Testing the Effectiveness of Lottery Incentives in Online Experiments

An Application to Sustainable Criollo Meat

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Sustainable Southwest Beef
knowledge and tools for ranch and rangeland resilience

TEXAS A&M UNIVERSITY

Motivation

Experimental Terminology

Gold Standard: Fully incentivized experiments with representative samples

Incentivized Experiments: Tie people's actions to outcomes[1] resulting in more accurate valuations[2]

- High Costs
- Non-representative samples

Hypothetical Studies:

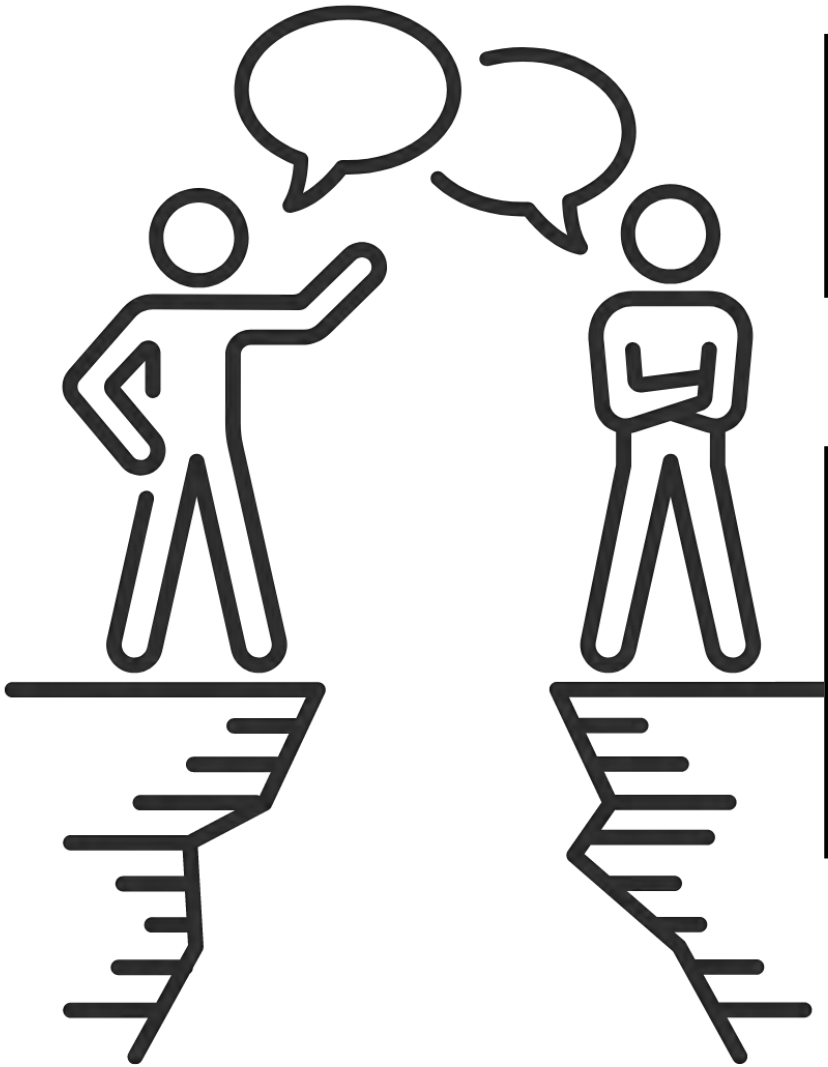
- Representative samples[3]
- Less expensive[3]
- Inconsequential (hypothetical bias)

Hypothetical Bias: The overvaluation of a good or service in the absence of incentives[4]

- Understanding and mitigating hypothetical bias has an extensive literature[5]

. 1: Smith 1976; 2: Charness, Gneezy, and Halladay 2016; 3: Ellis, Savchenko, and Messer 2022, 2023; 4: Penn and Hu 2018; 5: List and Gallet 2001; Murphy et al. 2005; Haghani et al. 2021; Gschwandtner and Burton 2020; Penn and Hu 2021a, 2021b

The Gold Standard



Do lottery incentives recover unbiased consumer valuations?

Theory: Any possibility of realization induces true or "unbiased" valuations

- i.e., the same valuations as full incentives

What are Lottery Incentives?

- Lottery incentives are where only a subset of subjects is randomly selected for realized decisions
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  - In other frameworks: **Everyone** has at least one decision realized
  - In our framework: Only **some** have their decision realized (some people end up with nothing)

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  - In other frameworks: **Everyone** has at least one decision realized
  - In our framework: Only **some** have their decision realized (some people end up with nothing)
- Previous investigations of lottery incentives:
  - Fairness in Ultimatum games[7]
  - Risk aversion in dynamic choice games[8]
  - Donations in dictator games[9]
    - All implemented a 10% lottery incentive

6: Azrieli, Chambers, and Healy 2018; Brown and Healy 2018; 7: Bolle 1990; 8:Baltussen et al. 2012; 9: Clot, Grolleau, and Ibanez 2018

Experimental Overview

Main Research Goals

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Experimental Design Overview

- We conduct an online experiment with U.S beef consumers
- Participant is told there was a probability (treatment) of their decisions being realized
  - 4 treatments: full incentives, hypothetical, and 2 lottery incentive levels
- Participants is faced the following scenario:
  - Receives $5 and a conventional steak
  - Asks WTP to exchange for a Criollo steak via an incentive-compatible auction mechanism
- Based on Treatment: A subset of participants have their decision realized and their selected steak (conventional or Criollo) is delivered to their home

Preview of Findings

Key Findings

Compared to the fully incentivized condition:

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1. Valuations in lottery incentive conditions are not statistically different

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Key Findings

Compared to the fully incentivized condition:

1. Valuations in lottery incentive conditions are not statistically different
2. Valuations in the hypothetical condition are statistically higher
3. Consumers are willing to pay a premium for sustainable Criollo beef

What are Criollo Cattle?

Why Sustainable Beef?

Why Should We Care: Preferences on sustainability is an important question for beef producers in the Southwest U.S.

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- Consumers have indicated a willingness to pay a premium[10] for:
  - Premium attributes: natural, organic, locally grown
  - Social attributes: food safety, animal welfare, and environmental sustainability

10: Xue et al. 2010; Umberger, Boxall, and Lacy 2009; Napolitano et al. 2010; Angulo, Gil, and Tamburo 2005; Galyean, Ponce, and Schutz 2011; Lusk and Schroeder 2004; Chang, Lusk, and Norwood 2009

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- Consumers have indicated a willingness to pay a premium[10] for:
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  - Social attributes: food safety, animal welfare, and environmental sustainability

- Provides our design with:
  - Logistically complex product due to steaks' high perishability
  - A good boundary condition in our experiment for other less-perishable agricultural products

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Experimental Design

Experimental Design Overview

- Online experiment in the Summer of 2022 via Qualtrics (Pre-registered: AEARCTR-0009687)
- 2,072 U.S. beef consumers recruited via Forthright Access
  - Participants represent all U.S. states and territories Map
- Participant told there is a probability (treatment) of their decisions being realized
  - 4 treatments: full incentives, hypothetical, and 2 lottery incentive levels
- Participants face the following scenario:
  - Receive $5 and a conventional steak
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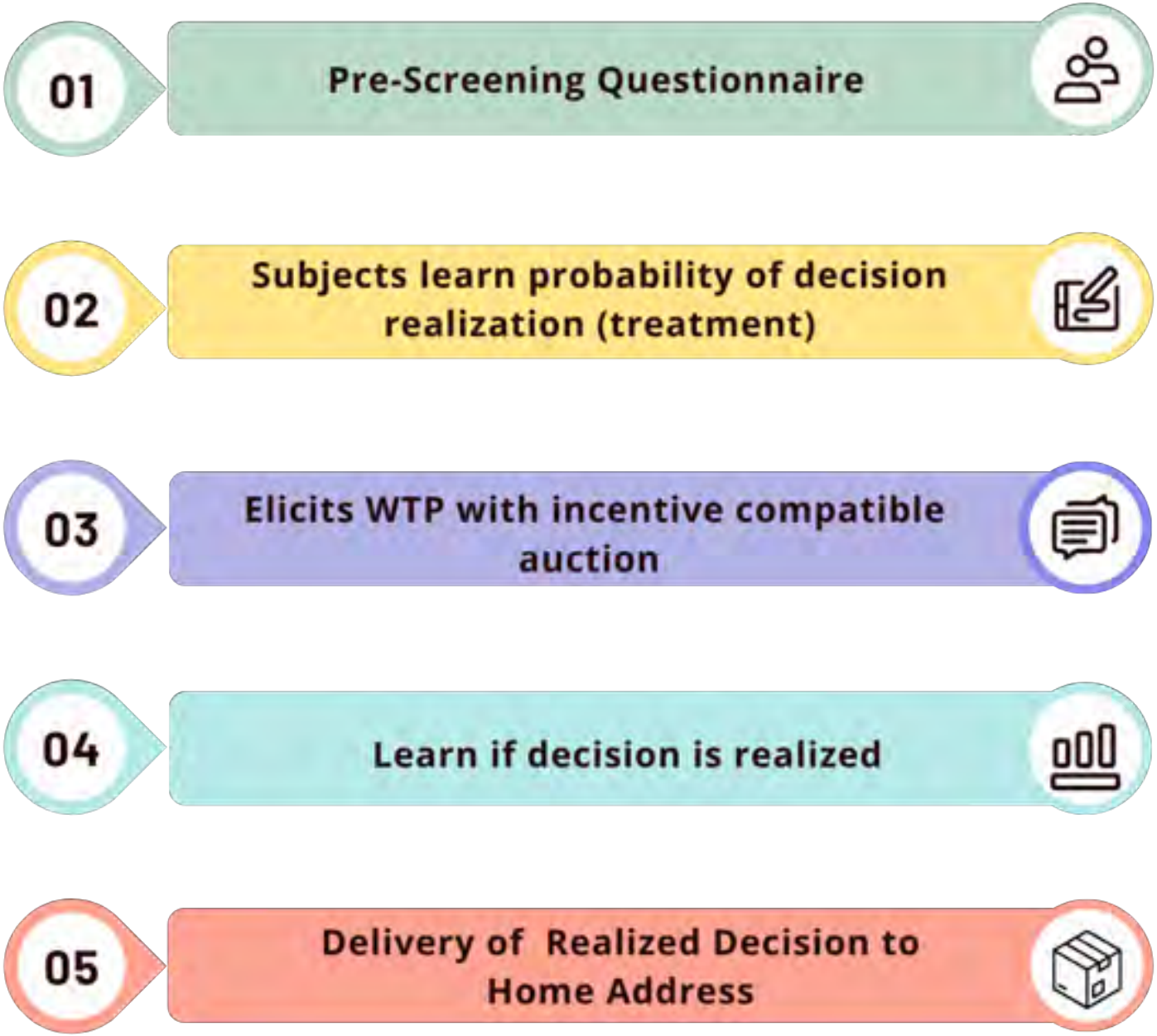
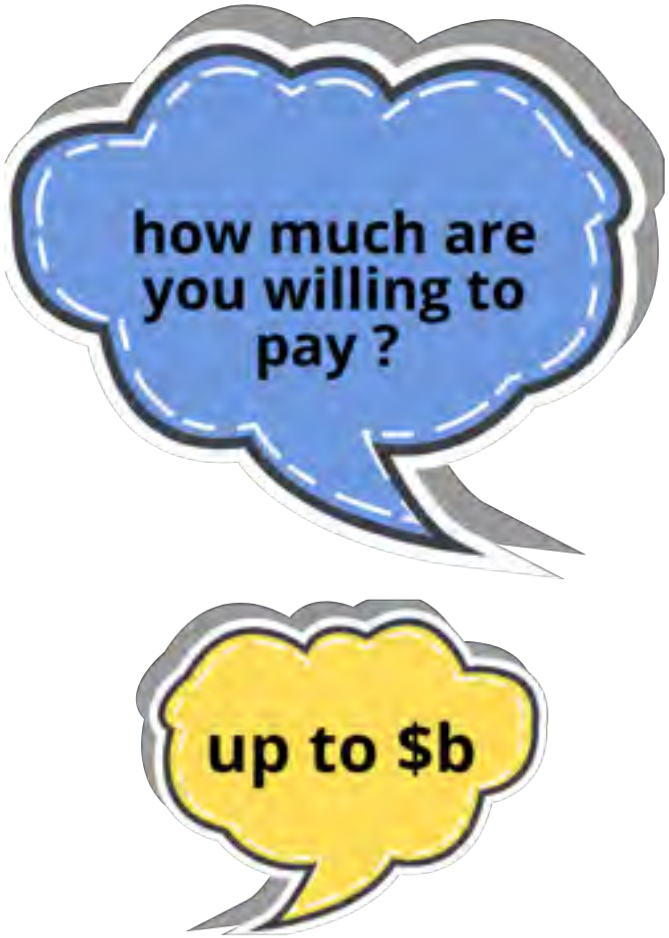
- Based on Treatment: A subset of participants have their decision realized and their selected steak (conventional or Criollo) is delivered to their home

Experiment Timeline



Becker–DeGroot–Marschak Mechanism (1964)

BDM Mechanism



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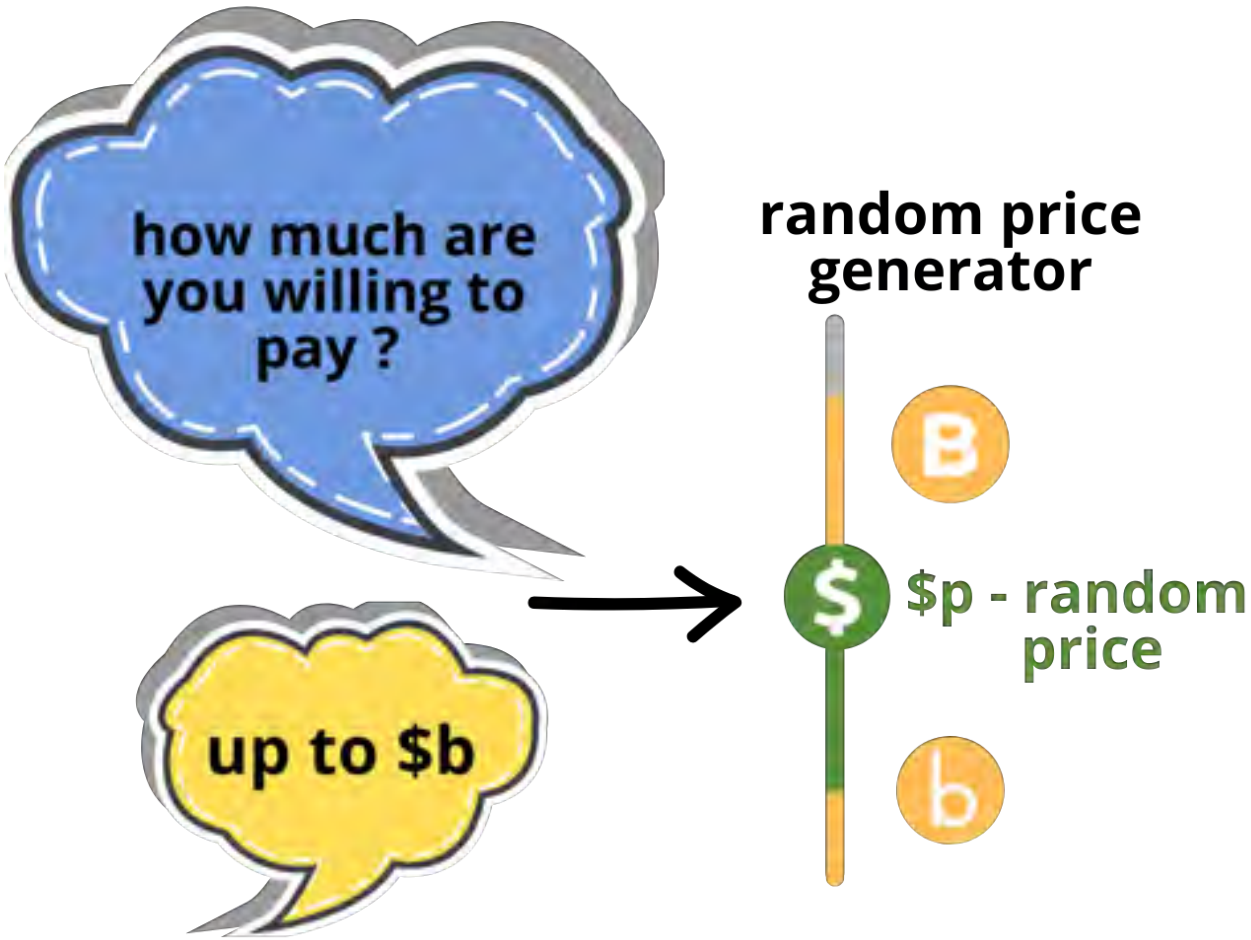

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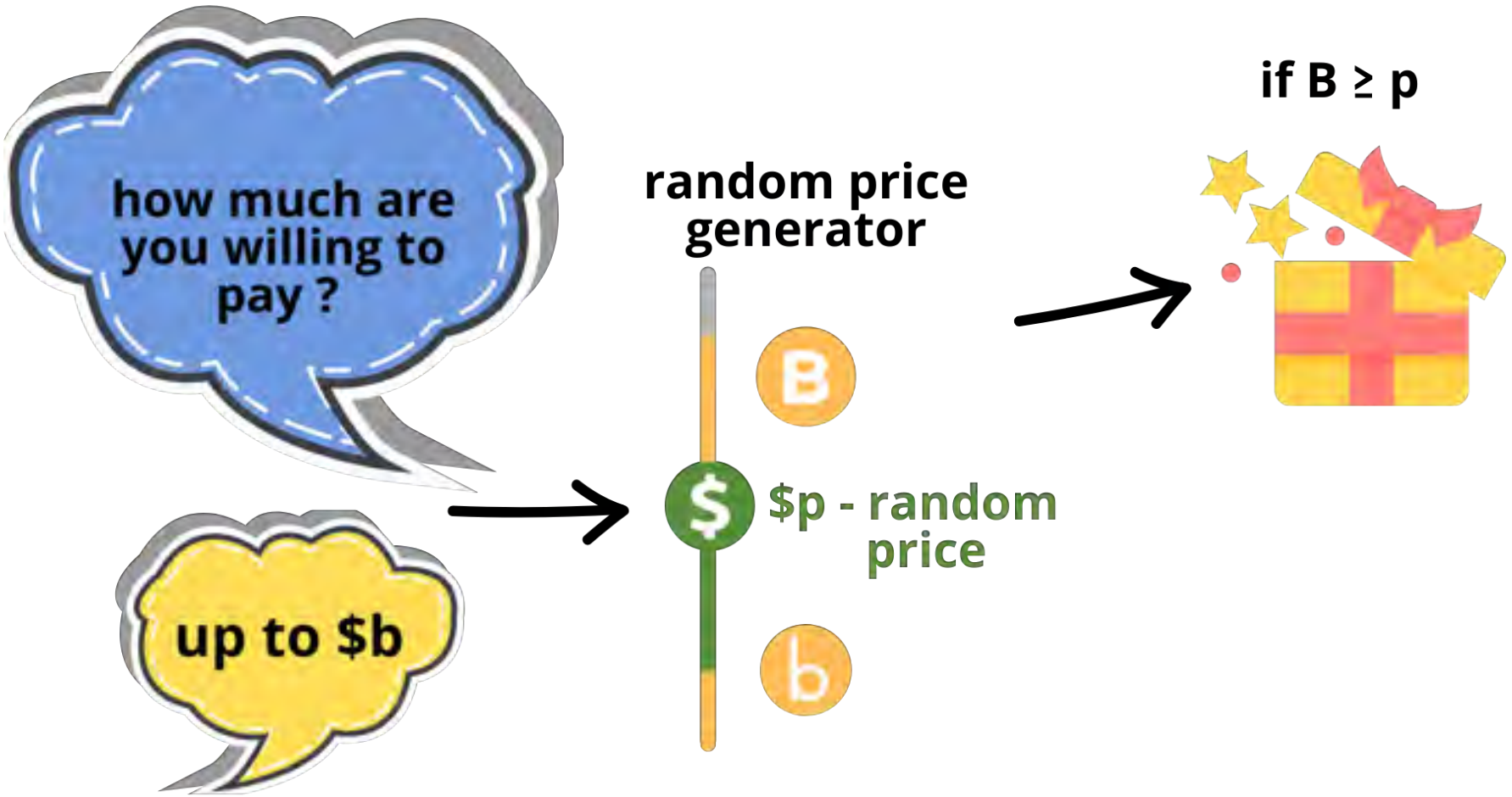

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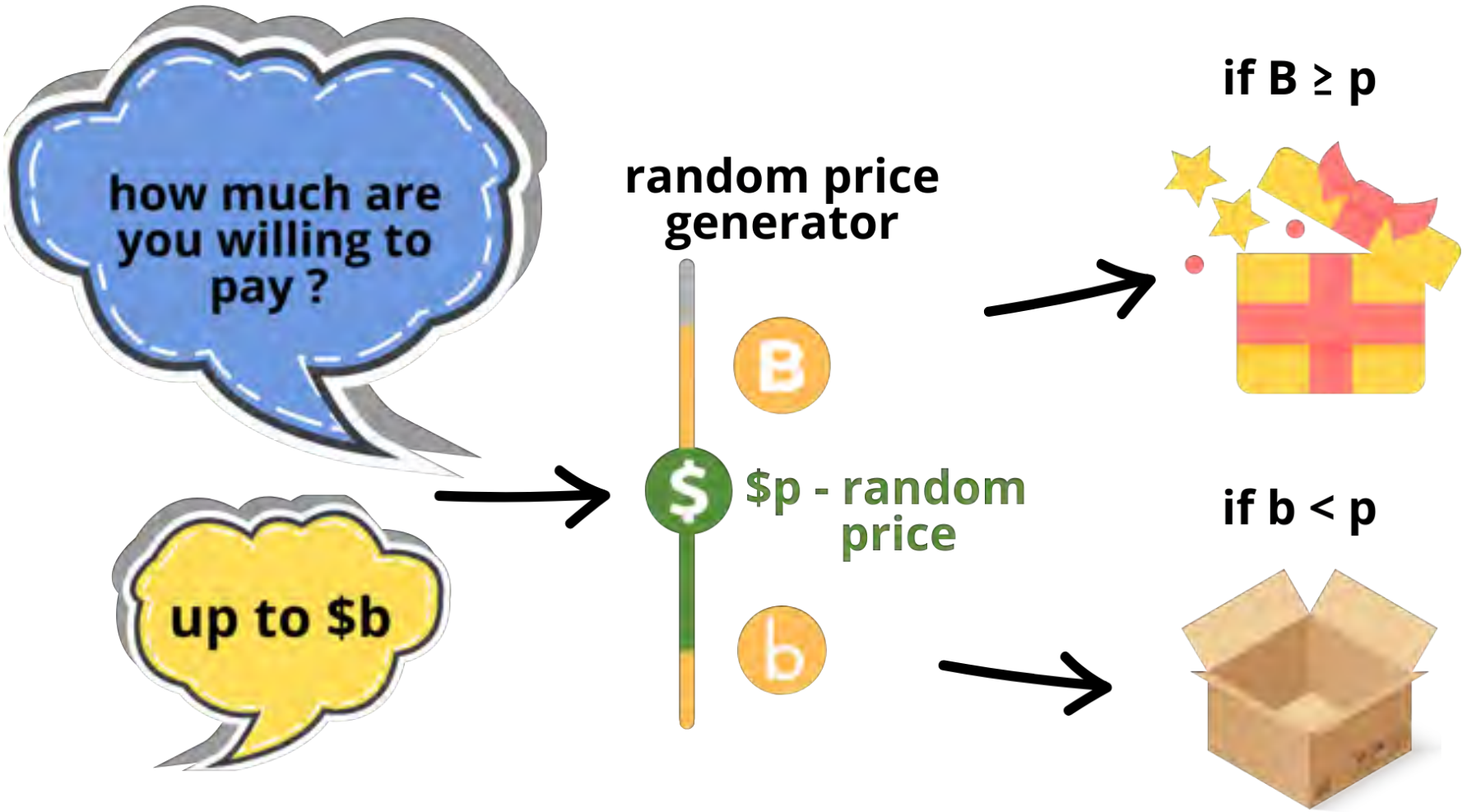

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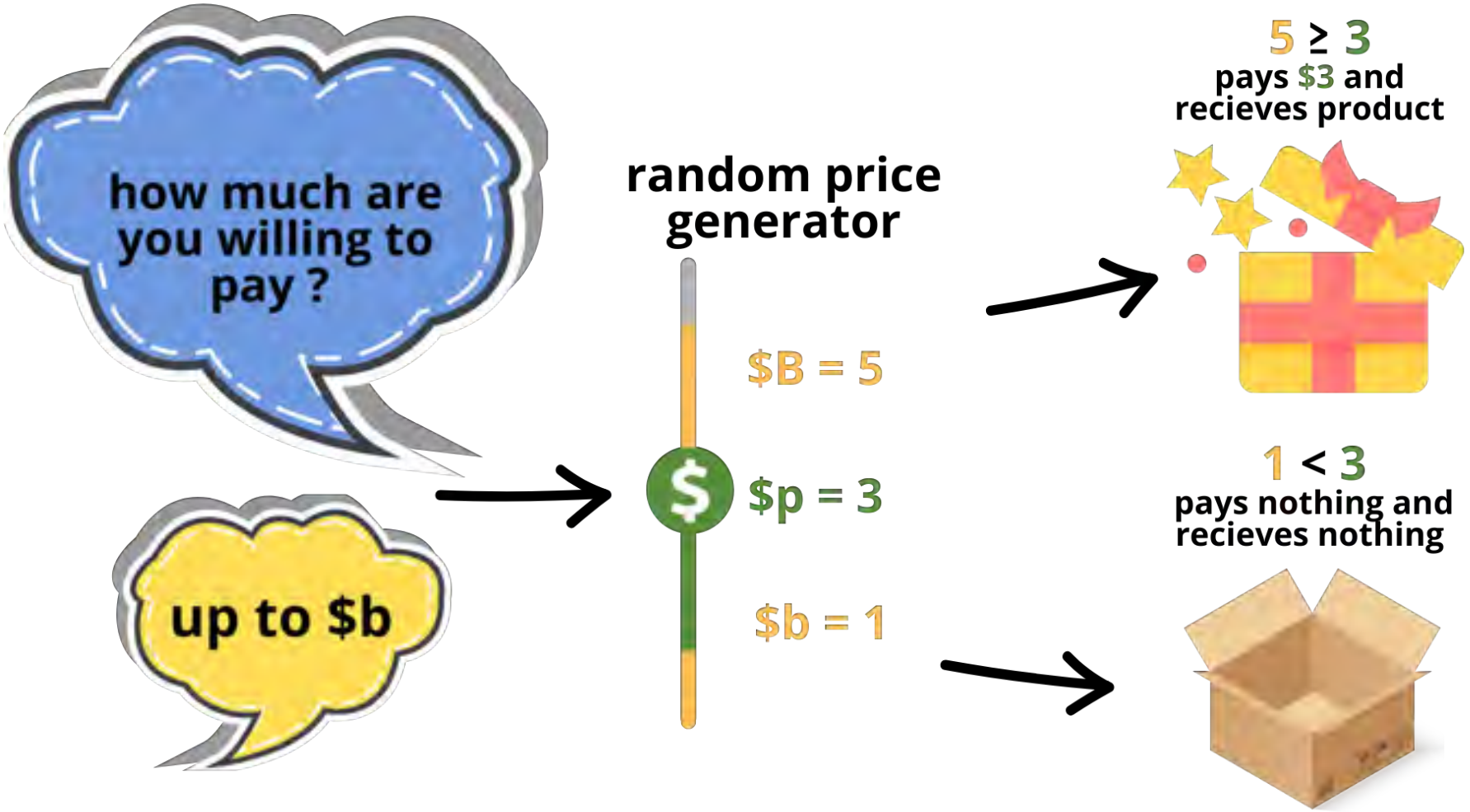

Main Decision

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- If participant's decisions is realized (treatment dependent):
  - If b is greater than or equal p, then the individual pays p and receives the sustainable Criollo steak
  - If b is less than p, then the individual pays nothing and keeps the conventional steak
- Two levels of support (between-subject randomization): \$0-\$4 (low) and \$0-\$5 (high)

Overview of Treatments

- Randomized into four between-subjects treatments

Table: Treatments and Probability of Realization

Treatment	Probability of Decision to be Realized	N
100%	All subjects are selected for realization	101
10%	10% of subjects are selected for realization	500
50 out of 500	50 out of 500 subjects are selected for realization	502
Hypothetical	No subjects are selected for realization	465

- Some participants' decisions are realized
  - i.e., based on the random price and their decision, a conventional or Criollo steak is delivered to their home address

Delivery Based on Experimental Outcome

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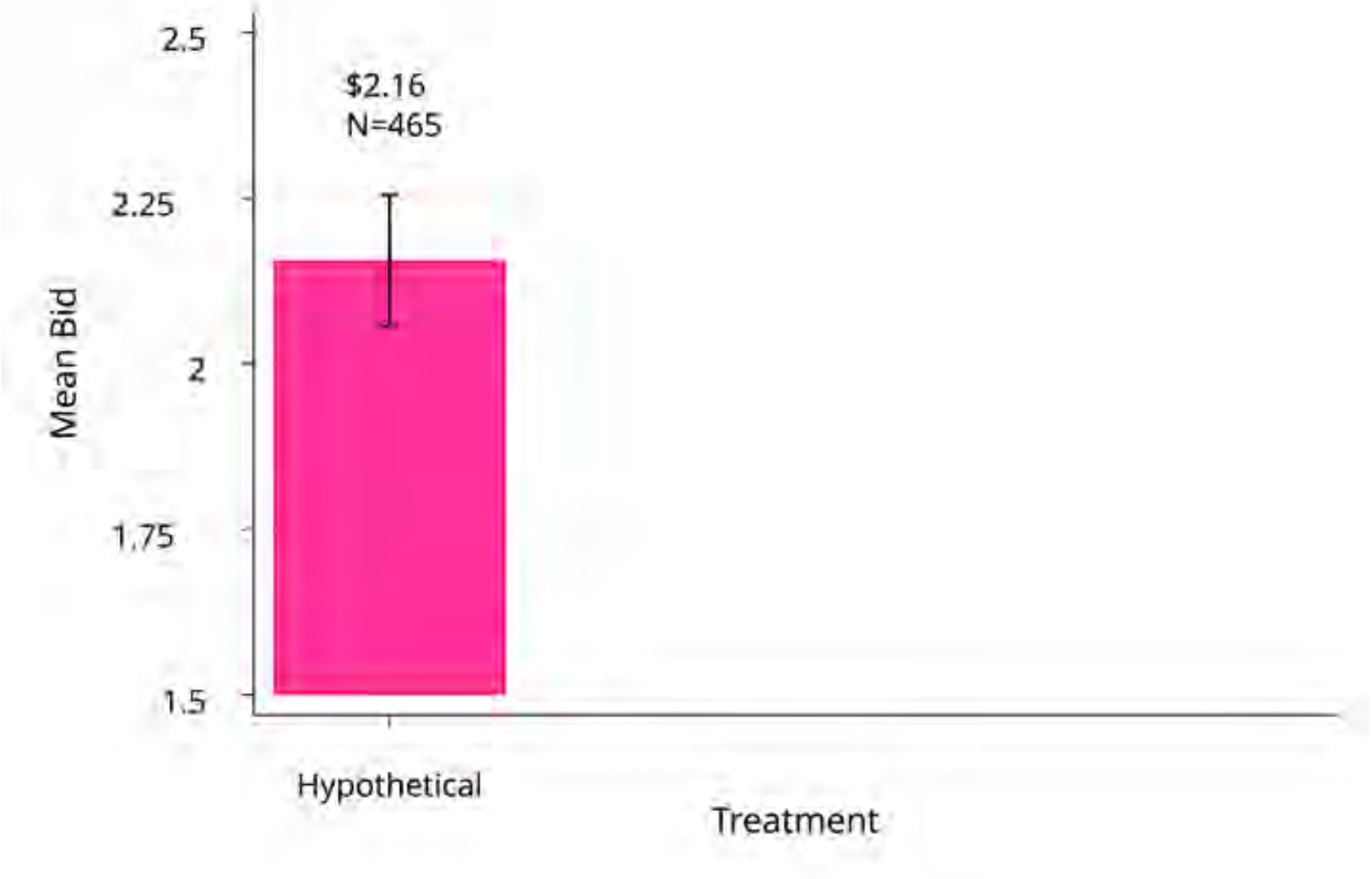
Checking for Balanced Sample

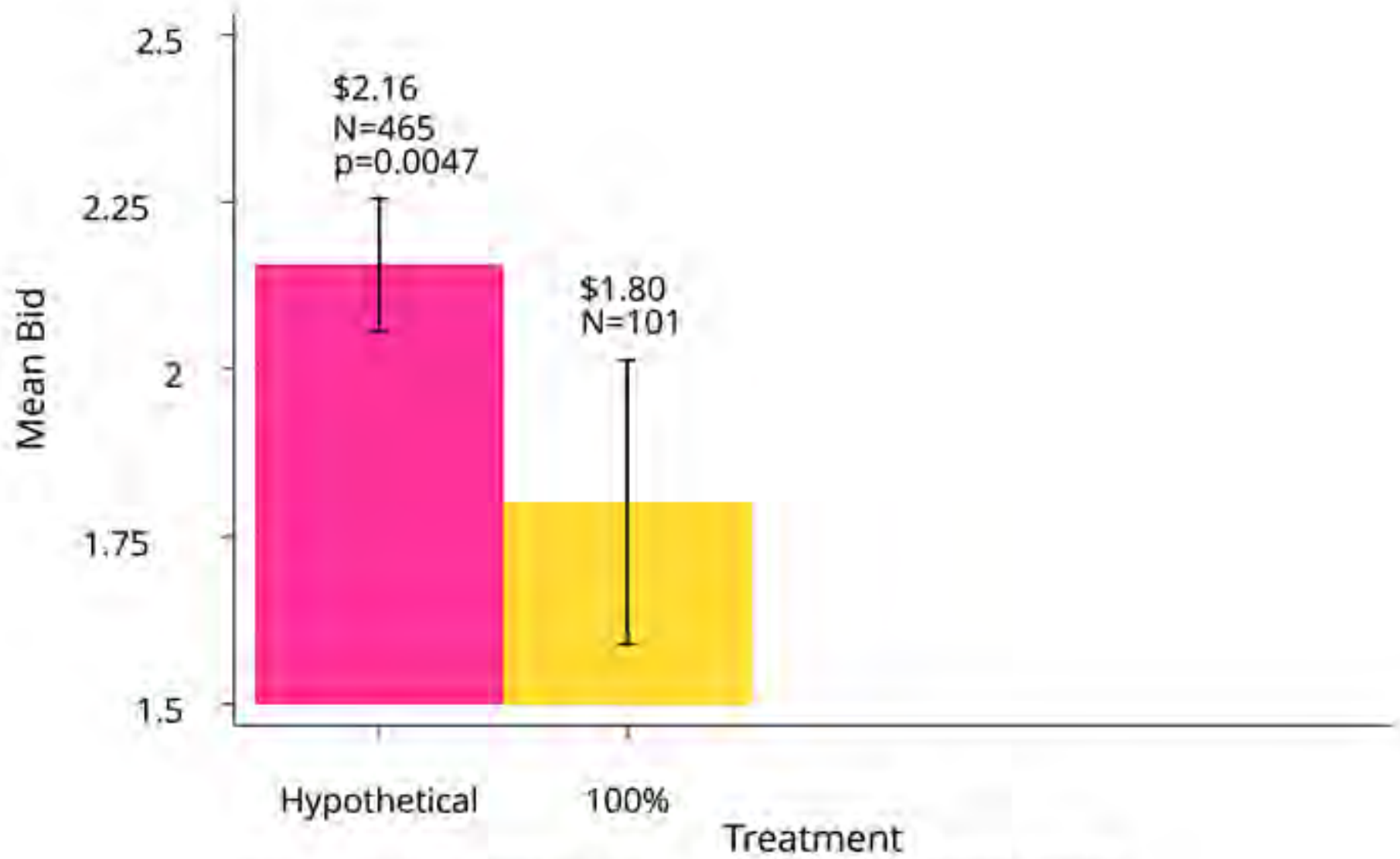
Table: Pairwise Normalized Differences between Treatments for Observable Characteristics

	Hypothetical vs.			10% vs.		50/500 vs.
	10%	50/500	100%	50/500	100%	100%
Gender	0.0933	0.0130	0.2546	0.0940	0.1697	0.2500
Age	0.0342	-0.0793	0.0787	-0.1139	0.0446	0.1586
MSC	0.0560	-0.0522	0.1439	-0.1083	0.0887	0.1954
MeatImportance	0.0626	0.0107	0.1705	-0.0523	0.1132	0.1617
Children	0.0483	0.0726	0.1050	0.1210	0.1535	0.0323
Income	-0.0841	-0.0493	-0.0910	0.0364	-0.0099	-0.0452
Marital	0.0280	0.0352	0.0022	0.0632	0.0302	0.0330
Education	0.1003	0.0369	0.1288	0.1147	0.2157	0.1038
Hispanic	0.0924	0.1269	0.2265	0.0345	0.1342	0.0997
Region	0.0497	0.0544	0.3073	0.0576	0.3192	0.3365

WTP in Hypothetical Condition

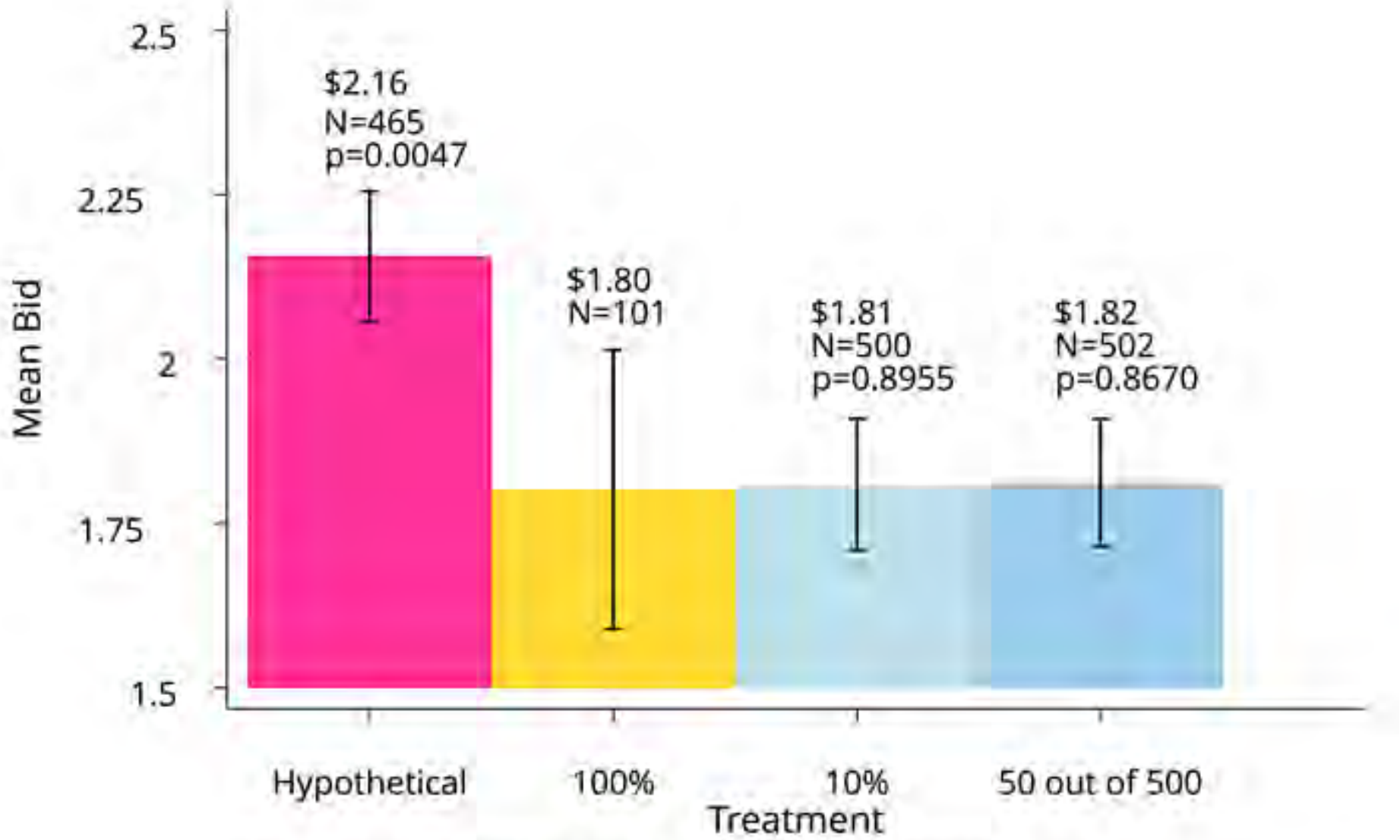


WTP in 100% Condition



*exact p-values of Mann-Whitney tests comparing treatments to 100%

WTP in 10% Lottery Incentives Treatments



*exact p-values of Mann-Whitney tests comparing treatments to 100%

Testing the Limits of Lottery Incentives

Ex-Post Testing of A Lower Boundary

Is 1% Lottery Incentives Effective?

- We implement an additional 1% lottery incentive treatment to investigate a lower boundary

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Theory: All conditions with **any** possibility of realization provide incentives to bid your unbiased valuation
Treatment Hypothesis: 1% lottery incentives condition will not significantly differ from other incentive conditions

1% Experimental Procedures

- Recruited 500 new subjects via Forthright Access
  - Standardized differences show effective quasi-randomization of subjects

Pairwise Standard Differences

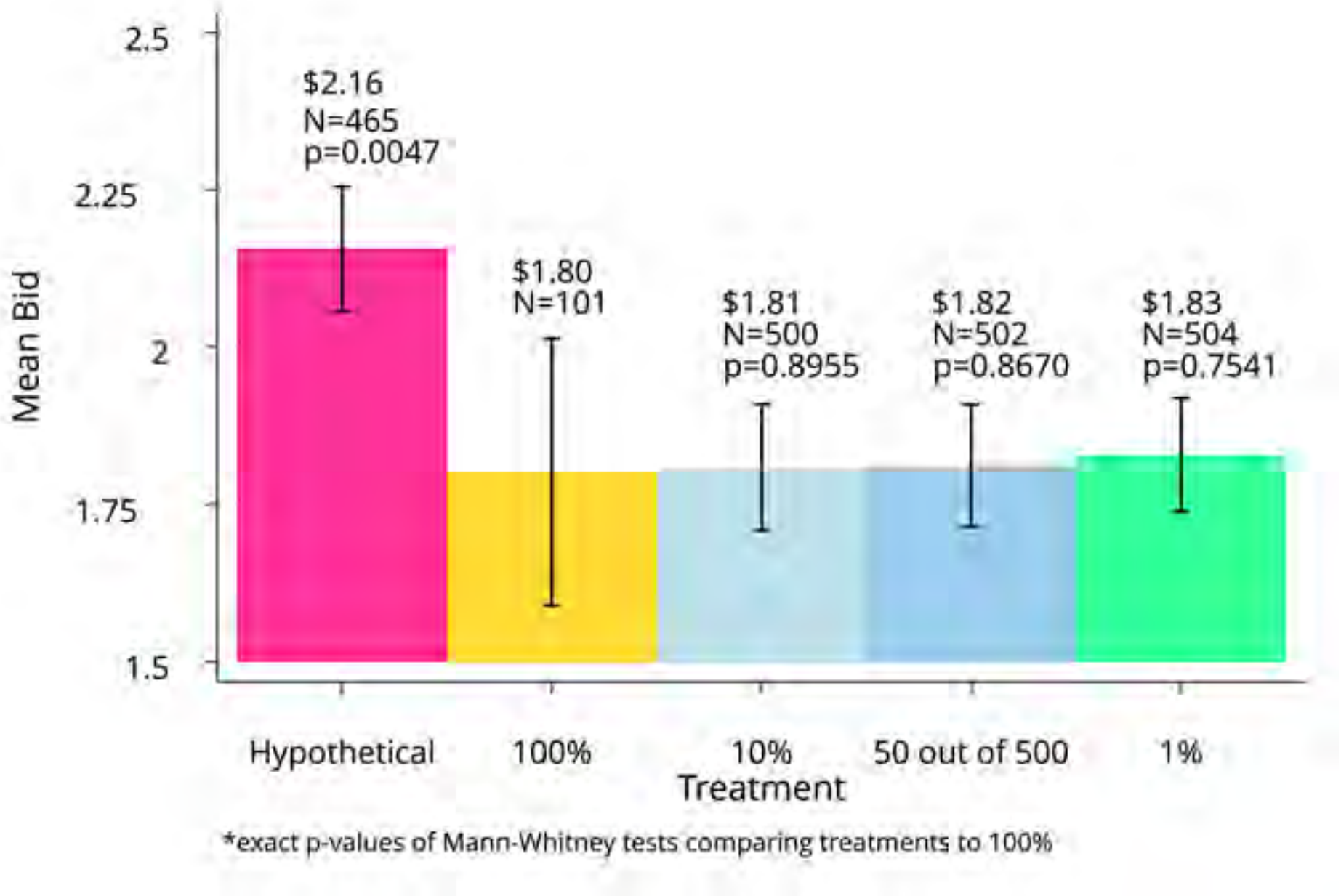
1% Experimental Procedures

- Recruited 500 new subjects via Forthright Access
  - Standardized differences show effective quasi-randomization of subjects

Pairwise Standard Differences

- Identical experimental procedures as the initial experiment:
  1. Presented with a scenario of receiving $5 and a conventional steak
  2. Asked their maximum willingness to pay to exchange the steak for a sustainable Criollo steak
  3. 1 in 100 participants randomly selected to have their decisions realized

1% is Not Different than 100% Incentives



Lottery Incentives are Effective

10% Elicits Unbiased Consumer Valuation

- No statistical differences in WTP compared to fully incentivized
- Lower costs allows for a more representative sample

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- No statistical differences in WTP compared to fully incentivized
- Lower costs allows for a more representative sample

1% also Elicits Unbiased Valuations

- No statistical differences between a 1% and 100% probability of realized decisions when eliciting unbiased consumer valuations

- Caveat: We are unsure if the 1% probability scheme will hold in a dynamic framework with repeated unrealized resolutions
  - Online panelists are a public good

So What Are the Cost Benefits?

Costs Comparison of Incentive Schemes

Table: Comparison of Experimental Costs by Sample Size and Incentive Type

	N =500	N =1000	N = 2000
Hypothetical (0%)	$ 1,500.00	$ 3,000.00	$ 6,000.00
1%	$ 1,734.69	$ 3,469.39	$ 6,938.77
10%	$ 3,846.93	$ 7,693.86	$ 15,387.72
100%	$ 24,969.30	$ 49,938.60	$ 99,877.20

Conclusion

Our methodology provides an approach to how to implement lottery incentive schemes to experimental designs for large-scale, geographically diverse samples

- Lottery incentives of 1% and 10% can elicit consumer valuations that are not statistically different than full incentives while reducing costs

My Research Pipeline

- "Examining the Influence of Price and Income on Global Saturated Fat Intake: Evidence from 160 Countries" (with Muhammad, A., Yenerall, J.N, and Dariush Mozaffarian.) *Under Review*
- Continued work on market valuations of Criollo beef with the Sustainable Southwest Beef Project
  - Market outlook paper is currently under development.
- "Just Quit: How Hope Influences an Individual's Persistence Levels" (with M.A. Palma & P. Feldman)
  - The goal of this project is to investigate how payment mechanisms effect payment and productivity
- "Evaluation of the Effects of Attachment Priming and Social Isolation on Food Preferences" (with M.A. Palma & C.D. Rethorst)
  - Investigating how attachment priming and social isolation impact the difference in the quantity of food consumed by individuals when foods are healthy vs unhealthy

Thank You!

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Number of Subjects in Each State

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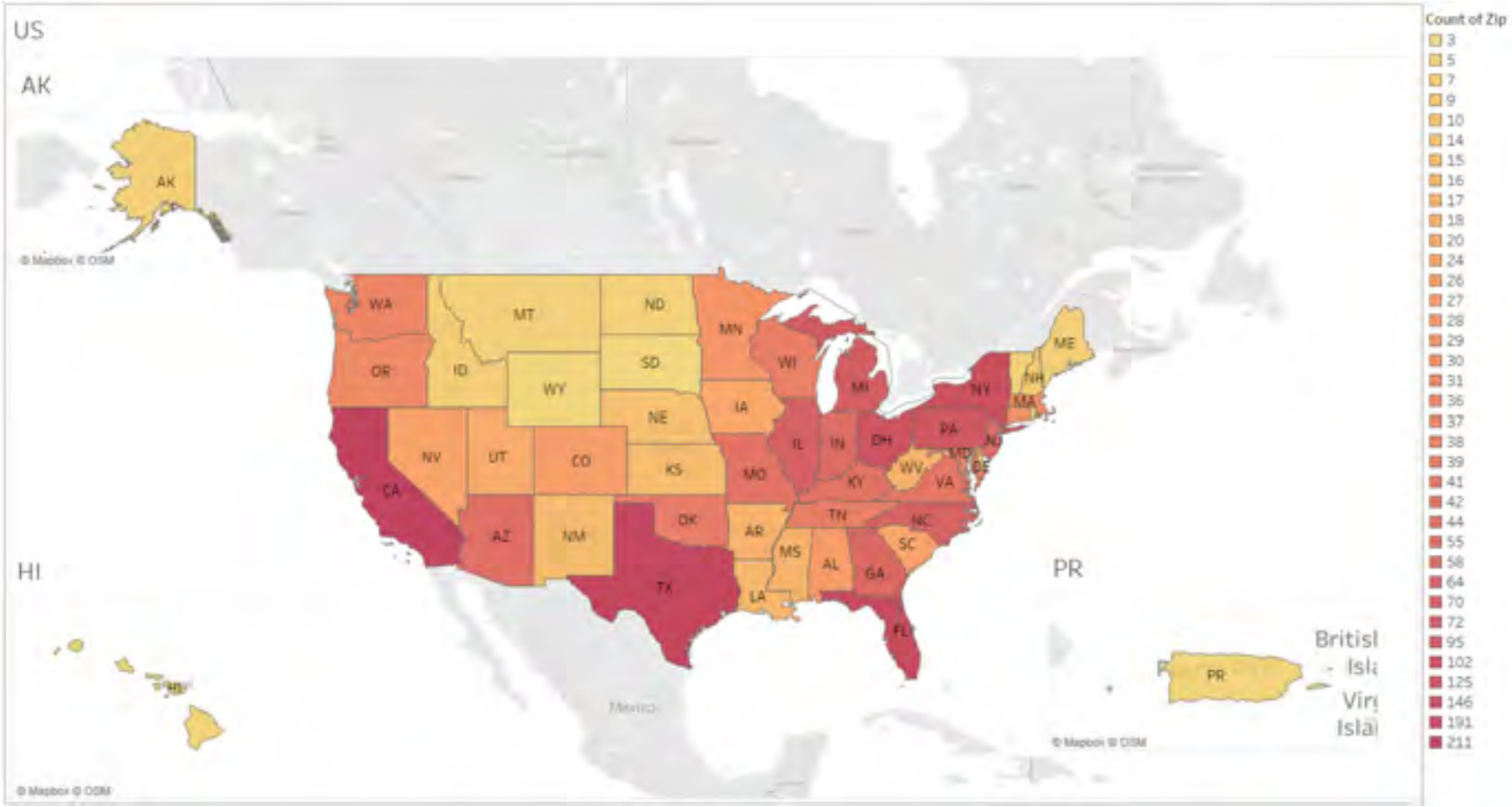

Sample

Table: Comparison of the Means of Demographics for Non-Hypothetical Sample

	Non-Hypothetical Participants
Age	46
Gender	52% Male
	48% Female
Marital Status	61% Unmarried
Income	$60,081
Children <18 in HH	34.64%

Magnitudes are comparable but are not statistically identical

BDM Instructions

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Please read the following scenario very carefully:

On top your earnings from Part I, you will receive **$5 subject to the conditions described below**. In this Second Part you will be endowed with a conventional sirloin steak of approximately 6 oz that will be **shipped** to your **home address free** of **charge** (in the next screen you will be given more information about each steak). For this reason, we will ask for your address information right after. We will also ask you to **submit a bid** to exchange this conventional sirloin steak **with a Criollo sirloin steak** of the same size.

Remember, there is a 1 in 10 chances that this scenario is realized.

Your bid will be compared to an unrelated fixed price that is equally likely to be a number between $0 and $5 and the following rules will be applied:

Rule 1: If **your bid** is **larger or the same as** the fixed price, you will buy the selected steak. In this case you had the high bid. But here is the interesting part! You will not pay the amount of your bid. Instead, you **pay the fixed price**, a price **lower** than **your bid**. The fixed price is subtracted from your earnings.

Rule 2: If **your bid is less** than the **fixed price**, you do not buy the steak and you do not pay anything.

Qualtrics BDM Slider

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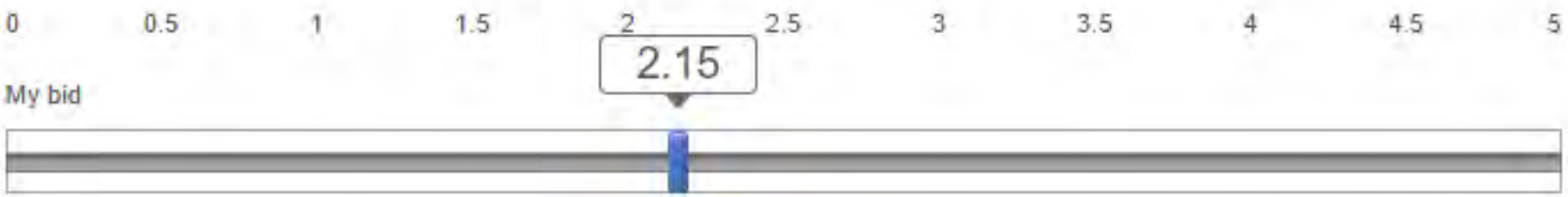
What is the maximum you would be willing to pay to exchange the conventional sirloin stake (Stake 1) to the Criollo sirloin steak (Steak 2). Please use the slider below to indicate your bid.

Your bid is: **$2.15**



Observable Characteristics of Samples

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Table: Pairwise Normalized Differences between the Treatments for Observable Characteristics

	Hypothetical vs.				1% vs.			10% vs.		50/500 vs.
	1%	10%	50/500	100%	10%	50/500	100%	50/500	100%	100%
Gender	0.1089	0.0933	0.0130	0.2546	0.0630	0.1019	0.1517	0.0940	0.1697	0.2500
Age	0.0739	0.0342	-0.0793	0.0787	-0.0395	-0.1545	0.0055	-0.1139	0.0446	0.1586
MSC	0.0701	0.0560	-0.0522	0.1439	-0.0140	-0.1225	0.0751	-0.1083	0.0887	0.1954
MeatImportance	0.1137	0.0626	0.0107	0.1705	-0.0537	-0.1041	0.0597	-0.0523	0.1132	0.1617
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Income	-0.0788	-0.0841	-0.0493	-0.0910	-0.0062	0.0305	-0.0160	0.0364	-0.0099	-0.0452
Marital	0.0862	0.0280	0.0352	0.0022	0.0582	0.1215	0.0884	0.0632	0.0302	0.0330
Education	0.0674	0.1003	0.0369	0.1288	0.0917	0.0860	0.1593	0.1147	0.2157	0.1038
Hispanic	0.1128	0.0924	0.1269	0.2265	0.0203	0.0142	0.1139	0.0345	0.1342	0.0997
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Bidding Behavior By Treatments

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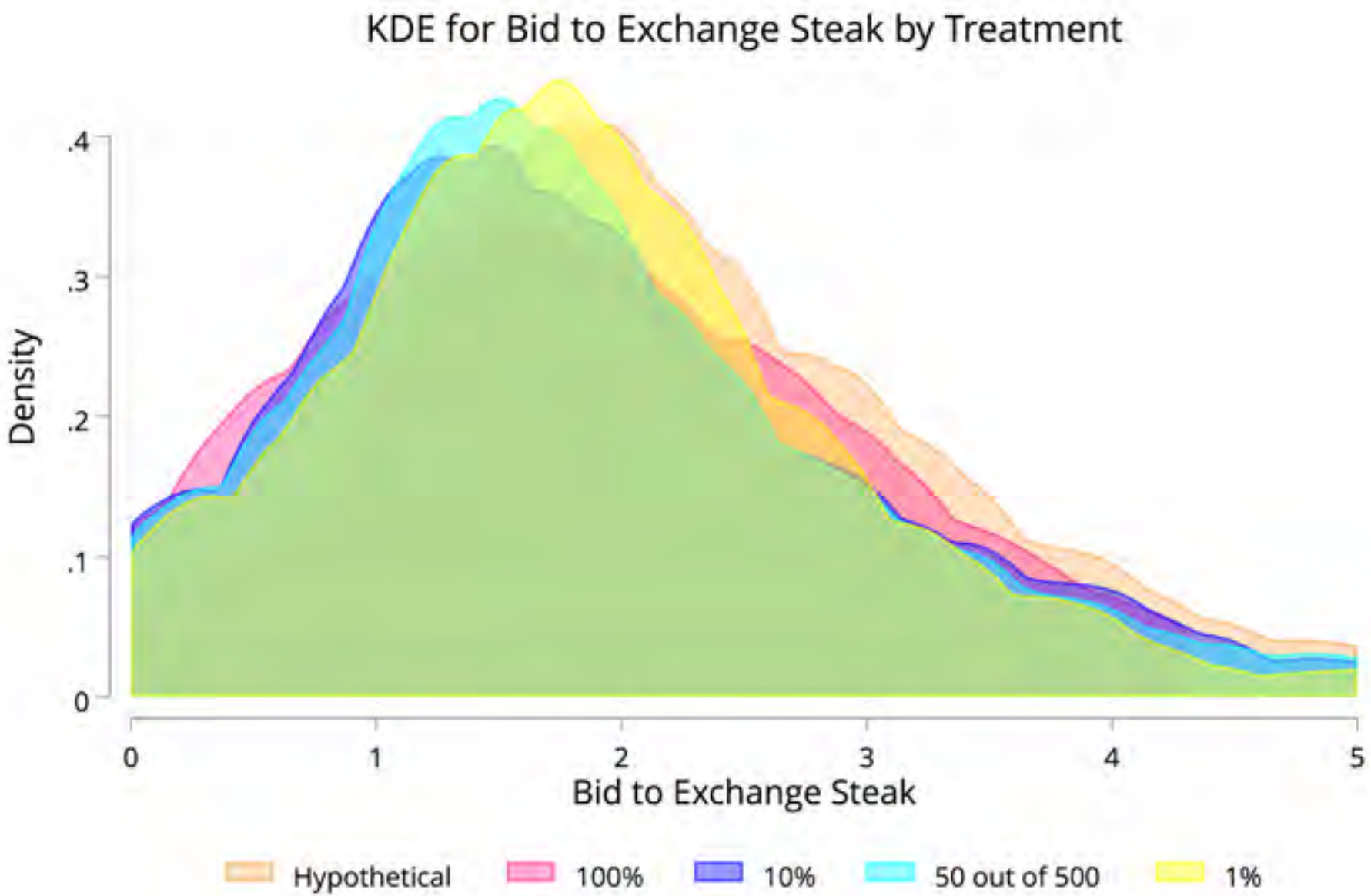

Costs for Our Implemented Experiments

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Table: Incurred Experimental Costs by Treatment Group

Treatment	N	Participation Fee ($3)	Additional Payment ($5 max)	Steak Cost	Total Cost
0%	465	$ 1,395.00	$ -	$ -	$ 1,395.00
1%	504	$ 1,512.00	$ 25.20	$ 211.37	$ 1,748.57
10%	500	$ 1,500.00	$ 250.00	$ 2,096.93	$ 3,846.93
50 out of 500	502	$ 1,506.00	$ 251.00	$ 2,105.32	$ 3,862.32
100%	101	$ 303.00	$ 505.00	$ 4,235.80	$ 5,043.80
Total	2072	$ 6,216.00	$ 1,031.20	$ 8,649.42	$ 15,896.62

Summary Statistics

Table: Summary Statistics of WTP to Exchange for Sustainable Criollo Steak by Treatment

	Overall			*High Support ($5)*			*Low Support ($4)*		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
100%	1.80	1.07	101	1.99	1.17	49	1.63	0.95	52
10%	1.81	1.13	500	1.92	1.24	250	1.69	1.00	250
50 out of 500	1.81	1.10	502	2.00	1.21	263	1.60	0.91	239
1%	1.83	1.03	504	1.97	1.09	248	1.69	0.94	256
Hypothetical	2.16	1.09	465	2.39	1.21	229	1.93	0.90	236
Total	1.89	1.09	2,072	2.06	1.20	1,039	1.72	0.95	1,033

Lottery Incentives Treatments

Table: Probability of Decision Realized by Treatment

	Probability of Decision to be Realized	N
100%	All subjects are selected for realization	101
10%	10% of subjects are selected for realization	500
50 out of 500	50 out of 500 subjects are selected for realization	502
1%	1% of subjects are selected for realization	504
Hypothetical	No subjects are selected for realization	465

Comparison of Incentive Schemes

	Hypothetical Treatment		Fully Incentivized Control		BRIS Treatments	
Constant	2.303***	(0.273)	1.491**	(0.678)	1.558***	(0.146)
High support	0.493***	(0.107)	0.358	(0.245)	0.312***	(0.057)
Perceived Price Diff	0.091***	(0.021)	0.090*	(0.051)	0.045***	(0.013)
Female	-0.179*	(0.103)	0.145	(0.256)	-0.038	(0.059)
Age	0.003	(0.003)	0.009	(0.009)	0.008***	(0.002)
No children in the HH	-0.182	(0.125)	-0.025	(0.300)	-0.257***	(0.068)
Income	-0.001	(0.030)	0.050	(0.078)	-0.002	(0.016)
Married	-0.065	(0.123)	0.093	(0.287)	0.066	(0.069)
Some College	-0.087	(0.137)	-0.571	(0.355)	0.003	(0.077)
Bachelor's Degree	-0.072	(0.154)	-0.651*	(0.386)	-0.053	(0.090)
Graduate or Professional Degree	-0.145	(0.199)	-0.883*	(0.488)	-0.241**	(0.119)
Non-Hispanic	-0.248*	(0.144)	-0.354	(0.391)	-0.155**	(0.079)
Midwest	-0.033	(0.165)	0.249	(0.435)	0.085	(0.087)
South	-0.113	(0.152)	0.246	(0.417)	0.036	(0.080)
West	-0.063	(0.176)	0.152	(0.409)	0.077	(0.092)
N	430		92		1383	

Standard errors in parentheses. * p<0.1, ** p<0.05 *** p<0.01

Lottery Incentives OLS Regressions

	Model 1 Base		Model 2 Base + Demographics	
Constant	1.635***	(0.106)	1.621***	(0.168)
Hypothetical	0.352***	(0.116)	0.367***	(0.120)
1%	0.025	(0.114)	0.059	(0.118)
10%	0.002	(0.116)	0.002	(0.120)
50 out of 500	-0.003	(0.115)	0.013	(0.120)
High support	0.344***	(0.047)	0.349***	(0.049)
Perceived Price Diff			0.057***	(0.011)
Female			-0.066	(0.050)
Age			0.007***	(0.002)
No children in the HH			-0.231***	(0.058)
Income			-0.001	(0.014)
Married			0.035	(0.058)
Some College			-0.038	(0.065)
Bachelor's Degree			-0.081	(0.076)
Graduate or Professional Degree			-0.237**	(0.099)
Non-Hispanic			-0.196***	(0.067)
Midwest			0.064	(0.075)
South			0.021	(0.070)
West			0.053	(0.079)
N	2072		1905	

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

Variable Definitions

Variable Name	Definition
Perceived Price Difference	Best guess in the difference of average retail prices
Gender	0 Male
	1 Female
Age	Age
MCS	Meat Consciousness Scale
Meat Importance	Aggregate of Meat Importances 1-3
Meat Importance 1	Importance of meat as a main meal in a typical weekday
Meat Importance 2	Importance of meat as a main meal over the weekend
Meat Importance 3	Importance of meat as a main meal in a restaurant
Children	0 Children <18 yo in the HH
	1 No children <18 in the HH
Income	1 Less than $25,000
	2 $25,000 to $34,999
	3 $35,000 to $49,999
	4 $50,000 to $74,999
	5 $75,000 to $99,999
	6 $100,000 to $124,999
	7 $125,000 to $149,999
	8 $150,000 to $174,999
	9 $175,000 to $199,999
	10 $200,000 to $249,999
	11 $250,000 or more
Martial	Martial Status
	0 Not Married
	1 Married
Education	1 High School or Less
	2 Some College
	3 Bachelor's Degree
	4 Graduate or Professional Degree
Hispanic	Are you of Hispanic, Latino, or Spanish origin or descent?
	0 Yes
	1 No