Randomized Trials (SOC 412)

Week 1 Lecture 2

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PRINCETON UNIVERSITY

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mit media lab

What we will cover today

Discuss reading

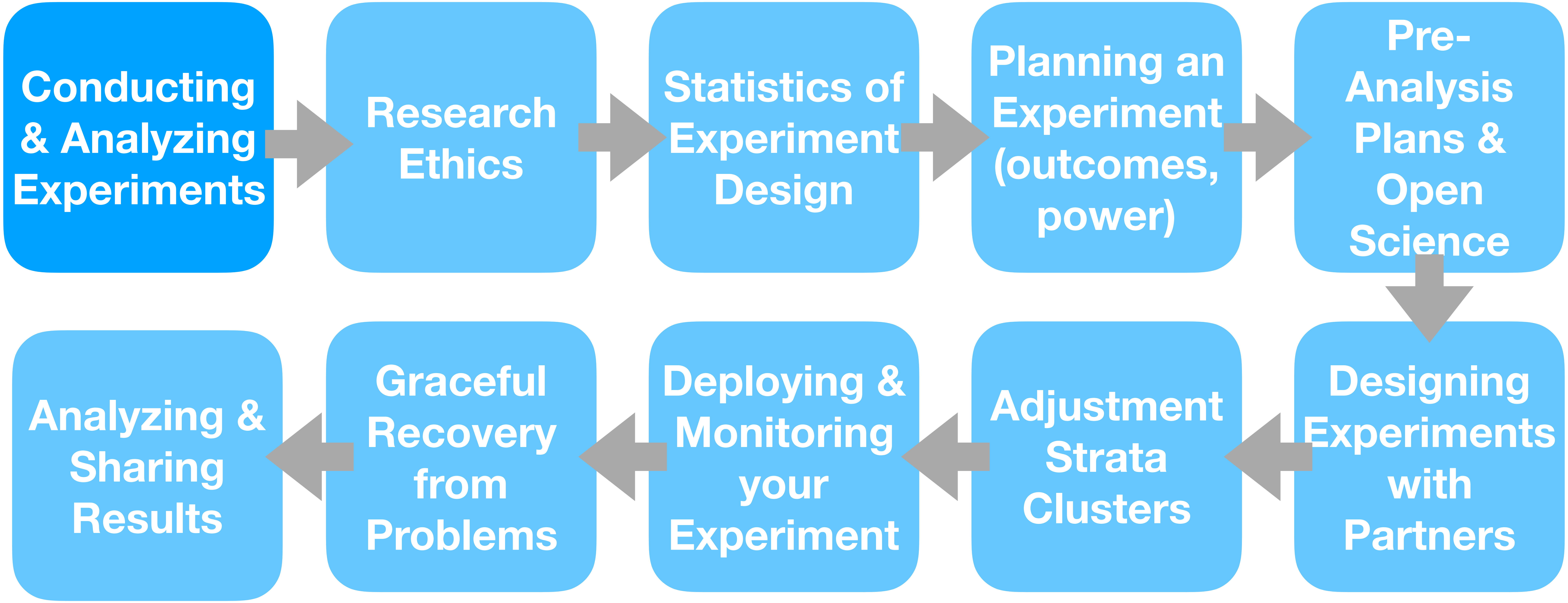
Introduction to randomized trials

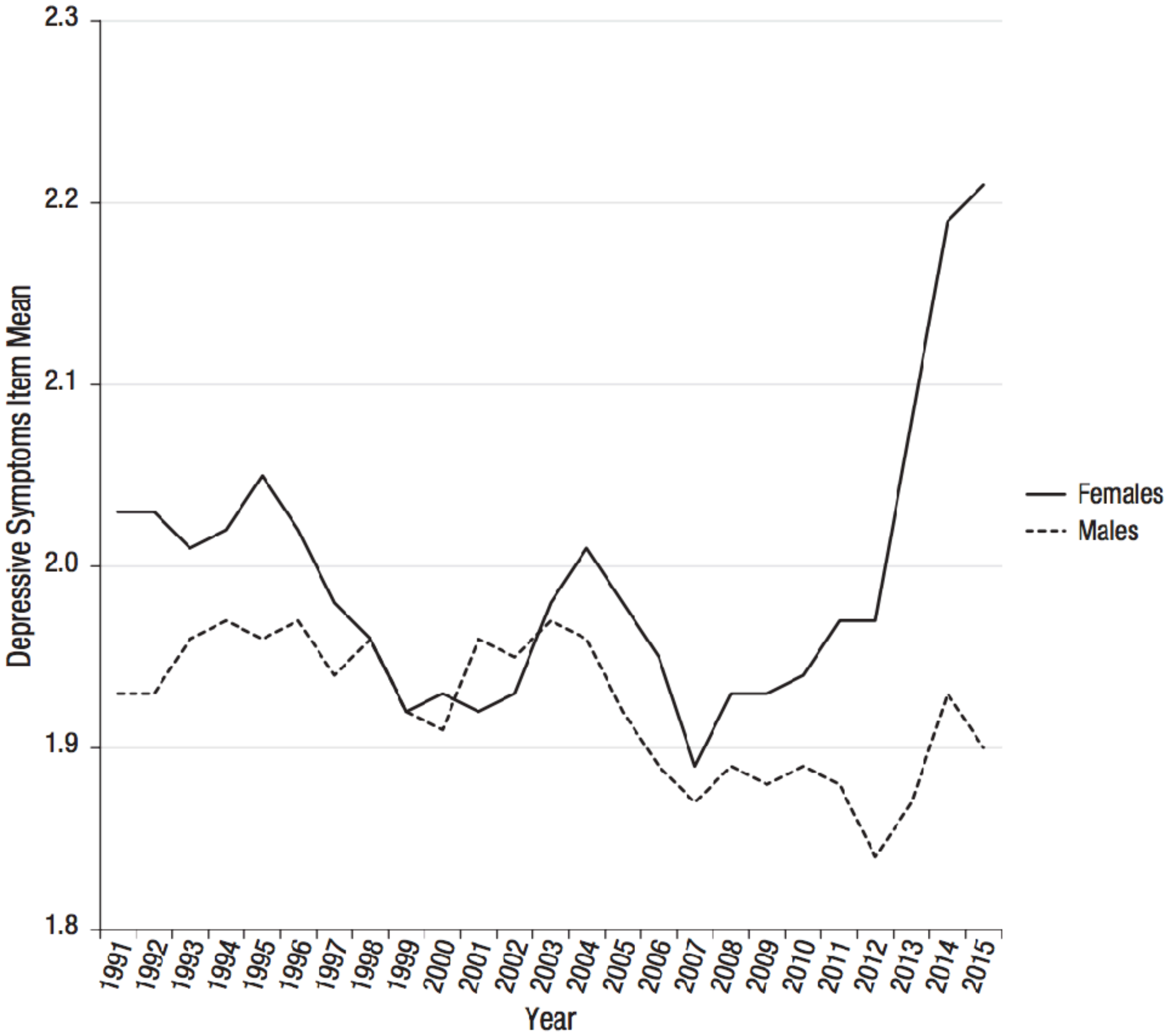
Discuss assignment

Discuss first full field experiment

Questions about Assignments

- Project Assignments: Due Monday evening?
- Reflective Writing Due Friday midday?


Conducting & Analyzing Experiments
Research Ethics
Statistics of Experiment Design
Planning an Experiment (outcomes, power)
Pre-Analysis Plans & Open Science
Designing Experiments with Partners
Adjustment Strata Clusters
Deploying & Monitoring your Experiment
Graceful Recovery from Problems
Analyzing & Sharing Results



Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among US adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, *6*(1), 3-17.

“ Next, we examined **possible causes of the increase in depressive symptoms** and suicide-related outcomes among adolescents

When examined individually, the four **suicide-related outcomes** were **all significantly correlated with electronic device use**

Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among US adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, *6*(1), 3-17.

Table 2. Correlations Between Screen and Nonscreen Activities and Depressive Symptoms (8th and 10th Graders, MtF) and Suicide-Related Outcomes (9–12th Graders, YRBSS), 2009–2015 *p < .001.

	Bivariate *r*	Controlled for sex, race, SES, grade, and region	Controlled for sex, race, SES, grade, and region and in-person social interaction	Girls (controlled for race, SES, grade, and region)	Boys (controlled for race, SES, grade, and region)
MtF (correlations with depressive symptoms)					
Screen activities					
Social media use	.05*	.03*	.06*	.06*	.01
TV viewing	.04*	.02*	.03*	.03*	.02*
Internet news use	.00	.00	.01*	.01	–.02
Nonscreen activities					
In-person social interaction	–.07*	–.08*	–.09*	–.08*	–.09*
Religious services attendance	–.15*	–.14*	–.14*	–.16*	–.13*
Sports or exercise	–.22*	–.19*	–.18*	–.20*	–.19*
Homework hours	–.06*	–.05*	–.06*	–.06*	–.04*
Print media use	–.11*	–.10*	–.09*	–.12*	–.08*
Having a paid job	.00	.01	.02*	–.01	.02*

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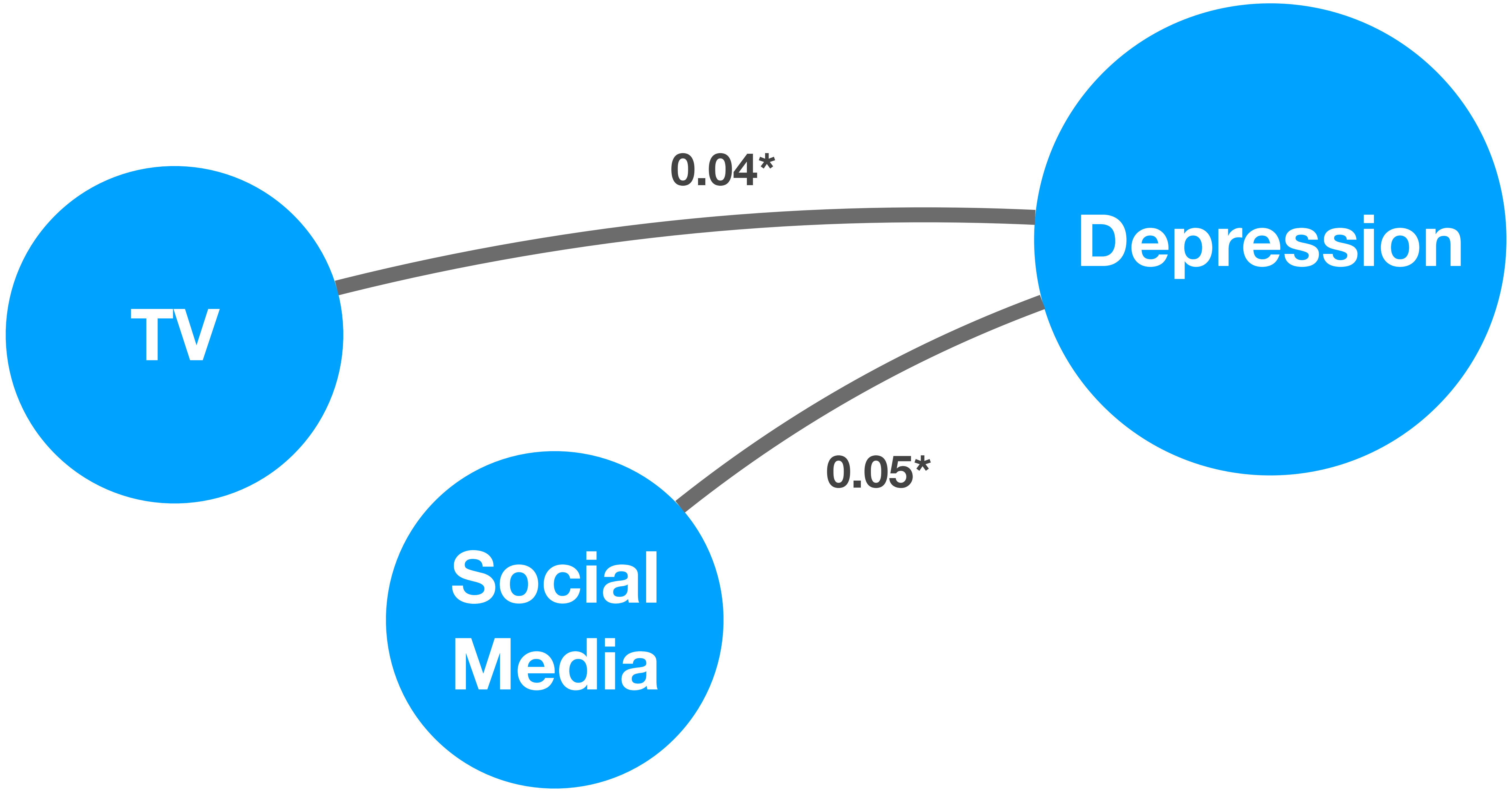
Correlation? Association? Description?



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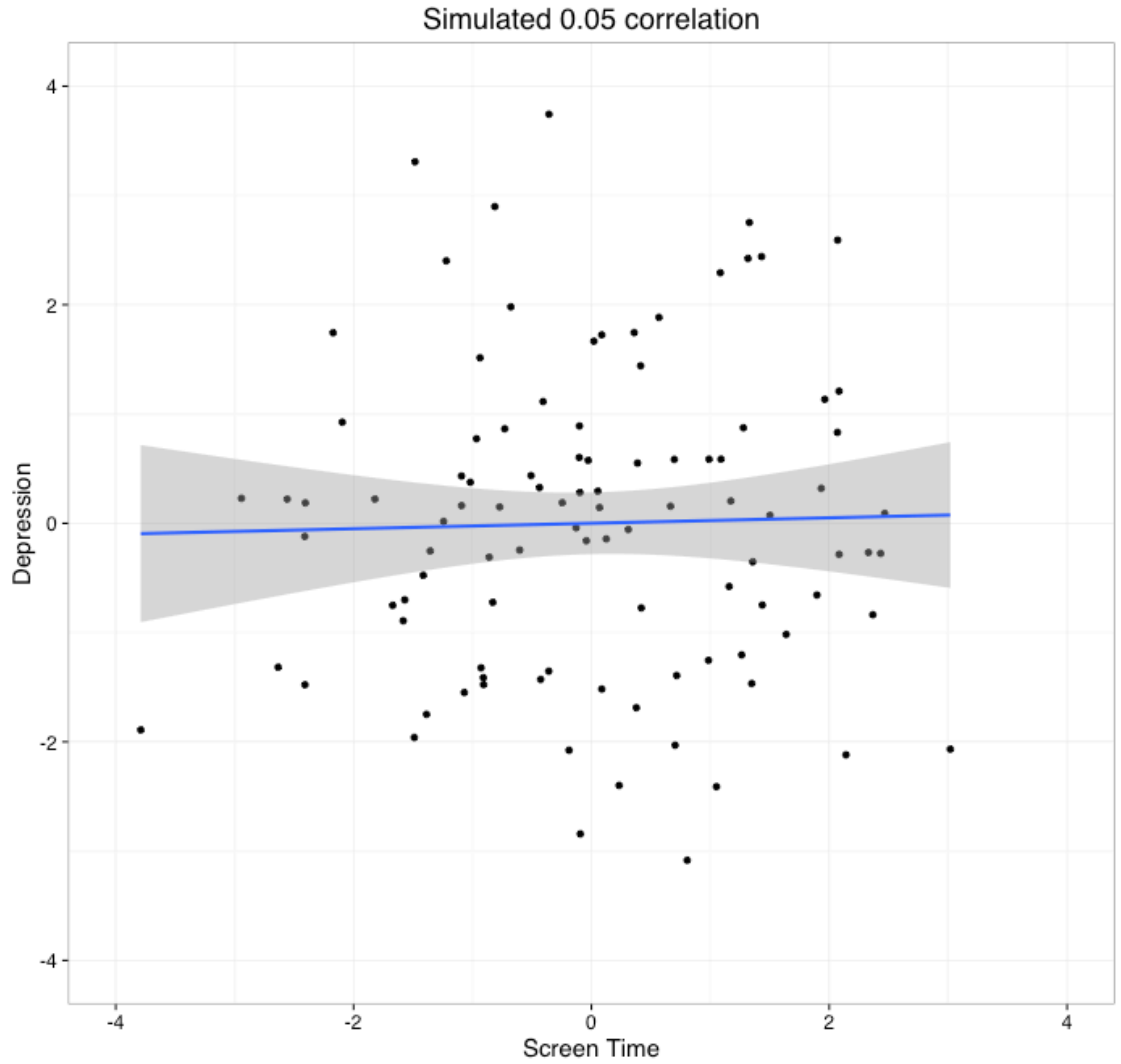
Correlation? Association? Cause?



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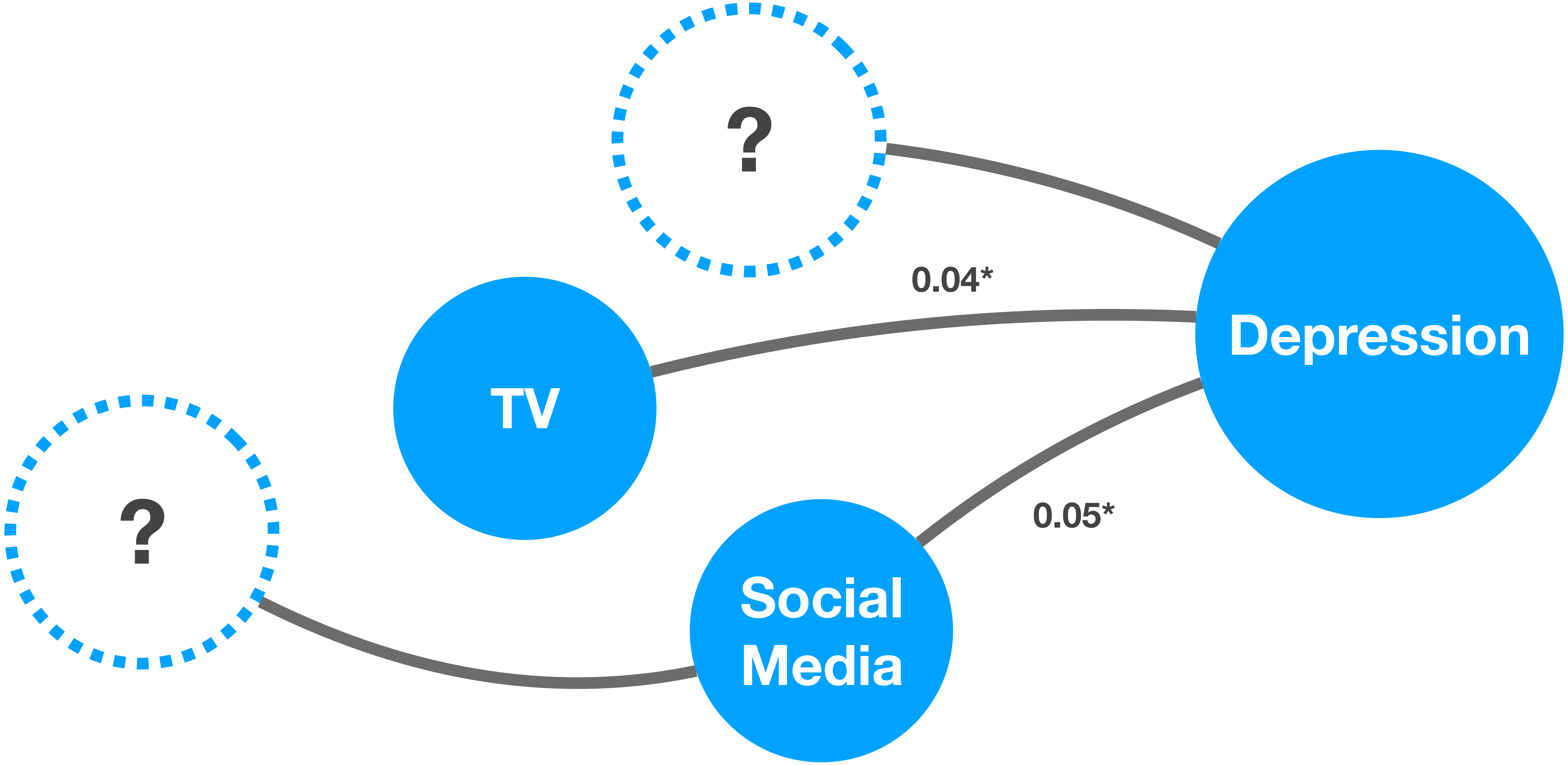
Unobserved Confounders



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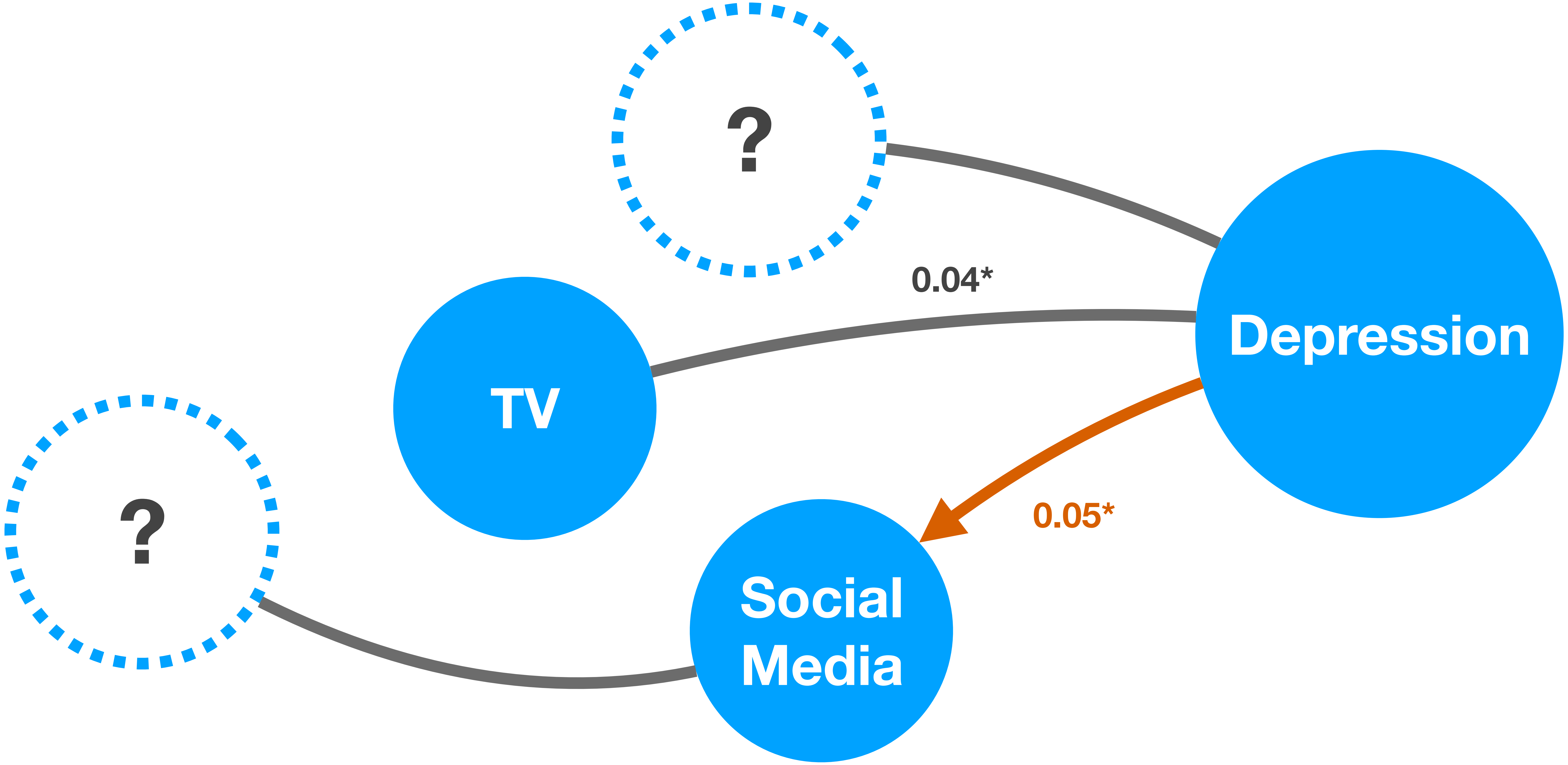
Direction of Causality (Selection Bias)



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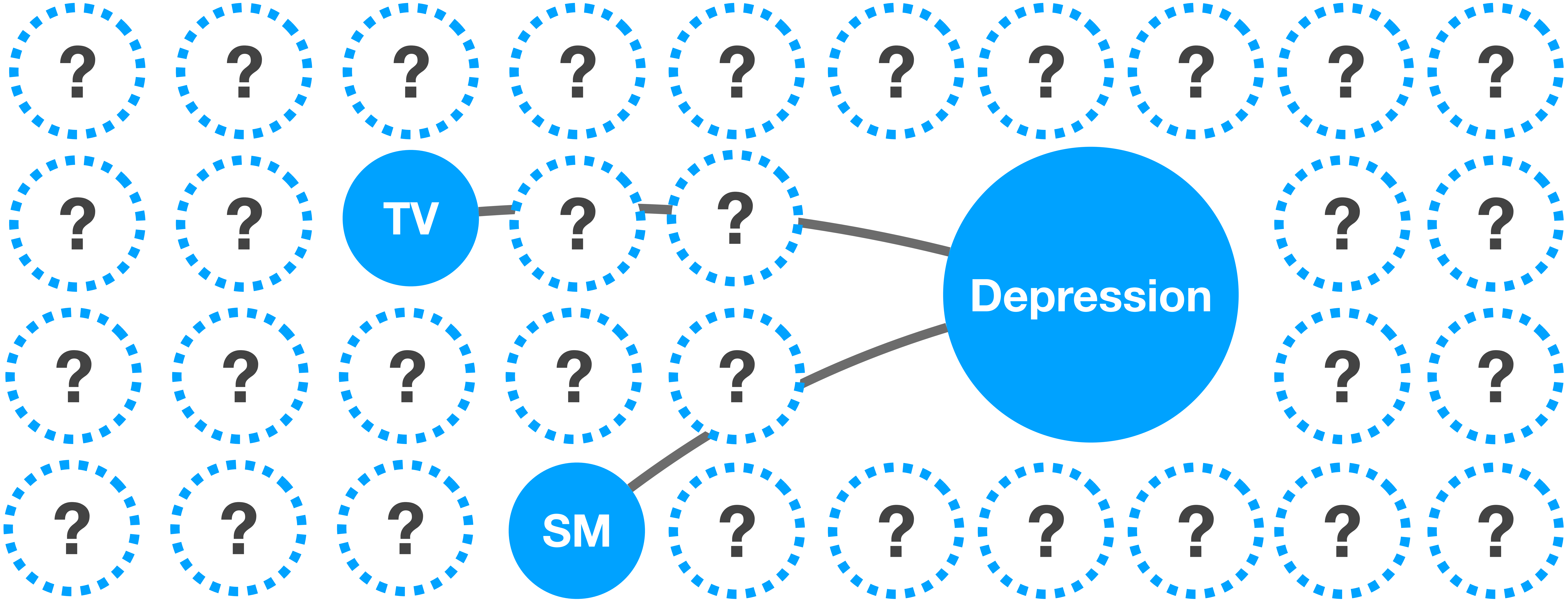
Multiple Comparisons



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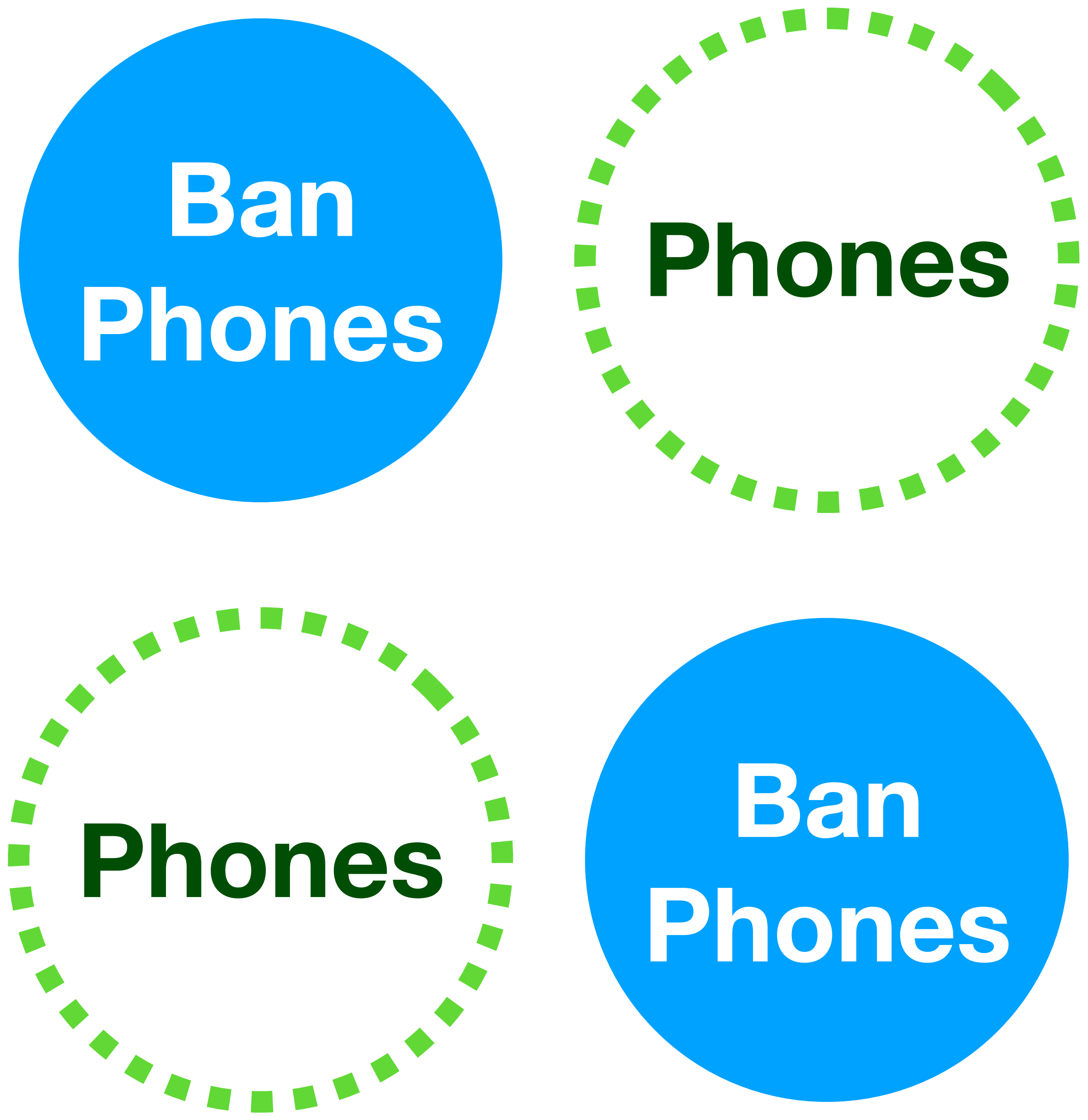
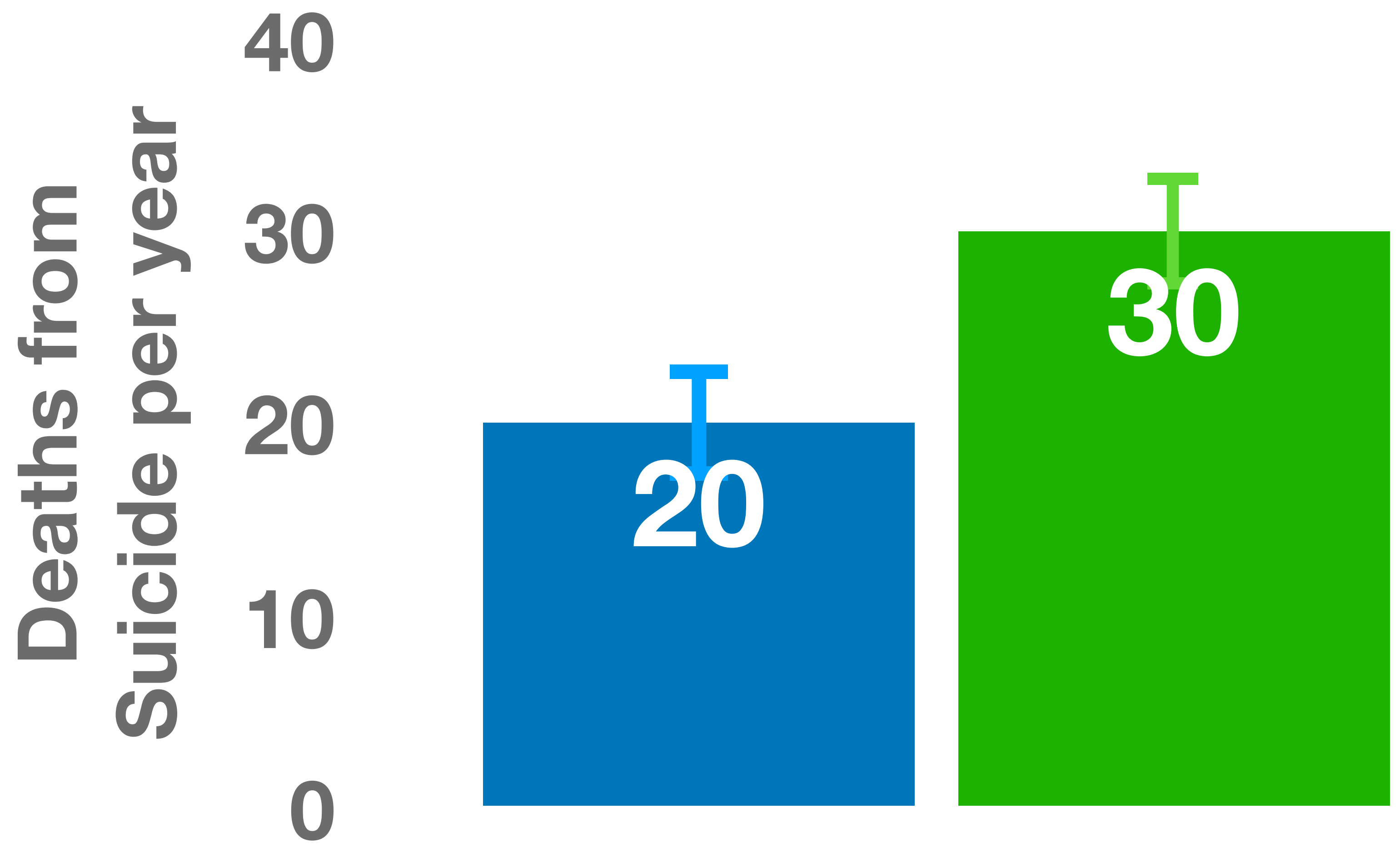
Observational Data Analysis

(**imagine** a dataset of depression cases)
(for schools that banned phones and those that didn't)





Why Experiment? (methodology)

- **Causal explanation** vs **description**
- Addresses **unobserved confounders**
- **Unbiased inference** (e.g. if the experiment were replicated an infinite number of times, our model would generate the right answer on average)
- Up-front design (“ex ante”) in principle **limits the analyst’s discretion**

Parts of an Experiment (example)

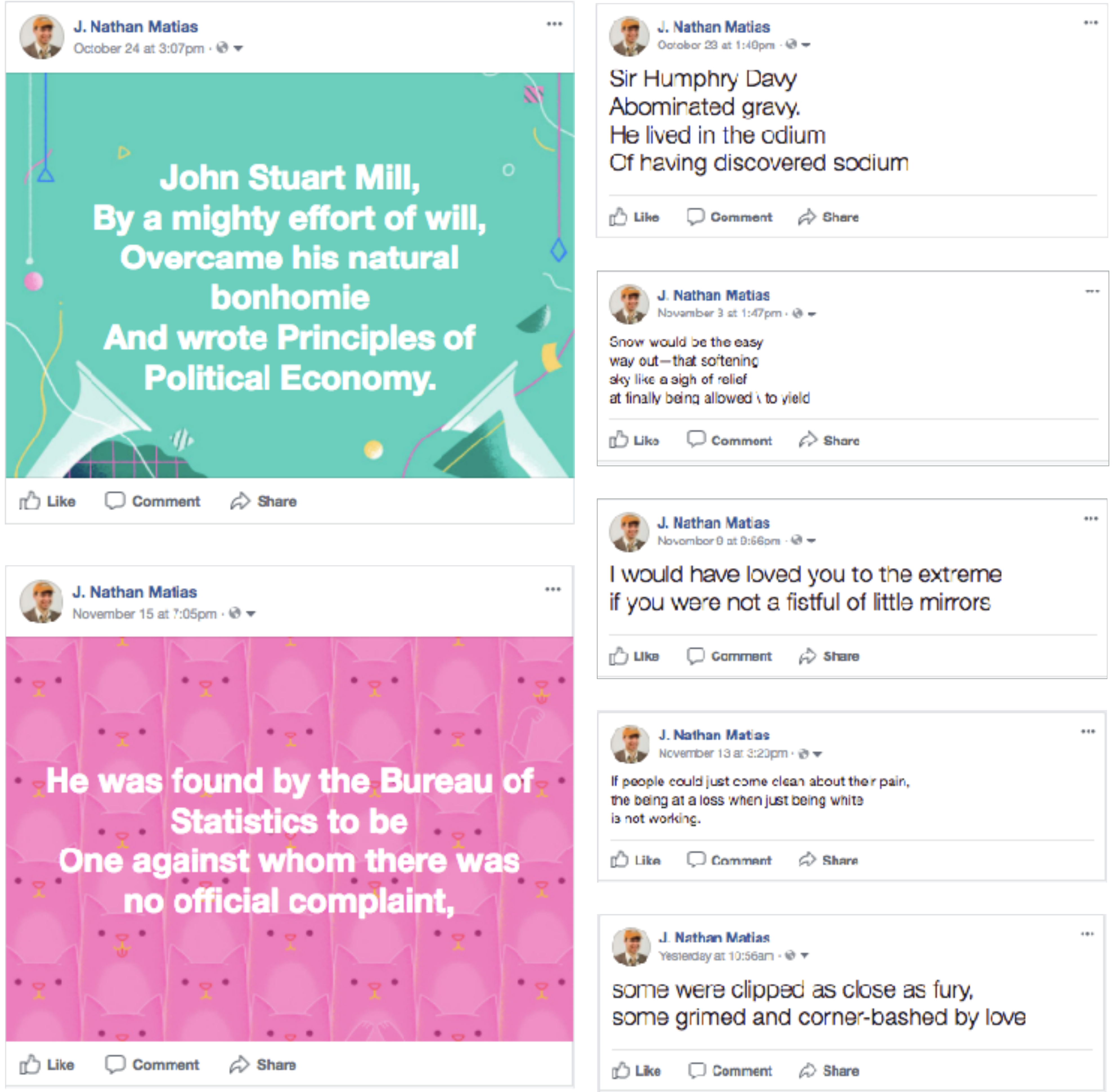
> When the skies opened and **dumped $185 million on an obscure Chicago poetry journal** in 2002, it was as much a burden as a gift…
>
> Barr still speaks in unpoetic terms like "cost per impact"

Fisher, Daniel. ***No Rhyme or Reason***. Forbes, Jan 7, 2011.

Parts of an Experiment

1. Does A Colored Background Increase Facebook Interactions on average?

2. If so, **by how much** on average?



Parts of an Experiment

Background Color

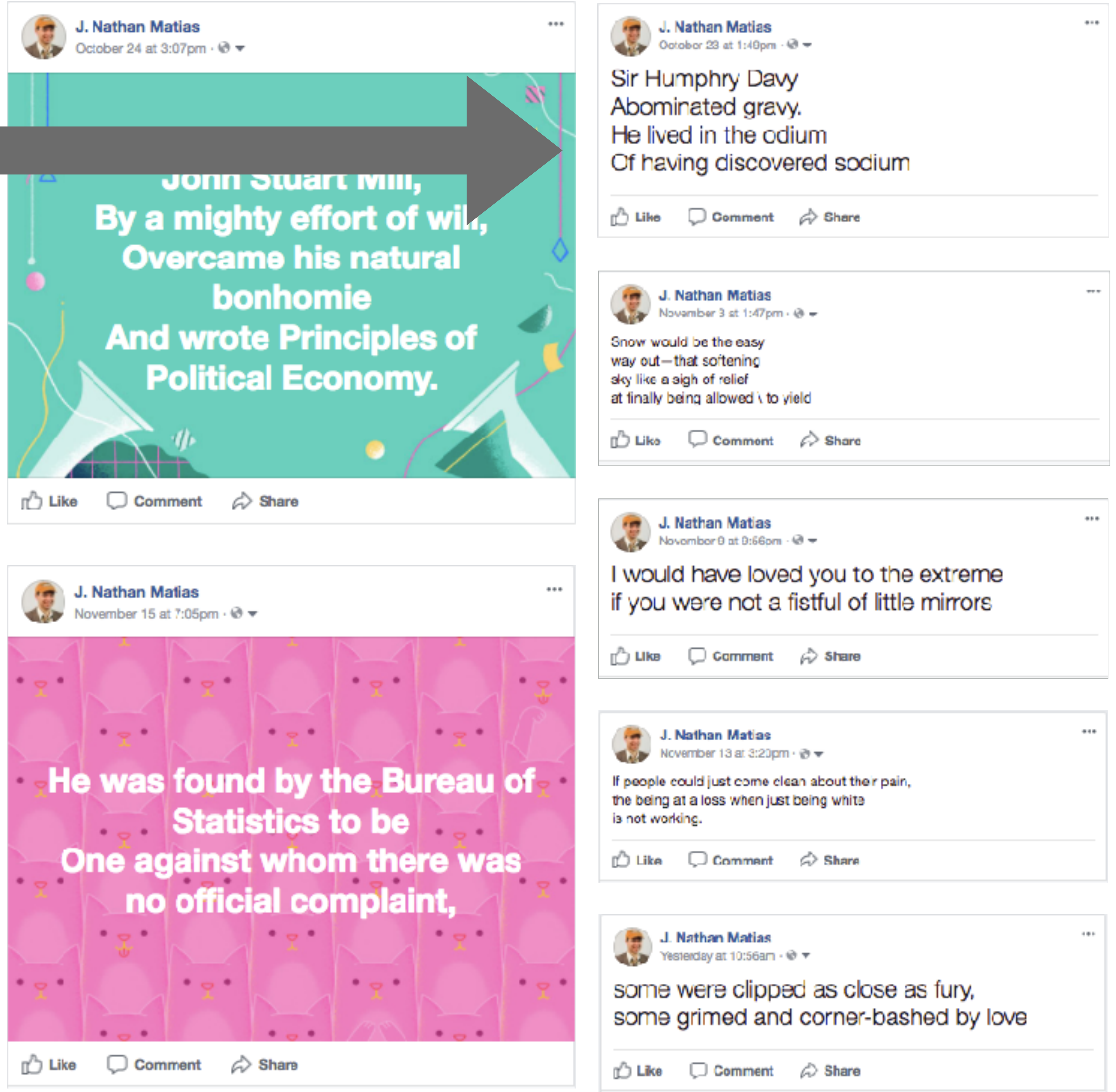
?

Comparison
(control)
(placebo)

1. Does A Colored Background Increase Facebook Interactions on average?

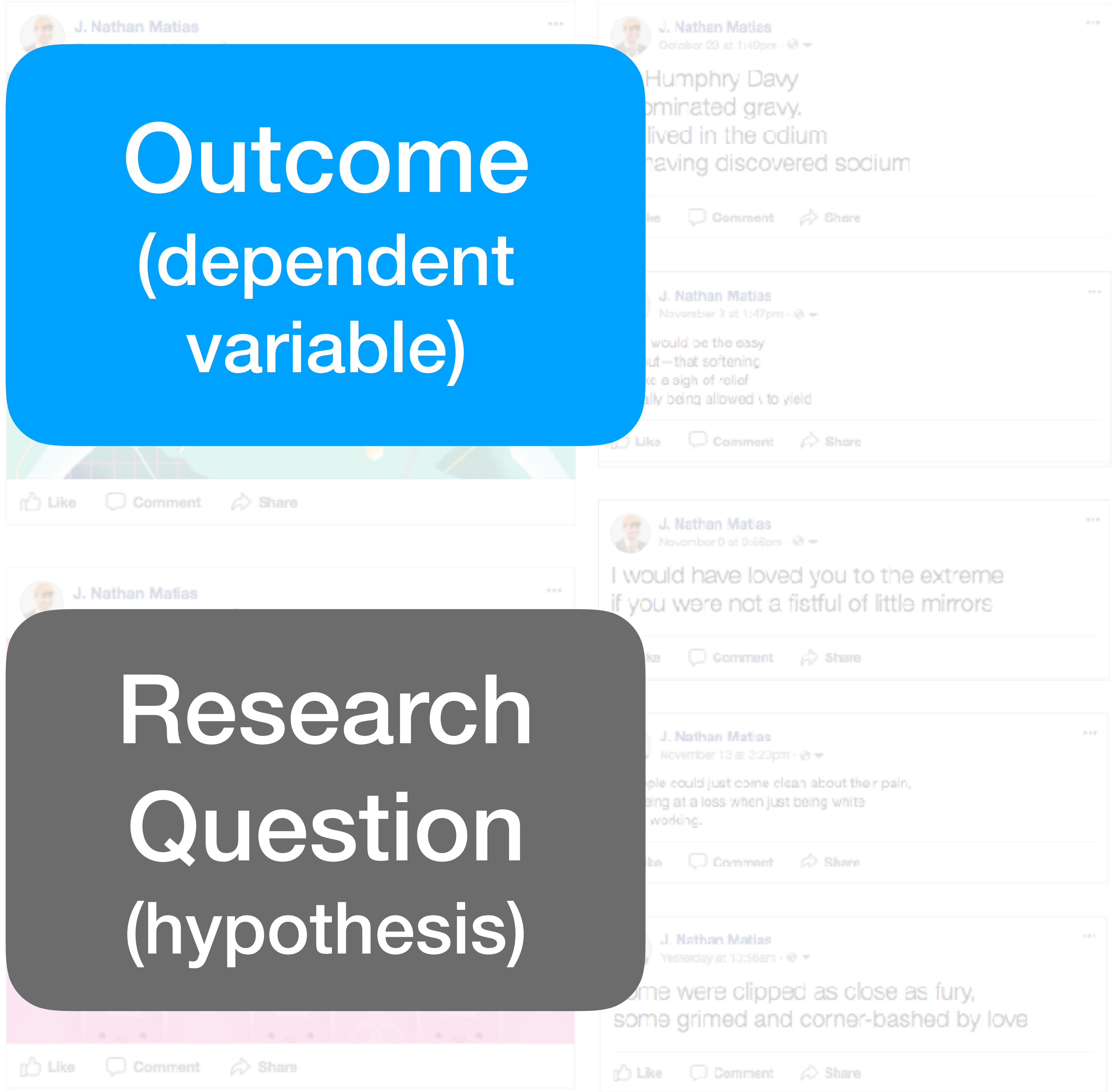
2. If so, by how

Intervention
(treatment)



Parts of an Experiment

Background Color ? Facebook Interactions



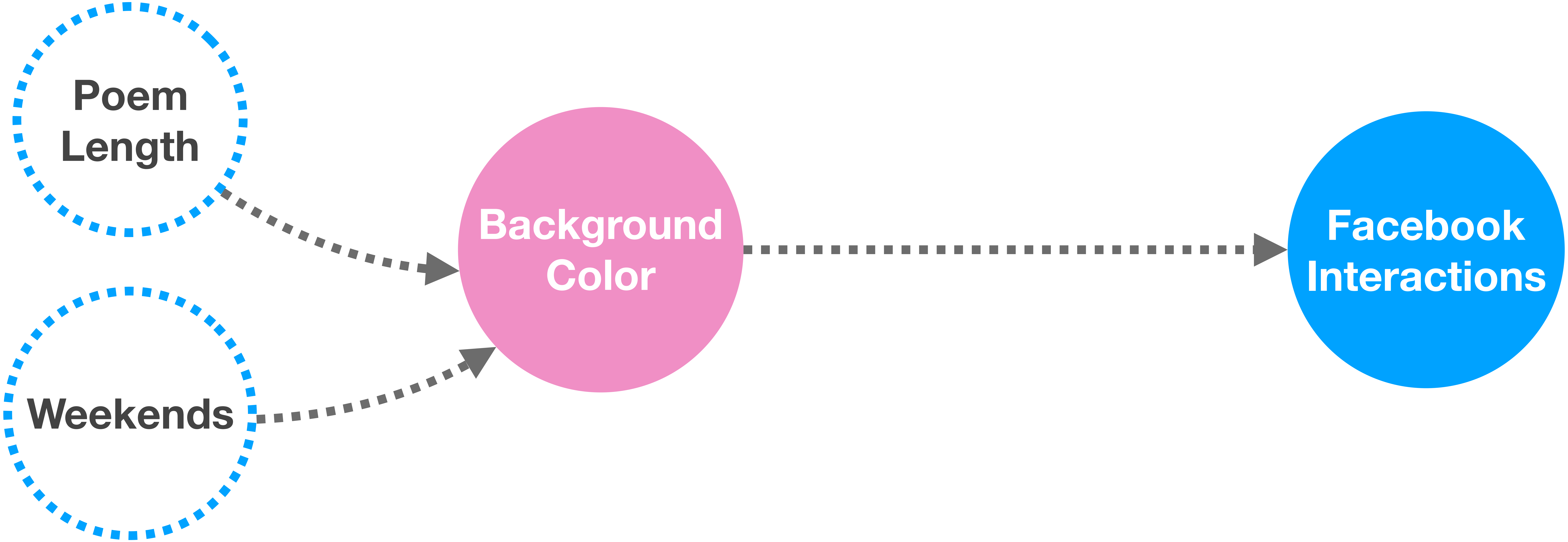
Outcome (dependent variable)

Research Question (hypothesis)

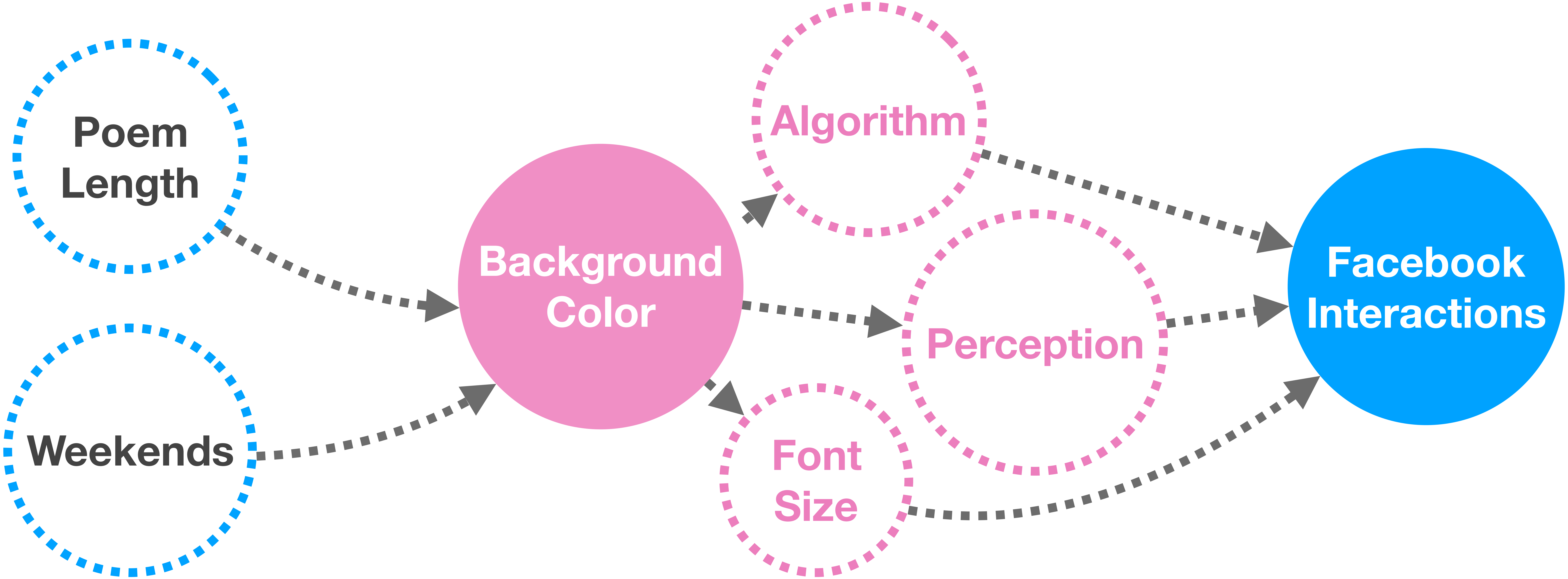
1. Does A **Colored Background** **Increase** **Facebook Interactions** on average?
2. If so, **by how much** on average?

Unobserved Confounders

(by the way, this graph is called a path diagram)

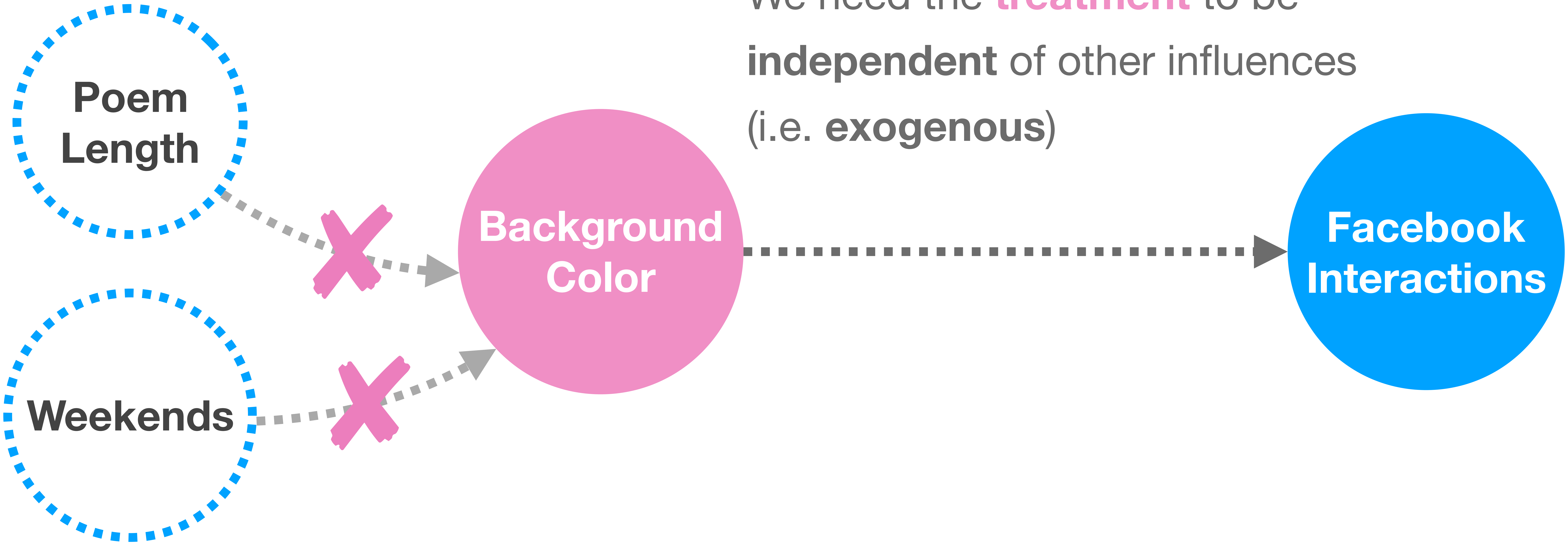


Unobserved Confounders



Independence of the Treatment

We need the **treatment** to be **independent** of other influences (i.e. **exogenous**)



Random Assignment

By using random assignment to choose between the **treatment** and **control** (conditions)

we ensure that the treatment is **independent** (exogenous) of outside influence, and that any **difference in outcomes** is due to **the effect of the intervention**

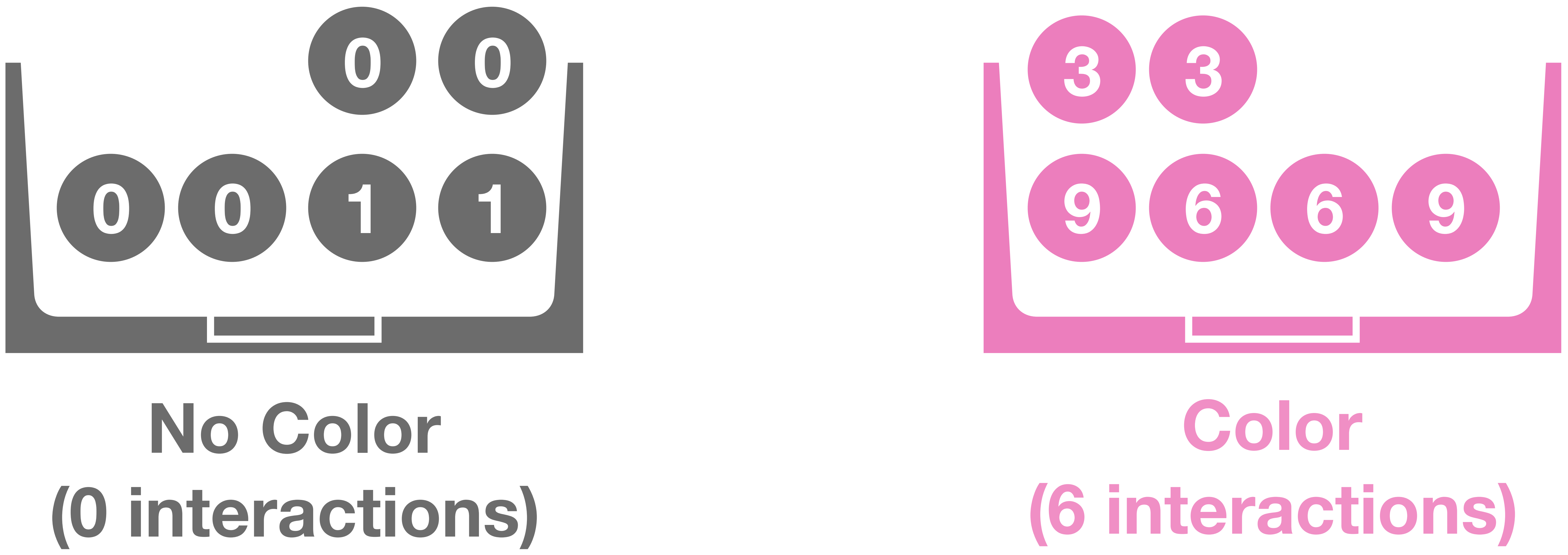
Understanding Randomization via Sampling

Imagine each poem has a basic potential “interactability” and that the poem-poster unconsciously allocates colors based on that factor

0 6 3 0 1 1 3 6 9 9 0 0

Understanding Randomization via Sampling

Imagine each poem has a basic potential "interactability" and that the poem-poster unconsciously allocates colors based on that factor



Understanding Randomization via Sampling

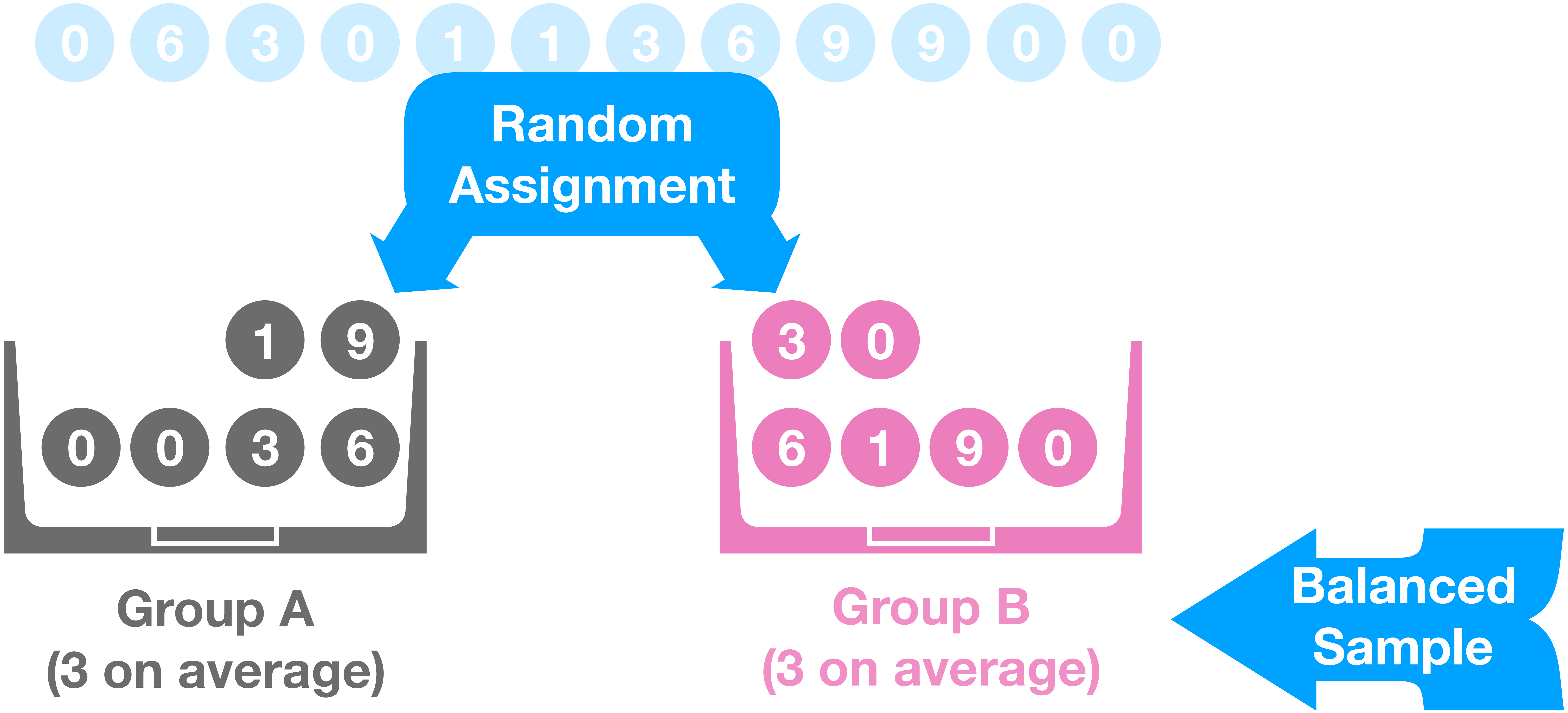
Now imagine that we allocate poems into groups based on a random sample

0 6 3 0 1 1 3 6 9 9 0 0

3 interactions on average

Understanding Randomization via Sampling

Now imagine that we allocate poems into groups based on a random sample



Understanding Randomization via Sampling

Now imagine that posting the colored background has an effect

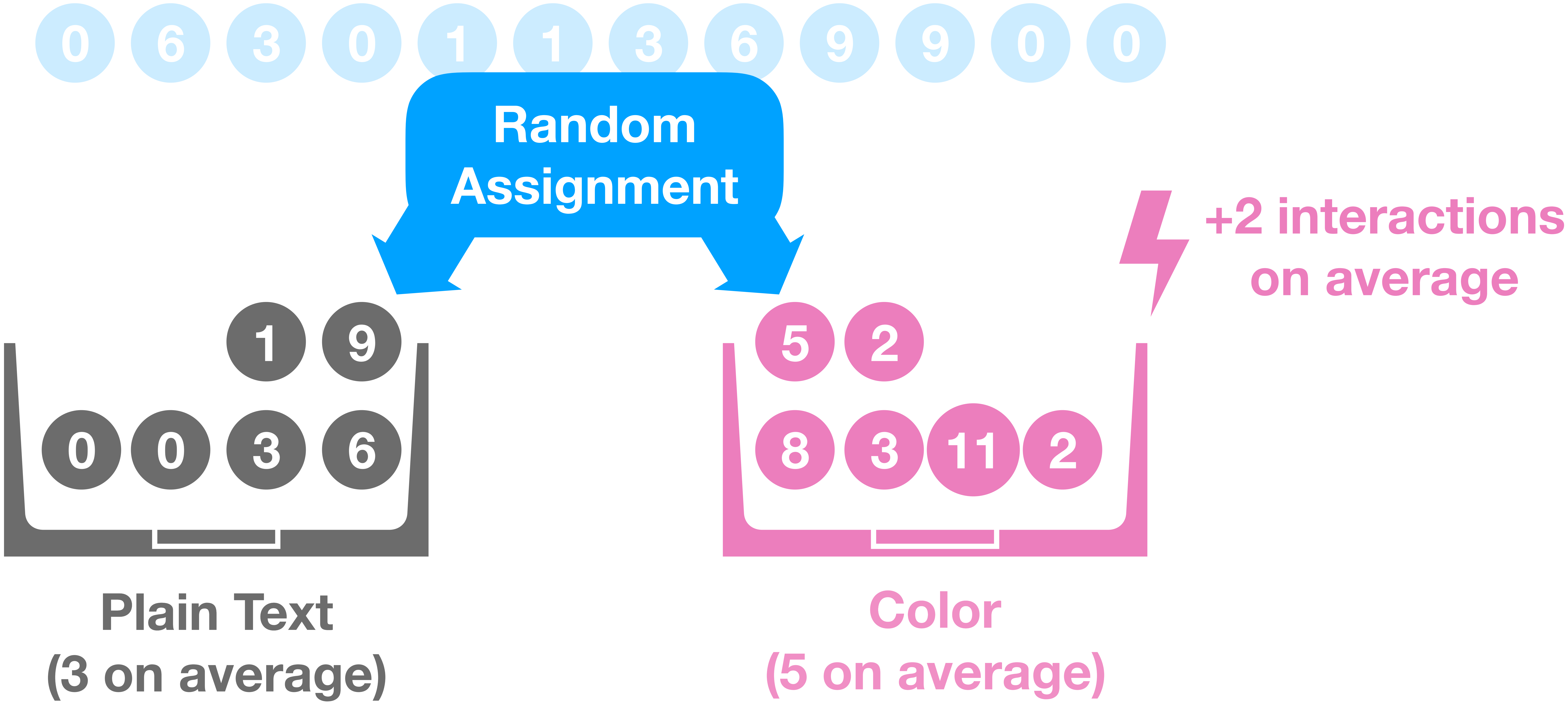
0 6 3 0 1 1 3 6 9 9 0 0

+2 interactions on average

Plain Text

Understanding Randomization via Sampling

Now imagine that posting the colored background has an effect

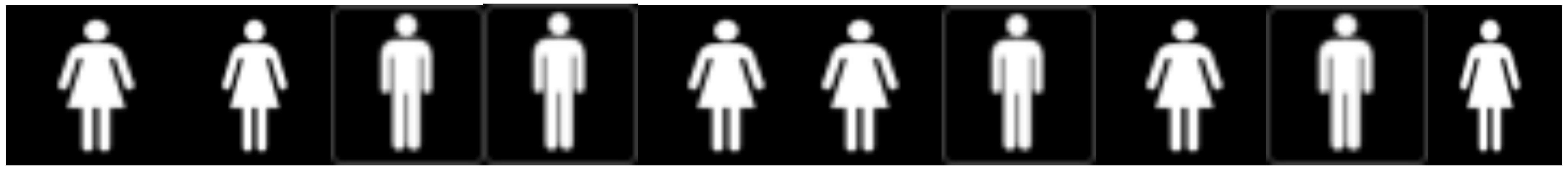


Common Methods of Random Assignment

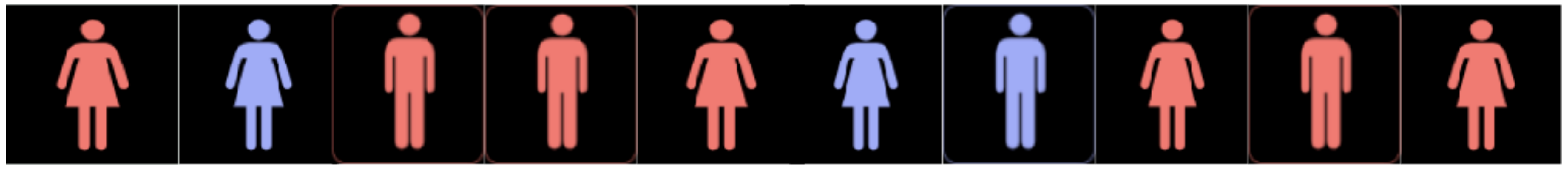
- **Simple randomization** (coin flips)
  - Problem: it's hard to get equal groups
- **Complete** (equal groups)
  - Example: sorted lists
- **Clustered**: (by group)
  - Randomized students by randomizing schools
- **Blocked**: (within groups)

Simple Randomization

Sample:



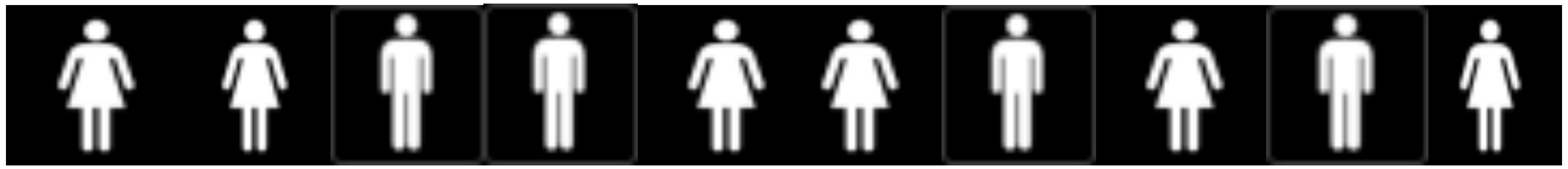
Iteration 1:



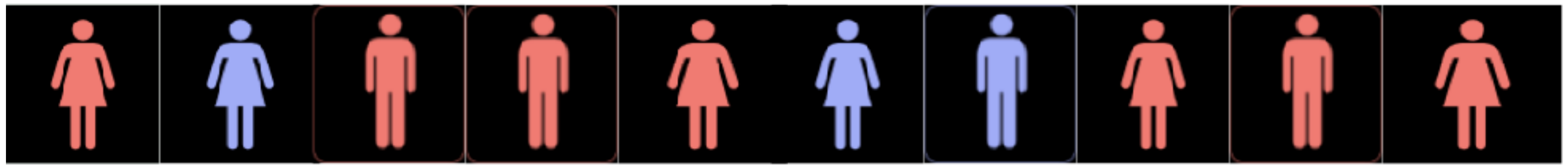
Simple Randomization

May not allocate the expected number of participants
to treatment and control

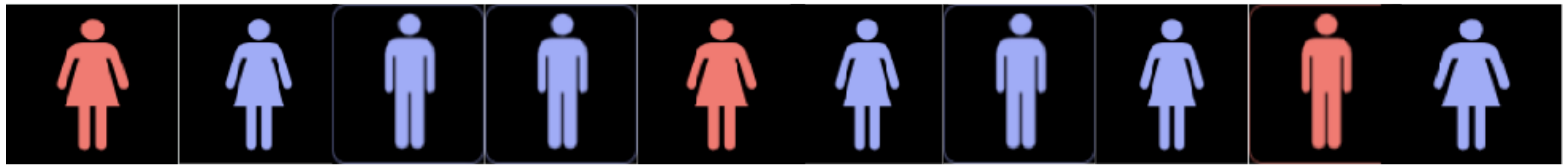
Sample:



Iteration 1:

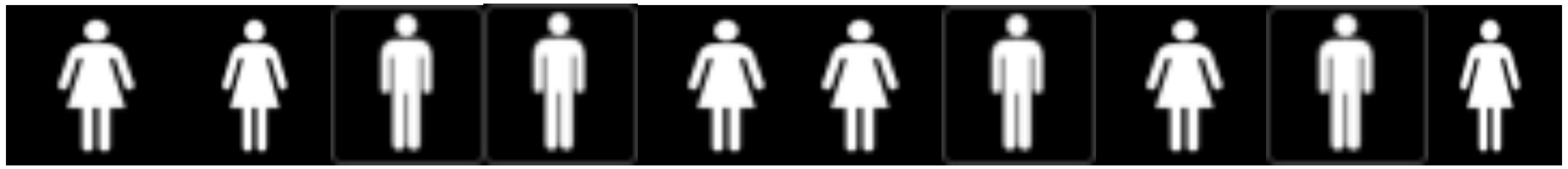


Iteration 2:

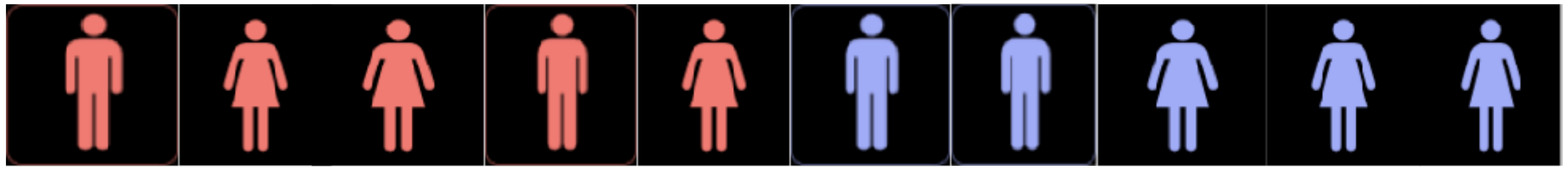


Complete Randomization

Sample:



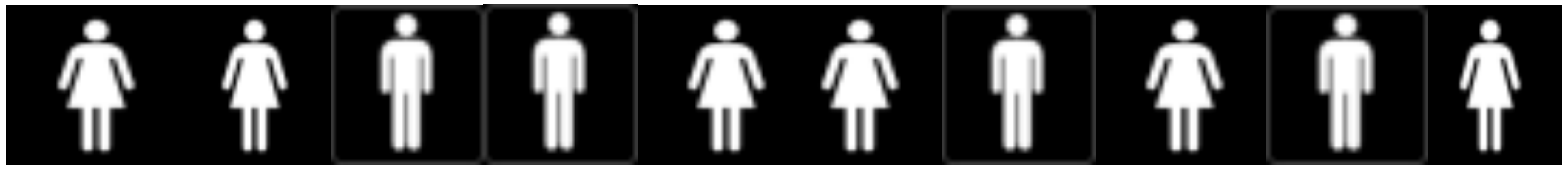
Iteration 1:



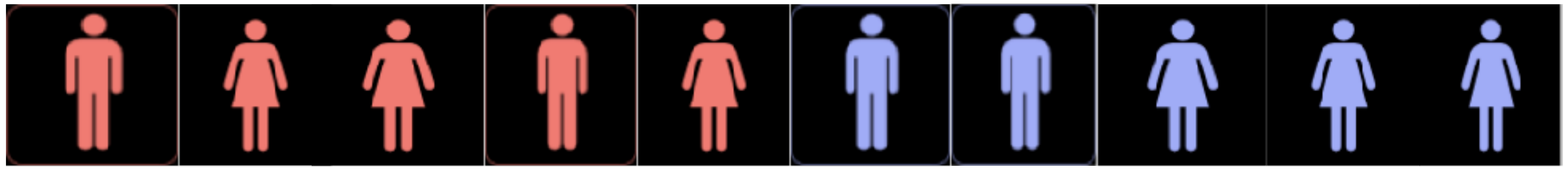
Complete Randomization

Always allocates the expected number of participants to treatment and control

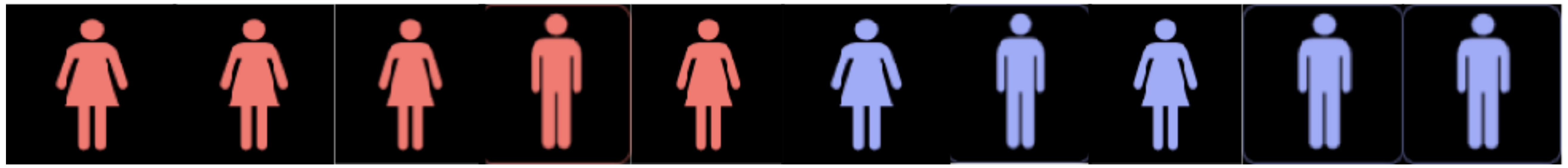
Sample:



Iteration 1:

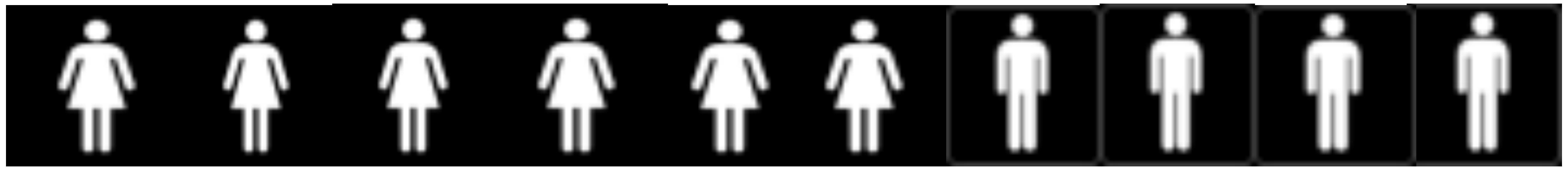


Iteration 2:



Blocked Randomization

Sample:

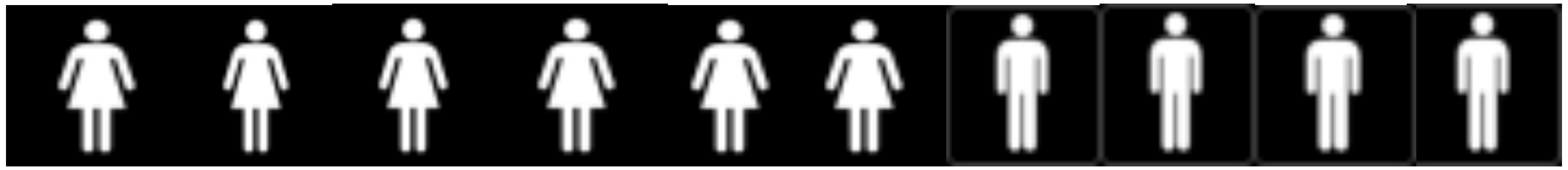


Iteration 1:

Blocked Randomization

Always maintains balance between characteristics (such as gender)

Sample:

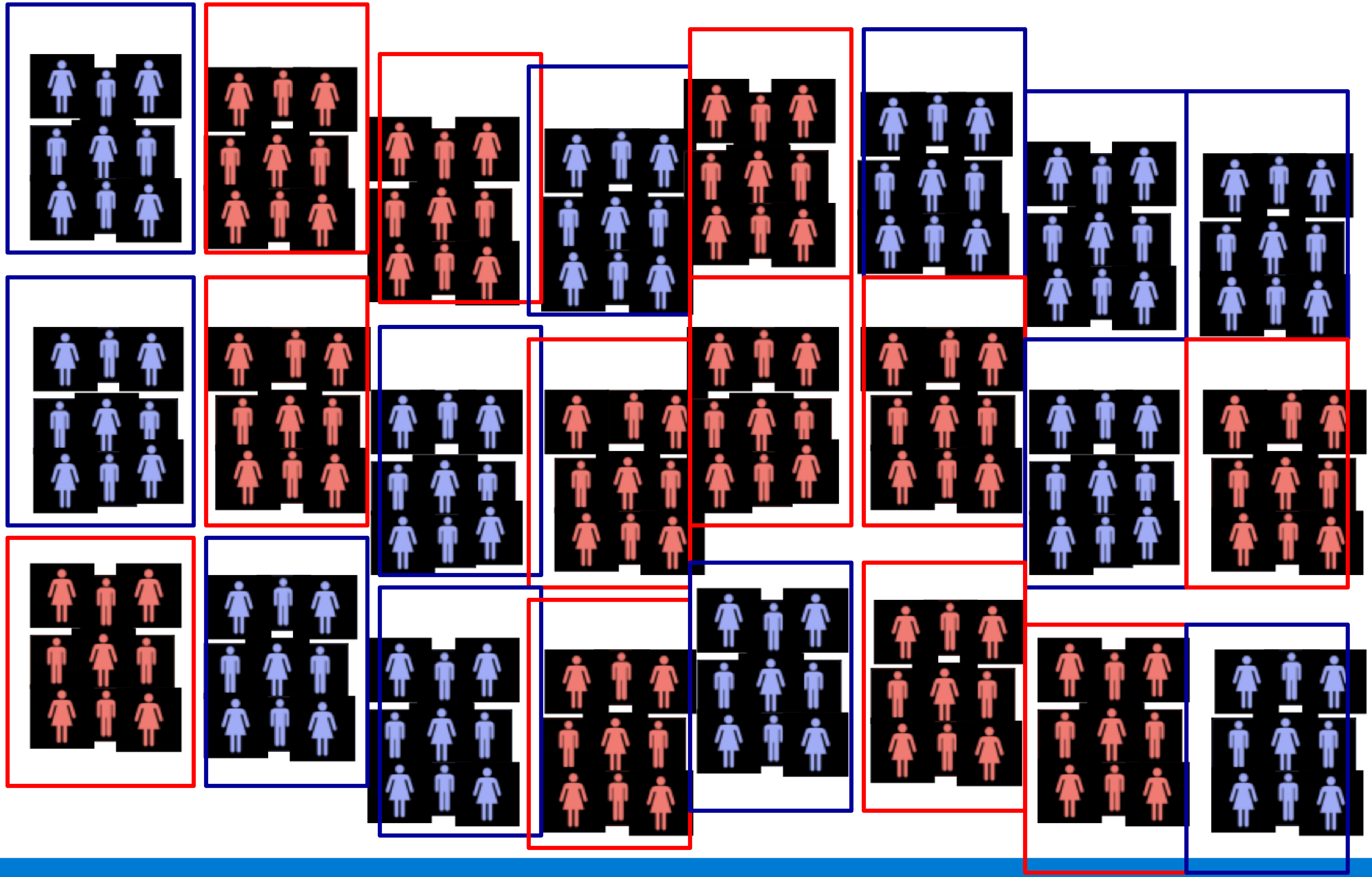


Iteration 1:

Iteration 2:

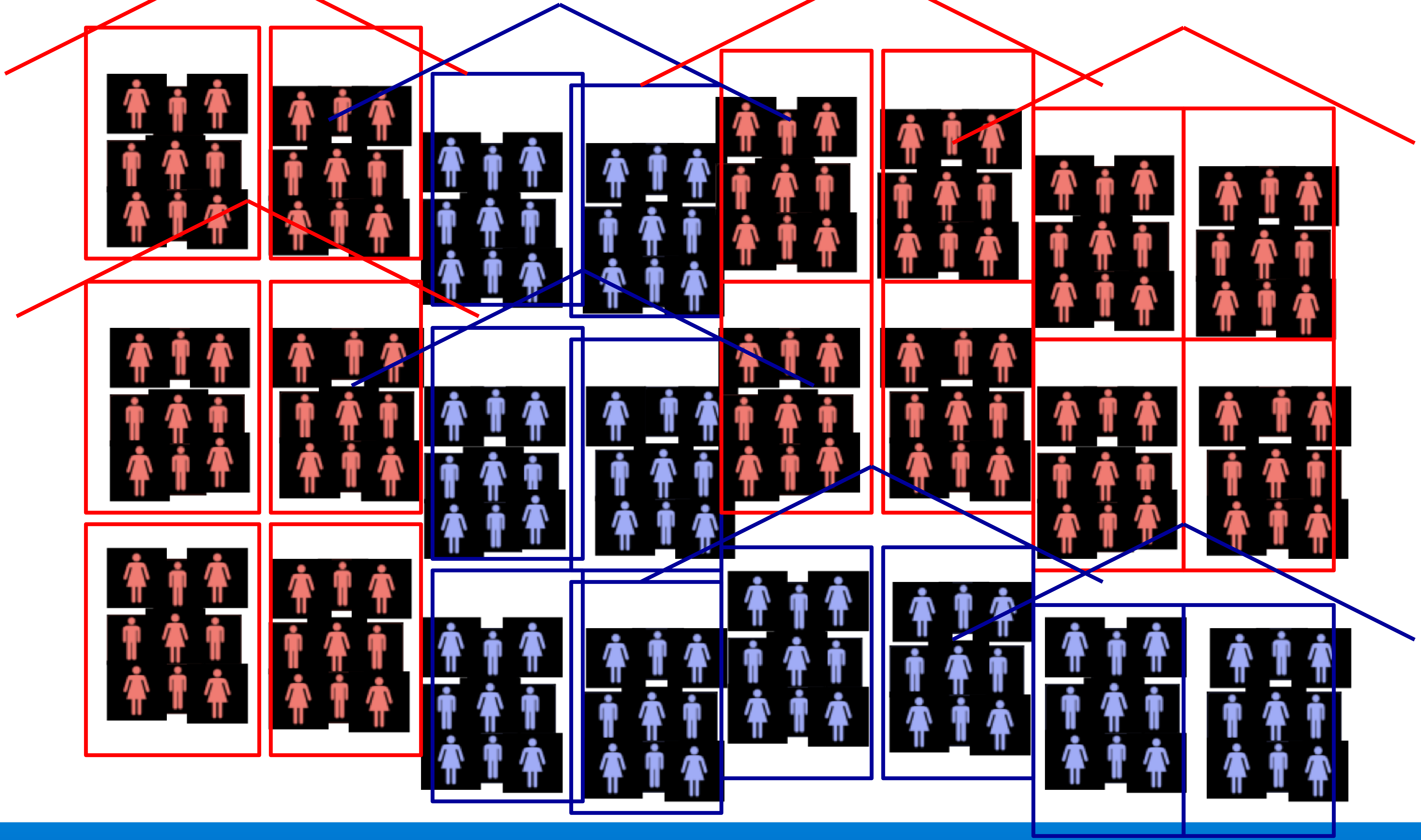
Clustered Randomization: Class

Clustered Randomization: Class

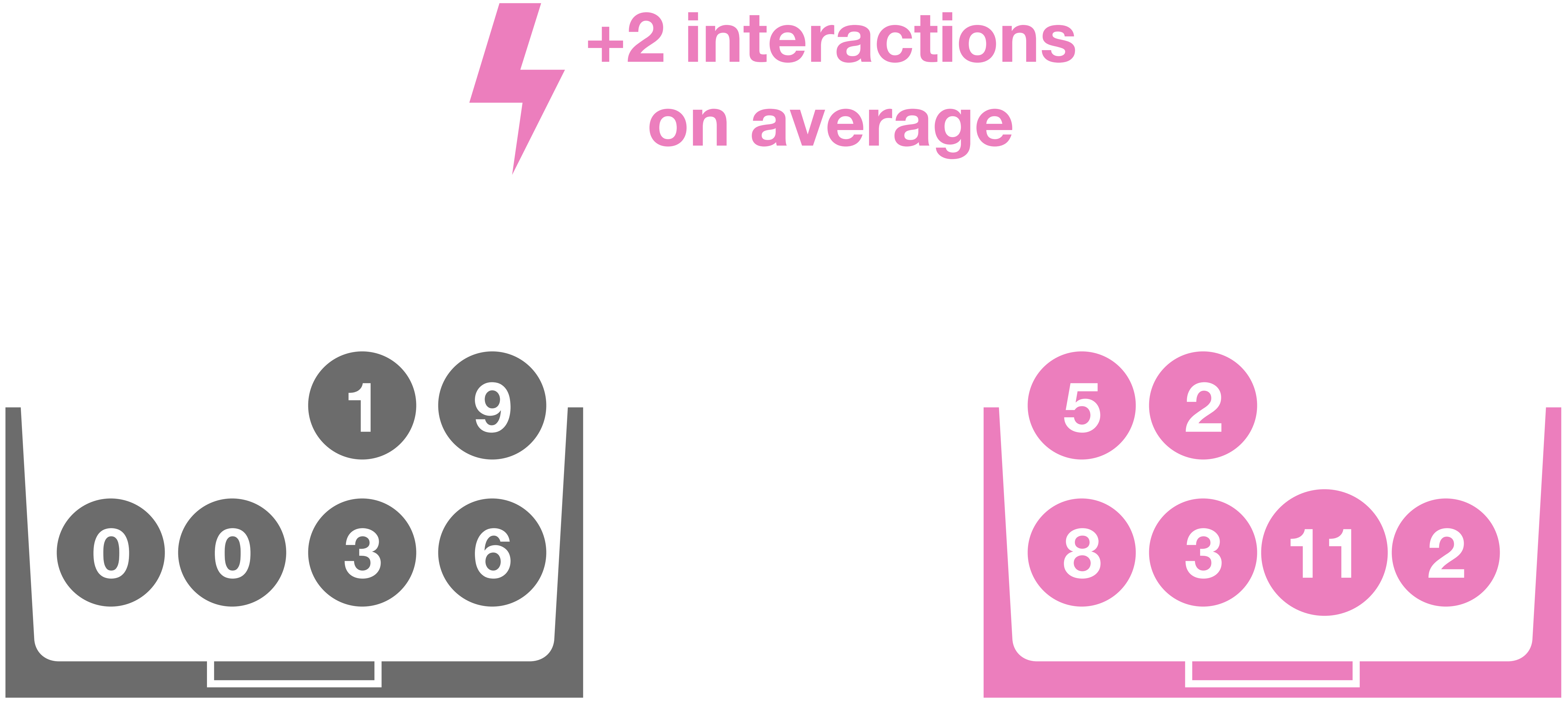


Clustered Randomization: School

Clustered Randomization: School



Average Treatment Effect (ATE)



Plain Text
(3 on average)

Color
(5 on average)

Average Treatment Effect (ATE)

$$Y = \alpha + \beta_1 X + \epsilon$$

$$Interactions = \alpha + \beta_1 Background + \epsilon$$

lm(interactions ~ condition, data=poems)

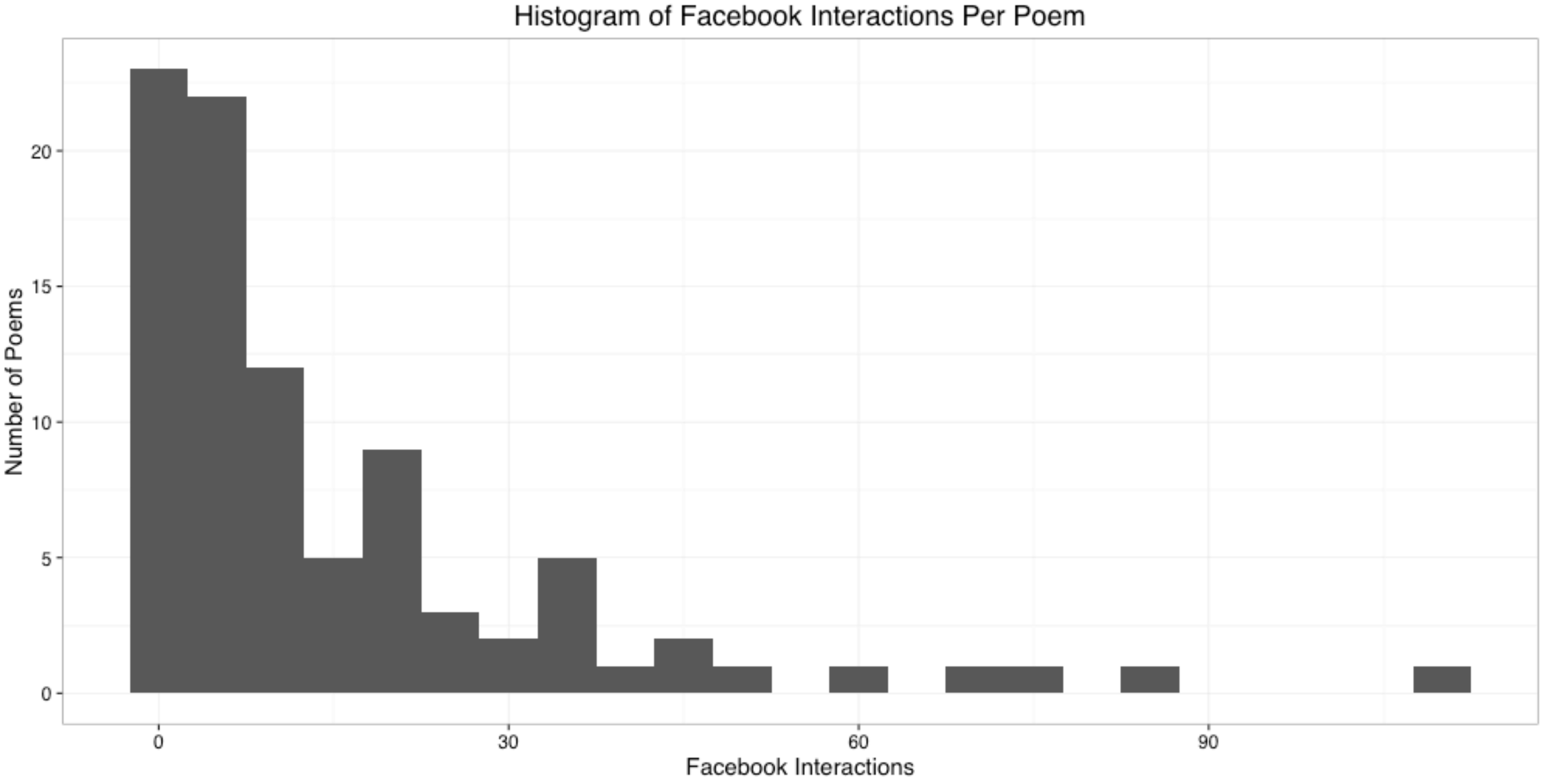
Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)

```
Call:
lm(formula = interactions ~ condition, data = poems)

Residuals:
    Min      1Q  Median      3Q     Max
-17.578 -11.578  -8.578   3.922  99.289

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)      11.711      3.008   3.893 0.000192 ***
conditionColor    7.867      4.254   1.849 0.067785 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 20.18 on 88 degrees of freedom
Multiple R-squared:  0.03741,	Adjusted R-squared:  0.02647
F-statistic:  3.42 on 1 and 88 DF,  p-value: 0.06778
```

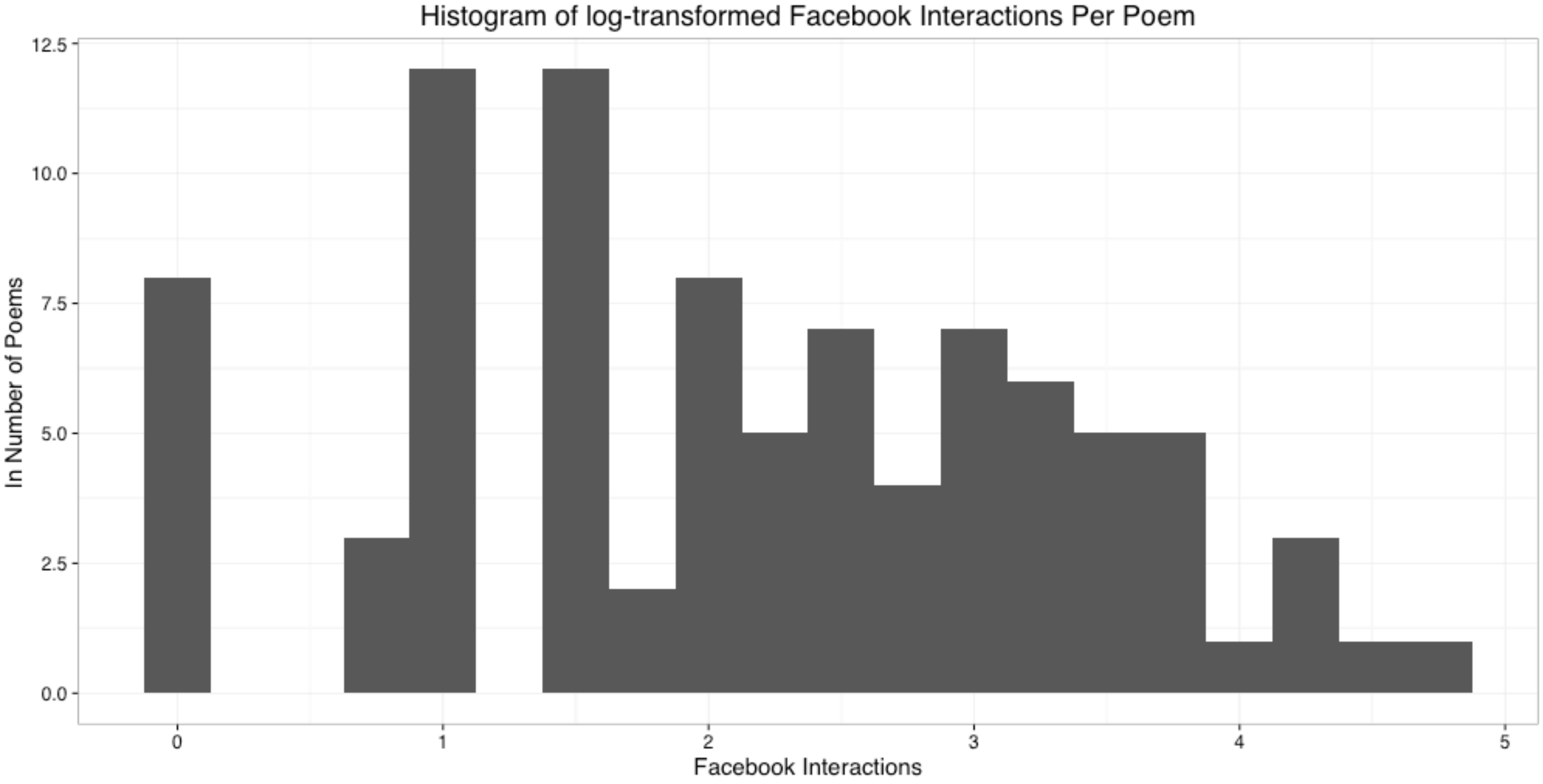
Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)



Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)



Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)

(log-transformed dependent variable)

$$\ln(Interactions + 1) = \alpha + \beta_1 Background + \epsilon$$

lm(*log1p*(interactions) ~ condition, data=poems)

Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)

(log-transformed dependent variable)

```
Call:
lm(formula = log1p(interactions) ~ condition, data = poems)

Residuals:
    Min      1Q  Median      3Q     Max 
-1.6856 -0.5869 -0.1596  0.7456  3.0329 

Coefficients:
               Estimate Std. Error t value Pr(>|t|)    
(Intercept)      1.6856     0.1635  10.309  < 2e-16 ***
conditionColor   0.9589     0.2312   4.147 7.74e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.097 on 88 degrees of freedom
Multiple R-squared:  0.1635, Adjusted R-squared:  0.154 
F-statistic:  17.2 on 1 and 88 DF,  p-value: 7.737e-05
```

Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)

(log-transformed dependent variable)

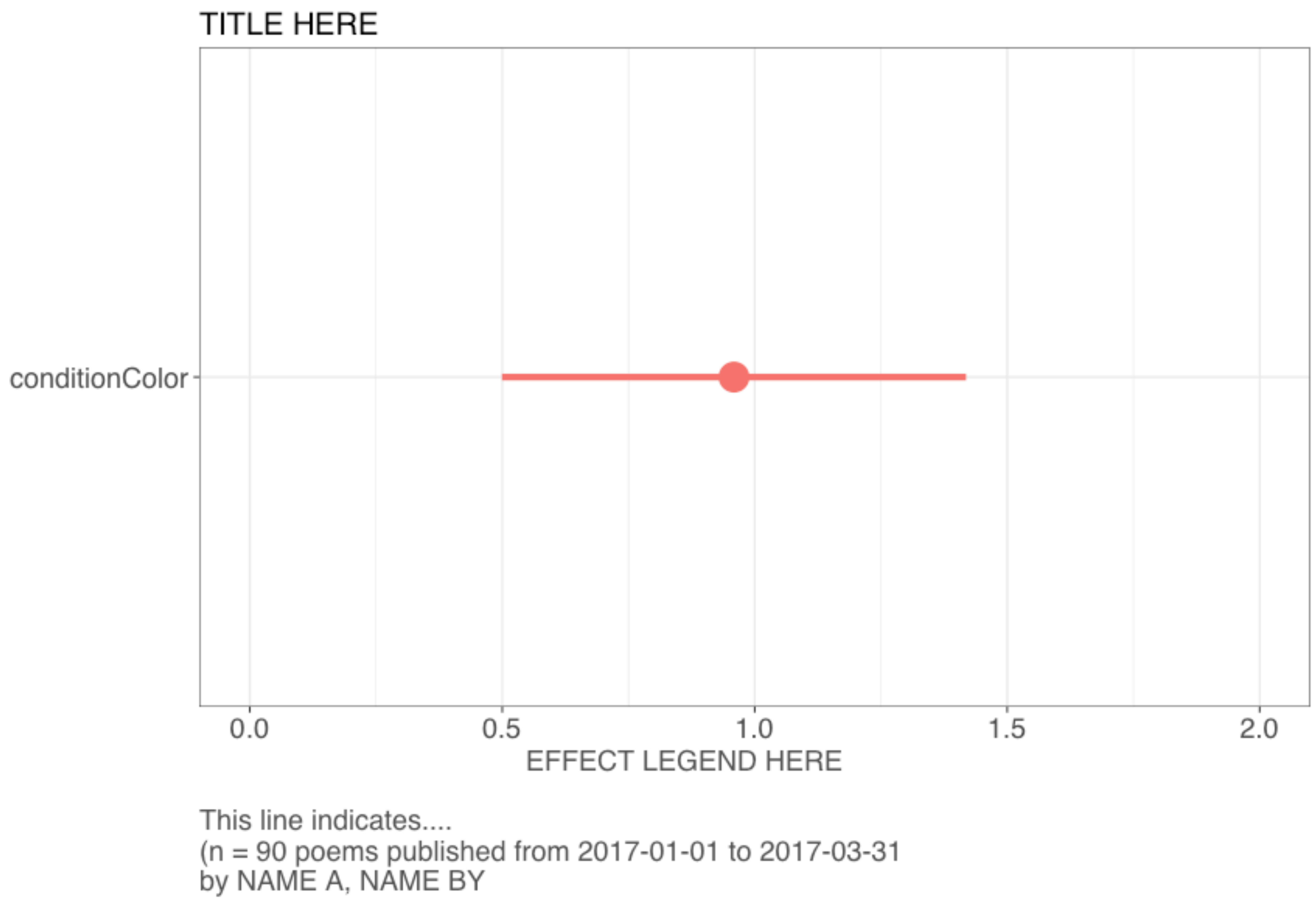
	Linear	Log-Transformed
Color	**7.87**	**0.96 *** **
	(4.25)	(0.23)
(Intercept)	11.71 ***	1.69 ***
	(3.01)	(0.16)
R^2	**0.04**	**0.16**
Num. obs.	90	90
RMSE	20.18	1.10

Linear models estimating log-transformed likes, comments, and shares per poem

Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

Average Treatment Effect (ATE)

(log-transformed dependent variable)

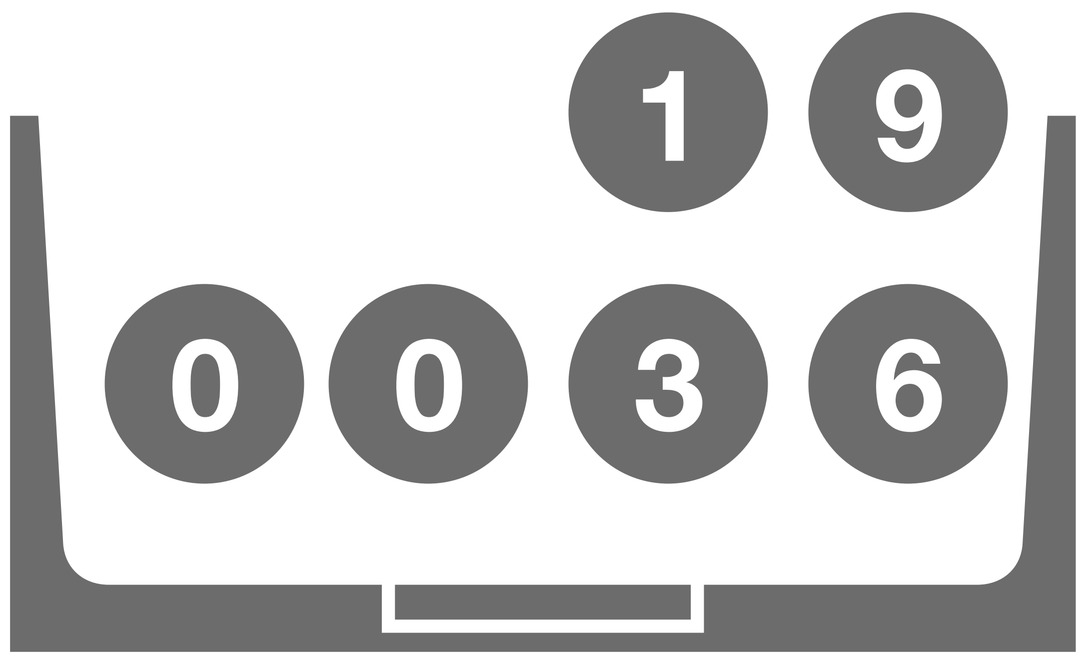


Example at github.com/natematias/SOC412/tree/master/1-facebook-poem

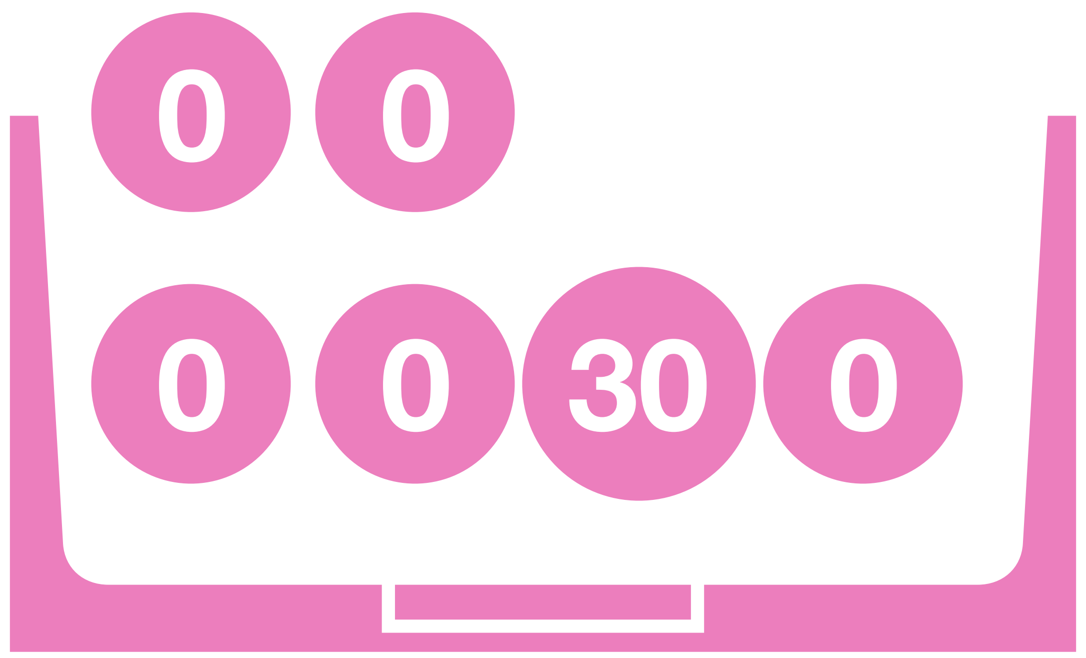
Average Treatment Effect (ATE)

APPLIES TO POPULATIONS **NOT TO INDIVIDUALS**

+2 interactions on average



Plain Text
(3 on average)



Color
(5 on average)

Assumptions of ATE

- **Random assignment** of participants to treatment
  - implies that receiving the treatment is statistically independent of participants' potential outcomes
- **Non-interference**: a participant's potential outcomes reflect only whether they receive the treatment themselves (not by others receiving it)

Assumptions of ATE

- **Excludability** a participant's potential outcomes respond only to the defined treatment, not other other extraneous factors that may be correlated with treatment
  - importance of defining the treatment precisely and maintaining symmetry between treatment and control groups (e.g. through blinding)

Conspicuously Absent Assumptions

- Random sampling of subjects from a larger population is not a core assumption
- The issue of "external validity" is a separate question that relates to the issue of whether the results obtained from a given experiment apply to other subjects, treatments, contexts, and outcomes
- For now, we aim only to estimate the ATE in our subject pool