Causal Inference: prediction, explanation, and intervention

Lecture 9: Psychology

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Project notes

- Project: Think about evaluation
- Paper: Like a conference paper, ~6-8 pages (can use e.g. AAAI, IJCAI, NIPS templates)
  - Should include motivation, detail on what you did, conclusions, and what you would do if you had more time
- Presentation
- References: required

1692 Two girls in Salem having fits and convulsions

Doctors suspect witchcraft

1976 Ergot hypothesis

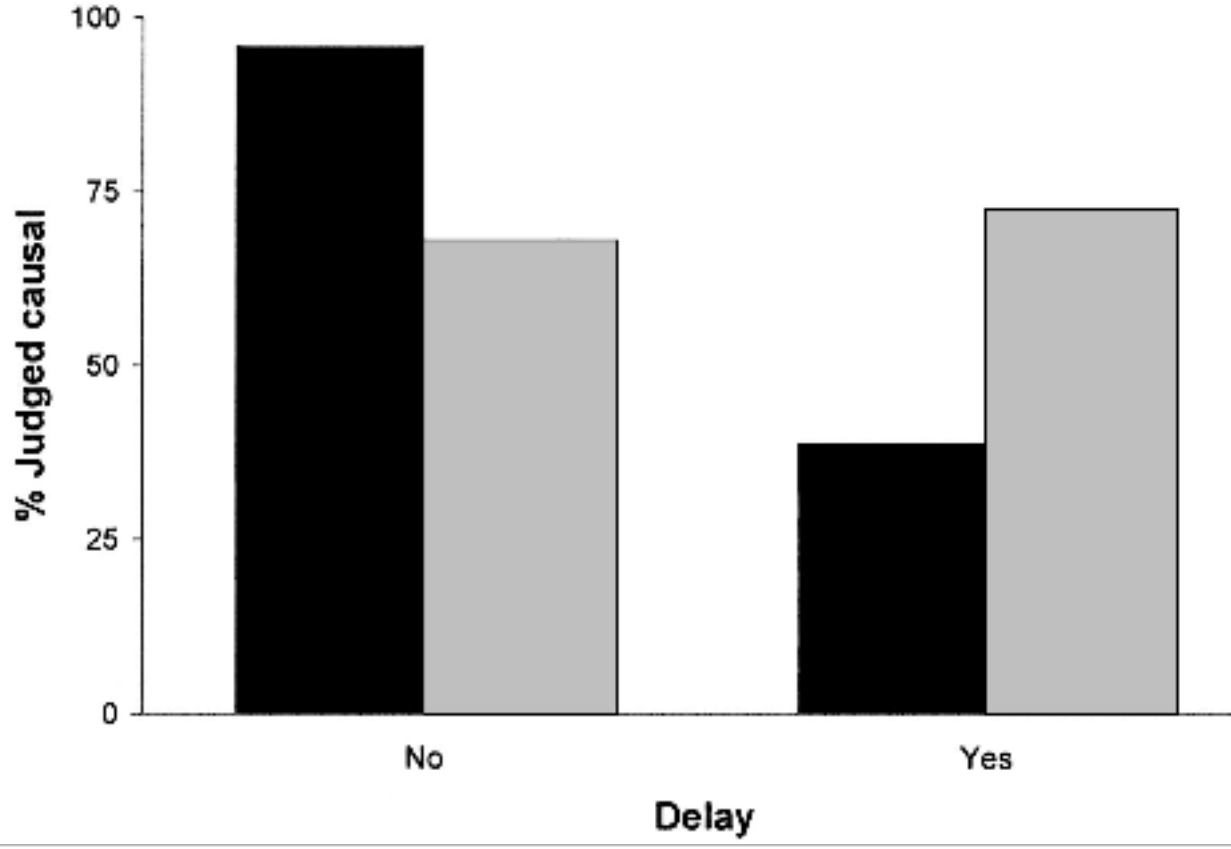
Learning about causes

- Perception: direct experience
- Inference: deduction from noncausal info

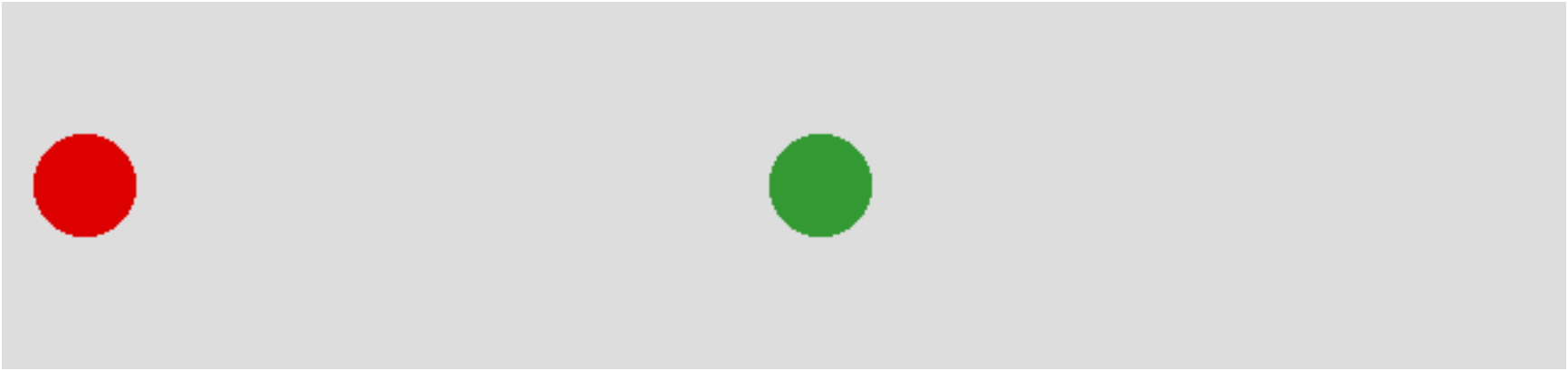
Are perception and inference separable?

- What happens when perception and inference conflict?
- How to test?

Split brain

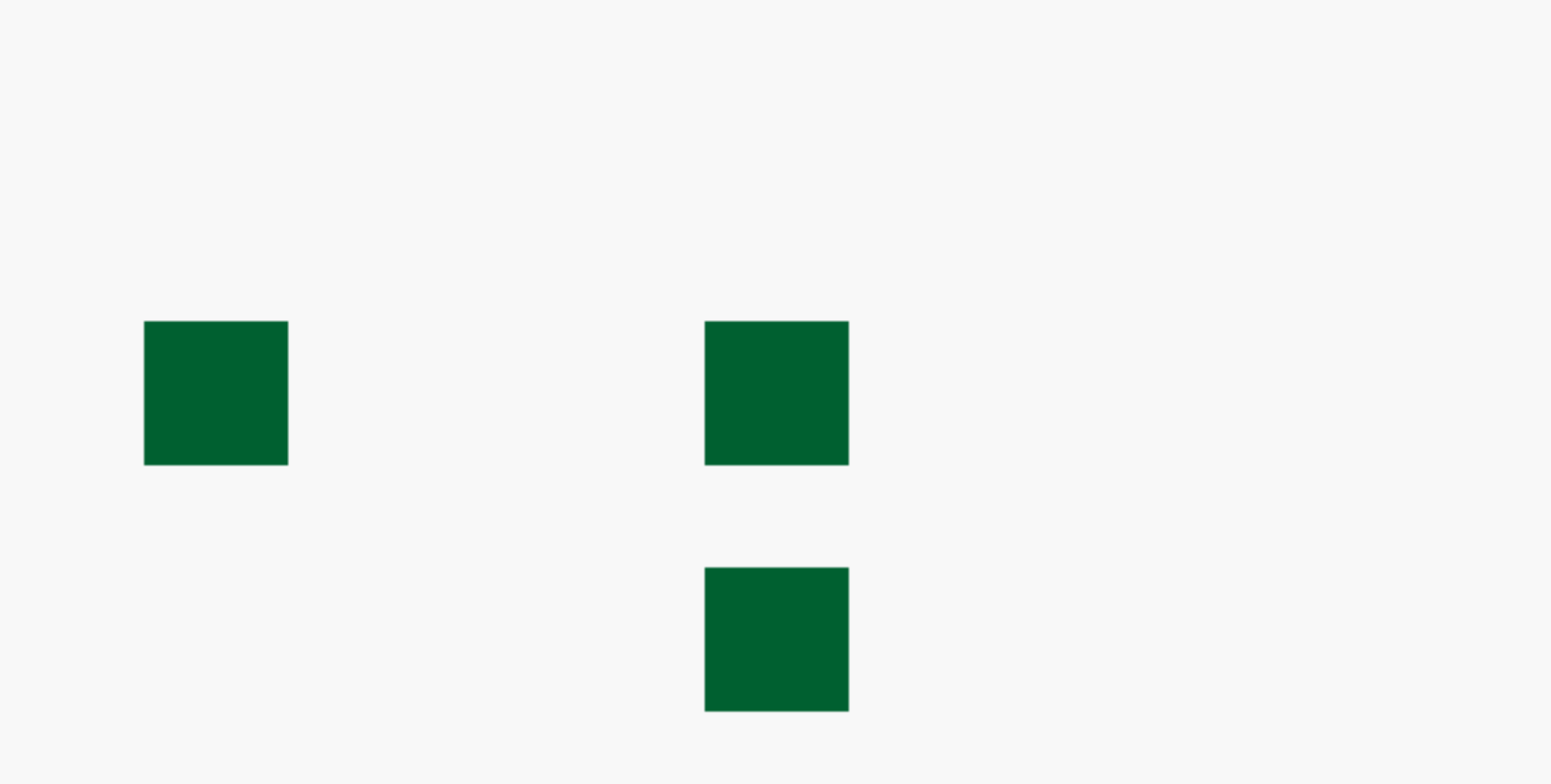


Is causal perception innate?

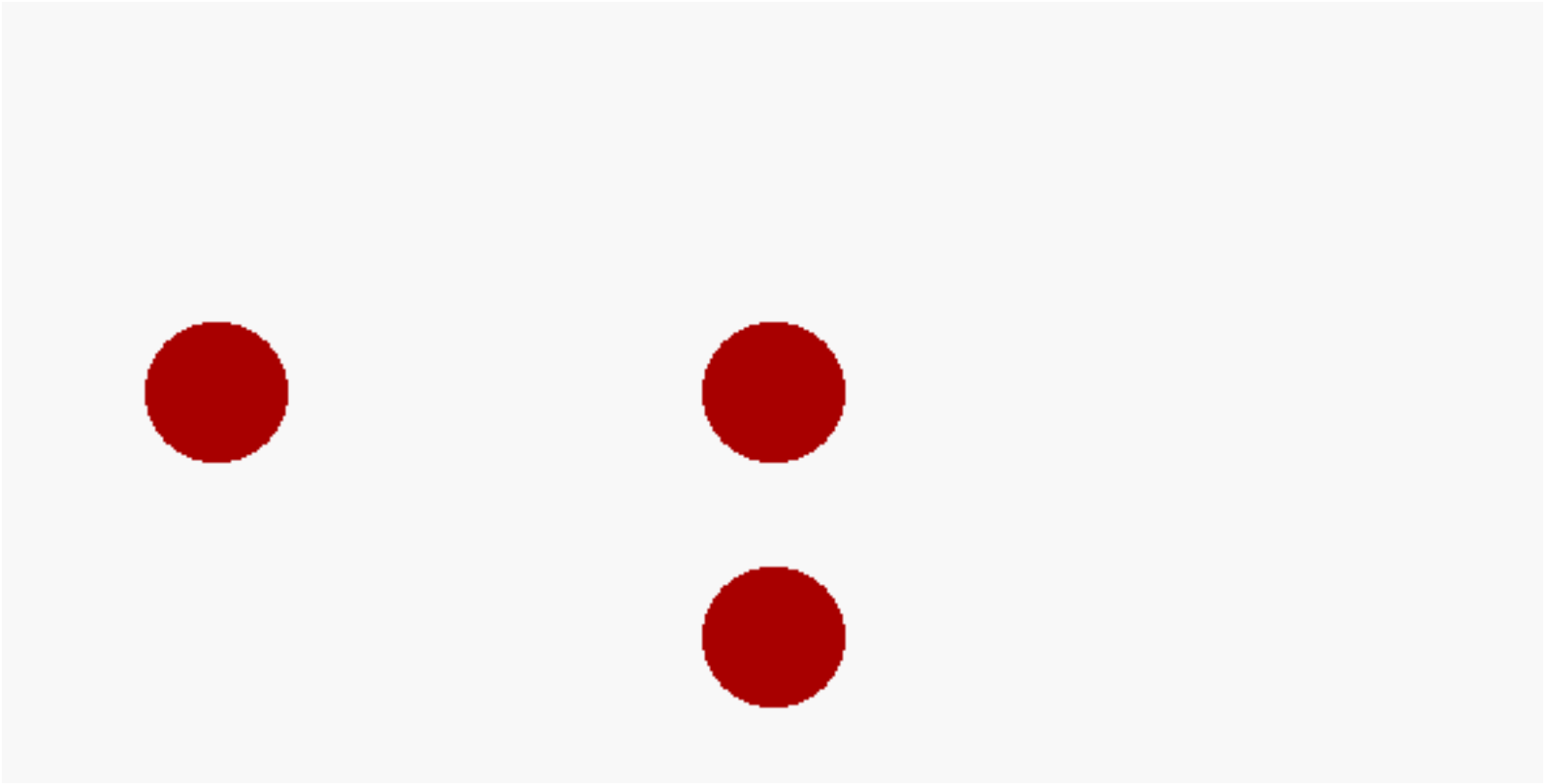


http://perception.yale.edu

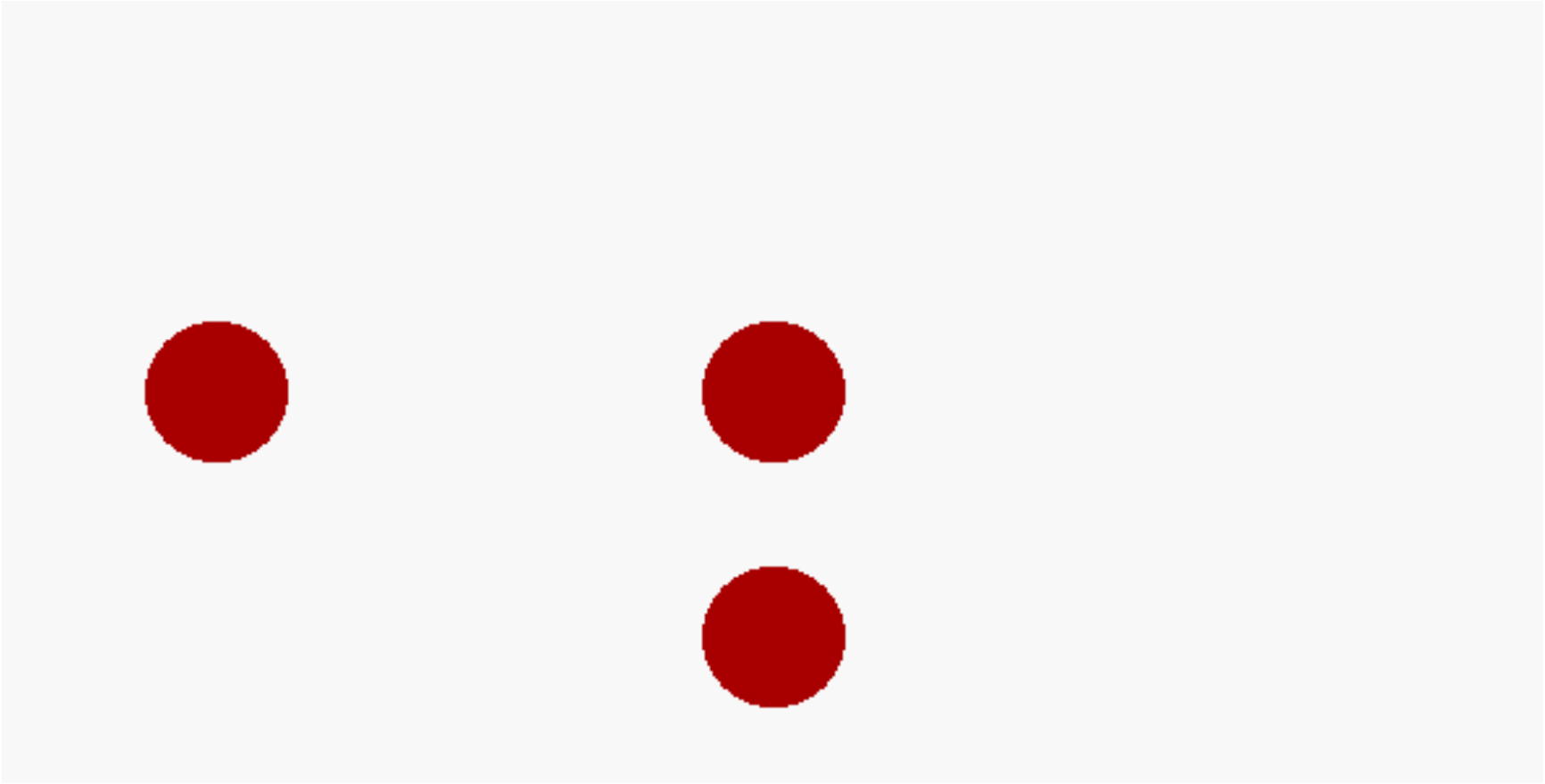
Habituation



http://perception.yale.edu



http://perception.yale.edu



http://perception.yale.edu

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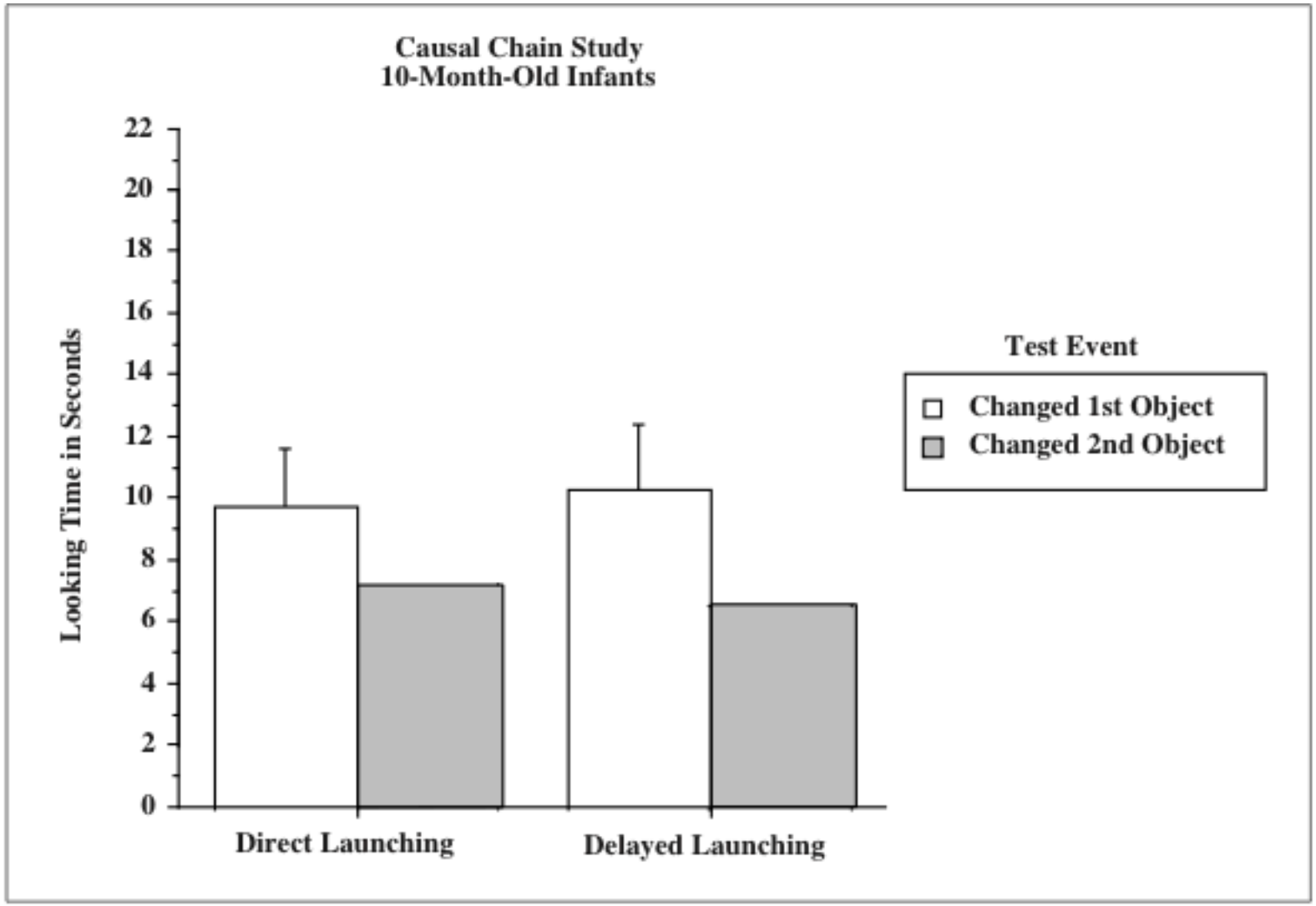
Groups	Habituation		Recovery	
	First Trial	Last Trial	Mean Look per trial	Test Trial − Last Trial
Direct launching				
$n = 17$	38.1	6.9	15.0	+ 9.5
	(51.8)	(4.0)	(12.9)	(13.1)
Delayed reaction				
$n = 17$	17.2	7.6	11.4	+ 2.9
	(10.2)	(3.6)	(3.9)	(5.6)

$N = 34$, mean age = 27.1 weeks.

Leslie AM, Keeble S (1987) Do six-month-old infants perceive causality? Cognition 25(3):265-288.

Perception and age

- 6 and 10 mos: simple rels between objects
- Causal sequences: 15 mos and +



1. Cohen LB, Rundell LJ, Spellman BA, Cashon CH (1999) Infants' perception of causal chains. Psychological Science 10(5):412-418

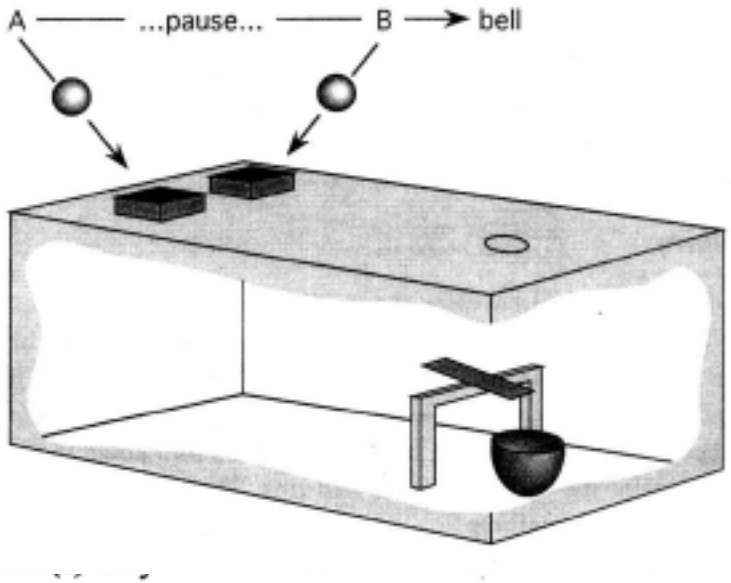
Conflicting perception/inference

Table 4
Results of Causal and Noncau

Measure
Proportion correct of contiguous/fast choices[a]
Proportion correct of delayed/slow choices
Number of children with no errors
Number of children with fast error(s) only
Number of children with slow error(s) only
Number of children with both errors
Total number of participants[b]

[a] Two trials per participant contr
participated in both tasks; each p

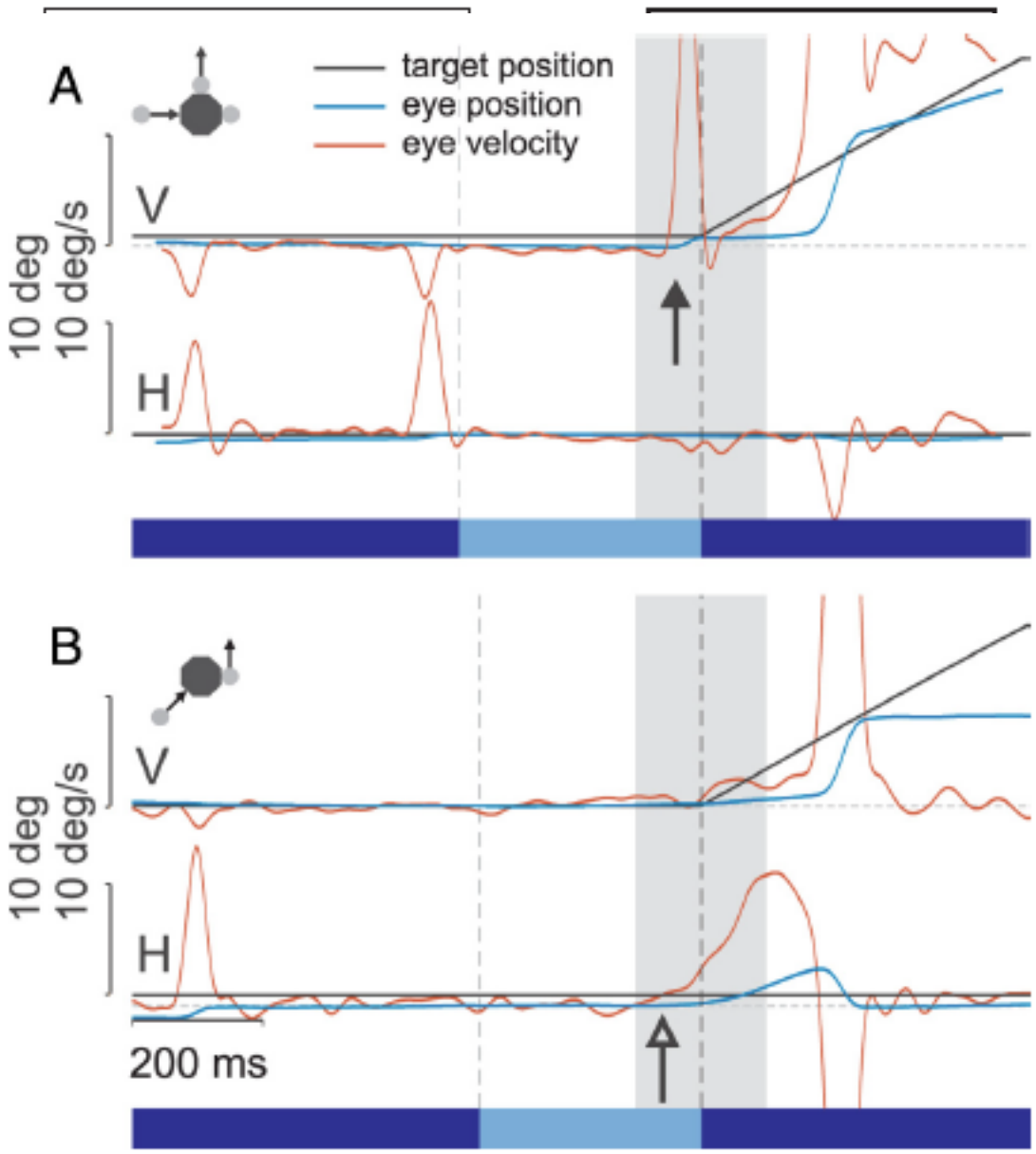
Table 9
Results of Causal and Noncausal Tasks in Experiment 2



	ask	ncausal	
	years	9/10 years	Adults
Propo con		.94	1.00
cho		.95	1.00
Propo del	.88	29	16
Numb no	.97	1	0
Numb fast	2	0	0
Numb slo	3	2	0
Number of children with both errors[b]	1	32	16
	3 2 4 0		

the 9/10-year-olds and adults

Schlottmann A (1999) Seeing It Happen and Knowing How It Works: How Children Understand the Relation Between Perceptual Causality and Underlying Mechanism. Developmental Psychology 35(5):303-31



Attribution Biases Oculomotor Responses. The Journal of Neuroscience 30(31):10517-10525

Inference

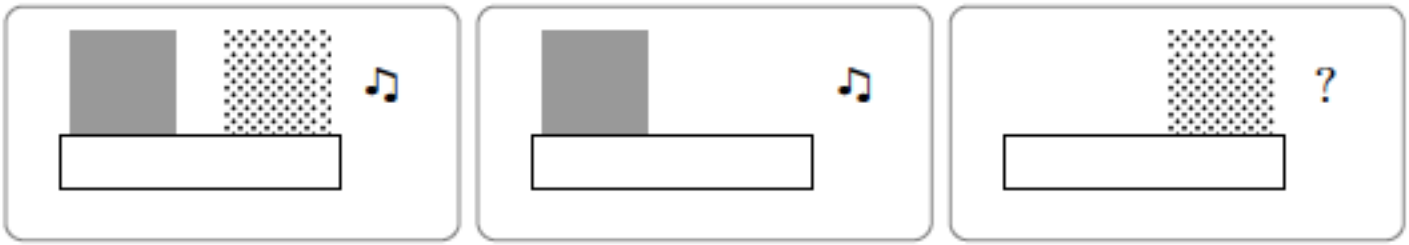
- Why doesn’t my espresso machine work?
- What affects running speed?

Basic inference task



Which block makes the music play?

Backward blocking



Sobel DM, Tenenbaum JB, Gopnik A (2004) Children's causal inferences from indirect evidence: Backwards blocking and Bayesian reasoning in preschoolers. Cognitive Science 28(3):303-333.

Indirect inference

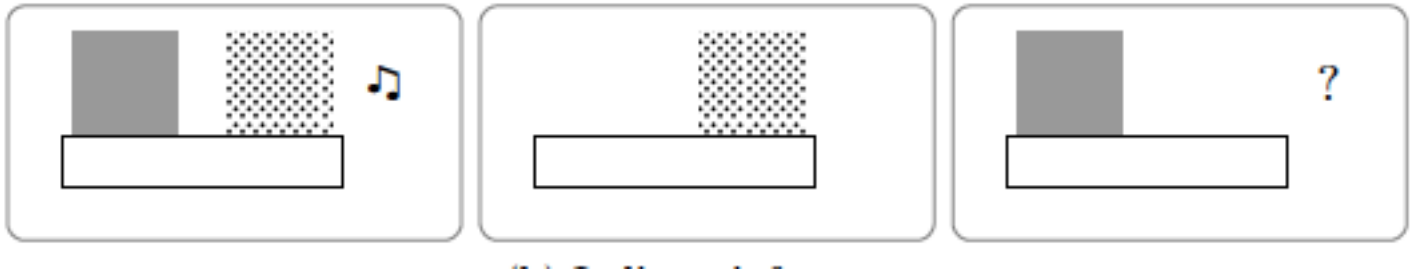


Table 1
Average number of "yes" responses to the "Is it a blicket?" question in Experiment 1

Age and object	Indirect screening-off	Backward blocking
3-year-olds		
Object demonstrated alone (A)	0.25 (0.58)	1.94 (0.25)
Object not demonstrated alone (B)	2.00 (0.00)	1.00 (0.82)
4-year-olds		
Object demonstrated alone (A)	0.00 (0.00)	2.00 (0.00)
Object not demonstrated alone (B)	2.00 (0.00)	0.25 (0.68)

Notes. Standard deviation in parentheses. Maximum response is 2.

Types of evidence

- Association – how often things co-occur
- Mechanistic – how cause produces effect
  - Used more in assessing token causality

- Does A cause B?
  - Limitations?
- Usually
  - Have to identify possible causes
  - Determine to what extent they're causes

- Structure vs strength

Intervention

Table 1
Accuracy on the Causal Structure Questions and Percentages of the Learners Who Responded Correctly (%C) on All 12 Questions in Experiment 1

Model	Condition: Self-Intervention Accuracy *M*	*SD*	%C	Condition: Observation of Intervention Accuracy *M*	*SD*	%C
Chain	11.18	1.29	59	9.88	2.23	35
Diamond	11.06	0.75	24	9.47	2.50	24
Chain with A→D link	11.06	1.20	53	9.35	2.85	24
Common effect and chain	11.65	0.86	82	9.18	3.38	35

Note—Accuracy responses are out of a maximum of 12.

Blame

- Who's at fault for a car accident?
- Why was Alice late to a meeting?

The vice-president of a company went to the chairman of the board and said:

> We are thinking of starting a new program. It will help us increase profits, but it will also harm the environment.

The chairman of the board answered:

> I don't care at all about harming the environment. I just want to make as much profit as I can. Let's start the new program.

They started the new program. Sure enough, the environment was harmed.

The vice-president of a company went to the chairman of the board and said:

> We are thinking of starting a new program. It will help us increase profits, and it will also help the environment.

The chairman of the board answered:

> I don't care at all about helping the environment. I just want to make as much profit as I can. Let's start the new program.

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Knobe effect/side effect effect

- Study: 78 people in NYC park, each one randomly assigned to one story

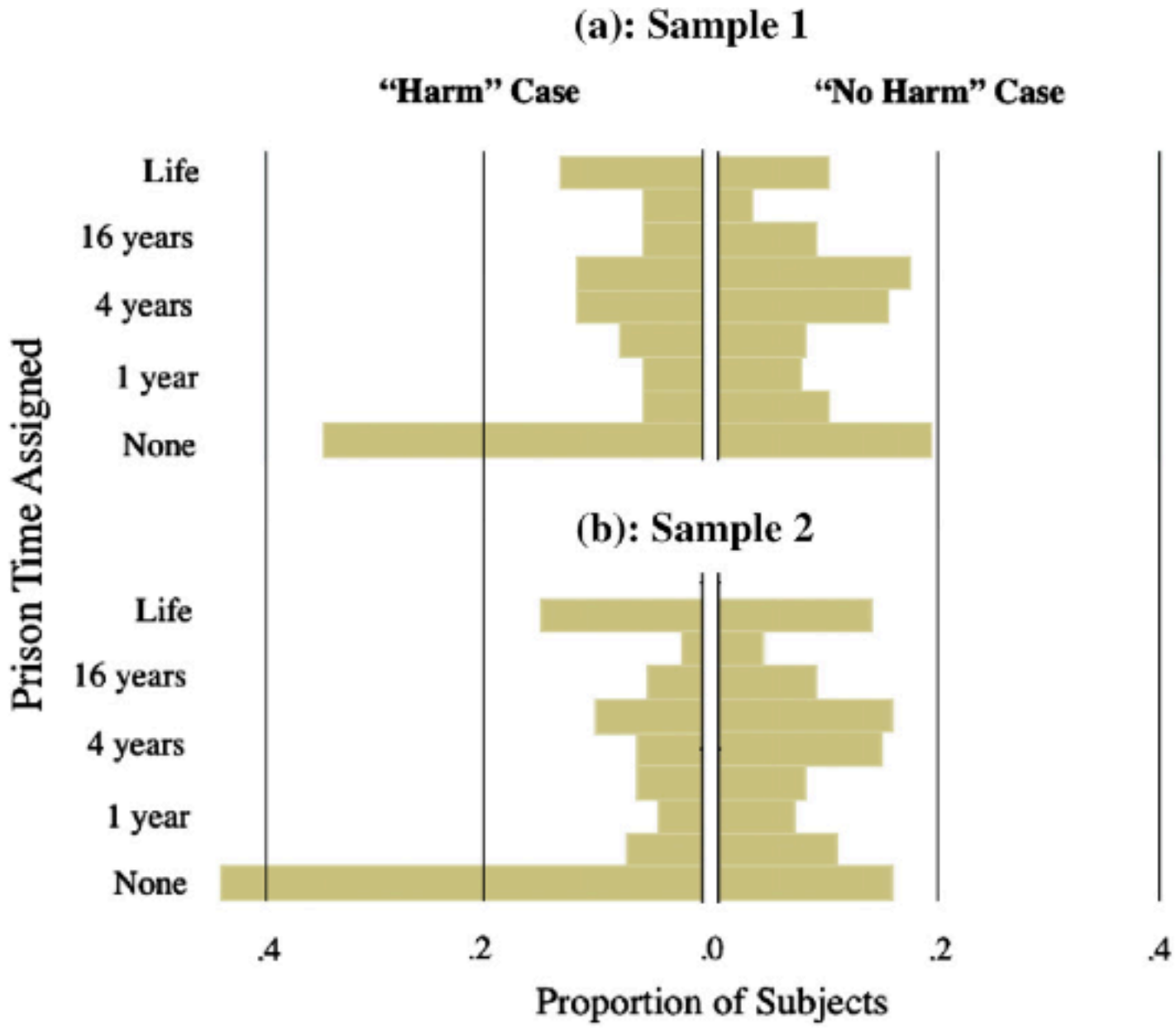
- Harm: chairman blamed for harming environment (82%), actions deemed intentional
- Help: chairman given no credit for helping environment (77%), actions deemed unintentional

difference $p<.001$

Knobe, J. (2003). "Intentional Action and Side Effects in Ordinary Language." Analysis, 63, 190-193.

Intentionality

- Goals vs side effects
- Intent vs actual outcome


(a): Sample 1
"Harm" Case
"No Harm" Case
Life
16 years
4 years
1 year
None
Prison Time Assigned
(b): Sample 2
Life
16 years
4 years
1 year
None
.4
.2
.0
.2
.4
Proportion of Subjects

Norm violation

- No credit for doing what one should
  - Not littering
  - Not cheating on exams
- Blame if violating behavioral standard
  - Jaywalking

Students in a dorm get a copy of their biology final.

Most students cheat. John Granger did not.

The exam is graded such that only the top 20 students get an A. Granger was 20th. A pre-med student was 21st and missed the GPA cutoff or med school by .07 points!

Did Granger cause her to fail to meet the cutoff?

Is he to blame?

Were his actions good/bad?

Alicke, M. D., Rose, D., & Bloom, D. (2011). Causation, norm violation, and culpable control. *The Journal of Philosophy*, *108*(12), 670-696.

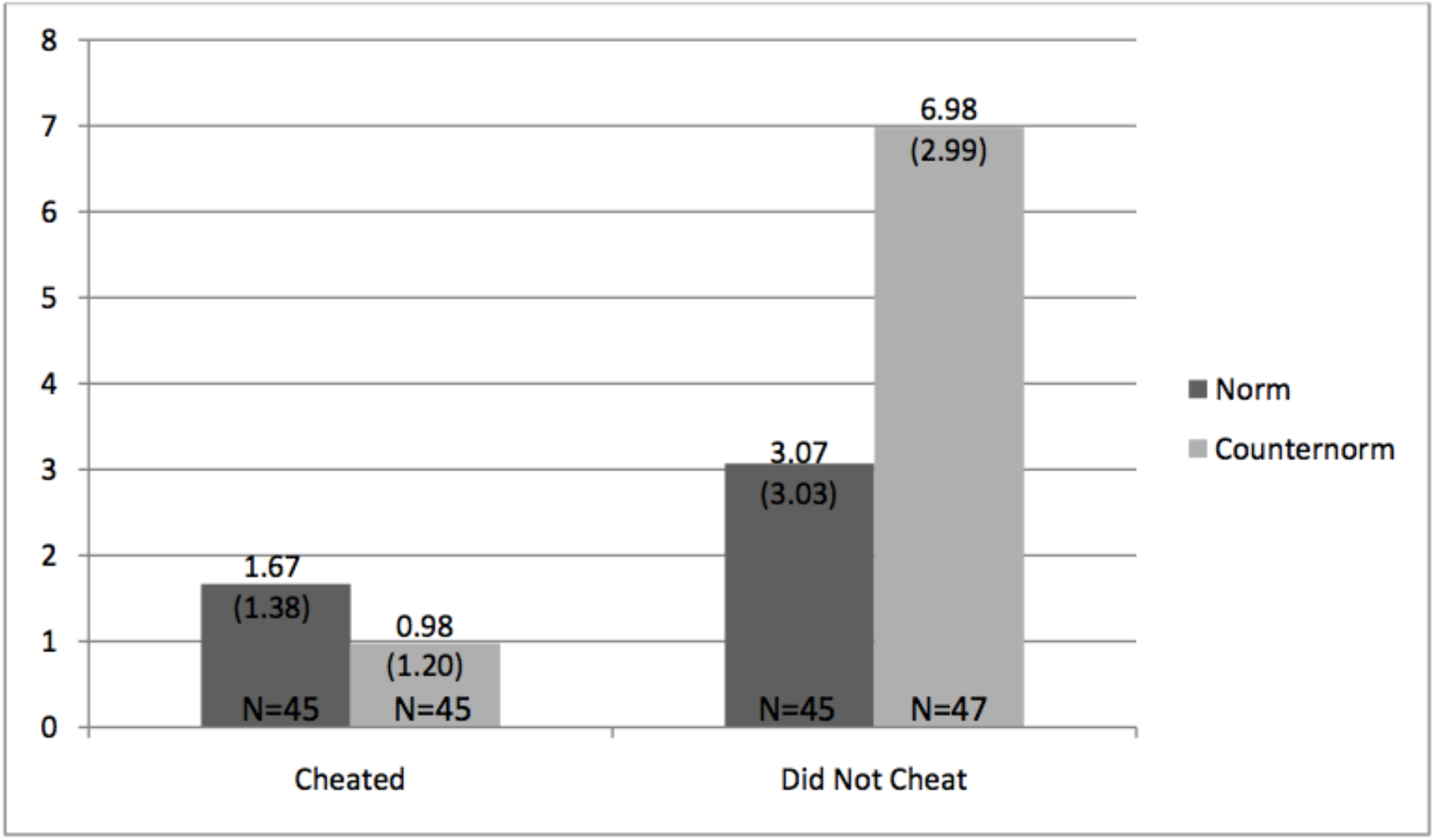
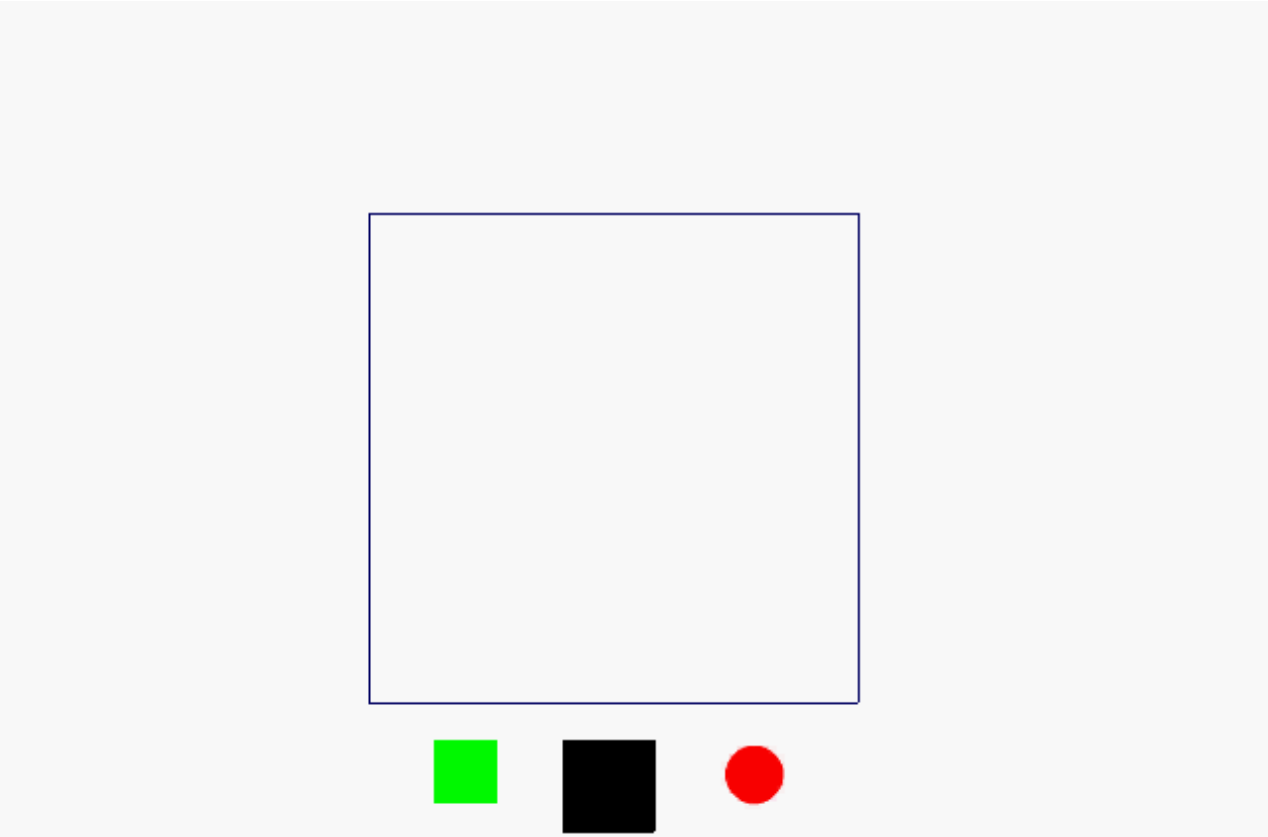


Figure 6: Evaluative Ratings[20]

- Who are the subjects in these studies?

Heider and Simmel



Analogue of Heider & Simmel, 1944. Animation by H.G. Nevarez & B.J. Scholl, Yale University

At ge

- Partici om India a
- Subjec f a good behav y it was done

Table 2
Proportion of References to General Dispositions and Context Among Main American and Hindu Subgroups

I had to construct a house, and for that I had given advance money for Agent A to do that construction work. Agent A had promised—he had given in writing—that he would do that particular work. I gave him an advance of 1,500 rupees. He utilized it for his personal purposes, and then he never did that work or returned the money. That man, he deceived me up to the extent of 1,500 rupees. That's a great injustice. But I can go to the court of law. I have the documents, everything.

The Hindu subject explained the behavior by reference to the agent's socioeconomic position: "The man is unemployed. He is not in a position to give that money." Another Hindu

15 years	.18	.23	.42	.39
11 years	.11	.17	.30	.39
8 years	.11	.12	.36	.34

Miller JG (1984). Culture and the Development of Everyday Social Explanation. Journal of Personality and Social Psychology 46(5): 961-978.

Morris & Peng

- Fundamental attribution error: overly focusing on personal vs. contextual factors in explaining behavior
- Ultimate attribution error: negative behavior for other groups = internal cause (external for self group), while positive = situational (internal for self group). Basically making FAE to diff degree for in-group vs out-group

Culture and Cause: American and Chinese Attributions for Social and Physical Events

Michael W. Morris and Kaiping Peng

The authors argue that attribution patterns reflect implicit theories acquired from induction and socialization and hence differentially distributed across human cultures. In particular, the authors tested the hypothesis that dispositionalism in attribution for behavior reflects a theory of social behavior more widespread in individualist than collectivist cultures. Study 1 demonstrated that causal perceptions of social events but not physical events differed between American and Chinese students. Study 2 found English-language newspapers were more dispositional and Chinese-language newspapers were more situational in explanations of the same crimes. Study 3 found that Chinese survey respondents differed in weightings of personal dispositions and situational factors as causes of recent murders and in counterfactual judgments about how murders might have been averted by changed situations. Implications for issues in cognitive, social, and organizational psychology are discussed.

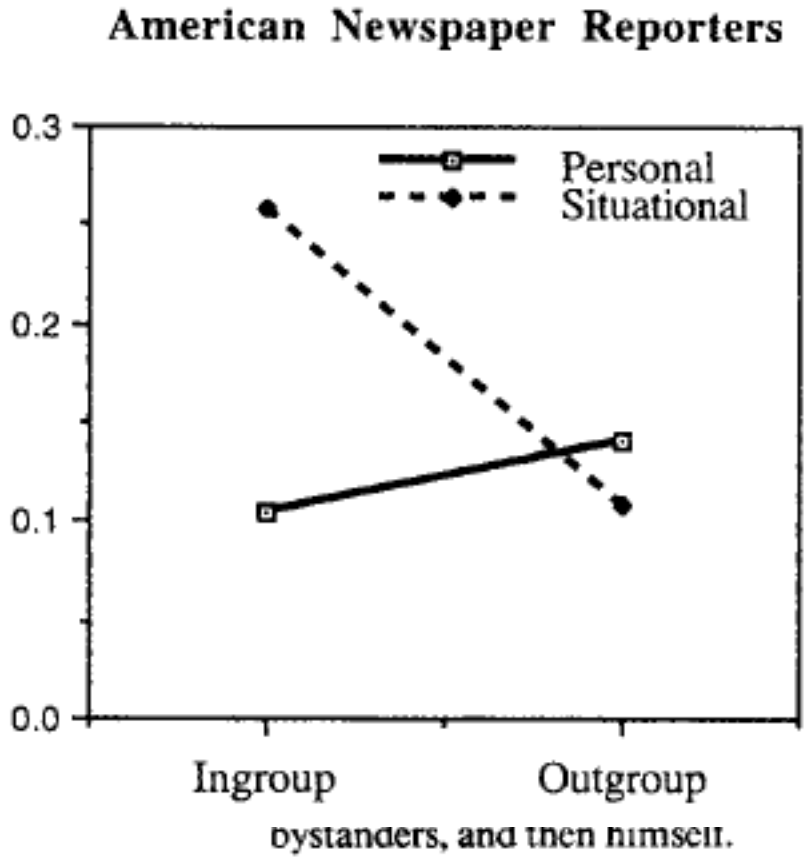
Table 2

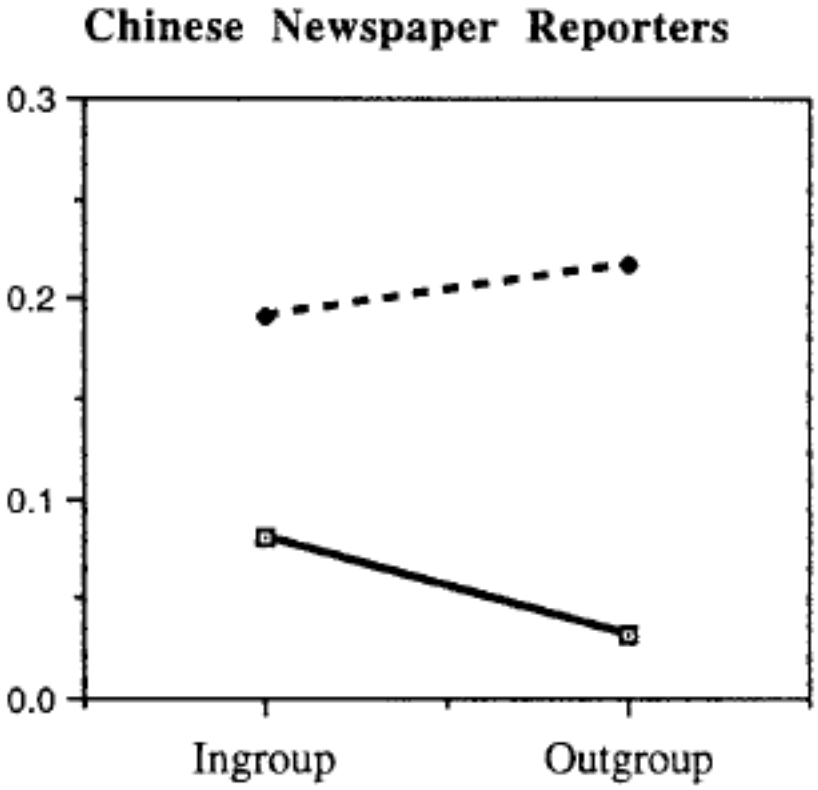
Causal Perception of Social Events by American and Chinese Subjects

	Display set								
	Compulsion			Connection			Collection		
Perception	*M*	*F*	*p*	*M*	*F*	*p*	*M*	*F*	*p*
High school subjects[a]									
Internal force									
American	3.17	29.73	.001	3.28	1.54	.22	3.13	.28	.60
Chinese	2.56			3.13			3.05		
External force									
American	3.27	10.49	.001	2.14	8.69	.004	1.91	4.98	.03
Chinese	3.61			2.42			2.15		
Graduate school subjects[b]									
Internal force									
American	3.07	.09	.77	1.94	1.50	.23	3.44	1.41	.24
Chinese	3.00			2.11			3.84		
External force									
American	3.77	.07	.79	3.95	.22	.64	1.69	2.21	.15
Chinese	3.82			3.84			1.38		

[a] $df = 1, 193$. [b] $df = 1, 42$.

Newspaper reports





Evaluating explanations & counterfactuals

We want to ask your opinion about some explanations for the murder that have been given by the news media. We are not simply asking whether you think each statement is true or false. We want to know your opinion about *to what extent* each of these factors was a *cause* of the shooting.

Subjects were asked to rate each factor by using the following scale: 1 = *not a cause at all*, 2 = *a minor cause*, 3 = *one of many causes*, 4 = *a major cause*, 5 = *a very important cause*, 6 = *an extremely important cause*, 7 = *the most important cause*.

Now we want your opinion about some hypothetical questions—questions about whether this person would have murdered had things been slightly different. We want you to imagine that the world was different in one way only. Would this difference matter? If everything was the same except for this factor, would he have murdered?

The rating scale was as follows: 1 = *definitely not*, 2 = *very likely not*, 3 = *probably not*, 4 = *an even chance*, 5 = *probably*, 6 = *very likely*, 7 = *definitely*.

Some Causes of Murder That Were Weighted Differently Across Cultures (Study 3: Causal Judgment Task)

Table 5

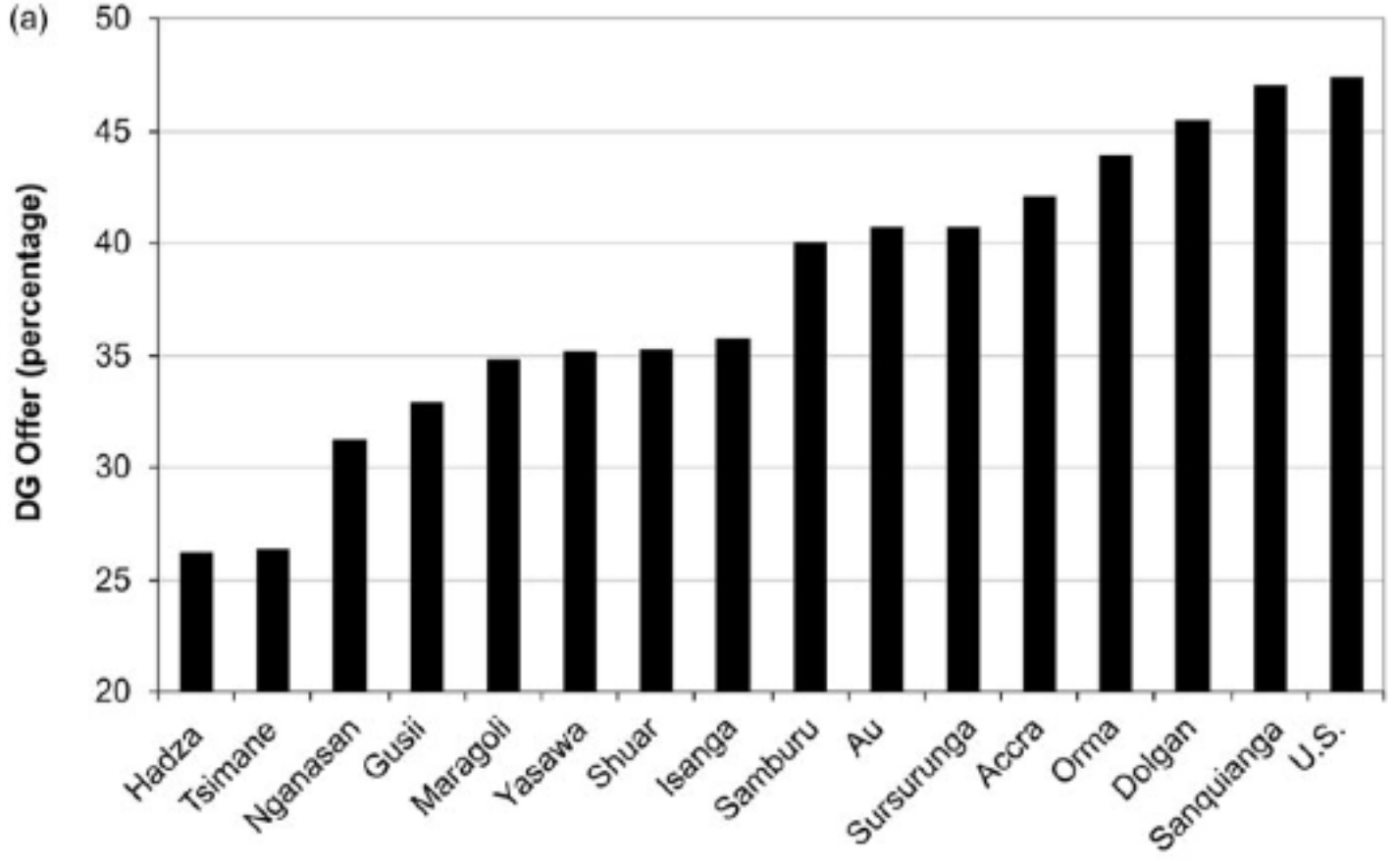
Some Counterfactual Situations That Were Simulated Differently Across Cultures (Study 3: Counterfactual Judgment Task)

Lu murder		McIlvane murder	
Lu's advisor had worked harder to prepare him for his defense and for the job market.	A 3.9*** C 1.8	McIlvane's supervisor had worked harder to motivate him and explain the post office rules to him.	A 4.3*** C 2.5
Lu belonged to a religious group.	A 4.6 C 3.0	McIlvane belonged to a religious group.	A 4.4*** C 2.5
Lu had many friends or relatives in China also studying in Iowa.	A 3.5* C 2.4	McIlvane had many friends or relatives in Royal Oak.	A 3.7* C 2.8
Lu had gotten a job.	A 3.5*** C 1.3	McIlvane had won his appeal and gotten his job back.	A 2.1 C 1.6
Lu had been a student from Ireland rather than from China.	A 4.2 C 3.8	McIlvane had been a Chinese-American rather than an Irish-American.	A 4.8*** C 2.7
Lu had stayed in China for his PhD studies.	A 3.9*** C 1.5	McIlvane had stayed in the Marines (and been removed from a job there).	A 3.8 C 3.6
Lu was married and had children.	A 3.6** C 2.1	McIlvane was married and had children.	A 3.7 C 3.0
The student nominated had been American, not Chinese.	A 5.6** C 3.7	McIlvane had lost his job due to the Royal Oak post office closing rather than due to being fired.	A 2.3 C 1.8
Lu's advisor had been Chinese, not American.	A 5.2 C 4.5	McIlvane's supervisor had been more caring and sympathetic.	A 2.8* C 2.0

Note. A = American; C = Chinese. Shown are the nine items with greatest cultural differences in ratings of the likelihood of murder in the counterfactual situation. Ratings can be interpreted with scale labels: 1 = *definitely not*, 4 = *an even chance*, 7 = *definitely*.

* $p < .05$. ** $p < .005$. *** $p < .001$.

The weirdest people in the world?



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sampling from a single subpopulation. Overall, these empirical patterns suggests that we need to be less cavalier in addressing questions of *human* nature on the basis of data drawn from this particularly thin, and rather unusual, slice of humanity. We close by proposing ways to structurally re-organize the behavioral sciences to best tackle these challenges.

- Do views change over time?
- Or does understanding of expectations change?

Table 2. Percent measure: causal attributions as a function of conversational cue and cue order

	Attributions		
	Dispositional	Situational	Other
Conversational Cue			
Overall			
Personality ($n = 30$)	33.9	38.8	27.3
Social ($n = 30$)	19.7	57.7	24.6
Cue After Story			
Personality ($n = 15$)	32.5	40.2	27.3
Social ($n = 15$)	20.9	61.0	18.1
Cue Before Story			
Personality ($n = 15$)	35.2	37.4	27.4
Social ($n = 15$)	18.5	50.4	31.1

Notes: Personality = 'Institute of Personality Research'; Social = 'Institute of Social Research'. Percent measure = mean percentage of responses.

reverse pattern emerged for dispositional attributions. Methodological and conceptual implications are discussed. *Copyright © 1999 John Wiley & Sons, Ltd.*

Revisiting Morris & Peng

- Subjects: ethnic Chinese in Hong Kong, ethnic whites in U.S.
- Replicated Morris & Peng fish result
- But perceived consensus rather than actual beliefs mediated effect

Zou X, Tam K-P, Morris MW, Lee S-L, Lau IY-M, Chiu C-Y (2009) Culture as common sense: perceived consensus versus personal beliefs as mechanisms of cultural influence. Journal of Personality and Social Psychology 97(4):579-597.

Biases

- Sampling bias
- Confirmation bias
  - Seeking positive evidence
  - Discounting negative evidence