Experimental Design

Robert Thorstad

Tutorial for Insight Data Science

Joe’s Widget Factory

Home About Us Buy Widgets

Welcome to Joe’s widget factory website, where we make awesome widgets!

Is the new website better?

To Know, We Need an Experiment

Fix other variables

Change only website

Fundamentals of Experimental Design

Randomization

Largest Effect in Psychology:
people differ from other pepole!

Tips

- Blind participants to condition
- Run both conditions at same time
- Randomize, don’t stratify

Replication

We know the website is better because it works for <u>many</u> people -> generalize to population

Tips

- Apply this same logic to the population of experiments: **meta-analyze yourself!**

Old website **Control** New website

Types of Experimental Designs

Between-Subjects

Old website

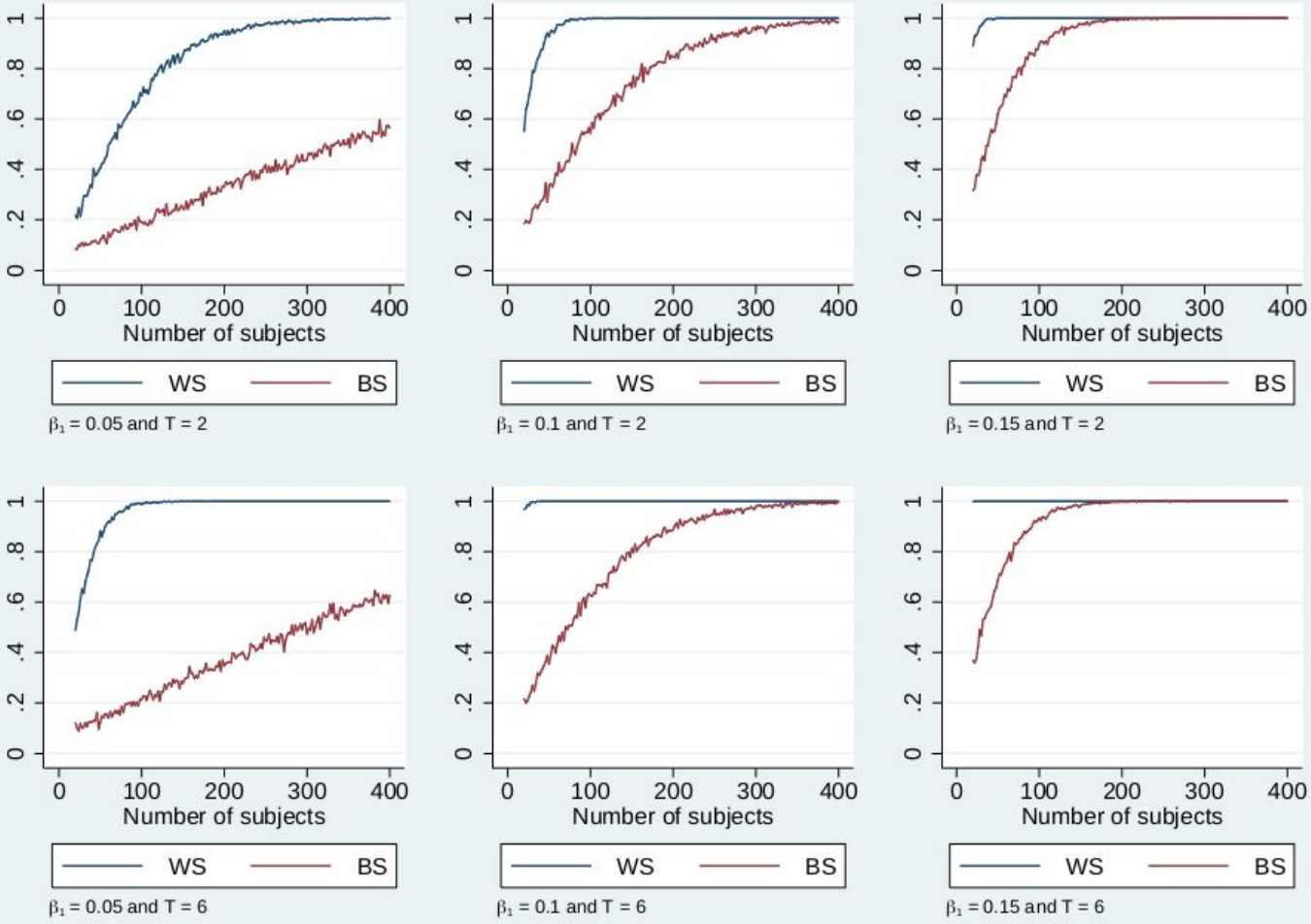
New website

Advantages

- Logistically easier
- No order effects

Disadvantages

- Very low power


0
.2
.4
.6
.8
1
0
100
200
300
400
Number of subjects
WS
BS
β_1 = 0.05 and T = 2
β_1 = 0.1 and T = 2
β_1 = 0.15 and T = 2
β_1 = 0.05 and T = 6
β_1 = 0.1 and T = 6
β_1 = 0.15 and T = 6

Within Subjects

Old website then new website in **counter-balanced order**

Advantages

- Higher statistical power

Disadvantages

- Can have order effects (-> counterbalance)

P Values and Beyond

P-value is ONLY for answering this skeptic:

p(results at least as extreme under H0)

Can’t interpret:

- Magnitude
- “Trending” to significance

Beware “optional stopping”

Check once and only once

Re-using pilot studies is optional stopping

We also want effect sizes

“How much” does this work? E.g.:

Cohen’s D

95% CI

Designing a BAD Experiment

Selection Bias

Social Desirability Bias

Do you like ice cream?
Probably answer honestly

Are you a nice person?
Probably not answer honestly

Try to ask more implicitly

Response Bias

How was your flight today?

BAD! -> likely to answer
GREAT! -> likely to answer
MEH -> you have to **incentivize me to answer**

Research Ethics

Consent

Do you need consent for A/B tests?

Do your users even know they are being experimented on?

Experimental evidence of massive-scale emotional contagion through social networks

Adam D. I. Kramer[a,1], Jamie E. Guillory[b], and Jeffrey T. Hancock[c,d]

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Edited by Susan T. Fiske, Princeton University, Princeton, NJ, and approved March 25, 2014 (received for review October 23, 2013)

Emotional states can be transferred to others via emotional contagion, leading people to experience the same emotions without their awareness. Emotional contagion is well established in laboratory experiments, with people transferring positive and negative emotions to others. Data from a large real-world social network, collected over a 20-y period suggests that longer-lasting moods (e.g., depression, happiness) can be transferred through networks [Fowler JH, Christakis NA (2008) *BMJ* 337:a2338], although the results are controversial. In an experiment with people who use Facebook, we test whether emotional contagion occurs outside of in-person interaction between individuals by reducing the amount of emotional content in the News Feed. When positive expressions were reduced, people produced fewer positive posts and more negative posts; when negative expressions were reduced, the opposite pattern occurred. These results indicate that emotions expressed by others on Facebook influence our own emotions, constituting experimental evidence for massive-scale contagion via social networks. This work also suggests that, in contrast to prevailing assumptions, in-person interaction and nonverbal cues are not strictly necessary for emotional contagion, and that the observation of others' positive experiences constitutes a positive experience for people.

computer-mediated communication | social media | big data

Emotional states can be transferred to others via emotional contagion, leading them to experience the same emotions as those around them. Emotional contagion is well established in laboratory experiments (1), in which people transfer positive and negative moods and emotions to others. Similarly, data from a large, real-world social network collected over a 20-y period suggests that longer-lasting moods (e.g., depression, happiness) can be transferred through networks as well (2, 3).

The interpretation of this network effect as contagion of mood has come under scrutiny due to the study's correlational nature, including concerns over misspecification of contextual variables or failure to account for shared experiences (4, 5), raising important questions regarding contagion processes in networks. An experimental approach can address this scrutiny directly; however, methods used in controlled experiments have been criticized for examining emotions after social interactions. Interacting with a happy person is pleasant (and an unhappy person, unpleasant). As such, contagion may result from experiencing an interaction rather than exposure to a partner's emotion. Prior studies have also failed to address whether nonverbal cues are necessary for contagion to occur, or if verbal cues alone suffice. Evidence that positive and negative moods are correlated in networks (2, 3) suggests that this is possible, but the causal question of whether contagion processes occur for emotions in massive social networks remains elusive in the absence of experimental evidence. Further, others have suggested that in online social networks, exposure to the happiness of others may actually be depressing to us, producing an "alone together" social comparison effect (6).

Three studies have laid the groundwork for testing these processes via Facebook, the largest online social network. This research demonstrated that (*i*) emotional contagion occurs via text-based computer-mediated communication (7); (*ii*) contagion of psychological and physiological qualities has been suggested based on correlational data for social networks generally (7, 8); and (*iii*) people's emotional expressions on Facebook predict friends' emotional expressions, even days later (7) (although some shared experiences may in fact last several days). To date, however, there is no experimental evidence that emotions or moods are contagious in the absence of direct interaction between experiencer and target.

On Facebook, people frequently express emotions, which are later seen by their friends via Facebook's "News Feed" product (8). Because people's friends frequently produce much more content than one person can view, the News Feed filters posts, stories, and activities undertaken by friends. News Feed is the primary manner by which people see content that friends share. Which content is shown or omitted in the News Feed is determined via a ranking algorithm that Facebook continually develops and tests in the interest of showing viewers the content they will find most relevant and engaging. One such test is reported in this study: A test of whether posts with emotional content are more engaging.

The experiment manipulated the extent to which people (N = 689,003) were exposed to emotional expressions in their News Feed. This tested whether exposure to emotions led people to change their own posting behaviors, in particular whether exposure to emotional content led people to post content that was consistent with the exposure—thereby testing whether exposure to verbal affective expressions leads to similar verbal expressions, a form of emotional contagion. People who viewed Facebook in English were qualified for selection into the experiment. Two parallel experiments were conducted for positive and negative emotion: One in which exposure to friends' positive emotional content in their News Feed was reduced, and one in which exposure to negative emotional content in their News Feed was reduced. In these conditions, when a person loaded their News Feed, posts that contained emotional content of the relevant emotional valence, each emotional post had between a 10% and 90% chance (based on their User ID) of being omitted from their News Feed for that specific viewing. It is important to note

Significance

We show, via a massive (N = 689,003) experiment on Facebook, that emotional states can be transferred to others via emotional contagion, leading people to experience the same emotions without their awareness. We provide experimental evidence that emotional contagion occurs without direct interaction between people (exposure to a friend expressing an emotion is sufficient), and in the complete absence of nonverbal cues.

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The authors declare no conflict of interest.

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Ethical Review

Ethics Boards can Spot Unintended Negative Consequences

Do A/B tests have such review?

PNAS PNAS PNAS PNAS

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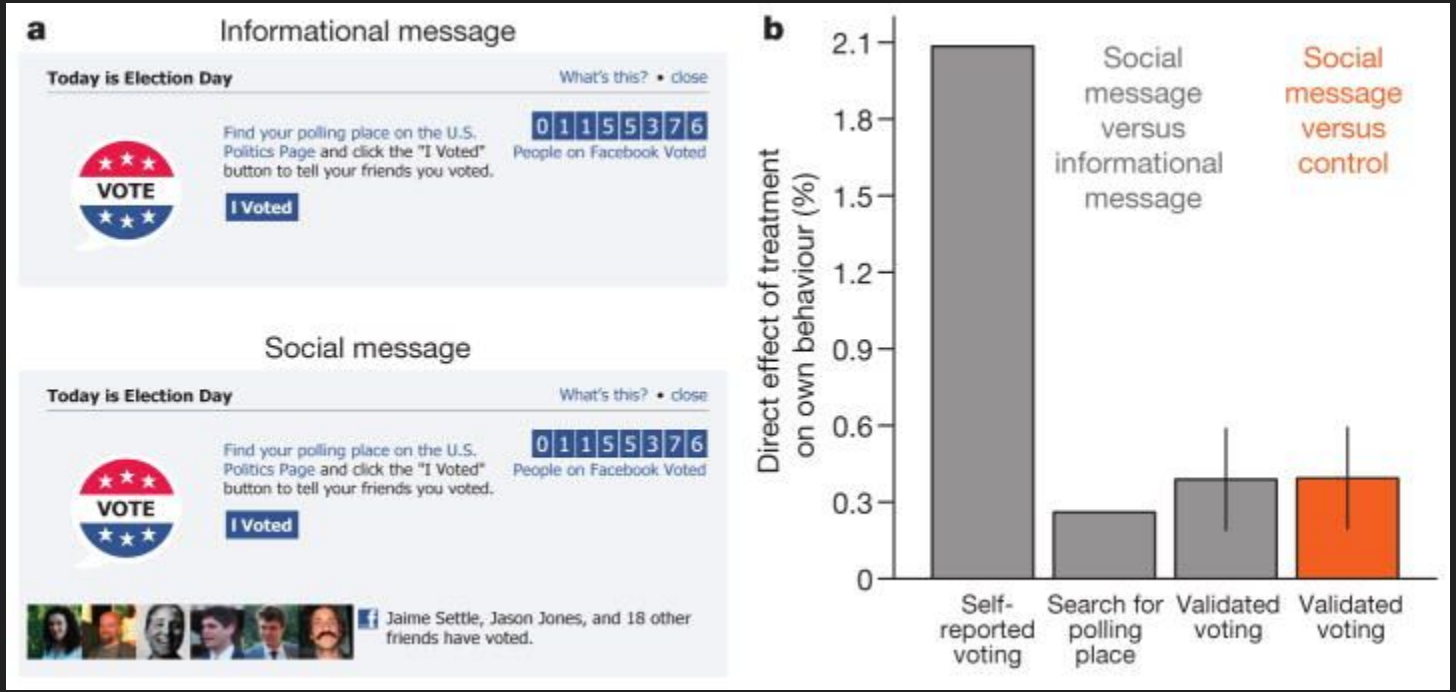
Clinically suicidal populations ?

Affect an election???



Key Points

At a minimum show your experiment to a layperson and ask about potential harms

Get consent when you can...and you usually can

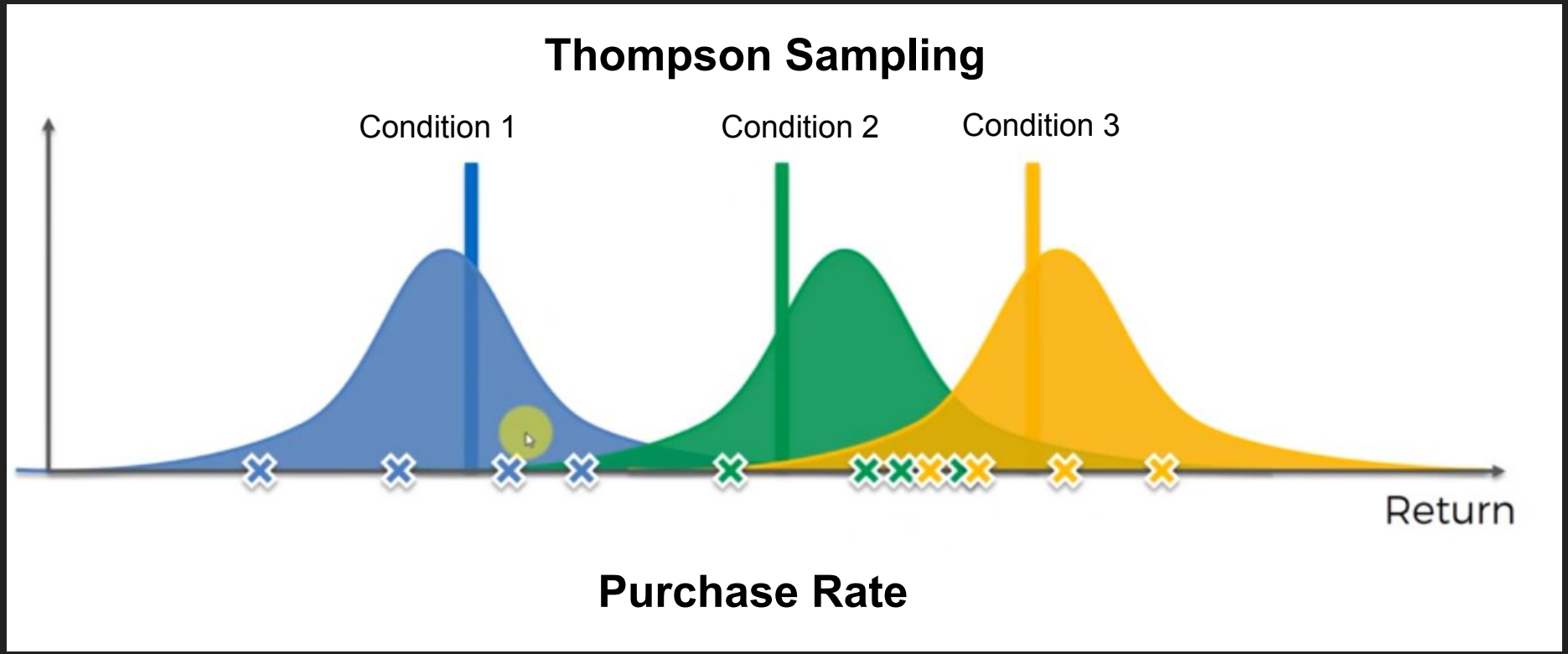
Bandit Experiments

High-Level Idea

Running conditions that don't work costs $$$

Try to **assign more participants to conditions that are working well**

Sample 1X from each distribution and assign participant to best performing condition



My personal opinion: problems with bandit experiments

Conceptually: **Do bandit experiments address a problem worth solving?** Is this a plausible set up that we (should) run conditions so bad we want to stop them early?

Also: Stopping rule/optional stopping? Any gurantees about false negative and false discovery rates?

Final Thoughts

- Designing a good experiment is an art that takes years of practice
- Most of designing a good experiment is not statistical …. It's in the design/logic
- Think hard about ethics, especially in data science. We are behind the scientifically accepted minimum.

Correlation is not causation, but it's a damn good hint

~ Attributed to Ed Tufte