For the Love of Veggies

What kind of evidence would be most persuasive to reduce global meat consumption?

W241 Final Project
Lee Moore, Sonal Thakkar, Peter Trenkwalder

What happened with 123 Magic?

An experiment to replicate prior findings on 123 Magic approach to managing tantrums in young children
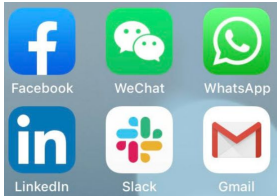
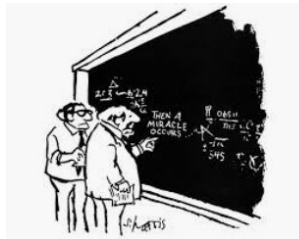## What did we do right?

Started early

Negotiated free content
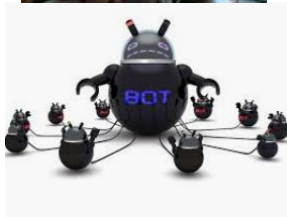
Aggressive recruitment

What went wrong?

Incorrect assumptions

Poor product

Bot Attack!

Motivation for Meat consumption-focused topic

Growing evidence that meat consumption leads to worse health and has important negative effects on the environment
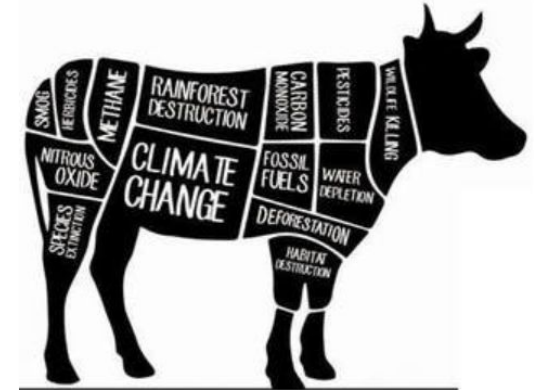
HOWEVER:

Causal claims in nutrition are very hard to make

Individuals differ substantially - relevance of the ATE?

Climate change itself is still denied by many

So what type of evidence should we prioritize developing if we want to drive a change in global meat consumption?

Objective

Assess the impact of different forms of evidence on individuals willingness to change intent to decrease meat consumption, based on 5 level scale

○ Regular Meat Eater (2 or more meals a day with meat)

○ Moderate Meat Eater (1 meal a day with meat)

○ Low Meat Eater (less than 1 meal a day with meat, some days I don't eat meat at all)

○ Vegetarian (no meat, but some milk or eggs)

○ Vegan (no animal-related products)

Approach:

- 3 "Evidence Panels" + 1 placebo panel developed
- Individuals randomized to see 2 of the 4 panels
- For each panel, they had 3 tasks *assuming the passage was true*

Panel X: Placebo

Please review the images below and answer the following questions:

1.Reading comprehension (compliance checker)

What do you see in the above images?

○ Motor Vehicles

○ A sky filled with stars

○ Baby animals

2.Free text (sentiment analysis)

Please provide a few comments below on how this makes you feel

3.Select a new 'level' of meat consumption preference

Now that I have seen these images, during a typical week I would now prefer to be a

○ Regular Meat Eater (2 or more meals a day with meat)

○ Moderate Meat Eater (1 meal a day with meat)

○ Low Meat Eater (less than 1 meal a day with meat, some days I don't eat meat at all)

○ Vegetarian (no meat, but some animal-related products)

○ Vegan (no meat or animal-related products)

3 Evidence Panels

Panel A: Population Health

Please review the paragraph below carefully. Then answer the following questions assuming that the content is true:

Scientific research proves that eating meat in general will increase the risk of dying from cancer, heart attacks and strokes, and accelerates the aging process. Eating high levels of red and processed meats results in worse health outcomes, and even consuming white meat and animal-related products (dairy and eggs) increases the risk of poor long-term health.

Panel B: Personalized Nutrition

Please review the paragraph below carefully. Then answer the following questions assuming that the content is true:

Imagine that in the near future, your annual check-up now includes a genetic screening via DNA sequencing as well as a physical examination, behavior assessment, family history, and blood tests. The combination of this genetic technology and big data can provide an FDA-validated personalized assessment of your health risks associated with your behavioral profile. Your results come back that eating meat (and to a lesser extent meat-related products like dairy and eggs) will increase your specific risk of premature death from cancer, heart attack and strokes and will accelerate your aging process.

Panel C: Environmental Health

Please review the paragraph below carefully. Then answer the following questions assuming that the content is true:

The global scientific community has proven that climate change exists and that livestock is the primary driver due to their massive emissions of climate-changing greenhouse gases. They find consumption of beef in America alone creates the equivalent greenhouse gas emissions of 50 million cars. While red meat causes the greatest strain on the environment, white meat also causes significant impact as well. This research makes it evident that if more people shift to a vegetarian or, better yet, a vegan diet, we could make a meaningful impact on the direction of climate change.

Hypothesis: Personalized Nutritional Recommendations (Panel B) would drive greatest willingness to change

Survey Implementation

➢ **Survey method:** Survey administered to Mturk users ($0.40 payment)
➢ **2-Stage Pilot Survey**:
  ○ Stage 1 pilot previewed by a group of friends.
  ○ Stage 2 administered to 40 Mturk respondents
➢ **Intent of Pilot:** Identify any issues with our initial study format
➢ **Pilot result:**
  ○ Vegans reported no change in behavior - plan to cxcluded vegans from analysis since they would skew the results.
  ○ 80% attrition in our pilot - therefore Moved to Qualtrics (instead of HTML format inside of MTurk) to enable randomization within the survey and allow for 1 combined survey rather than 2 surveys

Histogram of baseline meat consumption by gender: Male=1/Female=2 (n=40)
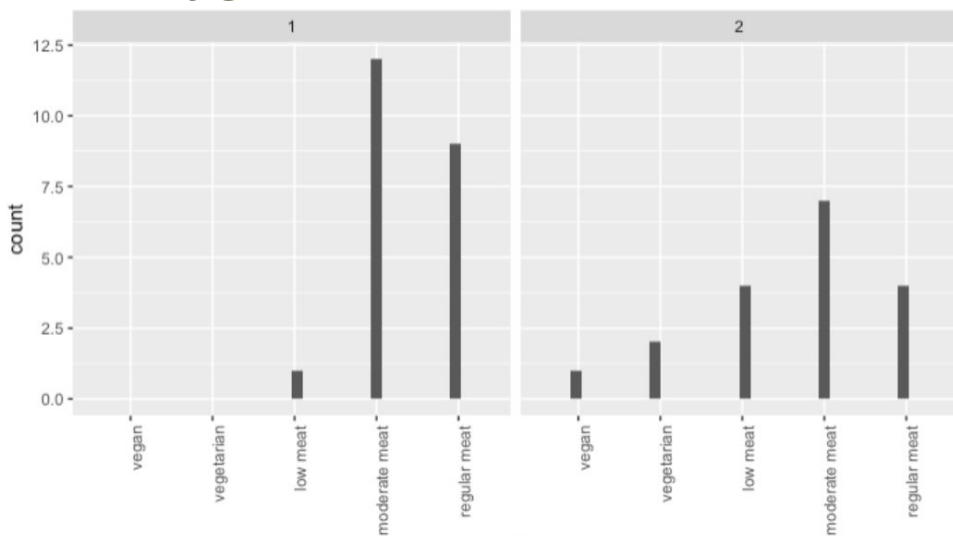
Data cleansing and EDA

➢ **Data Load:** Qualtrics Survey allows for export of data as csv files
➢ **R libraries used**: data.table, dplyr, ggplot2, MASS, lmtest, multiwayvcov, sandwich
➢ **Initial EDA:**
   ○ Step 1: Load the data into dataframe to merge 3 interaction panel information columns into a single column (only 1 out of the 3 columns would be populated for any subject)
   ○ Step 2: Load the csv files into data.tables
   ○ Step 3: Filter for Progress==100, filter out ResponseId!="R_2QWJzIp4HhXwMld" since that was Pete's test response and remove the unnecessary columns like EndDate
   ○ Step 4: Rename the columns using setnames from "Q4" to "age_bin" for example.
   ○ Step 5: Check out the structure of the data table using str(data_table_name)
➢ **Record Counts for the first panel:**

   ○ **"Total number of records 861"**
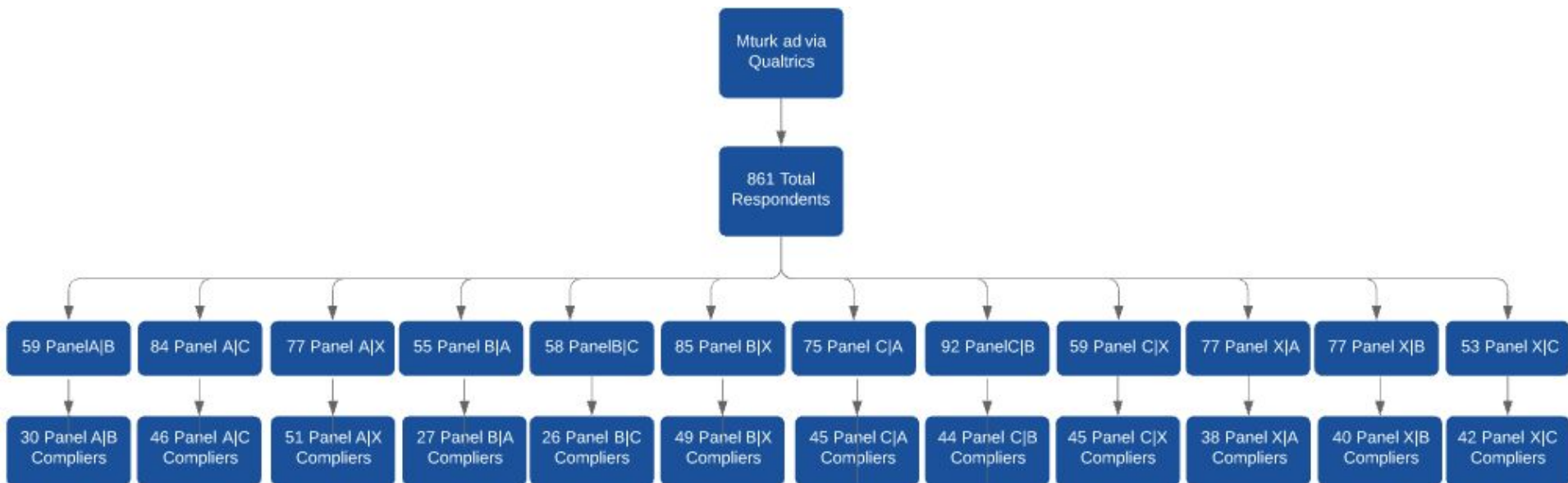
   ○ **"Total number of Control Panel's 207"**

   ○ **"Total number of Panel A's 220"**

   ○ **"Total number of Panel B's 198"**

   ○ **"Total number of Panel C's 226"**

Flow Diagram
for 1st randomization only
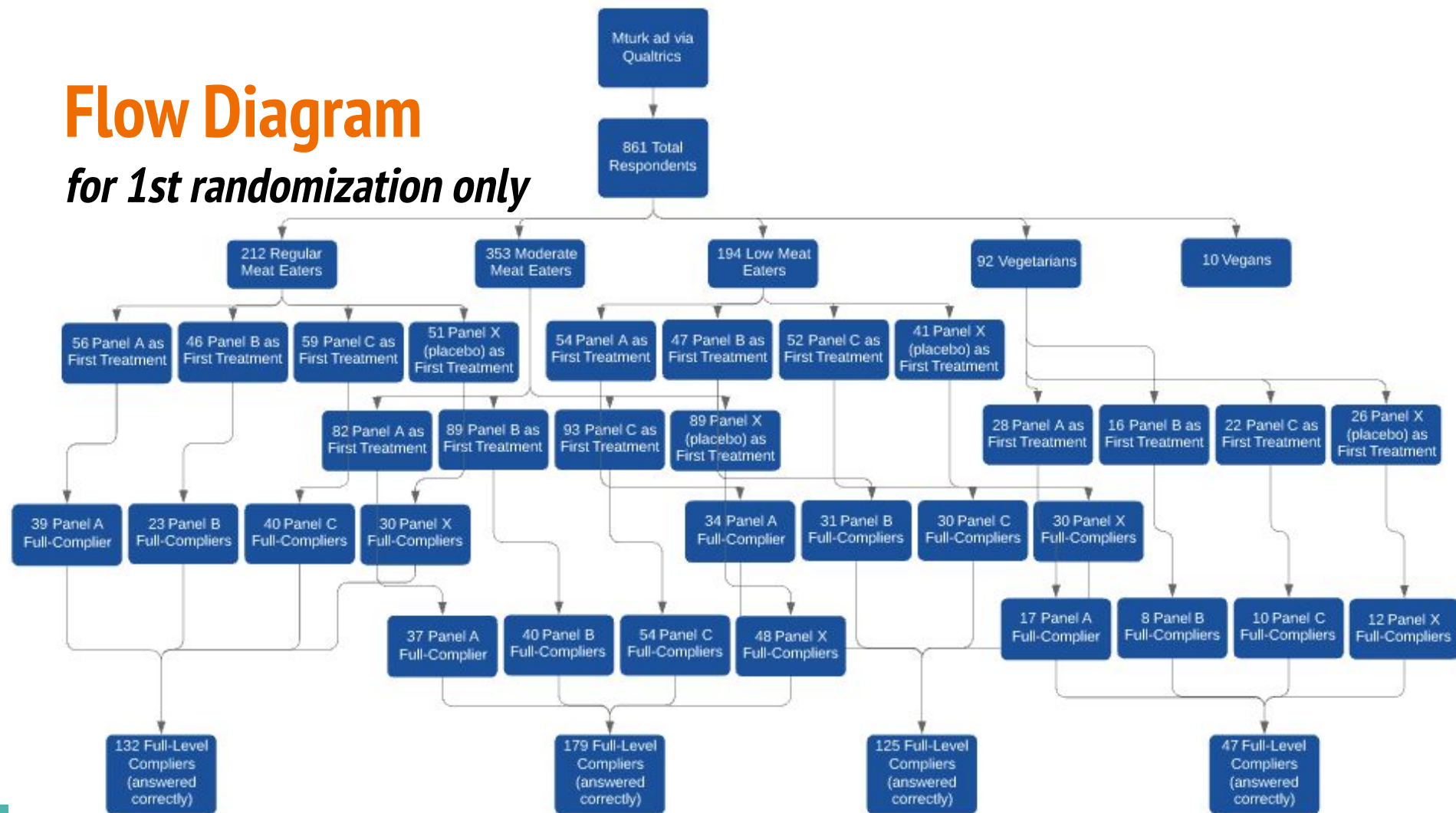
Flow Diagram

Treatment Panel Interaction (10 sample)

treatment_1 <chr>	treatment_both <chr>	base.consumption <chr>	both_correct <dbl>	reduced_cons_count <dbl>
A	A B	Regular	1	9
A	A B	Low	1	2
A	A B	Moderate	1	6
A	A C	Moderate	1	10
A	A C	Regular	1	8
A	A C	Low	1	4
A	A X	Low	1	3
A	A X	Regular	1	8
A	A X	Moderate	1	3
B	B A	Regular	1	2

EDA

The proportion of the treated who would consume less appears greater than the proportion of the control who would consume less for those who initially reported to be moderate to regular meat eaters

Baseline Consumption
2: Vegetarians
3: Low
4: Moderate
5: Regular
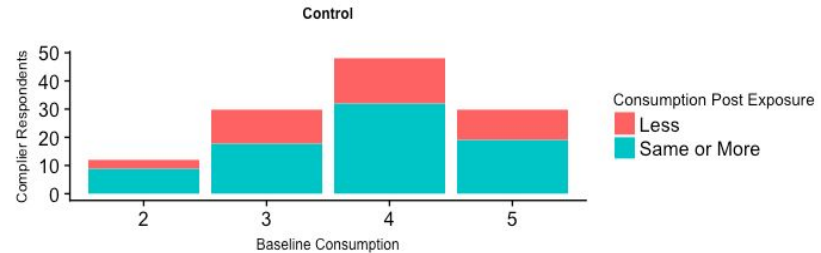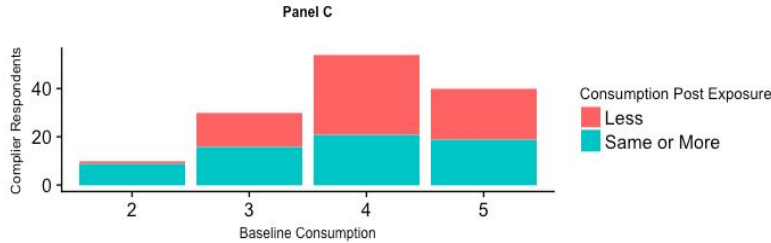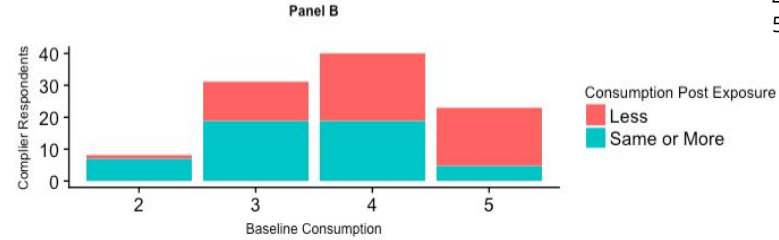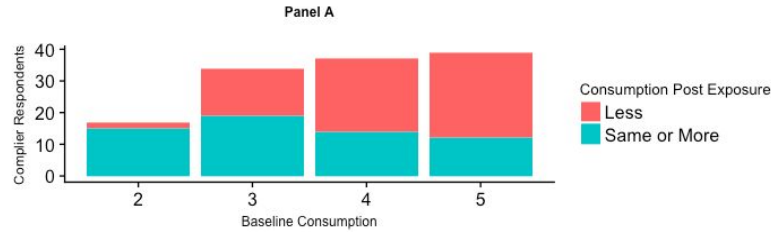
EDA

Demographic covariates don't appear to signal a susceptibility to lowering meat consumption
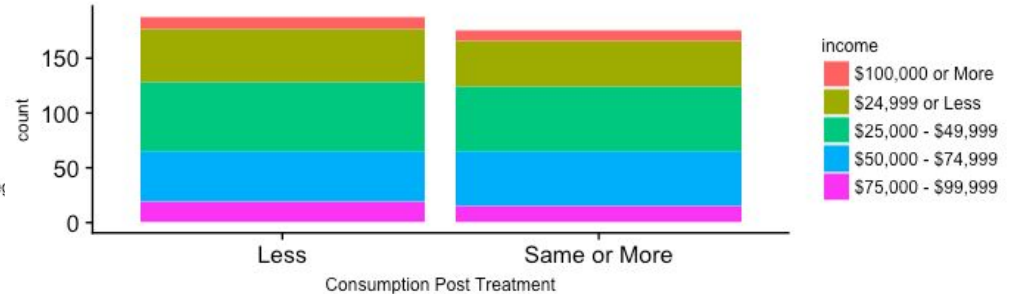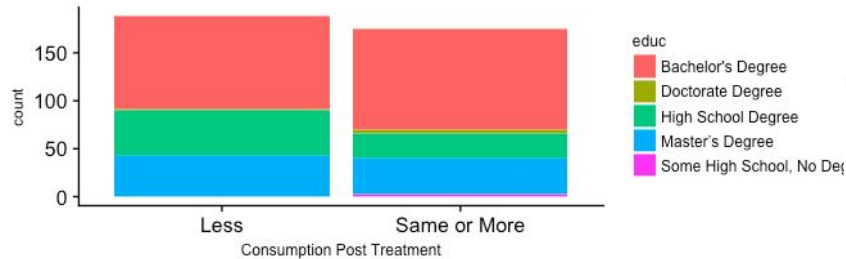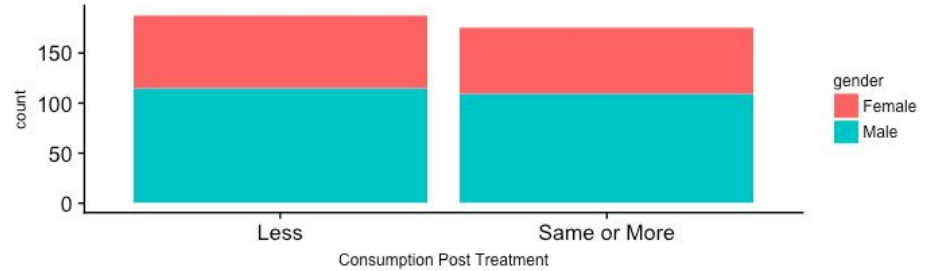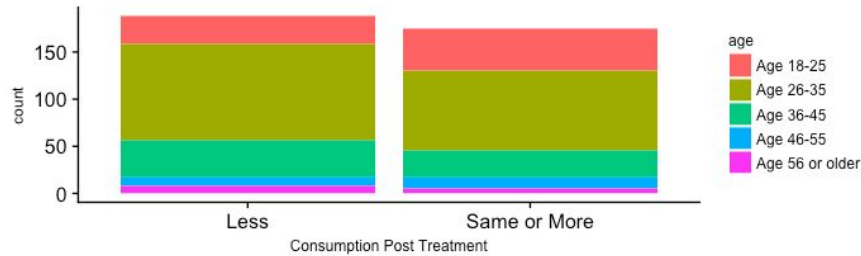
EDA

Concern related words like "scared", "bad","sad", "concerned" tend to occur in higher frequency among the treated who would eat less meat, but we can see similar words appear in the responses from those treated who would eat the same or more meat

Treated who Would Eat Less

Sentiment	Negative	Neutral	Positive
Score	.15	.68	.17

Treated who Would Eat the Same or More

Sentiment	Negative	Neutral	Positive
Score	.11	.66	.23

Regression - 1st Panel (primary) analysis

$Y* = \beta 0 + \beta(\text{Treated1}) + \beta(\text{Baseline Intention}) + e$ | Compliers = True

1st panel (against placebo)

treatment_group	CACE 95% Confidence Interval
A	0.058 to 0.304
B	0.033 to 0.292
C	0.047 to 0.288

- Generally, there is a positive complier causal effect across all panels for increasing the percent of people who are willing to lower meat consumption

- Note: Covariate Analysis and Test for Heterogeneity did not yield any significant interactions or covariates from our demographic information that would help generate more precise estimates of the CACE

Y* is a binary outcome
where 1 = decrease in meat consumption and 0 = same or more in meat consumption

The panel differences from placebo are driven by moderate and regular meat eaters

Moderate Eaters	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.313374	0.072221	4.3391	2.42E-05
A	0.298538	0.108668	2.7472	0.006643
B	0.172705	0.107955	1.5998	0.11146
C	0.264471	0.098449	2.6864	0.007923
baseline intention	0.119759	0.090569	1.3223	0.187807

Regular Eaters	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.311131	0.087646	3.5499	0.0005412
A	0.359817	0.115524	3.1147	0.0022767
B	0.442502	0.124899	3.5429	0.0005544
C	0.193043	0.118871	1.624	0.1068629
base.intention	0.166606	0.124532	1.3379	0.183334

Regression - 2nd panel analysis

$Y^* = \beta 0 + \beta(\text{Treated1})^*\beta(\text{Treated2}) + \beta(\text{Baseline Intention}) + e$ | Compliers = True

$Y2^* = \beta 0 + \beta(\text{Treated2}) + \beta(\text{Baseline Intention}) + e$ | Compliers = True

```
Analysis of Variance Table

Model 1: outcome.binary ~ treatment_1 + base.intention.binary
Model 2: outcome.binary ~ treatment_1 * treatment_2 + base.intention.binary
  Res.Df    RSS Df Sum of Sq      F Pr(>F)
1    478 117.59
2    470 116.71  8   0.87765 0.4418 0.8958
```

- Based on the F-score, we'd fail to reject the null hypothesis that the two models are the same, so we can evaluate treatment 2 independently of treatment 1

results for 2nd panel (against placebo)

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.402281	0.044317	9.0773	< 2e-16	***
A	0.144677	0.063309	2.2853	0.02273	*
B	0.111349	0.062367	1.7854	0.07483	.
C	0.015284	0.061999	0.2465	0.80539	
base.intention	-0.048557	0.050492	-0.9617	0.33671	

- Treatment A, when shown as the second panel, has the only significant impact with respect to lowering reported meat consumption.
- We may be seeing this change in effect between Panels when they're exposed first in the sequence vs second in the sequence because compliance drops from sequence 1 to 2.

Y* is a binary outcome
where 1 = decrease in meat consumption and 0 = same or more in meat consumption

Proportional Odds Logistic Regression

Example: Regular Meat Eaters randomized to panel A v. panel X for their 1st treatment

```
Call:
polr(formula = factor(outcome_1, levels = c("Vegan", "Vegetarian",
    "Low", "Moderate", "Regular")) ~ treatment.group + base.intention.binary,
    data = dt %>% filter(treatment_1 == "A" | treatment_1 ==
        "X") %>% filter(both_correct == 1), Hess = TRUE)

Coefficients:
                        Value Std. Error t value
treatment.group       -0.8078     0.2339  -3.454
base.intention.binary -1.0569     0.2623  -4.029

Intercepts:
                   Value  Std. Error t value
Vegan|Vegetarian  -3.4962    0.3185  -10.9773
Vegetarian|Low    -1.7217    0.2221   -7.7506
Low|Moderate      -0.3363    0.1907   -1.7634
Moderate|Regular   1.0506    0.2099    5.0061

Residual Deviance: 723.1557
AIC: 735.1557
```

Treatment

Vegan|Vegetarian	Vegetarian|Low	Low|Moderate	Moderate|Regular
0.06365748	0.33965865	0.61573221	0.89162411

Control

Vegan|Vegetarian	Vegetarian|Low	Low|Moderate	Moderate|Regular
0.02942006	0.15165268	0.41671336	0.74088196

The probability of wanting to eat 1 meal a day with meat or less when treated with content from Panel A is 62% versus 42% when exposed to control content

Conclusion

All 3 evidence types are significant to drive intent to eat less meat

Insight	Implication
Panel A stronger than Panels B/C (but not statistically different)	Hypothesis on Personalized Nutrition (Panel B) being more important rejected. Ironically, Population Health (Panel A) evidence is the least 'fictitious' of the three.
'Regular' and 'Moderate' meat eating groups drive the positive result	Importance of targeting messages to specific groups to have the greatest impact
2nd panel analysis suggest all effects disappear except for Panel A	Lethargy among respondents? Implies either (1) conduct a more robust experiment (tiered payment for better compliance & to incentive thoughtful responses) or (2) if it's true, beware of overloading messages when building a persuasive argument
Proportional Odds Logistic Regression is very difficult to interpret	Simpler is better. Even if we understand it, our audience might not? Linear Regression with binary outcomes overcomes this nicely :-)

Caveats: Focus on analysis based of 'truth' being predetermined ignores the most challenging aspect of the problem

Questions?

Appendix

Treated who Would Eat Less

A

Sentiment	Negative	Neutral	Positive
Score	.18	.65	.17

B

Sentiment	Negative	Neutral	Positive
Score	.19	.69	.12

C

Sentiment	Negative	Neutral	Positive
Score	.10	.69	.21

Treated who Would the Same or More

Sentiment	Negative	Neutral	Positive
Score	.12	.68	.20

Sentiment	Negative	Neutral	Positive
Score	.13	.65	.22

Sentiment	Negative	Neutral	Positive
Score	.09	.65	.26

Mturk respondents

#Vegans - Excluded

Regular Meat Eaters

Moderate Meat Eater

Low Meat Eater

Vegetarians

Total randomized

Lorem Ipsum

Lorem Ipsum

Total Compliers

	A	B	C	X	
A		8	5	8	26
B	8		8	5	26
C	5	8		8	26
X	8	5	8		26
	21	26	26	26	#