Exploring the Effect of Motivational Quotes on Motivation

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Introduction

Motivation plays a crucial role in productivity and overall well-being. This study aims to examine whether receiving a daily motivational quote via email impacts self-reported motivational levels at the end of the day. Specifically, we investigate whether exposure to motivational messaging increases motivation relative to a control condition that does not have such messaging. Our experiment employs a randomized controlled trial (RCT) to measure the causal effect of motivational quotes on daily motivation.

Research Question

The primary question driving this study is: Does receiving a daily motivational quote via email increase self-reported motivation at the end of the day? Our hypothesis is that individuals who receive a motivational quote will report higher levels of motivation compared to those who do not. The null hypothesis (H_0) states that there is no difference in motivation between those who receive a motivational quote and those who do not. Additionally, we explore whether demographic or contextual factors (age, gender, occupation, first language, day-of-the-week) impact the result.

Experimental Design

The study was designed to measure the impact of motivational quotes on daily motivation levels. To test our hypothesis, we conducted a three-day experiment in which participants received daily emails at 10:00 AM, followed by a survey at 5:00 PM each day to rate their motivation on a standardized scale. We used two Qualtrics Surveys to collect our results. First with a participants survey which included: name, email address, gender, age, occupation, and first language. Since the experiment was over multiple days we wanted to make sure our participants were aware before entering the survey, so we used a poster with the sign up link (A1). The next survey was sent out at 5:00 PM to both the treatment and control groups. It included the day of week, if they felt motivated or not during the day (Y/N), and motivation score on a scale of 1 to 10. The motivation score served as the primary metric for our regression analysis.

Treatment and Randomization

Participants were randomly assigned to either the treatment or control group each day using complete randomization. The control group received a "Did you know?" dull fact via email (A2), while the treatment group received the same fact along with a randomly selected motivational quote (A3). We wanted to use a fact that was "dull" that was not going to impact the motivation score, for example a funny fact may affect this (A4). To account for potential variations in the effectiveness of specific quotes, we used nine different motivational quotes (A5), which were randomly assigned to treatment participants. This additional level of randomization ensured that any observed effects were due to the presence of motivational messaging rather than the specific wording of a given quote. Randomization was performed at the user level, allowing for the

possibility that participants could be assigned to either the treatment or control group across all three days. Additionally, due to the relatively small sample size, this could have introduced some skew into the data. By randomizing daily, we also aimed to minimize the risk that observed differences in motivation were driven by individual personality traits rather than the treatment itself. These measures help ensure excludability, meaning that any differences in motivation scores can be attributed to the presence of motivational quotes rather than other confounding factors.
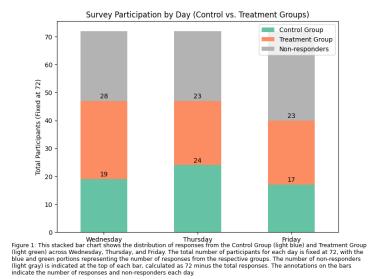
Pilot Run

Before launching the full experiment, we conducted a two-day pilot run with four participants to identify any potential issues in our study design. Each day, two participants were randomly assigned to the control group, while the other two were placed in the treatment group and received a motivational quote along with the dull fact. Two different motivational quotes were tested over the course of the pilot. The purpose of this preliminary trial was to ensure that the email delivery, survey distribution, and response collection processes functioned smoothly. After completing the pilot run, we reviewed participant responses and confirmed that there were no logistical issues or concerns with the study design, and we proceeded with the full experiment as planned.

Power Analysis

Power analysis, we simulated a power analysis to see how many samples we need to detect a true effect of 0.2. Given that we do not expect a large impact from the motivational quotes, our goal was to ensure the study is sensitive enough to capture even subtle effects. With a significance level of 0.05 and a desired power of 80%, our analysis suggested a sample size of 737 would be necessary to detect such a small effect reliably. This approach helps minimize the risk of false negatives and ensures that even modest effects, if they exist, are likely to be detected. With our limitations of the experiment it will likely be underpowered, if the true effect is small.

Exploratory Data Analysis

Figure 1: This stacked bar chart shows the distribution of responses from the Control Group (light blue) and Treatment Group (light green) across Wednesday, Thursday, and Friday. The total number of participants for each day is fixed at 72, with the blue and green portions representing the number of responses from the respective groups. The number of non-responders (light gray) is indicated at the top of each bar, calculated as 72 minus the total responses. The annotations on the bars indicate the number of responses and non-responders each day.

Over the 3-day experiment, survey emails were sent to 72 participants daily, but only 40 to 47 responded per day, resulting in lower-than-expected compliance rates (Figure 1). This discrepancy can be attributed to non-compliers, participants who were intended for the treatment or control group but did not complete the survey, possibly due to missed emails or emails going into spam. The response rates between groups did not show significant variation, suggesting consistent non-compliance across both treatment and control groups. The intent-to-treat (ITT) analysis included all participants based on their initial group assignment, regardless of survey completion, preserving the study's integrity.
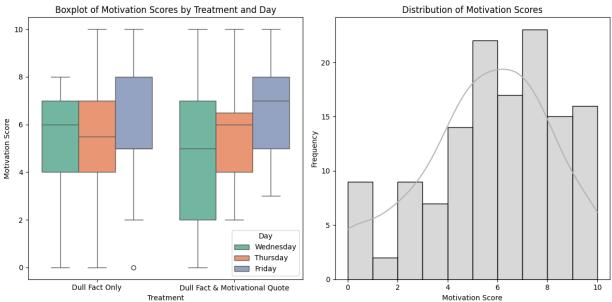

Figure 2: The boxplot on the left shows the distribution of Motivation Scores across different treatments (PSA Only vs. PSA & Motivational Quote) and days (Wednesday, Thursday, Friday). It provides insights into how motivation scores vary with treatment and across different days. The histogram on the right presents the overall distribution of Motivation Scores, highlighting the central tendency and spread of the data.

The boxplot analysis (Figure 2) shows a noticeable increase in motivation scores on Friday for both the treatment and control groups, possibly indicating a natural boost in motivation at the end of the week. The long box for the treatment group on Wednesday suggests high variability in

motivation scores, with some participants responding positively to the motivational quotes and others showing little change. The distribution of motivation scores is left-skewed, meaning most participants scored in the middle to high range. This is reflected in the box plot as well, where the mean motivation score for both groups each day hovers around 6, indicating that while the intervention may benefit some, its impact may be limited for the majority.

Randomization Check

Z-Test for Proportion Check

Day	Total Participants	Participants in Treatment	Treatment Proportion (%)	P value
Wednesday	47	28	59.6	0.181048
Thursday	47	23	48.9	0.884002
Friday	40	23	57.5	0.337287

Figure 3: This table presents the results of a randomization check on those that reponded to the daily survey, showing the distribution of treatment assignments across different days (Wednesday, Thursday, and Friday). The results indicate that the treatment distribution does not significantly deviate from 50% across all three days.

We conducted a Z-Test on the compilers to determine whether the proportion of participants in the treatment group differed from 50% on each day. The results indicate that the proportion does not differ significantly from 50% on any day. Specifically, the p-values for Wednesday, Thursday, and Friday are all above 0.05, meaning that the randomization was done properly.

Pre-Treatment Characteristics Check

Figure 4: Regression for Pre-treatment Characteristics Check

	(1)	(2)
Intercept	3.500***	0.633***
	(0.544)	(0.062)
treatment	0.662	0.015
	(0.732)	(0.084)
Observations	134	134
R^2	0.006	0.000
Adjusted R^2	-0.001	-0.007
Residual Std. Error	4.215 (df=132)	0.483 (df=132)
F Statistic	0.818 (df=1; 132)	0.033 (df=1; 132)
Note:		$^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Model 1 checks if treatment and control have significant differences in first language.
Model 2 check if treatment and control have significant employment status differences.

We also conducted a balance check for two pre-treatment characteristics, first language and employment status. In both regressions, treatment was used as the explanatory variable. The first regression used 'first language' as the outcome, while the second used 'employment status' as the outcome. Both analyses yielded p-values above 0.05, indicating that the differences between the control and treatment groups were not statistically significant. Therefore, the control and treatment groups are balanced, and the randomization was successfully implemented.

4

Analysis and Results

Figure 5: Regression for Motivation Score

		Dependent variable: Motivation_Score		
	(1)	(2)	(3)	(4)
C(Day, Treatment(reference='Wednesday'))[T.Friday]		1.018*	0.155	
		(0.565)	(0.877)	
C(Day, Treatment(reference='Wednesday'))[T.Thursday]		0.544	0.059	
		(0.544)	(0.807)	
C(Employment_Status, Treatment(reference='Employed'))[T.Student]				-1.620**
				(0.658)
Intercept	5.383***	4.877***	5.316***	6.409***
	(0.341)	(0.470)	(0.603)	(0.524)
treatment	0.292	0.313	-0.423	0.822
	(0.458)	(0.458)	(0.781)	(0.712)
treatment:C(Day, Treatment(reference='Wednesday'))[T.Friday]			1.474	
			(1.148)	
treatment:C(Day, Treatment(reference='Wednesday'))[T.Thursday]			0.831	
			(1.095)	
treatment:C(Employment_Status, Treatment(reference='Employed'))[T.Student]				-0.778
				(0.890)
Observations	134	134	134	134
R^2	0.003	0.028	0.040	0.148
Adjusted R^2	-0.004	0.005	0.003	0.128
Residual Std. Error	2.638 (df=132)	2.625 (df=130)	2.628 (df=128)	2.457 (df=130)
F Statistic	0.407 (df=1; 132)	1.227 (df=3; 130)	1.069 (df=5; 128)	7.526*** (df=3; 130)

Note: *p<0.1; **p<0.05; ***p<0.01

Model 1 examines the effect of treatment on Motivation Score.
Model 2 includes day effects with Thursday compared to Wednesday as the baseline.
Model 3 includes interaction effects between treatment and day, highlighting the differing effects across days.
Model 4 examines the impact of employment status on the treatment effect by comparing Employed vs Unemployed.

In the above regression analysis, Model 1 examines the relationship between treatment and motivation scores. The average motivation score for the control group is approximately 5.4, while the treatment effect is around 0.3. However, this effect is not statistically significant. Additionally, the R-squared value (0.003) suggests that the model explains very little of the variation in motivation scores.

To explore potential variations in the treatment effect, we also conducted several follow-up regressions incorporating demographic and contextual covariates.

Model 2 includes day-of-the-week as a covariate, comparing motivation scores on Thursday and Friday to the baseline (Wednesday). The results indicate that motivation scores on Friday are significantly higher than Wednesday by approximately 1 point (p<0.1), while the difference for Thursday is not statistically significant. This suggests that day-of-the-week effects may influence motivation, independent of treatment.

Model 3 introduces an interaction between treatment and day-of-the-week to assess whether the treatment effect varies across days. The interaction terms for treatment × Thursday and treatment × Friday are not statistically significant, indicating that the treatment effect remains consistent across all days and does not exhibit meaningful variation based on the day of the week.

Model 4 examines the interaction between treatment and employment status. The occupational information collected from the participant survey was categorized into a binary employment status: "Student" vs. "Employed." The results show that students have motivation scores that are 1.6 points lower than employed participants, and the effect is statistically significant with $p<0.05$. Compared to previous models, both the intercept and treatment effect increased, but the interaction term for treatment had a negative coefficient, indicating that the treatment effect was weaker for students compared to employed individuals. While the R-squared value improved, it remained relatively low, suggesting that the model's overall explanatory power is still limited.

Limitations

Throughout the experiment, we encountered several limitations. Firstly, not all participants completed the questionnaire each day, even if they received and viewed the email in the morning. This posed a challenge for the Intent-to-Treat (ITT) analysis, as many individuals in the treatment group did not provide responses. Additionally, we were unable to track how many participants opened the emails or at what time, limiting our ability to assess engagement accurately.

Our test was also underpowered. According to our power analysis, detecting an effect size of 0.2 would have required 737 observations, but our study included only 134. This insufficient sample size reduced the study's ability to detect small effects, meaning a genuine impact of motivational quotes might have gone unnoticed.

Another limitation was the potential for spillover effects, as a significant number of participants were part of the MSBA program and may have discussed the emails with each other. As a result, those in the control group could have been indirectly influenced by motivational quotes, violating the non-interference assumption.

Finally, we faced an issue of unequal exposure to conditions due to user-level randomization. Some participants consistently remained in the treatment or control group, which may have introduced individual bias. This could occur if certain participants naturally had higher or lower levels of motivation, regardless of the treatment condition.

Conclusion

This study examined whether receiving daily motivational quotes via email influenced self-reported motivation levels. While the treatment group showed a small increase in motivation scores, the effect was not statistically significant, suggesting that motivational quotes alone may not meaningfully impact daily motivation.

Further analysis revealed that motivation levels were higher on Fridays compared to Wednesdays, indicating natural fluctuations in motivation throughout the week. Additionally, students reported lower motivation than employed participants, though the treatment effect did not significantly differ by employment status. However, low R-squared values across models suggest that motivation is influenced by other unobserved factors beyond those tested in this study.

To address the limitations mentioned earlier, we plan to improve response rates by customizing emails with participants' names and offering incentives for participation. Additionally, we will

implement an email tracking system to monitor non-responders and send reminders, addressing both low engagement and the study's limited statistical power.

Future iterations will extend the study duration to at least a week to observe long-term effects more accurately. To minimize participant discussion effects, we will implement cluster randomization, assigning groups rather than individuals to treatment and control conditions. Furthermore, we will apply stratified or matched-pair randomization to create more balanced groups and reduce individual-level bias. By implementing these improvements, we aim to enhance the study's reliability and obtain more meaningful results.

Appendix

A1: Flyer for Participants Signup

A2: Example of a control email:

A3: Example of a treatment email:

Your Daily PSA : Day 1 ✓✓ ×

Kuang-Ching Amanda Ting <kcting@bu.edu>
to bcc: elizabethunderhill, bcc: eduardgorbunov1995, bcc: Roxy, bcc: wenxinl, bcc: achi12, bcc: Ohmsri, bcc: huawan, bcc: Guypeled8, b

Good Morning,

Did you know?

The sky is blue because of light scattering. Shorter wavelengths (blue) scatter more than longer ones (red).

Start your day with this quote:

"Opportunities don't happen, you create them." — Chris Grosser

Wishing you all a great day ahead!

Best,

Team Crystal, Courtney, Christina, and Amanda

A4: Fact Table

Fact 1	The sky is blue because of light scattering. Shorter wavelengths (blue) scatter more than longer ones (red).
Fact 2	The highest point on Earth is Mount Everest. It's been the highest point for a while now. No changes expected.
Fact 3	Water covers about 71% of the Earth's surface. That's a lot of water. Nothing surprising here.

A5: Quote Table

Quote 1	**"The future depends on what you do today."** — Mahatma Gandhi
Quote 2	**"It always seems impossible until it's done."** — Nelson Mandela
Quote 3	**"Opportunities don't happen, you create them."** — Chris Grosser
Quote 4	**"Doubt kills more dreams than failure ever will."** — Suzy Kassem
Quote 5	**"Hardships often prepare ordinary people for an extraordinary destiny."** — C.S. Lewis

Quote 6	**"Work hard in silence, let success make the noise."** — Frank Ocean
Quote 7	**"Small progress is still progress. Keep pushing forward!"**
Quote 8	**"Your future self is watching. Make them proud."**
Quote 9	**"It does not matter how slowly you go as long as you do not stop."** - Confucius