

# Gov 50: 7. Randomized Experiments

Matthew Blackwell

Harvard University

# Roadmap

1. Randomized experiments
2. Calculating effects

# Political canvassing study



## POLITICAL SCIENCE

### Durably reducing transphobia: A field experiment on door-to-door canvassing

David Broockman<sup>1\*</sup> and Joshua Kalla<sup>2</sup>

Existing research depicts intergroup prejudices as deeply ingrained, requiring intense intervention to lastingly reduce. Here, we show that a single approximately 10-minute conversation encouraging actively taking the perspective of others can markedly reduce prejudice for at least 3 months. We illustrate this potential with a door-to-door canvassing intervention in South Florida targeting antitransgender prejudice. Despite declines in homophobia, transphobia remains pervasive. For the intervention, 56 canvassers went door to door encouraging active perspective-taking with 501 voters at voters' doorsteps. A randomized trial found that these conversations substantially reduced transphobia, with decreases greater than Americans' average decrease in homophobia from 1998 to 2012. These effects persisted for 3 months, and both transgender and nontransgender canvassers were effective. The intervention also increased support for a nondiscrimination law, even after exposing voters to counterarguments.

- Can canvassers change minds about topics like transgender rights?
- Experimental setting:
  - Randomly assign canvassers to have a conversation about transgender right or a conversation about recycling.
  - Trans rights conversations focused on “perspective taking”
- Outcome of interest: support for trans rights policies.

# Causal effects & counterfactuals

- What does “ $T_i$  causes  $Y_i$ ” mean?  $\rightsquigarrow$  **counterfactuals**, “what if”
- Would respondent change their support based on the conversation?
- Two **potential outcomes**:
  - $Y_i(1)$ : would respondent  $i$  support ND laws if they had trans rights script?
  - $Y_i(0)$ : would respondent  $i$  support ND laws if they had recycling script?
- **Causal effect**:  $Y_i(1) - Y_i(0)$ 
  - $Y_i(1) - Y_i(0) = 0 \rightsquigarrow$  script has no effect on policy views
  - $Y_i(1) - Y_i(0) = -1 \rightsquigarrow$  trans rights script lower support for laws
  - $Y_i(1) - Y_i(0) = +1 \rightsquigarrow$  trans rights script increases support for laws

# Potential outcomes

$i$	$T_i$	$Y_i$	$Y_i(1)$	$Y_i(0)$
Respondent 1	0	0	???	0
Respondent 2	1	1	1	???

- **Fundamental problem of causal inference:**
  - We only observe one of the two potential outcomes.
  - Observe  $Y_i = Y_i(1)$  if  $T_i = 1$  or  $Y_i = Y_i(0)$  if  $T_i = 0$
- To infer causal effect, we need to infer the missing counterfactuals!

# 1/ Randomized experiments

# Match groups not individuals



- **Randomized control trial:** each unit's treatment assignment is determined by chance.
  - Flip a coin; draw red and blue chips from a hat; etc
- Randomization ensures **balance** between treatment and control group.
  - Treatment and control group are identical **on average**
  - Similar on both observable and unobservable characteristics.

# A little more notation

- We will often refer to the **sample size** (number of units) as  $n$ .
- We often have  $n$  measurements of some variable:  $(Y_1, Y_2, \dots, Y_n)$
- How many in our sample support nondiscrimination laws?

$$Y_1 + Y_2 + Y_3 + \dots + Y_n$$

- Notation is a bit clunky, so we often use the **Sigma notation**:

$$\sum_{i=1}^n Y_i = Y_1 + Y_2 + Y_3 + \dots + Y_n$$

- $\sum_{i=1}^n$  means sum each value from  $Y_1$  to  $Y_n$



# Averages

- The **sample average** or **sample mean** is simply the sum of all values divided by the number of values.
- Sigma notation allows us to write this in a compact way:

$$\bar{Y} = \frac{1}{n} \sum_{i=1}^n Y_i$$

- Suppose we surveyed 6 people and 3 supported nondiscrim. laws:

$$\bar{Y} = \frac{1}{6} (1 + 1 + 1 + 0 + 0 + 0) = 0.5$$

# Quantity of interest

- We want to estimate the average causal effects over all units:

$$\begin{aligned}\text{Sample Average Treatment Effect (SATE)} &= \frac{1}{n} \sum_{i=1}^n \{Y_i(1) - Y_i(0)\} \\ &= \frac{1}{n} \sum_{i=1}^n Y_i(1) - \frac{1}{n} \sum_{i=1}^n Y_i(0)\end{aligned}$$

- Why can't we just calculate this quantity directly?
- What we can estimate instead:

$$\text{Difference in means} = \bar{Y}_{\text{treated}} - \bar{Y}_{\text{control}}$$

- $\bar{Y}_{\text{treated}}$ : sample average outcome for treated group
- $\bar{Y}_{\text{control}}$ : sample average outcome for control group
- When will the difference-in-means is a good estimate of the SATE?

# Why randomization works

- Under an RCT, treatment and control groups are random samples.
- Average in the treatment group will be similar to average if all treated:

$$\bar{Y}_{\text{treated}} \approx \frac{1}{n} \sum_{i=1}^n Y_i(1)$$

- Average in the control group will be similar to average if all untreated:

$$\bar{Y}_{\text{control}} \approx \frac{1}{n} \sum_{i=1}^n Y_i(0)$$

- Implies difference-in-means should be close to SATE:

$$\bar{Y}_{\text{treated}} - \bar{Y}_{\text{control}} \approx \frac{1}{n} \sum_{i=1}^n Y_i(1) - \frac{1}{n} \sum_{i=1}^n Y_i(0) = \frac{1}{n} \sum_{i=1}^n \{Y_i(1) - Y_i(0)\} = \text{SATE}$$

# Some potential problems with RCTs

- **Placebo effects:**

- Respondents will be affected by any intervention, even if they shouldn't have any effect.
- Reason to have control group be recycling script

- **Hawthorne effects:**

- Respondents act differently just knowing that they are under study.

# Balance checking

- Can we determine if randomization “worked”?
- If it did, we shouldn’t see large differences between treatment and control group on **pretreatment variable**.
  - Pretreatment variable are those that are unaffected by treatment.
- We can check in the actual data for some pretreatment variable  $X$ 
  - $\bar{X}_{\text{treated}}$ : average value of variable for treated group.
  - $\bar{X}_{\text{control}}$ : average value of variable for control group.
  - Under randomization,  $\bar{X}_{\text{treated}} - \bar{X}_{\text{control}} \approx 0$

# Multiple treatments

- Instead of 1 treatment, we might have multiple **treatment arms**:
  - Control condition
  - Treatment A
  - Treatment B
  - Treatment C, etc
- In this case, we will look at multiple comparisons:
  - $\bar{Y}_{\text{treated, A}} - \bar{Y}_{\text{control}}$
  - $\bar{Y}_{\text{treated, B}} - \bar{Y}_{\text{control}}$
  - $\bar{Y}_{\text{treated, A}} - \bar{Y}_{\text{treated, B}}$
- If treatment arms are randomly assigned, these differences will be good estimators for each causal contrast.

## **2/** Calculating effects

# Transphobia study data

```
## reinstall gov50data if necessary  
library(gov50data)
```

---

Variable Name	Description
age	Age of the R in years
female	1=R marked "Female" on voter reg., 0 otherwise
voted_gen_14	1 if R voted in the 2014 general election
vote_gen_12	1 if R voted in the 2012 general election
treat_ind	1 if R assigned to trans rights script, 0 for recycling
racename	name of racial identity indicated on voter file
democrat	1 if R is a registered Democrat
nondiscrim_pre	1 if R supports nondiscrim. law at baseline
nondiscrim_post	1 if R supports nondiscrim. law after 3 months



# Peak at the data

```
trans
```

```
## # A tibble: 565 x 9
##   age female voted_gen_14 voted_gen_12 treat_ind racename
##   <dbl> <dbl>         <dbl>         <dbl>         <dbl> <chr>
## 1    29     0           0             1             0 African~
## 2    59     1           1             0             1 African~
## 3    35     1           1             1             1 African~
## 4    63     1           1             1             1 African~
## 5    65     0           1             1             1 African~
## 6    51     1           1             1             0 Caucasi~
## 7    26     1           1             1             0 African~
## 8    62     1           1             1             1 African~
## 9    37     0           1             1             0 Caucasi~
## 10   51     1           1             1             0 Caucasi~
## # i 555 more rows
## # i 3 more variables: democrat <dbl>, nondiscrim_pre <dbl>,
## #   nondiscrim_post <dbl>
```

# Calculate the average outcomes in each group

```
treat_mean <- trans |>
  filter(treat_ind == 1) |>
  summarize(nondiscrim_mean = mean(nondiscrim_post))
treat_mean
```

```
## # A tibble: 1 x 1
##   nondiscrim_mean
##             <dbl>
## 1             0.687
```

```
control_mean <- trans |>
  filter(treat_ind == 0) |>
  summarize(nondiscrim_mean = mean(nondiscrim_post))
control_mean
```

```
## # A tibble: 1 x 1
##   nondiscrim_mean
##             <dbl>
## 1             0.648
```

# Calculating the difference in means

```
treat_mean - control_mean
```

```
## nondiscrim_mean  
## 1 0.039
```

We'll see more ways to do this throughout the semester.

# Checking balance on numeric covariates

We can use `group_by` to see how the mean of covariates varies by group:

```
trans |>
  group_by(treat_ind) |>
  summarize(age_mean = mean(age))
```

```
## # A tibble: 2 x 2
##   treat_ind age_mean
##   <dbl>     <dbl>
## 1         0     48.2
## 2         1     48.3
```

# Checking balance on categorical covariates

Or we can group by treatment and a categorical control:

```
trans |>
  group_by(treat_ind, racename) |>
  summarize(n = n())
```

```
## # A tibble: 9 x 3
## # Groups:   treat_ind [2]
##   treat_ind racename          n
##   <dbl> <chr>          <int>
## 1     0 African American    58
## 2     0 Asian                2
## 3     0 Caucasian            77
## 4     0 Hispanic           150
## 5     1 African American    68
## 6     1 Asian                4
## 7     1 Caucasian            75
## 8     1 Hispanic           130
## 9     1 Native American      1
```

Hard to read!

# pivot\_wider

`pivot_wider()` takes data from a single column and moves it into multiple columns based on a grouping variable:

```
trans |>
  group_by(treat_ind, racename) |>
  summarize(n = n()) |>
  pivot_wider(
    names_from = treat_ind,
    values_from = n
  )
```

`names_from` tells us what variable will map onto the columns

`values_from` tell us what values should be mapped into those columns

```
trans |>
  group_by(treat_ind, racename) |>
  summarize(n = n()) |>
  pivot_wider(
    names_from = treat_ind,
    values_from = n
  )
```

```
## # A tibble: 5 x 3
##   racename      `0`    `1`
##   <chr>         <int> <int>
## 1 African American    58    68
## 2 Asian                2     4
## 3 Caucasian           77    75
## 4 Hispanic           150   130
## 5 Native American    NA     1
```

# Calculating diff-in-means by group

```
trans |>
  mutate(
    treat_ind = if_else(treat_ind == 1, "Treated", "Control"),
    party = if_else(democrat == 1, "Democrat", "Non-Democrat")
  ) |>
  group_by(treat_ind, party) |>
  summarize(nondiscrim_mean = mean(nondiscrim_post)) |>
  pivot_wider(
    names_from = treat_ind,
    values_from = nondiscrim_mean
  ) |>
  mutate(
    diff_in_means = Treated - Control
  )
```

```
## # A tibble: 2 x 4
##   party      Control Treated diff_in_means
##   <chr>      <dbl>  <dbl>      <dbl>
## 1 Democrat    0.704    0.754      0.0498
## 2 Non-Democrat 0.605    0.628      0.0234
```



# Creating more complicated groups with case\_when

```
trans |>
  mutate(
    age_group = case_when(
      age < 25 ~ "Under 25",
      age >=25 & age < 65 ~ "Bewteen 25 and 65",
      age >= 65 ~ "Older than 65"
    )
  ) |>
  count(age_group)
```

```
## # A tibble: 3 x 2
##   age_group          n
##   <chr>             <int>
## 1 Bewteen 25 and 65  369
## 2 Older than 65     116
## 3 Under 25          80
```

# Calculating ATE by age group

```
trans |>
  mutate(
    treat_ind = if_else(treat_ind == 1, "Treated", "Control"),
    age_group = case_when(
      age < 25 ~ "Under 25",
      age >=25 & age < 65 ~ "Bewteen 25 and 65",
      age >= 65 ~ "Older than 65"
    )
  ) |>
  group_by(treat_ind, age_group) |>
  summarize(nondiscrim_mean = mean(nondiscrim_post)) |>
  pivot_wider(
    names_from = treat_ind,
    values_from = nondiscrim_mean
  ) |>
  mutate(
    diff_in_means = Treated - Control
  )
```

```
## # A tibble: 3 x 4
##   age_group      Control Treated diff_in_means
##   <chr>          <dbl>   <dbl>         <dbl>
## 1 Bewteen 25 and 65  0.694   0.683        -0.0112
## 2 Older than 65     0.576   0.614         0.0378
## 3 Under 25         0.556   0.829         0.273
```