

# How psychological theories and neuro-cognitive experiments can extend our understanding of hypothetical bias in choice experiments

Dr Milad Haghani



THE UNIVERSITY OF  
SYDNEY



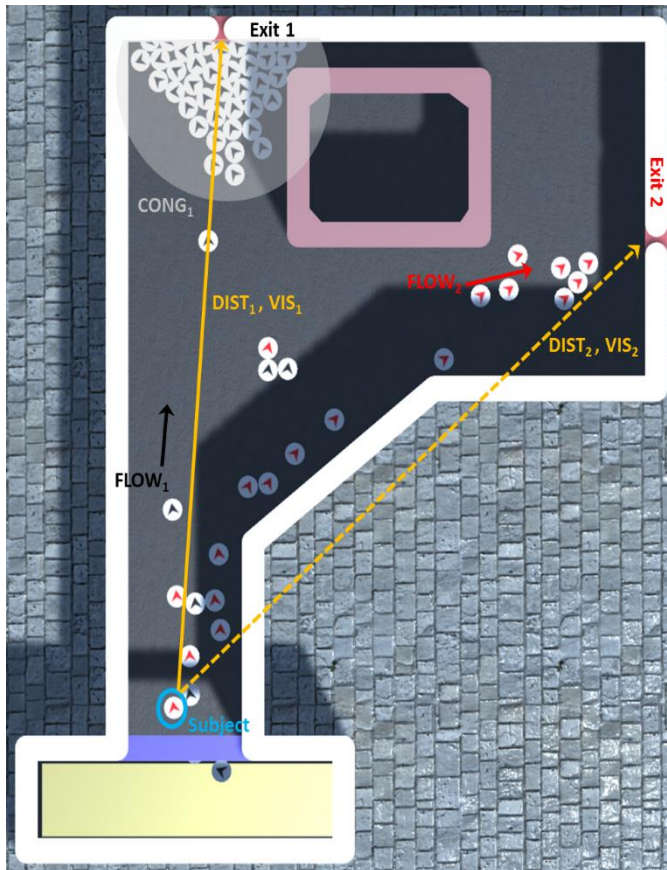
THE UNIVERSITY OF  
MELBOURNE



**Hypothetical bias:  
from individual case studies to a broader interdisciplinary  
perspective**

# EXIT CHOICE MODEL OF PEDESTRIANS

## Logit model formulation



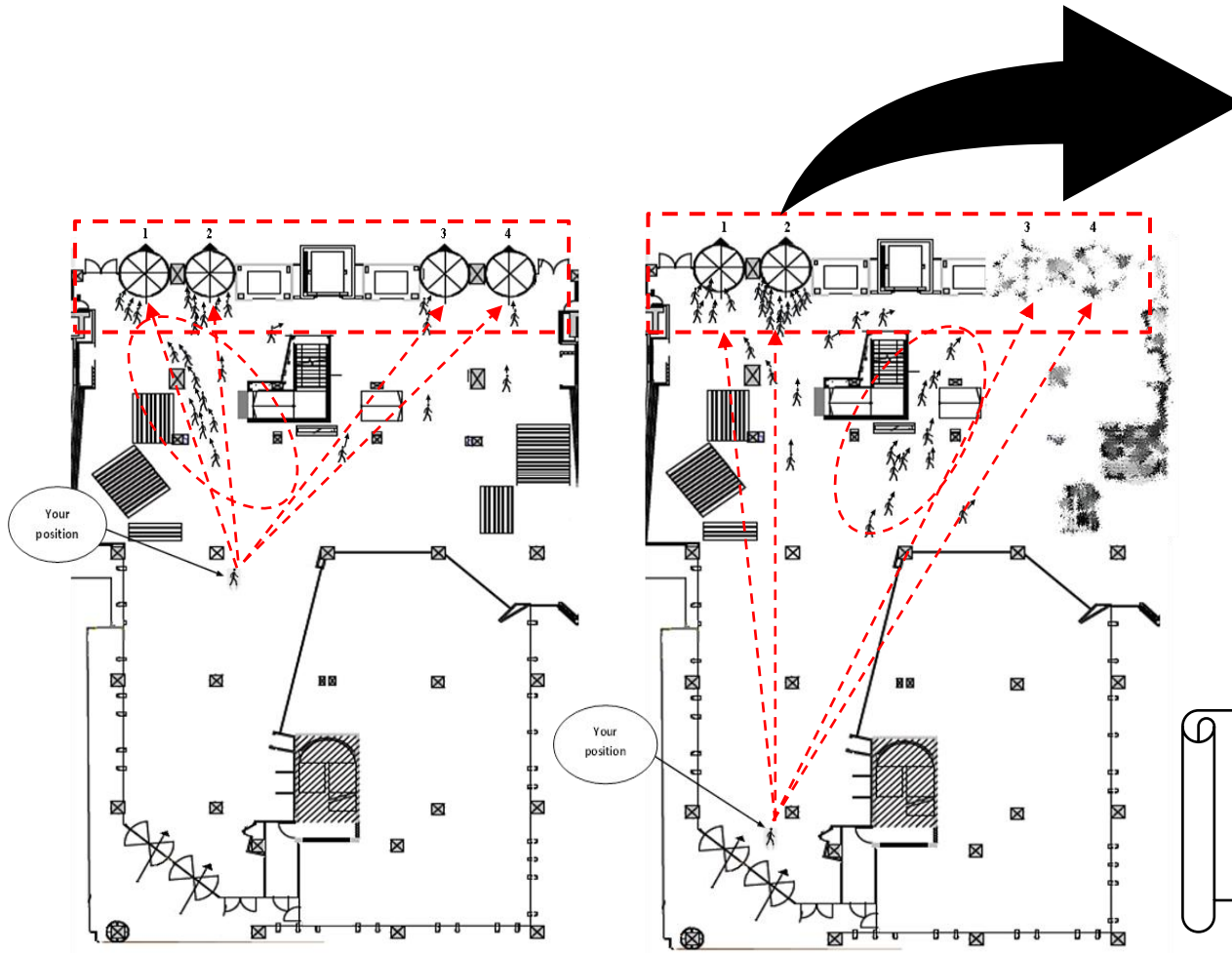
### – Utility functions

$$V_{\text{Exit } i} = \beta_1 \cdot \text{Distance} + \\ \beta_2 \cdot \text{Congestion} + \\ \beta_3 \cdot \text{Flow} \cdot \text{Visibility} + \\ \beta_4 \cdot \text{Flow} \cdot (1 - \text{Visibility}) + \\ \beta_5 \cdot \text{Visibility}$$

### – Probability of choosing an exit $i$

$$P_{\text{Exit } i} = \frac{\exp(V_{\text{Exit } i})}{\sum_j \exp(V_{\text{Exit } j})}$$

# STATED CHOICE SURVEY

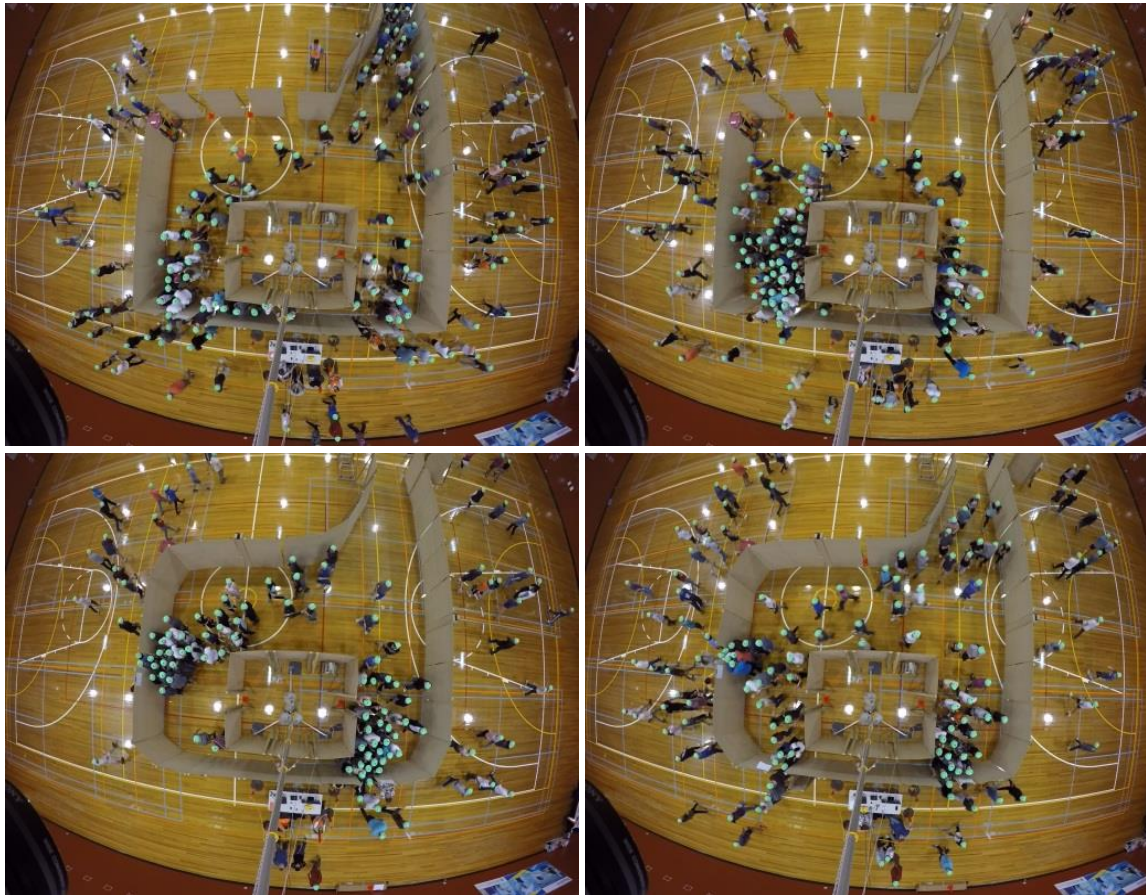


Early 2014  
Monash University Campus  
(not a staged photo)

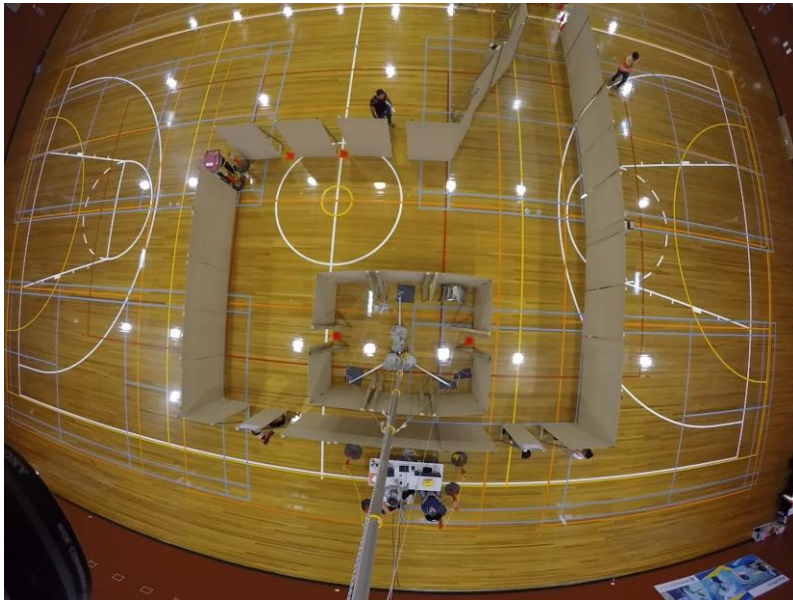
Sceptical colleague: Where is the "actual" data?

# QUASI-EXPERIMENTAL OBSERVATIONS

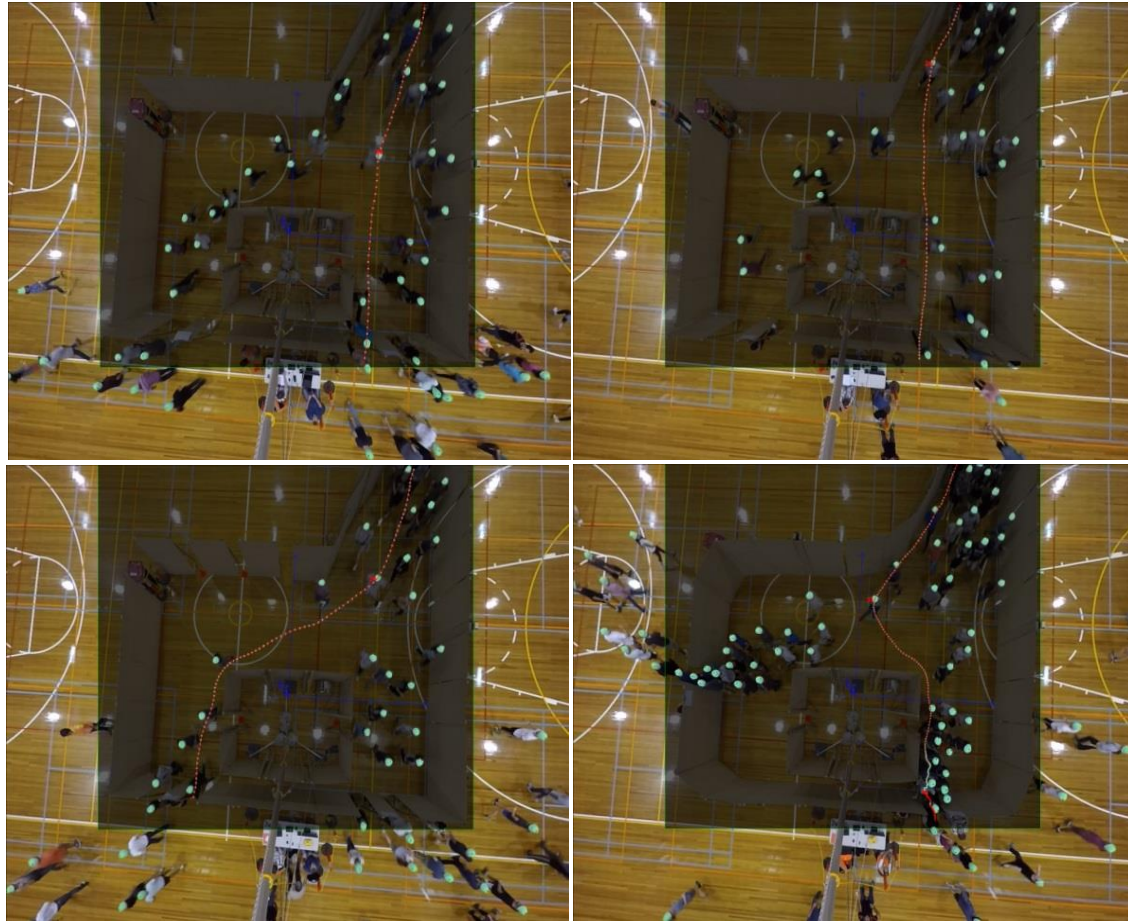
Early 2015  
Monash University Campus – Basketball court



# QUASI-EXPERIMENTAL OBSERVATIONS

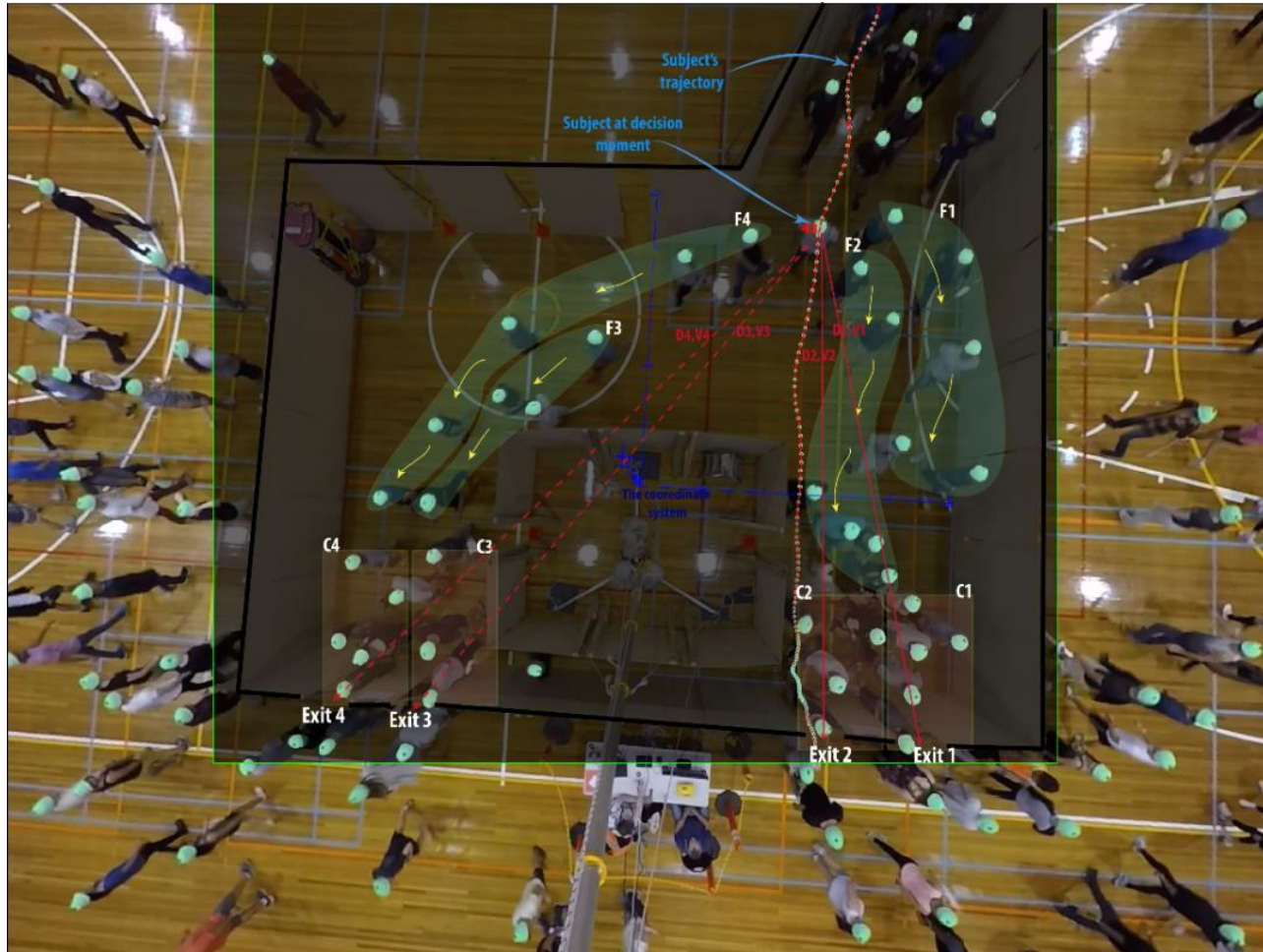


# CHOICE OBSERVATION EXTRACTION



# CHOICE OBSERVATION EXTRACTION

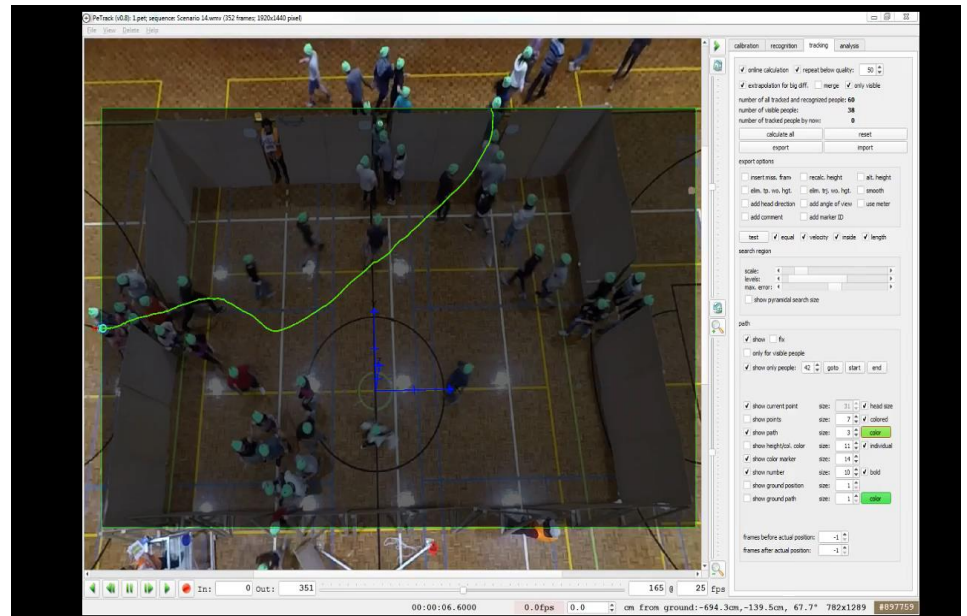
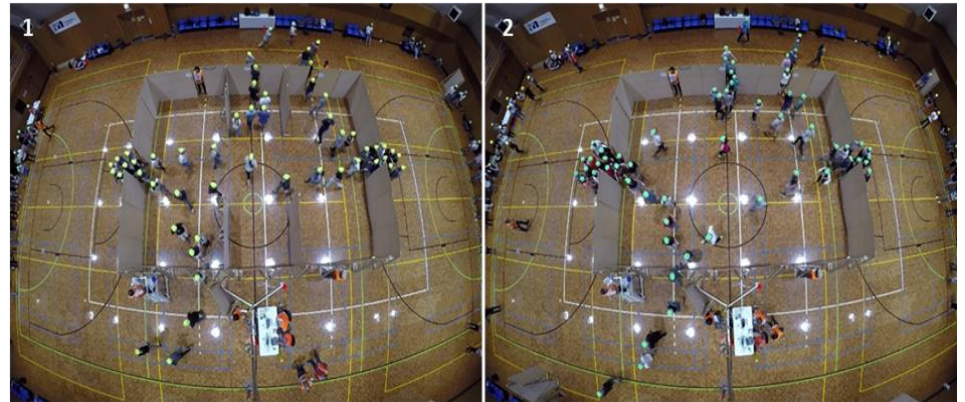
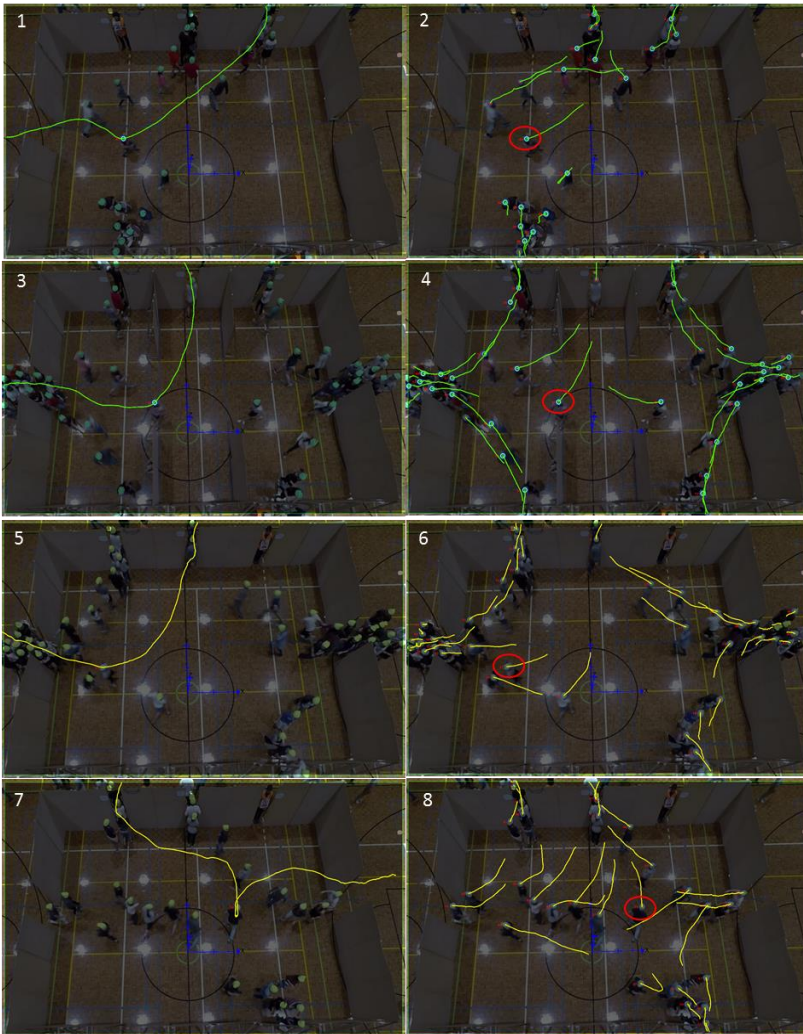
## Sample observation #1





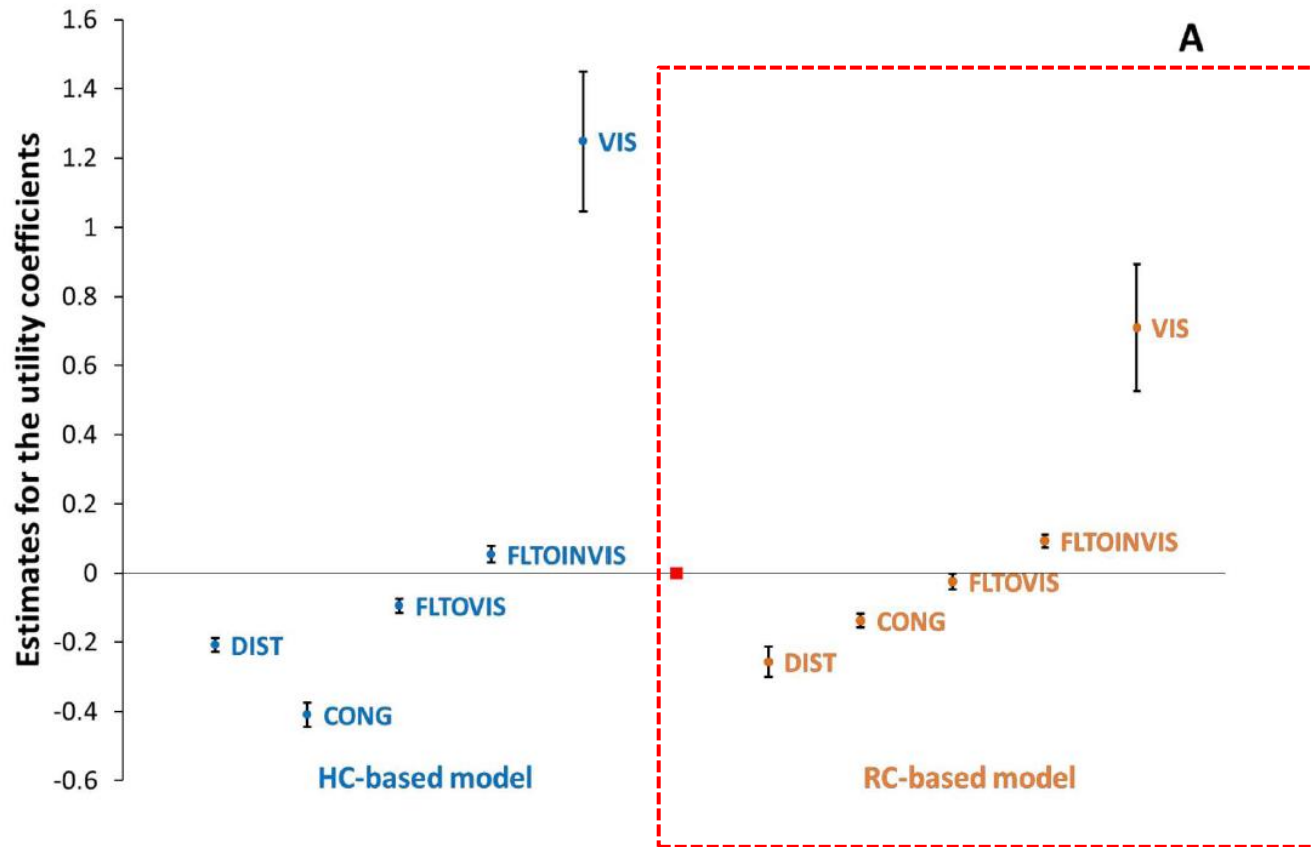
# ANOTHER QUASI EXPERIMENT

Early 2017  
Melbourne University Campus – Basketball court



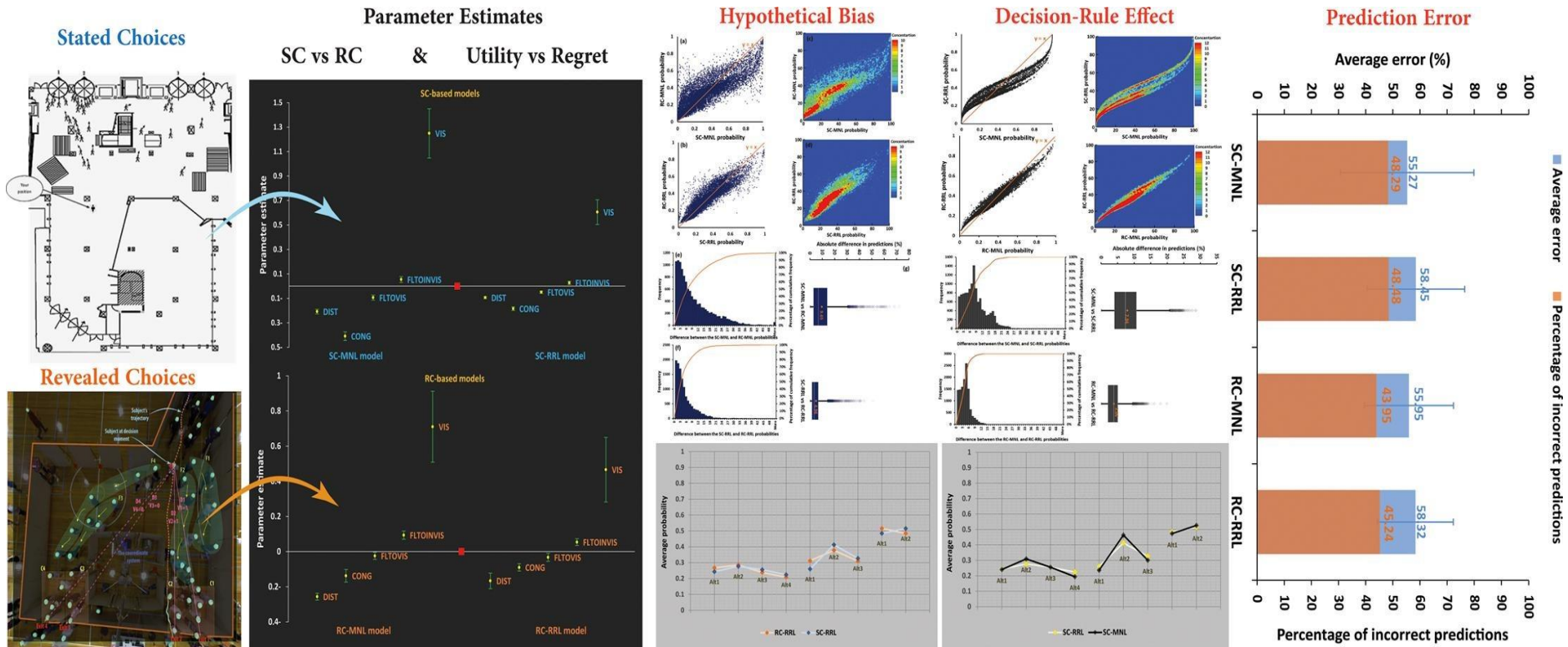
# OUTCOMES

## Parameter estimates



# OUTCOMES

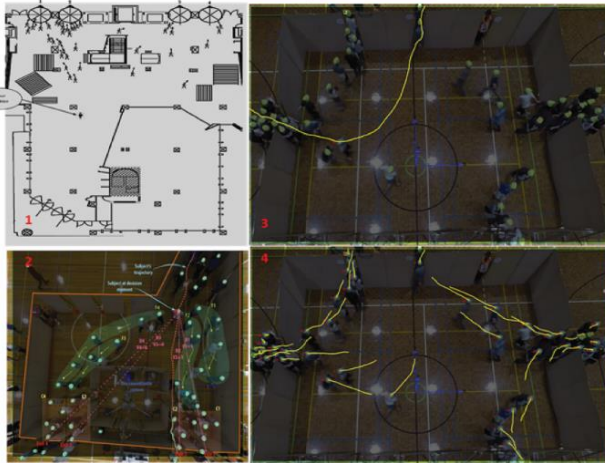
## Parameter estimates, choice probabilities, “market shares”, prediction errors



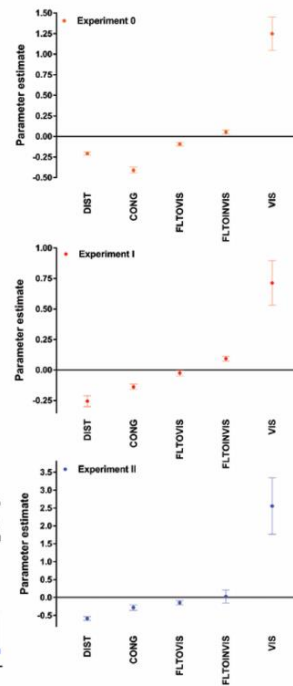
# OUTCOMES

## Parameter estimates, exit shares & prediction errors at “ultra-aggregate levels”

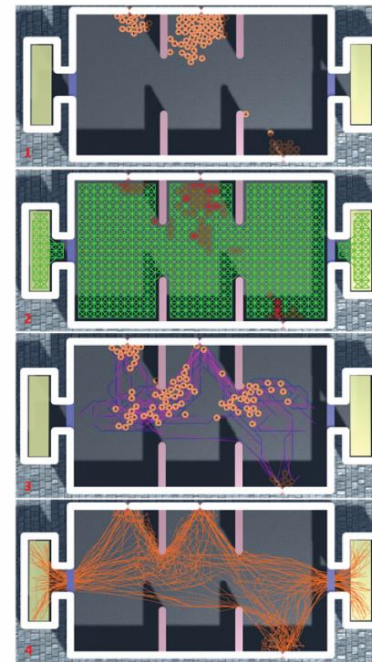
External and internal validity of evacuation experiments



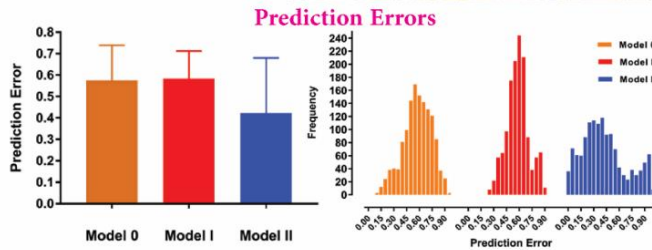
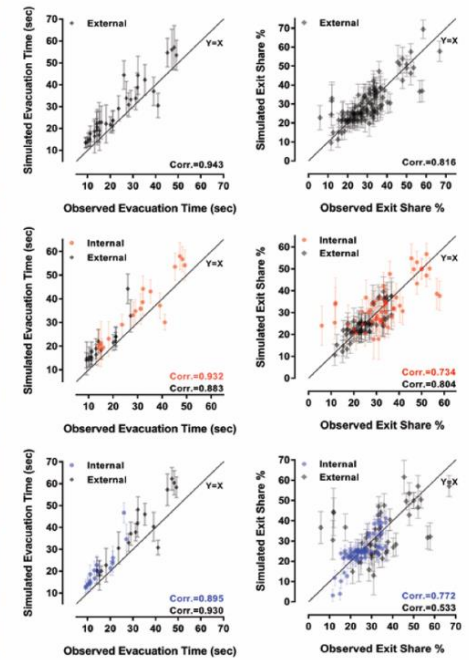
Parameter estimates



Computer simulations



Validity based on aggregate measures



# SOURCES

Transportation Research Part A 116 (2018) 361–388



Contents lists available at [ScienceDirect](#)

## Transportation Research Part A

journal homepage: [www.elsevier.com/locate/tra](http://www.elsevier.com/locate/tra)



Hypothetical bias and decision-rule effect in modelling discrete directional choices



Transportation Research Part A 130 (2019) 134–157



Contents lists available at [ScienceDirect](#)

## Transportation Research Part A

journal homepage: [www.elsevier.com/locate/tra](http://www.elsevier.com/locate/tra)



Laboratory experimentation and simulation of discrete direction choices: Investigating hypothetical bias, decision-rule effect and external validity based on aggregate prediction measures



# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

**A collaborative study funded by Australian Research Council (ARC) DP180103718  
Ongoing since August 2018**



Michiel Bliemer  
University of Sydney



Harmen Oppewal  
Monash University



Emily Lancsar  
Australian National University



John Rose  
University of Technology Sydney

Haghani, M., Bliemer, M., Rose, J., Oppewal, H., Lancsar, E., 2020. Hypothetical bias in stated choice experiments: Part I. Integrative synthesis of empirical evidence and conceptualisation of external validity.

Haghani, M., Bliemer, M., Rose, J., Oppewal, H., Lancsar, E., 2020. Hypothetical bias in stated choice experiments: Part II. Macro-scale analysis of literature and effectiveness of bias mitigation methods

# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

Investigating evidence from various domains of applied economics + psychology



Environmental & resource economics

+



Consumer economics & marketing

+



Health economics

+



Transport economics

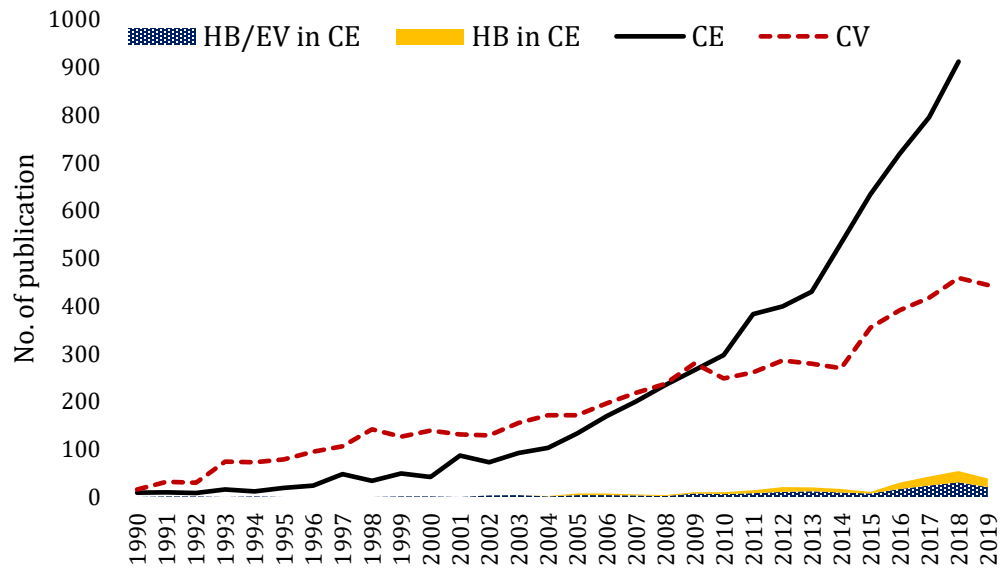
+



Psychology & cognitive neuroscience

# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

## Disentangling SC (or DCE) studies of hypothetical bias from CV





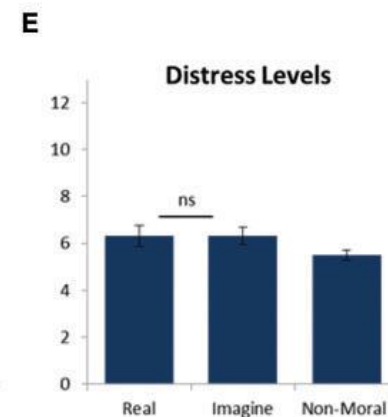
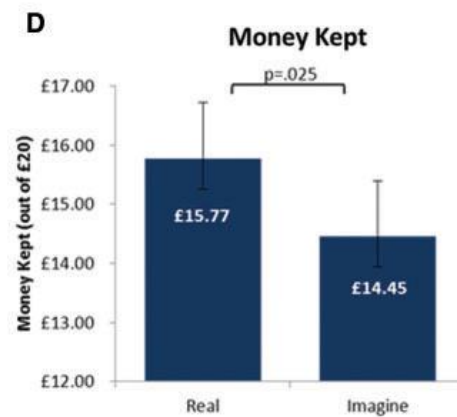
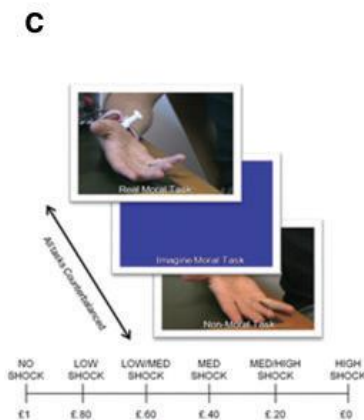
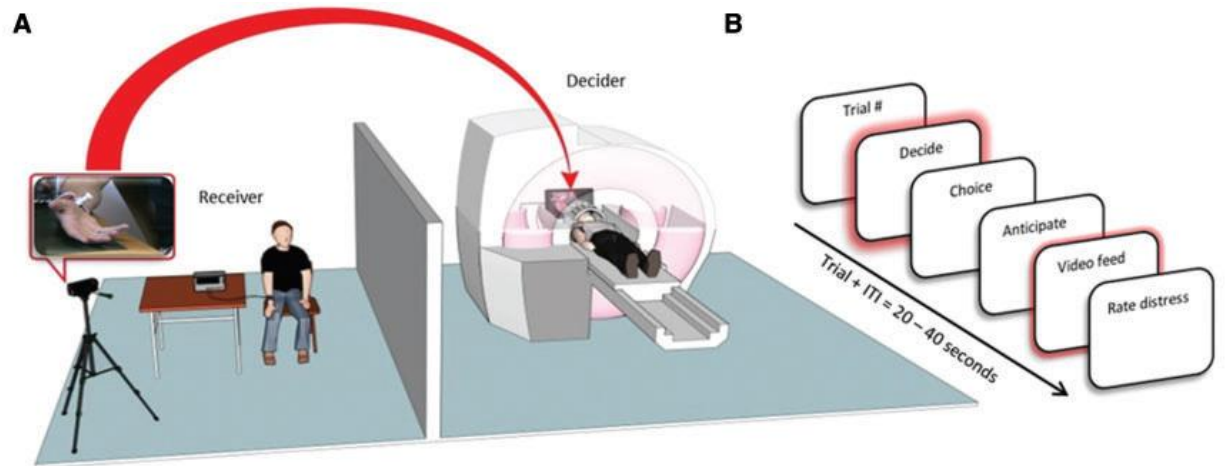
# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

Hypothetical bias is an undeniable reality in CE



# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

How is the field of cognitive neuroscience helping?



# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

## How is the field of cognitive neuroscience helping?

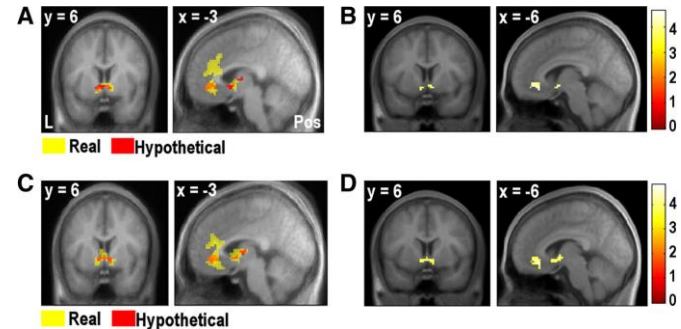
The Journal of Neuroscience, January 12, 2011 • 31(2):461–468 • 461

Behavioral/Systems/Cognitive

### Hypothetical and Real Choice Differentially Activate Common Valuation Areas

Min Jeong Kang,<sup>1</sup> Antonio Rangel,<sup>2,3</sup> Mickael Camus,<sup>2</sup> and Colin F. Camerer<sup>2,3</sup>

<sup>1</sup>Haas School of Business, University of California, Berkeley, California 94720, and <sup>2</sup>Humanities and Social Sciences, and <sup>3</sup>Computational and Neural Systems, California Institute of Technology, Pasadena, California 91125



frontiers in  
NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE  
published: 10 June 2013  
doi: 10.3389/fnins.2013.00104



### fMRI evidence of a hot-cold empathy gap in hypothetical and real aversive choices

Min J. Kang<sup>1</sup> and Colin F. Camerer<sup>1,2\*</sup>

<sup>1</sup> Humanities and Social Sciences, California Institute of Technology, Pasadena, CA, USA  
<sup>2</sup> Computational and Neural Systems, California Institute of Technology, Pasadena, CA, USA



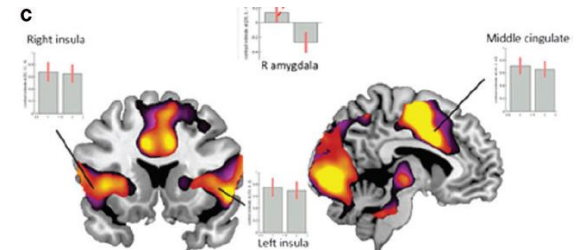
doi:10.1093/scan/nss069

SCAN (2012) 7, 743–751

### Differential neural circuitry and self-interest in real vs hypothetical moral decisions

Oriel FeldmanHall,<sup>1,2</sup> Tim Dalgleish,<sup>1</sup> Russell Thompson,<sup>1</sup> Davy Evans,<sup>1,2</sup> Susanne Schweizer,<sup>1,2</sup> and Dean Mobbs<sup>1</sup>

<sup>1</sup>Medical Research Council, Cognition and Brain Sciences Unit, 15 Chaucer Road, Cambridge CB2 7EF, UK and <sup>2</sup>Cambridge University, Cambridge CB2 1TP, UK



# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

## How is the field of cognitive neuroscience helping?



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)



Transportation Research Part A 39 (2005) 279–293

TRANSPORTATION  
RESEARCH  
PART A

[www.elsevier.com/locate/tra](http://www.elsevier.com/locate/tra)

frontiers in  
NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE  
published: 10 June 2013  
doi: 10.3389/fnins.2013.00064

fMRI evidence of a hot-cold empathy gap in hypothetical and real aversive choices

Min J. Kang<sup>1</sup> and Colin F. Camerer<sup>1,2\*</sup>

<sup>1</sup> Humanities and Social Sciences, California Institute of Technology, Pasadena, CA, USA  
<sup>2</sup> Computational and Neural Systems, California Institute of Technology, Pasadena, CA, USA

## Valuing time and reliability: assessing the evidence from road pricing demonstrations ☆

David Brownstone<sup>a,\*</sup>, Kenneth A. Small



PERGAMON

Transportation Research Part A 37 (2003) 373–387

TRANSPORTATION  
RESEARCH  
PART A

[www.elsevier.com/locate/tra](http://www.elsevier.com/locate/tra)

## Drivers' willingness-to-pay to reduce travel time: evidence from the San Diego I-15 congestion pricing project

David Brownstone<sup>a,\*</sup>, Arindam Ghosh<sup>b</sup>, Thomas F. Golob<sup>c</sup>, Camilla Kazimi<sup>d</sup>, Dirk Van Amelsfort<sup>e</sup>

<sup>a</sup> Department of Economics, University of California, Irvine, CA 92697-5100, USA

<sup>b</sup> Department of Economics, University of California, Irvine, CA 92697-5100, USA

<sup>c</sup> Institute of Transportation Studies, University of California, Irvine, CA 92697-3600, USA

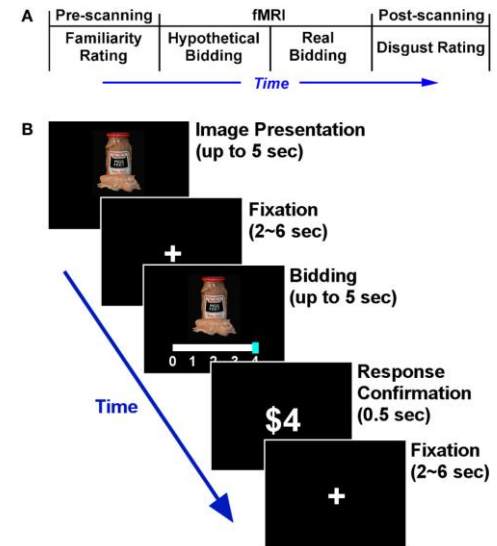
<sup>d</sup> Department of Economics, San Diego State University, 92182, USA

<sup>e</sup> Bureau Goudappel, Coffeng, The Netherlands

Received 10 August 1999; received in revised form 11 June 2002; accepted 18 July 2002

### Abstract

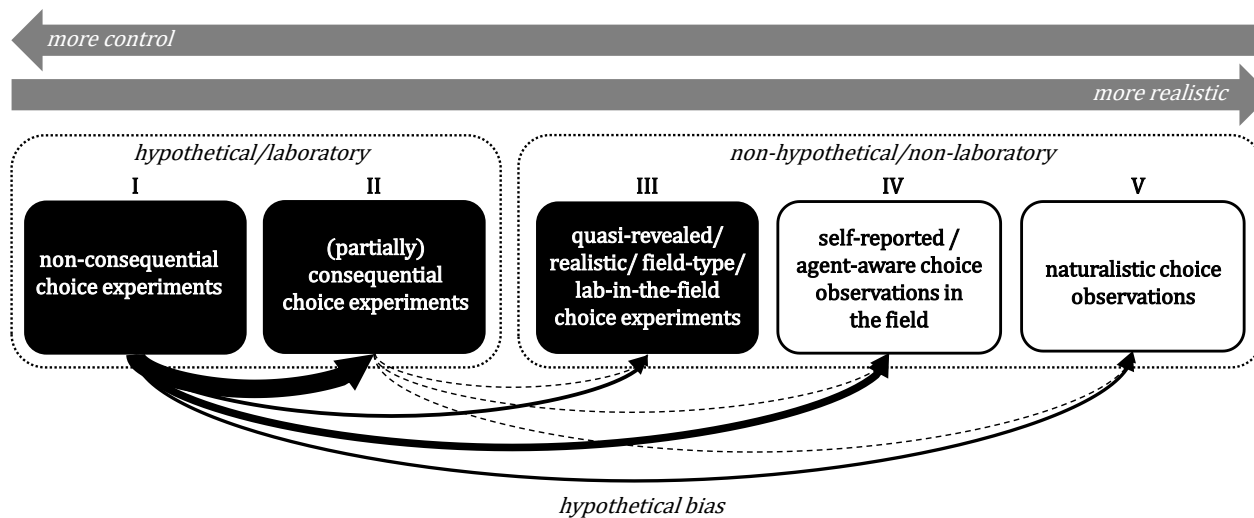
The adoption of congestion pricing depends fundamentally upon drivers' willingness to pay to reduce travel time during the congested morning peak period. Using revealed preference data from a congestion pricing demonstration project in San Diego, we estimate that **willingness to pay to reduce congested travel time is higher than previous stated preference results**. Our estimate of median willingness to pay to reduce commute time is roughly \$30 per hour, although this may be biased upward by drivers' perception that the toll facility provides safer driving conditions. Drivers also use the posted toll as an indicator of abnormal congestion and increase their usage of the toll facility when tolls are higher than normal.  
© 2003 Elsevier Science Ltd. All rights reserved.



Kang, M.J., Camerer, C.F., 2013. fMRI evidence of a **hot-cold empathy gap** in hypothetical and real aversive choices. *Frontiers in neuroscience* 7, 104.

# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

Towards a unified, inclusive and pragmatic definition of hypothetical bias



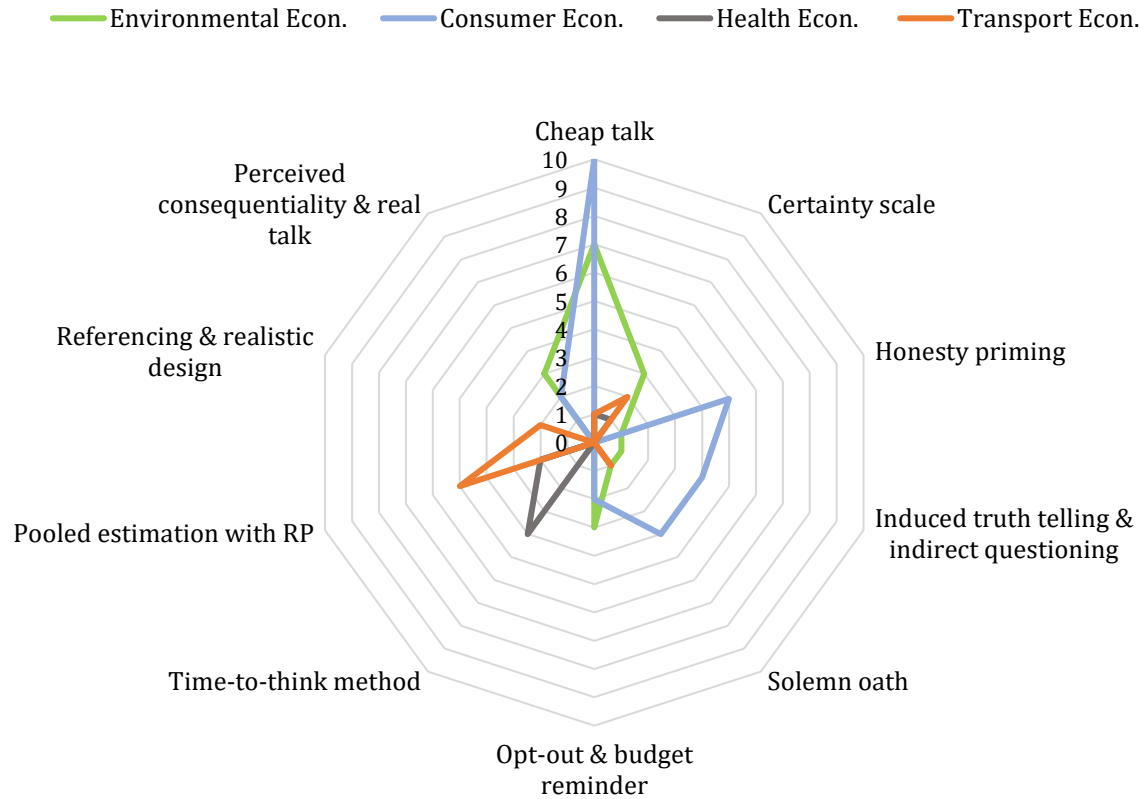
# AN INTEGRATIVE MULTIDISCIPLINARY OVERVIEW OF HYPOTHETICAL BIAS

## Causes/sources/explanations of hypothetical bias



# HYPOTHETICAL BIAS MITIGATION METHODS

## Variations across disciplines



# HYPOTHETICAL BIAS MITIGATION METHODS

## Linking mitigation strategies to sources of hypothetical bias

