W241 - Final Project

How to Spend 5 Minutes

Robert Deng, Dan Guevarra, and Yannie Lee

Abstract

This study hopes to uncover the effects of social media and meditation on stress levels. We utilize a within subject design to expose each of the experiment participants to both social media and meditation, using blood pressure to quantify stress levels before, during, and after the experiment. We ended up analyzing the data with 3 models - one focusing on understanding the effects of each treatment individually, and two others that included treatment familiarity for meditation and social media. Unfortunately, we are unable to conclude that either treatment had any impact on stress and were surprised to find out that social media seemed to decrease stress more than social media.

Introduction

Social Media has become a staple of modern life. We consume a lot of it throughout the day whenever we have down time on our laptops or on our mobile devices. There have been claims[1] that people feel more dissatisfied about their lives after consuming social media and a new term, FOMO, has emerged to describe this feeling. Concurrently, over the past several years, there has also been a larger emphasis on mindfulness in our society as a way of promoting well being[2]. There are apps and podcasts focused on meditation and mindfulness. The question we explored for the final project is: “Given you have 5 minutes during the day, are you better off consuming social media, or listening to a mindfulness podcast?”. This question is particularly interesting because it will help people make better decisions around how to spend their time during the day.

Experimental design

Our experiment is designed to answer the question outlined above to help people living in modern society make more informed decisions about how to spend 5 minutes of downtime. We devised an experiment that helped us understand if consuming 5 minutes of social media or meditating for 5 minutes would help people relax, using

[1] http://www.pewinternet.org/2015/01/15/social-media-and-stress/
[2] https://medicalxpress.com/news/2017-11-mindfulness-meditation-relieve-stress-bad.html

blood pressure as a measure of stress. Our decision to use blood pressure as a measure for stress was inspired by the paper "How to measure stress in Humans"[3] published by the Centre for Studies on Human Stress based in Quebec, Canada which indicated blood pressure was a good physiological measure of stress.

We ended up focusing our recruitment efforts on millennials aged 24-34, who have at least 1 active social media account that they peruse. We decided to standardize every experimental trial procedure to ensure consistency since each of the three team members administered the experiment. At a high level, each participant were exposed to both treatments (social media and meditation) for 5 minutes each. We took blood pressure measurements at three different points of the experiment - once at baseline, once in between the first and second treatment, and once at the end of the second treatment. At each of these three points, we took the respondent's blood pressure twice. The blood pressure monitor was taken off after each set of measurements. We decided to take blood pressure at each point twice because during the pilot study, we noticed that blood pressure tended to fluctuate slightly between the first and second readings and then tailed off to be more stable after the second reading. As such, we decided to take the measurement twice and use the average in our models to adjust for this variance.

To decide which treatment (social media or meditation) was administered first, we split the 48 respondents into two different groups. One group received the social media activity first then meditation, while the other group received meditation followed by social media. All activities were administered via the participant's mobile phone. To enable this, we decided to use a meditation video we found on Youtube. A design description using ROXO grammar is given below.

Meditation First (N = 23)	R	$O_{1a}\,O_{1b}$	X_{Med}	$O_{2a}\,O_{2b}$	X_{FB}	$O_{3a}O_{3b}$
Social Media First (N = 25)	R	$O_{1a}\,O_{1b}$	X_{FB}	$O_{2a}\,O_{2b}$	X_{Med}	$O_{3a}O_{3b}$

The risk of non-compliance was low in this experiment because we observed each participant and monitored their social media and meditation video consumption in the same room to ensure compliance. We also noted if and when there were major deviations in either activity. However, it is important to mention that the tests could be administered in a wide array of environments for convenience. It could have been in the comfort of someone's home, at the office, or even at a coffee shop.

Randomization engineering

[3] http://www.stresshumain.ca/Documents/pdf/Mesures-physiologiques/CESH_howMesureStress-MB.pdf

We utilized a simple alternating assignment procedure to achieve random assignment. Each experiment administrator took note as to which group their last participant was in, and we kept running counts in our data entry sheet for checking meditation-first and social media-first group sizes. Group counts were further broken down by gender as an anticipated covariate. We ended up having 23 respondents with meditation first and 25 respondents receiving social media first. We note that the meditation-first treatment group is deficient by N=2 female subjects which would have achieved parity with the social media-first group.

Experimental materials

The two treatments we administered were social media and the meditation video. Each treatment was administered for the same amount of time, and the administrator stayed with the participant at each of treatments were administered.

We defined social media as anything with a newsfeed specific function - Facebook, Instagram, Snapchat, or Twitter. We asked the participants to browse these platforms on their phones. For each experiment, the experimenter would set an alarm for 5 minutes and 20 seconds to match the treatment length of the mindfulness video. The goal is to test for the effect of social media consumption epitomized by the newsfeed scroll where users consume content rapidly. We thought the newsfeed had the most potential to cause a detectable reaction and hypothesized that users seeing status updates from their friends could cause social comparison and cause FOMO.

The mindfulness video we chose for our treatment was one we found on Youtube at this link: https://www.youtube.com/watch?v=dEzbdLn2bJc. We considered other audio mindfulness recordings, including ones that were from apps that are marketed for mindfulness like Calm, but ultimately decided to go with the youtube video because we saw that it impacted respondent's stress levels during the trial phase, and it was easier to access as there was no need to download an app. The video is 5 minutes and 20 seconds long and focused on introducing the concept of mindfulness, walking the listener through mindfulness techniques that involved being more aware of his/her feet as well as developing a focus for breathing.

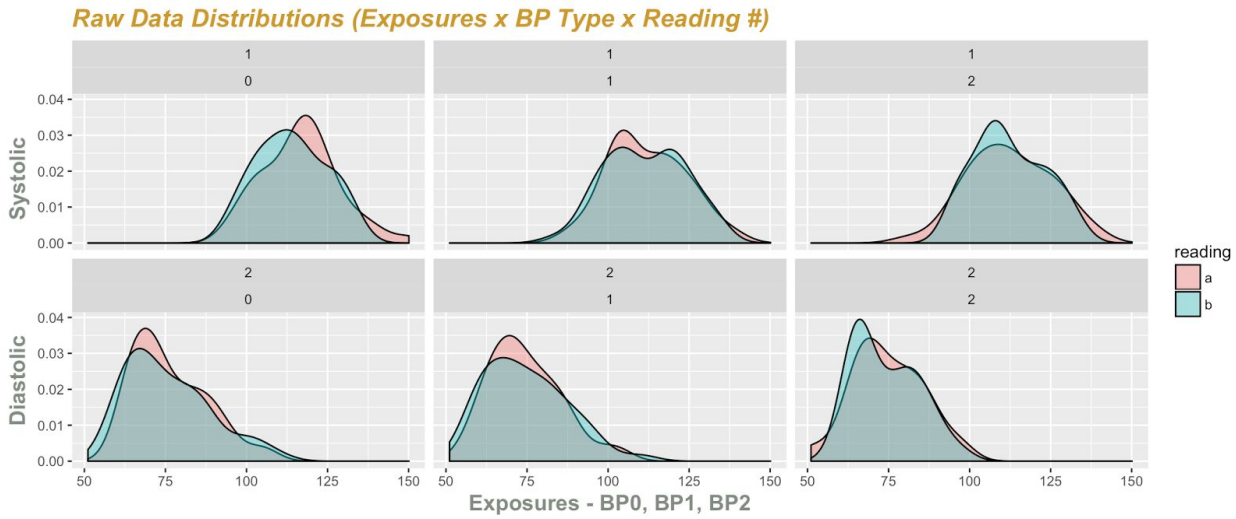
Variable Measurement

We decided to measure each participants' stress level by measuring their blood pressure. We also collected a number of covariates to help us understand the data better during the analysis phase including:

- Race
- Relationship to administrator
- Gender
- Age
- Regular Facebook / Social Media Usage
- Regular meditation / mindfulness
- Education Level
- Marital Status
- # Kids
- Pre-measurement Activity

To standardize blood pressure measurement, we bought 3 identical blood pressure monitors through Amazon and distributed them to each of the team members during immersion. We decided to take blood pressure on the left arm, closer to the heart, elevated at shoulder height, with the respondent's palm up, feet flat on floor, legs not crossed, and not talking. Because the monitor also reported on heart rate, we collected data for that as well.

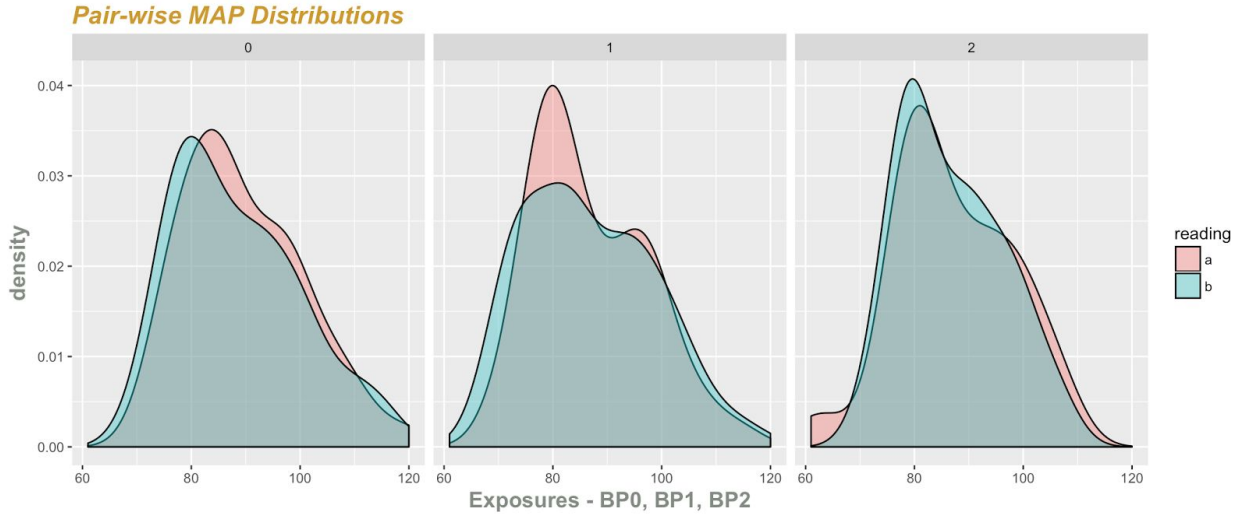
Blood pressure is the measure of force that blood exerts on the walls of blood vessels. When blood pressure is measured, two numbers are appear (eg - 120/80 mmHg). The first number, in this case 120, represents the systolic pressure which occurs when the heart pushes blood out of the arteries. The second number, 80, represents the diastolic pressure, which is the pressure of the heart at rest. The distribution of each diastolic and systolic blood pressure reading is plotted below which shows that the variance between the first and second readings at each observation point in the experiment is very minimum.



We decided to combine these two measures using mean arterial pressure (MAP) which is defined as the average arterial blood pressure during a single cardiac cycle[4]. The reason that MAP is important is that it reflects the haemodynamic perfusion pressure of the vital organs. The simple way to calculate the patient's MAP is to use the following formula:

$$MAP = [\ (2 \times diastolic) + systolic\ ] / 3$$

The reason that the diastolic value is multiplied by 2, is that the diastolic portion of the cardiac cycle is twice as long as the systolic. We use this metric in our models to describe the person's stress levels. The MAP distributions are plotted below showing that they are similar and suitable for comparison. (barring the one skew for Measure 1a)

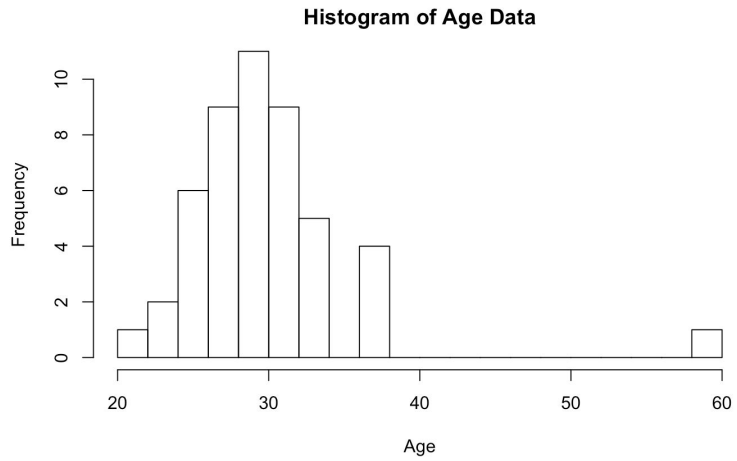


[4] https://thenursepath.blog/2016/12/08/mean-arterial-pressure-map/

Exploratory Data Analysis

We collected covariates that allowed us to better understand who our participants were. The covariates included race, gender, age, marital status and the number of kids along with pre-measurement activity, and whether they regularly use social media or meditate. As we asked our friends and family to participate in the study, most of the participants are representative of people from our lives, which limits our ability to generalize the results to a larger population. We provide a summary for the 48 respondents below.

Age



Most (40 out of 48) of our participants represented are between the ages of 25 and 34, with a couple of outliers. The oldest person was 60, while the youngest was 21.

Gender/Race

	Female	Male	Total
Asian	17	13	30
Asian/Hispanic	2	0	2
Hispanic	4	10	14
Caucasian	0	2	2

Total	23	25	48

Of the 48 respondents, we had 23 females and 25 males. This is evidence that the randomization procedure worked well, since we have a pretty even split. We also had 30 Asians and 14 Hispanics. We've also highlighted some race/age combinations where we may have enough data to build specific models.

Treatment Familiarity

		Meditation Familiarity		Total
		No	Yes	
Social Media Usage	No	1	0	1
	Occasionally	7	2	9
	Often	30	8	38
Total		38	10	48

We bucketed our participant's social media usage into three buckets - none, occasionally, and often. We defined not using social media as not having any habitual usage, occasionally as using social media less than once daily, and often as using social media more than once per day. Similarly, we bucketed users into meditation familiarity, defining users as familiar with meditation if they practiced mindfulness, meditation, or practiced yoga.

Most of our respondents used Social Media often, defined as using social media at least once per day. There was only one that didn't have a social media habit. Most people also didn't have familiarity with meditating regularly - only 10 of the 48 respondents suggested they meditated or practiced yoga or mindfulness.

Relationship status, Children, and Baseline Activities

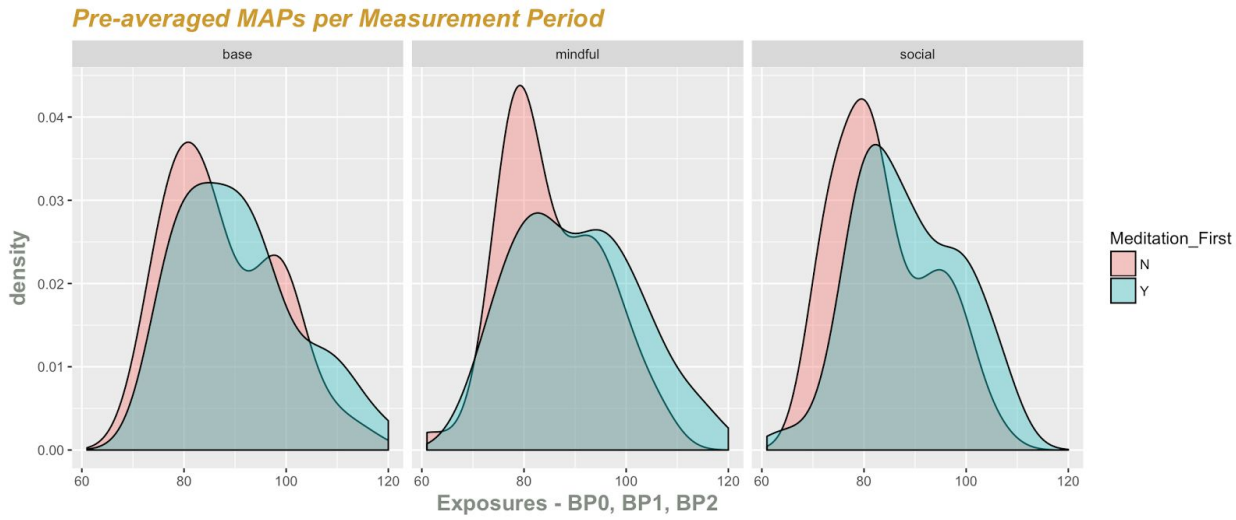
Most participants did not have children - only 4 out of 48 had at least one child. There was a pretty even split between being single (18), in a relationship (14), and married (16), which is evidence that we did the randomization strategy was effective.

	Number of Children			
	0	1	3	Total
Single	18			18
In a relationship	10	3	1	14
Married	16			16
Total	48	3	1	48

Their baseline activities were pretty varied, including everything from eating, online shopping, sleeping coming from meetings or bible studies, or cooking. We did not attempt to bucket these baseline activities to use as covariates because there was so much variation.

Pre-treatment Measurement

In the next phase of modeling, plotting the pre-averaged MAPs outlined above between our two treatment groups (meditation_first), we see that the distributions are roughly similar. Almost all of the distributions are bimodal with 2 humps with a reasonable amount of overlap. (Note the small peak for Mindful:Meditation_First = N still persists, but still similar in distribution)



Note the bimodal tendencies above note that the distribution curvatures above are approximately similar with different skews

Models

We decided to build several models to understand the possible effect of social media consumption and mindfulness meditation on stress levels. We kept our pairwise MAP measurements as separate observations (no per-subject averaging) in order to preserve measurement variance going into our models.

Prior to applying models with the treatment variables of interest, we perform a diagnostic check of the no-anticipation, no-persistence assumptions required by our experimental design. Since the measurement periods are equally spaced, we constructed a time variable on an interval scale and mapped 0, 1, and 2 in accordance with outcome measurements O_1, O_2, and O_3. Performing a regression of MAP on the time variable yields a coefficient of -1.026 (0.390) with $p<0.01$ significance through clustered standard error (see figure 1 below). While there appears to be a definite negative correlation of MAP over time, the practical effect is small (up to -2) over the entire study period. In the following models, a treatment effect of similar magnitude and direction to the time coefficient should be taken with a grain of salt.

	Dependent variable:
	value
time	-1.026^{***}
	(0.390)
Constant	96.692^{***}
	(0.987)
Observations	287
R^2	0.836
Adjusted R^2	0.803
Residual Std. Error	4.785 (df = 239)
F Statistic	25.865^{***} (df = 47; 239)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 1

Following our concerns with selecting an appropriate control during the design phase, we decided to employ a within-subjects design commensurate with the following model suggested by Professor Reiley. The model regresses MAP on dummy variables corresponding to measurement stages: meditation-first, social media,

meditation-second. A per-subject variable was also included to model individual offsets in baseline MAP. As shown in figure 2 below, the resulting regression yielded a statistically significant coefficient for the “social” ($p<0.01$) dummy variable, but a non-significant estimate for “mindful2” ($p>=0.1$), which are interpreted as the average change in MAP due to social media consumption (-2.901) and mindfulness treatment following social media consumption (-1.724). This model suggests that mindfulness treatment has a small practical effect of lowering MAP. The surprising result is that social media consumption lowers MAP to a greater extent, which contradicts our expectation that mindfulness would lower stress. We note that in addition to the lack of statistical significance for the mindfulness treatment outcome estimates, the 95% confidence intervals for all three treatment coefficients overlap. From this model, we conclude that there’s no practical difference between treatments. We further explored the treatment order effect by breaking the “social” dummy variable into “social1” and “social2” denoting social media -first and social media-second but still found overlapping confidence intervals. Lastly, given the lack of statistical significance for the ordered meditation variables, we proceed with covariate analysis using a grouped mindfulness treatment variable combining “mindful1” and “mindful2”.

	Dependent variable:
	MAP
variablesocial	-2.901^{***}
	(0.789)
variablemindful1	-0.840
	(0.868)
variablemindful2	-1.724
	(1.060)
Constant	97.208^{***}
	(0.913)
Observations	287
R^2	0.842
Adjusted R^2	0.810
Residual Std. Error	4.710 (df = 237)
F Statistic	25.808^{***} (df = 49; 237)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 2 (subject coefficients omitted)

To tease out a distinguishable effect between treatments, one logical covariate to investigate is subject familiarity with meditation. Familiarity would answer whether or not the mindfulness treatment is more or less effective on changing MAP for people who meditate versus people who don't. We included interaction terms between the meditation and treatment variables. The regression coefficients shown in figure 3 show statistical significance for non-meditation subjects on both the mindfulness (-2.175) and social media (-3.521) treatments. The trend is consistent with our first model, with social media having a greater effect than mindfulness on lowering MAP. The regression also shows a lower MAP baseline for subjects who do meditate, so perhaps regularly practiced meditation does lead to lower MAP in general. The final interesting result from this model is that the effect of mindfulness (4.185) and social media (2.938) treatments on meditators' MAP is positive. Statistical significance was achieved on the estimate of mindfulness treatment on meditators. We may reason that meditators become more stressed by mindfulness treatment (as opposed to less stressed for non-meditators)

because the mindfulness video differs from their normal meditation routines. Meditators may have some expected order, timing, or sensory experience that does not parallel the our chosen mindfulness treatment.

	Dependent variable:
	MAP
variablemindful	-2.175^{**}
	(0.860)
variablesocial	-3.521^{***}
	(0.909)
meditationyes	-12.421^{***}
	(1.928)
variablemindful:meditationyes	4.158^{**}
	(1.781)
variablesocial:meditationyes	2.938
	(1.748)
Constant	97.565^{***}
	(0.937)
Observations	287
R^2	0.846
Adjusted R^2	0.814
Residual Std. Error	4.660 (df = 236)
F Statistic	25.954^{***} (df = 50; 236)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 3 (subject coefficients omitted)

An analogous covariate to meditation familiarity is social media usage. We investigate the effect of frequent social media users (more than twice per week) with occasional social media users (few times per week or less). There was a single subject that did not use social media, which we omit from the regression since a single data

point is not representative of group-level estimates. The regression result in figure 4 again shows similar treatment effects to the first model, and the second model on non-meditators: that both treatments lower MAP, and social media (-3.549) lowers it to a greater extent than mindfulness (-1.141) when applied to occasional social media users. Only the social media coefficient was statistically significant for the occasional user group. Frequent users saw positive, but small and statistically insignificant effects for both mindfulness (0.163) and social media (1.211) treatments. While frequent social media use may impact the MAP baseline (4.542), there doesn't appear to be any detectable treatment effect on this group.

	Dependent variable:
	MAP
variablemindful	−1.141
	(1.552)
variablesocial	−3.549**
	(1.709)
'facebook usage'often	4.542**
	(1.911)
variablemindful:'facebook usage'often	0.163
	(1.774)
variablesocial:'facebook usage'often	1.211
	(1.918)
Constant	97.230***
	(1.210)
Observations	281
R^2	0.850
Adjusted R^2	0.818
Residual Std. Error	4.615 (df = 231)
F Statistic	26.704*** (df = 49; 231)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 4 (subject coefficients omitted)

Conclusions

We saw a statistically significant decline in MAP based on time. As such, the statistically significant results that social media had on decreasing MAP are offset by this time trend and we are not able to say that either treatment (social media or

meditation) resulted in statistically significant results. We also dove into understanding how two key factors affected treatment effects. The first, the participant's familiarity with meditation, surprisingly showed that participants not familiar with meditation saw statistically significant effects for both treatments. However, those familiar with meditation saw an increase in MAP from meditation and a decrease in MAP from social media. The second factor we dove into is the participant's social media usage. For occasional social media users, both treatments lowered MAP with social media having a greater impact than mindfulness. The social media coefficient was statistically significant for the occasional user group. Frequent users saw positive, but small and statistically insignificant effects for both mindfulness and social media treatments.

Overall, we were surprised that consuming social media had more of an impact on stress levels than Meditation. However, we also think it opens the door for more research, since we now believe a person's familiarity with mindfulness could impact the results we see.