and time (discount rate) are all represented in this common substrate, apparently regardless of the decision-making domain. We therefore characterized the financial risk, financial ambiguity and financial time preferences of patients undergoing treatment for opiate use disorder on a weekly basis in the hope that these data might reveal changes in subject's preferences over illicit opiate consumption. We found that changes in ambiguity preferences observed week-to-week could be used to predict a form of acute relapse in patients undergoing treatment for opiate use disorder, the likelihood that subjects would use heroin or other illicit opiates in the coming week. When combined with a small set of more traditional measures like craving intensity, we found we could predict these reuse events with better than 70% accuracy, 7-10 days in advance. We subsequently migrated our neuroeconomic battery to a smartphone platform produced by Datacubed Health. Pilot studies in patients conducted on this platform demonstrated that we could retain essentially all participants with this tool over a six month treatment period, and that subjects were willing to provide daily data via smartphone at a rate 400% of that obtained with in person methods. These findings lay the groundwork for a new clinical trial designed to test the efficacy of using these neuroeconomic instruments to adjust medication and therapy dosages. Our hope is that these neuroeconomic tools for the treatment of opiate use disorder will reduce reuse during treatment and to improve treatment outcomes.

Conflict of Interest Note: Datacubed Health provides access to its platform for these studies pro bono. PWG serves on the board of Datacubed Health and has a financial interest in the company.

Conference Presenter: Lin He

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TITLE: Perception Differences Between Designers and Consumers Towards Product Design

ABSTRACT:
Purpose — Satisfying consumers' requirements has now become the top priority for every company. However, the existing research mainly focus on the perspective of consumer. Little has been discussed about whether product designers can accurately decode consumers' preferences. Using functional near-infrared spectroscopy (fNIRS), the current study aims to explore (1) the different design elements that influence designers' and consumers' perceptions of a product, respectively, and also (2) the cognitive mechanism underlying the perception differences between the consumers and designers when viewing a product.
Methodology — 20 designers were asked to design 3 cups focusing on comfortability, artistry, and cultural attribute, respectively. 22 consumers were asked to view the cups and evaluate them from several perspectives. The designers were also asked to view the cups designed by themselves and by other designers. We measured the brain activations of designers and consumers during the whole process.
Findings — Behavioral results indicated that, compared with consumers, designers gave higher ratings to the cups that they designed. More importantly, consumers and designers held different opinions of the most crucial dimensions that affect consumers' evaluation. fNIRS results showed that, overall, designers experienced higher reward when viewing products designed by themselves. Moreover, from the perspectives of different design elements, while viewing products emphasizing artistry, designers experienced higher reward than consumers. When viewing products emphasizing cultural attribute, consumers showed higher activations in brain regions related to cognitive pressure, indicating the difficulty in understanding the product design. We further demonstrated that the perception differences between the consumers and designers while looking at products emphasizing cultural attributes resulted from different knowledge structure.
Implications — The current study demonstrated that designers and consumers respond differently to different design element while evaluating products, which is largely due to different knowledge structure. It is helpful for designers to take consumers' knowledge structure into consideration and emphasize with consumers while designing a product.

Keywords: designer, consumer, perception differences, neurodesign, functional near-infrared spectroscopy

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TITLE: Some Work and Some Play: The Labor-Leisure Tradeoff Under a Limited Time Budget

ABSTRACT:
Dividing limited time between work and leisure is a common daily decision. Prior research that has investigated the labor-leisure tradeoff primarily focused on the cost-benefit of executing efforts between an effortful task vs. a non-effortful mental activity (Meyniel et al., 2013; Kool and Botvinick, 2014; Dora et al., 2020). It is unclear how individuals make decisions and its underlying decision process when true leisure is available. In the present study, we investigate real-time decision-making for time allocation between labor and leisure activities. We adapted a foraging paradigm (Sweis et al., 2018) into an online experiment in which participants have one hour to spend on instant entertainments and effortful tasks. For each trial, participants can choose from four activities in a main menu: watching a clip of fashion show, watching a video clip of cute animals, working on a physical effort task or working on a mental effort task. If participants choose to perform the effortful task, they can earn tokens which will be accumulated and converted to real monetary payoffs at the end of the experiment. At the end of each trial, participants can choose to stay on the same activity or switch to other activities. Critically, we ask participants to set a goal for their token collection before the experiment. The information of token goal, the number of collected tokens and a count-down timer are displayed on the top right of the page and constantly updated to remind participants of the progression. Participants are allowed to reset the token collection goal in the main menu during the experiment. Participants also fill in scales measuring procrastination (PS), susceptibility to temptation (STS), self-control (BSCS), as well as questionnaires about task aversiveness, fatigue, etc. Thus, the experimental setup imitates an ecologically valid scenario for trading leisure to money making opportunities. This setting allows us to capture important features including task performance, frequency of task switch, time allocation to each activity to understand whether and how individual behavioral traits predict their leisure-labor tradeoff under a time constraint. Preliminary results confirmed positive correlations between individual scores of personality scales on PS, BSCS and STS. Analysis on overall performance revealed a negative correlation between collected tokens and frequency of task switches. Analysis on overall performance and personality trait revealed no correlation between procrastination score and collected tokens. However, we found a tendency on participants who earned less than 2500 tokens (n= 18) that a higher score in procrastination leads to less earned tokens (t = -1.305, b = -0.31), but not on those who earned more than 2500 tokens (n= 22, t = -0.085, b = -0.018).

Conference Presenter: Liz Izakson

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TITLE: Not Only Contrast: An Assimilation Effect of Context on Value-Based Decisions

ABSTRACT:
Both perceptual and value-based choices are highly influenced by context. In perception, spatial context can lead to either contrast or assimilation effects. While, in value, previous studies demonstrated mainly contrast effects of context. However, as opposed to perceptual studies, in choice studies, the context is usually represented by other alternatives that are part of the available choice set. This limits the kind of context that can be tested to alternatives that only have lower values than the target. To overcome this problem, we examined the effect of spatial context on choice while displaying the context as it is usually displayed in perceptual tasks. That is, trials included both high and low value contexts but the context alternatives could not be chosen. We examined if our new design will induce either contrast or assimilation effect.

We performed two different experiments. 1) A *Choice* experiment (n = 24), which had two tasks: First, a BDM auction for different E-commerce products. Second, a binary-choice task in which subjects chose between two of the products they encountered in the BDM task. The products were surrounded by other products that served as context. 2) A *Valuation* experiment (Online: n = 101; Lab: n = 28) in which the first task was again a BDM auction, while the second task was another BDM auction but the target product was surrounded by other products that served as context. In all experiments, we systematically varied both the values of the target products and the context products. We examined, whether and to what extent, the surrounding products and their values affected subjects' choices (Exp. 1) and bids (Exp. 2).

In both experiments we found a significant assimilation effect of the context rather than a contrast effect. In the *Choice* experiment, the probability of choosing the higher-valued product was greater when it was surrounded by high-value products compared to low-value products. Similarly, in the *Valuation* experiment, bids increased when the target product was surrounded by high-value products in comparison to low-value products. We used the divisive normalization model to explain these effects.

Our results suggest that spatial context can also lead to an assimilation effect in value-based decision making and not only to a contrast effect as was previously shown. This could be because the different context representation we used (outside the choice set). Hence, we propose that the effect of context on valuation and choice is more complex than previously thought, and that it could be influenced by how context is presented. Our results highlight the importance of establishing a more general view of the effect of context on choice and valuation which takes into account both assimilation and contrast effects.

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TITLE: Neural Representation of Information Value During Ambiguous Decision-Making

ABSTRACT:
Several significant consumer decisions involve some degree of uncertainty arising from incomplete or inconclusive information. An extensive body of literature has demonstrated that people generally find such ambiguity aversive, and that feelings of uncertainty can lead to suboptimal decision making. However, less is known about how people use the partial information they do have to during such choices. We collected behavioral and fMRI data from 33 participants on a "Pro vs. Con" task, in which they received varying levels of valenced information about financial gambles. We found that increasing the amount of information revealed (regardless of valence) increases participants' willingness to engage in the gamble. In addition, we find an asymmetric influence of favorable over unfavorable information on willingness to purchase, replicating our prior research. In the neural data, when analyses of favorable and unfavorable information were decoupled, striatal activity appeared to preferentially track increasing amounts of unfavorable information. By contrast, OFC and dlPFC activity varied more according to the degree of favorable information. Collectively we find that under ambiguity, a network of reward related circuitry tracks the overall amount of information that is available but that there are differences in this representation for favorable and unfavorable information.

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TITLE: Oversampling of Minority Categories Drives Misperceptions of Group Compositions

ABSTRACT:
The ability to assess proportions underlies a wide range of judgments regarding our social environment. By making a quick visual scan (e.g., across an on-screen quilt of video feeds, or a busy street) we can obtain a rough idea of the social groups in attendance. Similarly, a glance around an academic conference room might reveal a stark gender disparity among attendees. Lab studies have shown that individuals are adept at extracting gist information—e.g., of average emotions, gaze direction, and group diversity—following brief glances at crowds. However, the kinds of visual information gathered during these glances, along with their influence on subsequent judgments, are unknown.

We collect eye-tracking data to examine the information-seeking patterns that underlie estimates of group proportions. We examine how visual samples (the collection of faces encompassed by participants' gaze) inform their impression of the entire crowd. Subjects performed second-long glances at face ensembles and declared their estimates of the true gender proportion on display (subjects were monetarily incentivized to declare accurate judgments). In a non-social stimuli condition, subjects declared analogous judgments toward image ensembles comprised of indoor and outdoor scenes.

Performance-wise, subjects exhibit a canonical pattern of judgment errors: small proportions are overestimated while large values are underestimated. Subjects' eye movements at sub-second timescales reveal that these biases follow from a tendency to visually oversample members of the gender minority. In other words, when a male majority crowd was on display, subjects were more likely to gaze at women during their second-long views (and vice versa). Rates of minority oversampling dovetail with magnitudes of judgment errors, response variability, as well as response times. Visual biases favoring the gender minority thus informs proportion judgments and affects the overall difficulty in estimation. All results are replicated at a within-subjects level with non-human ensembles using aforementioned natural scene stimuli.

Our results reveal that the presence of minority category members shapes the attention and subsequent impressions of viewers. The tendency to detect categorical outliers drives an initial overrepresentation of minority elements in subjects' gaze, resulting in a parallel pattern of estimation errors. Erroneous impressions of our environment are thus formed very rapidly—during initial glances at the people or places that surround us.

Conference Presenter: Arkady Konovalov

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TITLE: Neural Dynamics Underlying Strategic Decisions

ABSTRACT:
Strategic interactions involve complex decisions that need to integrate individual preferences, the history of play, and the decisions of interaction partners. Less complex decisions, such as food choice, risky and intertemporal choice, and static social allocations have been suggested to be governed by common choice mechanisms, since they can all be successfully described with the drift-diffusion model (DDM). Here we sought to demonstrate that strategic decisions may also involve these choice mechanisms, and to elucidate the temporal dynamics of these mechanisms at the neural level. We therefore combined the DDM and learning approaches to study strategic interactions in a simple repeated game, and recorded EEG to provide a dynamic neural validation for the basic concepts of this learning-DDM model: Accumulation of value for the strategic options and dynamic updates of values based on decisions of the players.

Subjects (N = 40) played the standard mixed-strategy "inspection" game (Hill et al 2017) with a real opponent (another subject), while their brain activity was measured using 128-channel EEG at 512 Hz sampling rate. On each trial, both subjects chose between letters H and T (restricted to 3 s). If the choices matched, one of the subjects received a reward, whereas in the case of mismatch, the other subject was rewarded. Each subject played the game for 400 trials with the same anonymous opponent. We presented the task and recorded RTs with Psychtoolbox.

The behavioral data were best explained using a computational model that combined the influence learning model (Hampton et al, 2007) with the standard 3-parameter DDM. In the EEG data, we identified dynamic neural correlates of various components of the fitted model, including the evidence accumulation process, the drift rate, the value of the chosen option, reward, and belief updates based on both the reward feedback the subjects' own choices. Using the clusters revealed with the model-based analysis, we found that the performance of each subject correlated strongly with gamma-band centro-parietal coherence in the EEG signal, whereas the choice of strategy correlated with fronto-parietal gamma-band coherence.

Our results offer neural validation for a model that describes choices in complex social situations as a combination of learning and DDM mechanisms, overlapping with characteristics of simple choice paradigms. Using EEG, we provide new insights into the neural processes underlying strategic choices, as well as the timing of belief updates in repeated social interactions.

Conference Presenter: Sangil Lee

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TITLE: Challenges in fMRI-based Lie Detection: Heterogeneous Neural Correlates

ABSTRACT:
Can we detect lies using fMRI? Previous studies have used instructed lying paradigms to identify neural correlates of deception; these involved heightened activity in areas such as the insula, inferior parietal lobule, middle frontal gyri, etc. Here we sought to extend these findings in a more naturalistic setting where participants were incentivized, but not instructed, to lie. This allows us to identify individuals who are more willing to lie for benefits versus those who are less willing to do so. We hypothesized that those who are more comfortable with lying would show less activity in regions found in previous studies of deception.

We use a messaging task from Jenkins, Zhu, and Hsu (2016) that uses a signaling framework to examine motivated deceptive behaviors. In the task, there were two monetary reward options, and participants played the role of the 'signaler' who sends a message to the 'recipient' about which of the two monetary outcomes the recipient should pick (e.g., much like the role of a financial advisor advising the client which option to choose). One outcome yields higher monetary reward to the signaler while the other outcome yields higher monetary reward to the recipient. In the simple preference condition, participants either tell the recipient that they would 'prefer the recipient choose option A' or 'prefer the recipient choose option B'. In the deception condition, participants either tell the recipient that 'option A will earn you more money' or 'option B will earn you more money'. Hence, the difference between the two conditions was that the selfish choice required lying in the deception condition while it did not in the preference condition.

Using meta-analysis ROIs from previous instructed lying studies, we were able to predict whether the participants were lying or not on a given trial, but only for those participants who showed aversion to lying. We found that regions such as insula and cingulate cortex showed increased activity to lying only if the participants were averse to lying, while participants who were comfortable with lying showed dampened activity in these regions. Furthermore, those who were comfortable with lying showed neural responses in the deception condition that were similar to their responses in the simple preference condition.
These results expand our understanding of neural correlates of deception. Heightened neural activity that co-occur with lying, as previously reported, are more likely to be found in those who are averse to lying, while those who are comfortable with lying may not show a particular neural signature of lying. These results imply that deception is a result of heterogeneous processes and that various factors such as motivation, inclination, and context of deception should be studied in conjunction with behavior.

Conference Presenter: Karolina M. Lempert

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TITLE: Aging Effects on Memory-Guided Social Decision-Making

ABSTRACT:
When making decisions about interacting with others, we often must recall the value of prior experiences with them. For example, in order to avoid falling for a scam a second time, we must remember that the person calling had previously taken advantage of us. Research in young adults has shown that retrieving an accurate association between a stimulus and its value (i.e., *associative memory*) is necessary to adaptively approach high-value stimuli and avoid low-value stimuli. Given that aging has been linked with a decline in associative memory, here we examined the effects of aging on memory-guided decision-making in social and non-social domains. Young ($n = 50$; aged 18-34), middle-aged ($n = 51$; aged 35-59) and older ($n = 43$; aged 60-92) adults completed a task in which they studied a series of faces along with how much the people pictured shared in a dictator game ($5 or $0 out of $10). The images shown were of real people who had made dictator game decisions in the lab previously. Participants also saw house images representing lotteries worth $5 or $0. Then participants made real-stakes choices about whether to interact with each person/house again. This was followed by recognition and associative memory tests. In all age groups, correct associative memory was necessary for making optimal decisions: there was a significant reward ($5/$0) x memory (no item/ item only/ associative) interaction effect on choice. Age was associated with worse associative memory ($r = -0.27$; $p<0.001$), however. This memory deficit resulted in older adults making suboptimal choices: unlike young and middle-aged adults, older adults' decisions were not influenced by whether stimuli were previously rewarded. Next we examined if decision-making differed when stimuli were social. Young and middle-aged adults responded strongly to social violations; they avoided social others that they remembered as being unfair more than they avoided houses that they remembered as being low-value. This effect was not present in older adults. In fact, older adults chose to interact with others *that they confidently remembered as being unfair* at a rate indistinguishable from chance (42.6%). Finally, while all participants were more likely to approach people who looked more trustworthy (according to ratings made by an independent group of subjects), the effect of perceived trustworthiness on choice increased with age. Our results suggest that poor associative memory combined with a bias toward approaching familiar faces (regardless of remembered value) might make older adults vulnerable to exploitation. This risk would be heightened if the perpetrator looked trustworthy.

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Title: All You Can Choose: The Influence of Choice Exclusivity on The Process and Experience of Decision-Making

Abstract:
Objective:
Choosing a single dish from a menu is typically harder and more anxiety-provoking than choosing from the same options in a buffet. In the lab, we typically study the former, menu-like choices, where choosing one option precludes choosing any of the others. Popular models of choice likewise typically assume some form of competition between options to account for choice exclusivity. Studying choices that lack (or relax) this exclusivity property could provide novel insights into the range of choices we engage with in our daily lives. Here, we developed a novel task that compares exclusive (menu-like) choices to non-exclusive (buffet-like) choices, and used this task to explore the mechanism of choice exclusivity.

Method:
Participants (N=17) viewed sets of four consumer products, and were asked to select their favorite item. They were then allowed to either choose any additional items they liked or not. Choice exclusivity was cued at the start of each trial. At the end of the session, participants rated how conflicted they felt during each of the 160 choices. An independent group of participants (N=38) performed a shortened web-based version of the experiment (120 choices) on Prolific.

Results:
Across these two studies, we found that, relative to exclusive choices, non-exclusive choices were faster and led participants to experience less conflict. This increase in response speed was not associated with a significant decrease in choice accuracy - participants were similarly likely to select the most valuable item as their first choice in both conditions. Exclusive and non-exclusive choices were also similarly influenced by the relative difference between chosen and unchosen values. In both conditions, participants were also faster to choose as the overall value of the set increased. However, overall value exerted a stronger influence on response speed for non-exclusive relative to exclusive choices, consistent with a less competitive and more independent (race-like) evidence accumulation process. Compared to exclusive choices, non-exclusive choices also generated less conflict the more valuable the options were.

Conclusion:
Our study validates a novel paradigm for studying a greater variety of real-world forms of choice, and our results provide novel insights into the impact of choice exclusivity on the dynamics and subjective experiences associated with decision making. In so doing, we lay the groundwork for new approaches to teasing apart mechanisms that make our choices better from those that make our choices (maybe unnecessarily) hard.

Conference Presenter: Stefano Palminteri

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TITLE: Context-Dependence Induces False Memories of Economic Values: A Test Across Three Decision-Making Modalities and Four Preference Elicitation Methods

ABSTRACT:
I will present results from several experiments (N=100 each) demonstrating that, in the context of human learning decision-making, the way in which options are arranged (the *choice architecture*) significantly affects the resulting memory representations of economic values. More specifically economic values stored in memories do not reflect objective values. In fact, memory distortions are generally consistent with a *partial range adaptation* process that we have recently proposed (Bavard et al. Science Advances, 2021). The results are robust across preference elicitation methods and decision-making modalities (experience-based or description-based).

Conference Presenter: Michael L. Platt

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TITLE: Neural Evidence for Brands as Extensions of the Self

ABSTRACT:
The concept of extended self is crucial for branding. Current evidence supporting this idea is primarily limited to stated, behavioral, and transactional data. Here we provide a neurobiological test of the hypothesis that people relate to their smartphone brands as extensions of themselves. Specifically, we used fMRI to measure hemodynamic responses in the brains of Apple and Samsung smartphone customers while they read news about the two brands. We found that reading news about one's own smartphone brand, relative to the other brand, activated the neural circuit involved in self-referential thought and introspection, and deactivates the neural circuit recruited by exteroceptive task engagement. Although Apple and Samsung customers reported similar identification with their own smartphone brand, activation of the self-referential circuit was greater in Apple customers than in Samsung customers. Our study provides neural evidence supporting the concept of extended self in branding. Our findings further demonstrate that brain imaging can uncover nuanced heterogeneity of extended self that is invisible to stated data, endorsing the complementary value of neuroscience for marketing research.

Conference Presenter: Antonio Rangel

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TITLE: Fixation Patterns in Simple Choice Reflect Optimal Information Sampling

ABSTRACT:
Simple choices (e.g., apple vs orange) are made by integrating noisy evidence that is sampled over time and influenced by visual attention; as a result, fluctuations in visual attention can affect choices. But what determines what is fixated and when during the decision process? We derive a model of optimal information sampling in simple choice where costly fixations are dynamically allocated to guide the sampling process. We find that in the optimal policy fixations are drawn to options whose value estimates are both high and uncertain. We find that the optimal policy provides a reasonable account of the fixation process during binary and trinary simple choice, as well as the difference between the two cases. Overall, the results show that the fixation process during simple choice is influenced dynamically by the value estimates computed during the decision process, in a manner consistent with optimal information sampling.

Conference Presenter: Blair Shevlin

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TITLE: Evaluating the Evidence for Preference-Based Attentional Capture in Binary Choice

ABSTRACT:
What is the relationship between gaze, value, and the decision process? Some researchers have argued that gaze amplifies value to drive the decision process, while others argue that gaze is drawn to options that are more likely to be chosen. In a recent article, Westbrook et al. (2020, *Science*) argued for a hybrid two-stage choice process, with an early stage where gaze amplifies information and a late stage where gaze is directed towards the to-be-chosen option. However, their analyses were not sufficient to support this claim because they would identify two stages even in one-stage data. Here, we took a more general approach for detecting whether gaze is drawn to preferred options (Sepulveda et al. 2020, *eLife*) and applied it to 11 datasets. Ultimately, we found support for preference-driven gaze in only a few specific cases, indicating that this is not a general feature of value-based decision-making.

Westbrook et al. used a bifurcation analysis to identify two stages of the decision process, finding that gaze amplification is strongest pre-bifurcation, while gaze bias is strongest post-bifurcation. However, we find that the model parameters from this approach are highly sensitive to the selection of the bifurcation point and may identify such differences even from simulations of a single-stage model. Thus, we argue that this approach cannot be relied on to distinguish between cognitive mechanisms.

Sepulveda et al. used an alternative analysis, examining how the correlation between gaze location and value difference evolves over the course of a trial. In their gaze-contingent paradigm, they find that this correlation increases over time. Applying the same analysis to the Westbrook dataset and simulations of a two-stage model, we also found gaze-value correlations that increase over time.

However, when we applied the same analysis to other datasets we found mixed evidence for this phenomenon. The datasets that we examined come from binary-choice eye-tracking experiments, some with options broken down into distinct attributes. These include choices from consumer goods, social allocations, risky prospects, and conditioned stimuli. We found that most datasets do not display any correlation between gaze and value. Datasets that do contain such patterns are those where subjects may have employed an alternative, search-based choice strategies.

In summary, our results suggest that goal framing and task structure can impact the relationship between gaze and choice, and that preference-based attentional capture only occurs in certain settings.

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TITLE: Emotions and Decision-making: Is Somatic Feedback (Equally) Indispensable for Decisions under Uncertainty and Risk?

ABSTRACT:
Introduction/problem: Visceral/somatic inputs influence risk assessment, somatic markers resolve choice indeterminacy, and guide long-term decisions. However, visceral influences are autonomic, and might increase regulatory demands, deplete inhibitory control, impacting long-term decision making specifically when the inhibitory demands are high (risk).

Hypothesis: Differential impact of somatic inputs on decisions under uncertainty and risk.

Method: We employed participants with spinal cord injury where the interaction of central and peripheral nervous system is disrupted, restricting availability of somatic feedback to the prefrontal cortex. We used heart rate variability, a marker of autonomic regulation of somatic feedback (cardiac). We examined the effects of poor vs. intact somatic input [spinal cord injury vs. healthy control] and high vs. low autonomic control in resting state heart rate variability (high vs. low HRV High Frequency) (N = 60, males) on decision making in the Iowa Gambling Task. Autonomic feedback guides long-term decision-making in the task (net scores reflect choice of long term reward in favor of risky, immediate rewards), as the 100 trials progress, first 40 trials (blocks 1 & 2) reflect decisions under uncertainty (outcomes unknown), last 40 trials (blocks 4 & 5) reflect decisions under risk (outcomes known).

Results: In a 2 (net scores block 1 vs. 2) $\times$ 2 (injury vs. healthy) $\times$ 2 (high vs. low HF –HRV) mixed-model ANOVA, main effect of net scores was not significant (*ns*), injury effect were *ns,* two-way interaction of HF-HRV was significant indicating that autonomic regulation benefitted decision making in uncertainty. For the analysis of net scores in the risk blocks (net scores block 4 vs. 5), the main effect was *ns*, two-way interaction showed injury group made more long term decisions, three-way interaction was significant, higher long term decisions in risk trials were made by the injury group with high HF HRV.

Conclusions: High autonomic regulation improved decision making under uncertainty, somatic inputs had no effect, whereas high autonomic regulation and reduced somatic inputs (spinal cord injury) improved decisions under risk. Moderation in somatic inputs and high somatic regulation facilitated inhibitory control and promoted long-term decision making under risk.

Conference Presenter: Stephanie M. Smith

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TITLE: Consumers Undervalue Multi-Option Alternatives in Two-Stage Choice

ABSTRACT:
Only rarely does a consumer's full decision process conclude at the moment of choice. Instead, each node in a decision tree typically leads to more decisions. Sometimes these are implicit, as when choosing a home implies choices among where to eat, where to shop, and who to visit. Other times these are explicit, as when choosing a restaurant implies choosing items from a menu or choosing to watch TV implies choosing a show. Even this narrower case of explicit multi-option alternatives is ubiquitous. Multi-retailer gift cards, airline choices, food/drink tickets (e.g., at fairs/festivals), and game tokens (e.g., at arcades) all constitute multi-option alternatives, as well. Here, we seek to understand how consumers integrate across options in a decision with a multi-option alternative.

In each of six studies (in two domains: consumer goods and incentivized risky gambles), participants make at least two types of choices: control choices and test choices. In the control choices, participants choose between two single-option alternatives (e.g., A vs. B). In the test choices, participants choose between a single-option alternative (e.g., A) and a multi-option alternative (e.g., B or C, where the value of B is greater than the value of C). We compare choice proportions for A in each choice type to test for the presence of undervaluation. In all studies, participants choose A significantly more often when it is contrasted with a multi-option alternative (B or C) than when it is contrasted with the highest-valued option from the multi-option alternative (B). In other words, adding C (as a component option with B) makes people less likely to choose "B or C" than they are to choose B. Moreover, the difference in value between B and C is predictive of the size of the effect; as C gets worse and worse (relative to B), participants show greater undervaluation.

Mouse-tracking reveals that participants who spend more time on A in test choices demonstrate a greater degree of undervaluation. In addition, participants who attend more to the dominated option (C) are less likely to choose the multi-option alternative. However, participants spend less time on the dominated option when the dominance relationship between B and C is more transparent/obvious.

Across all of our studies, participants regularly sacrifice a chance at maximizing their subjective value by inappropriately integrating the value of less-attractive options. Overall, this work contributes to our understanding of multi-stage consumer decision-making and how consumers assess the overall value of choices.

Conference Presenter: Sebastian Speer

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TITLE: The Effect of Stress on Intuitive (Dis)Honesty

ABSTRACT:
Our everyday life is full of situations in which we have to decide between the temptation to behave unethically for financial gains or to comply with social norms and maintain a positive image of ourselves as being a 'good person'. Often such moral conflicts have to be resolved under stress as for example when deciding whether to cheat in an exam or not.

Accumulating evidence suggests that acute stress and the associated cortisol response influences social decision-making (Starke et al.,2011; von Dawans et al., 2012). Importantly, the stress induced Deliberation-to-Intuition (SIDI) model proposes that decisions under acute stress result from a combination of impaired cognitive control and enhanced intuitive response tendencies (Yu, 2016). Here, we apply this model to understand the effect of stress on cheating behavior.

In a recent fMRI study (Speer et al, 2020), we found that cognitive control is not needed to be honest or dishonest per se, but that it depends on an individual's moral default. More precisely, cognitive control helped dishonest participants to be honest, whereas it promoted cheating for honest participants. Therefore, it can be hypothesized that stress would have a differential effect on moral decision making depending on a person's moral default. A person who is intuitively honest will become more honest under stress, whereas a cheater will cheat more, as self-control processes are impaired and intuitive decisions are facilitated.

To test this hypothesis, we combined our novel Spot-The-Difference Task (STDT), which allows for inconspicuously. measuring spontaneous and voluntary cheating, with the Maastricht Acute Stress test (MAST; Smeets et al., 2012), which combines social and physical stressors. Participants completed the first half of the STDT followed by the MAST (low or high stress condition) and then finished with the second half of the STDT. We used a drift diffusion model (DDM) to model choices and reaction times, to better disentangle the effect of intuition as commonly represented by the starting bias z and deliberation reflected by the drift rate v on dishonesty.

We found a significant interaction effect between Blocks (before vs after stress) and an individual tendency to cheat in the Stress condition but not in the control condition. Cheaters started to cheat more after stress whereas honest participants became more honest. Regressing the parameters from the DDM for each subject against their pre-post difference in cheating we find that only in the stress condition the starting bias z is a significant predictor of the change in cheating. This suggests that in the second block participants indeed seem to rely more on their intuition after stress which amplifies their inclination to cheat or be honest, confirming our hypothesis that stress would reduce cognitive control capacities and amplify a person's moral default.

Conference Presenter: Jennifer Trueblood

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TITLE: Leveraging Cognitive and Neural Network Models to Understand and Improve Medical Image Decision-making

ABSTRACT:
Improving the accuracy of medical image interpretation is critical to improving the diagnosis of many diseases. In pathology and radiology, individuals are tasked with identifying rarely occurring abnormalities in medical images. Over the past decade, it has been repeatedly demonstrated that extreme prevalence (both high and low) leads to an increase in errors. While this "prevalence effect" is well established, the cognitive and/or perceptual mechanisms responsible for it are not. Through an application to pathology image-based decision-making, we illustrate that a joint convolutional neural network and diffusion decision model can be used to disentangle different types of biases that might be present. Building on these results, we investigate aggregation algorithms for improving diagnostic accuracy. Research in human decision-making has shown that a Wisdom of the Inner Crowd approach can improve the accuracy of individual decision-makers. In this approach repeated judgments from the same decision maker on the same stimuli are aggregated. Since repeated decisions in medical contexts are time intensive and potentially costly, we test whether it is possible to aggregate decisions on not necessarily the same but similar images, leveraging neural network models to determine similarity.

Conference Presenter: Anita Tusche

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TITLE: Predicting Sales of New Consumer Products with fMRI, Survey, and Market Data

ABSTRACT:
This paper studies the relevance of different data sources for predicting sales of new products prior to their launch. Our approach combines market data of previously launched products with customer attitudes based on a representative survey, incentive compatible purchasing decisions, and functional magnetic resonance imaging (fMRI) data. We forecast sales of products before their launch and quantify the added value of each information source for prediction accuracy. We apply our model to weekly data of 21 new products in packaged foods and drinks categories of a large German supermarket chain. Results indicate that using brain images for the prediction of new products significantly increases forecast accuracy. Using brain images leads to a 28.6% better forecast than a constant only model. We find that the best combination of data sets is the pooling of fMRI data with an incentive compatible purchase question. With this approach, managers can learn the benefits of running fMRI experiments and/or traditional representative surveys, beyond modeling market data, to predict the market success of newly launched consumer products.

Conference Presenter: Zachary Wojtowicz
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TITLE: Boredom and Flow: An Opportunity Cost Theory of Attention-Directing Motivational States

ABSTRACT:
Many important processes are driven by attention and, in turn, the pains and pleasures that guide its allocation. In this paper we study the motivational states of boredom and flow, which, we argue, help individuals to efficiently allocate the scarce cognitive resource of attention by encoding information about the opportunity cost of maintaining focus. We develop a dual-self model in which one self (the executive) makes final decisions about how to allocate attention while the other self (the advisor) influences these decisions by changing how pleasurable or painful it is to maintain attention. The resulting utility specification provides a unified explanation of existing empirical evidence, makes novel behavioral predictions, and has important implications for welfare analysis. We illustrate the model's economic implications with applications to workplace design and industrial organization.

Conference Presenter: Xiaozhi Yang

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TITLE: Webcam-Based Online Eye-Tracking for Behavioral Research

ABSTRACT: Experiments are increasingly moving online (especially during the COVID epidemic). This poses a major challenge for researchers who rely on in-lab process-tracing techniques such as eye-tracking. Researchers in computer science have developed a web-based eye-tracking application (WebGazer; Papoutsaki et al., 2016) but it has yet to see use in behavioral research. This is likely due to the extensive calibration and validation procedure (~50% of the study time) and low/inconsistent temporal resolution (Semmelmann & Weigelt, 2018), as well as the challenge of integrating it into standard experimental software. Here, we incorporate WebGazer with the most widely used JavaScript library among behavioral researchers (jsPsych) and adjust the procedure and code to reduce calibration/validation and dramatically improve the temporal resolution (from 100-1000 ms to 20-30 ms or better). We test our WebGazer/jsPsych combination with a decision-making study on Amazon MTurk. We find little degradation in spatial or temporal resolution over the course of the ~30-minute experiment. We replicate previous in-lab findings on the relationship between gaze dwell time and value-based choice. In summary, we provide an open-source, accessible template for web-based eye-tracking in behavioral research and validate its use in research on decision-making.

Conference Presenter: Clarice Zhao

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TITLE: A Neuro-Autopilot Theory of Habit: Evidence from Canned Tuna

ABSTRACT:
There is a wide and implicit recognition of the significance of habits to people's well-being. In marketing and economic research, the existing literature on consumer choice typically models habits by allowing the preference for goods to change based on past consumption. While this approach is able to capture the empirical patterns of choice persistence, it ignores the role of attention and effort reduction in habitual decision making. The paper aims to integrate an established body of habit research in psychology and neuroscience into a consumer choice model.

We propose that habit represents one of two distinct decision-making modes. The habit mode automatically repeats past choices with minimal thought or deliberation. The other mode involves conscious deliberation over all available options. The transition between these decision modes is governed by the reliability of a reinforcement learning algorithm, in which the agent learns the values of alternatives and tracks their cumulative reward prediction errors.

We then provide empirical evidence for this concept of habit by analyzing consumer choices in the canned tuna category. In 2008, canned tuna producers shrunk the size of their packaging in the US market from 6oz to 5oz per can. The introduction of the 5oz cans staggered across brands and across stores. Using A.C. Nielsen household and scanner panel data, we construct a household-level consumer purchase data set between 2007 and 2010, which consists of 632 households and 9236 purchase occasions of individually packaged canned tuna.

Our structural model estimation results show that our neural-autopilot model of habit largely improves the model fit relative to the standard consumer choice model with state-dependent utility. We find strong evidence for choice persistence arising from a habitual autopilot decision mode – 91% of canned tuna choices are made in habit mode. These choices are not "optimal" in the sense of using all available information, but they also do not require cognitive effort. The effect of past choices on utility, i.e., the state-dependency parameter estimate, is halved after the model allows for autopilot. This indicates that state dependence may play a smaller role in choice persistence than estimated in previous literature.

Conference Presenter: Wenjia Joyce Zhao

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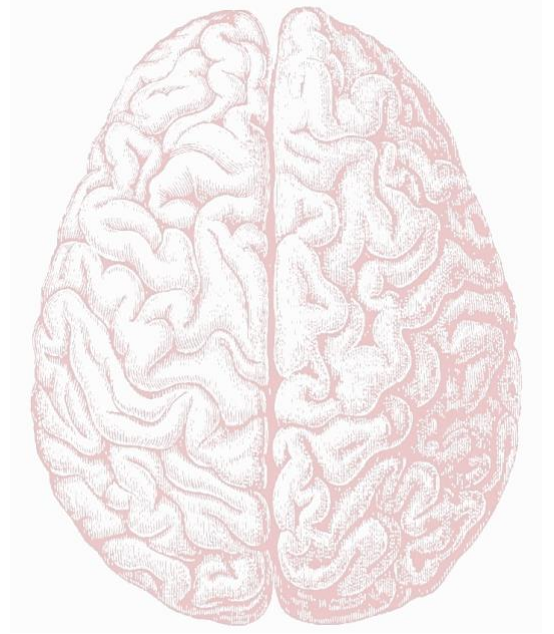3rd Author: Department of Psychology, University of Pennsylvania
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TITLE: Attentional Dynamics in Complex Value-Based Choice

ABSTRACT:
Attention is a key determinant of value-based choice. Yet we currently lack a general quantitative framework capable of providing a systematic account of attentional dynamics in large and complex choice sets, such as those encountered by decision makers in everyday choice settings (e.g. when choosing products in a grocery store). We build such a framework and apply it to eye-tracking data from a many-option food choice experiment. Our approach is based on established theories of attention and memory, and describes nuanced aspects of visual search dynamics, i.e., where people look at a given point in time and how this depends on what people have looked at previously. Our model quantitatively predicts key properties of the gaze patterns in the data such as the high probability of sampling neighbors, the frequent sampling and resampling of high-value items, and the delays before returning to an item. Overall, our quantitative, tractable, and general modeling framework provides novel insights regarding visual search dynamics in complex value-based choice. In doing so, it allows for the study of difficult but intriguing research questions regarding the interaction between attention and choice in everyday decisions.

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