Five Experimental Tests of the Effects of Short Messages on Compliance with COVID-19 Public Health Guidelines

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Abstract

Preventing the spread of COVID-19 requires persuading the vast majority of the public to significantly change their behavior in numerous, costly ways. However, it is unclear which persuasive strategies are most effective at convincing people who are not fully compliant to take recommended actions, such as wearing a mask and staying home more often. In five studies (N = 5,351) conducted from March - July 2020, we evaluated 56 short messages aimed at convincing people to comply with public health guidelines. In two within-subjects studies, participants rated the persuasiveness of many short messages drawn from both past research on persuasion and original crowdsourcing. In three pre-registered, between-subjects experiments, we tested whether the four top-rated messages from the previous studies led people who were not fully compliant to increase their intentions to comply. We do not find consistent effects of any message, though a message emphasizing civic responsibility to reciprocate healthcare workers' sacrifices performed best in three of five studies. Overall, these findings suggest that short messages are largely ineffective in increasing compliance with public health guidelines during advanced stages of the pandemic.

Keywords: COVID-19, persuasion, communication, health, messaging

Preventing the spread of the coronavirus requires persuading people to significantly change their behavior. Some of these behavior changes are easy (e.g., washing hands frequently), but some are costly (e.g., refraining from visiting friends or relatives). To reduce the spread of the virus and save lives, it is essential for people to change their behavior, but people are often reluctant to make costly changes. Moreover, widespread protection requires high compliance by the general population. Polling throughout the pandemic has shown that certain groups -- for example, conservatives, men, and people who consume news less often -- were less likely to engage in preventative behaviors (McCarthy, 2020; Ritter & Brennan, 2020).

To persuade more individuals to comply with public health guidelines, organizations and governments must know how to frame messages in ways that are compelling. A substantial body of work preceding the coronavirus pandemic has investigated how to frame messages that persuade people to engage in behaviors to protect public health. Some approaches include focusing on benefits to others (Grant & Hoffman, 2011) and highlighting approval by the recipient's social group (Drummond & Fischhoff, 2017). Beyond public health, there is a large body of work on persuasion in general (Cialdini, 1987).

Nevertheless, it is unclear which types of messages are persuasive in the context of the COVID-19 crisis in the United States: a pandemic unlike most people have seen before, in a deeply polarized country with historically-low trust in media (Brenan, 2019) and government (Pew Research Center, 2019). Consistent with this, views of COVID-19 have polarized along political lines (Newport, 2020), reported skepticism about the seriousness of the disease is high, and conspiracy theories regarding its origins have proliferated (Schaeffer, 2020).

Since the start of the COVID-19 pandemic, researchers have sought to understand which message framings are most effective for convincing people to engage in behaviors that prevent

the spread of the virus. Some research has suggested that prosocial framings of messages are more persuasive than self-interested framings (Jordan et al., 2020), and other research has found that arguments focusing on benefits to others are more persuasive to people who moralize public health (Luttrell & Petty, 2020). In addition, another study found that a message using a deontological moral frame was more persuasive than a control message (Everett et al., 2020). However, we are still learning what principles apply to the specific situation of the coronavirus pandemic.

The Present Research

There are many methods of persuasion, ranging from long, in-person conversations to short messages. We choose to test short messages for two main reasons. First, short messages are potentially scalable, as much of the information environment consists of these messages (e.g. social media posts, digital and print advertisements, PSAs, etc.). Second, these messages can offer theoretical insights as to which approaches are effective or ineffective at increasing intentions to change behaviors. This information may be applied to other forms of media, such as longer messages or speeches by organizational and government leaders. At the same time, short messages represent conservative tests of persuasive approaches because their brevity can lead to minimal impact on participants. This may be an increasing problem as the information environment is filled with more messages and views crystallize over time.

Our research contributes to current research on COVID-19 messaging by testing many messages, focusing on low-compliance individuals, and studying effects relative to an “active” control message. Each of these methodological features have unique advantages.

First, given the importance of identifying the most persuasive messages, it is valuable to test many messages in the same study with common dependent measures to assess which

messages are most effective. Here, we gather a large number of messages from past research on persuasion, recent research on messaging conducted during the pandemic, and original crowdsourcing from individuals who are not academics, and thus may offer very distinct insights.

Second, at the time this research was conducted, the majority of Americans reported that they were already complying with physical distancing and other public health guidelines (Murad, 2020). Consistent with this, in March of 2020, we ran pilot studies testing whether conservative moral value framed messages increased compliance. However, we found ceiling effects (see Supplementary Materials). Other researchers testing messages to increase compliance with coronavirus public health guidelines have also found high reported levels of compliance in the general population (Everett et al., 2020). While these self-reports are likely inflated by social desirability bias, this demonstrates that identifying the messaging approaches that are persuasive to individuals who are relatively low in compliance is of greatest interest. Further, the messages that are most persuasive to people who are not fully compliant could be different from the messages that are most persuasive to the general population.

Third, it is a stronger test to compare messages to an "active" control message that provides information on the virus and public health guidelines without a persuasive frame, than to compare messages with a control condition featuring no message or a neutral message. By comparing messages to active controls, we can isolate the effect of a particular framing, independent of the effect of receiving a reminder of the virus and desired behavioral responses.

In the early months of the COVID-19 pandemic (March 27 to July 14, 2020), we conducted five experimental studies to understand which messages were most effective at convincing low-compliance individuals to change their behaviors. In Studies 1-2, our goal was to

screen for top-performing messages. We did so by first testing 24 messages informed by prior literature (Study 1), then supplementing with a set of 25 messages drawn from 600 crowdsourced messages and additional messages from recent COVID-19 research (Study 2). We identified four messages that showed statistically significant effects. In Studies 3 and 4, which were pre-registered, we examined whether these messages increased self-reported compliance with public health guidelines, compared to an active control group. In Study 5, we replicated Study 4 with the most effective message to test the robustness of our results.

Study 1

Our goal in Study 1 was to identify promising messages to test further. We measured people's perceptions of the persuasiveness of 24 short messages aimed at convincing people to stay home to prevent the spread of COVID-19. The messages use a variety of persuasion techniques, detailed in the procedure section. Data, code, and materials for all studies in this paper are available online. (See https://osf.io/eqr4w/)

Method

Participants

Prior to the study, we conducted power analyses using G*Power (Faul et al., 2007), which showed 200 participants per pairwise comparison would be needed to detect an effect of Cohen's d = 0.3 (95% power, alpha = 0.01). With 24 treatment messages, and with each participant rating 10 messages, we aimed for a total sample size of at least 540. The final sample was N = 598 (275 men, 323 women, Mean age = 43.8, 42% liberal, 14% moderate, 44% conservative). Participants on Mechanical Turk completed the survey from March 27-30, 2020. At this point in the pandemic, some parts of the US were already under stay-at-home orders (Kates, 2020).

Procedure

We tested 24 short messages and a control message. The messages were based on a wide range of both general prior research on persuasion and message framing, and research specific to the current pandemic. All messages were two to four sentences long and advocated for staying home to prevent the spread of coronavirus. Examples of persuasive techniques and quotes from the corresponding messages are below (see Supplementary Materials for full message text).

- *Social proof* (Cialdini, Ch. 4, 1987): "90% of Americans are significantly changing their behavior"
- *Reciprocity* (Cialdini, Ch. 2, 1987): "As our health care workers put their lives on the line, we can do our part simply by staying home."
- *Formal authority* (Cialdini, Ch. 6, 1987): "in many parts of the US, you can be cited for a misdemeanor"
- *Moral purity framing* (Feinberg & Willer, 2013): "effects [of COVID-19] are disgusting, threatening our bodies by damaging tissue and impairing our breathing."
- *Patriotism framing* (Feinberg & Willer, 2015): "we all have a patriotic duty to do whatever we can to help our country."
- *Compassion and empathy for others* (Uskul & Oyserman, 2010): "The sick, elderly, and immunocompromised need our help."
- *Deontological and utilitarian moral framing* (Everett et al., 2020): "it's your duty" and "think of the consequences," respectively.
- *Emphasizing personal health threat* (Dunlop et al., 2009): "Young, healthy people all over the country are being hospitalized [...] This virus can hurt every one of us."

- *Explaining dynamics of viral spread* (Lammers et al., 2020): "on average, each person passed on the coronavirus to 2 to 3 people"
- *Political party framing* (Cohen, 2003): "President Trump and the Coronavirus Task Force have ordered all Americans…"
- *Identifiable victim* (Small & Lowenstein, 2005) : "Fiona was a healthy 26-year-old [...] and is now hospitalized, receiving oxygen from a ventilator, and fighting for her life."

Each participant viewed ten messages randomly selected from the set of 24 possible messages in a random order. Each message was rated 236-242 total times.

Persuasiveness: After reading each message, participants answered three questions gauging how persuasive participants found the message, including "How convincing do you find this reason for social distancing (staying home during the coronavirus pandemic)?" on scale from 1 (*Not convincing at all)* to 9 (*Extremely convincing).* Reliability was high, (α= .80) so we combined these into a composite.

Crowdsourced Messages: At the end, we asked participants to write their own two to four sentence message that they thought "might convince someone to follow current CDC guidelines like maintaining social distance and staying home except for essential reasons."

Results

We used a mixed-effects model to calculate main effects of message condition on persuasiveness, with a control message as the reference. The level 1 effect was the message, and the level 2 effect was the participant. We included controls for gender, age, race, education, and income.

The outcome variable was the beta value associated with each message. We used the Holm method to adjust p-values to account for multiple comparisons. The five most persuasive

messages emphasized: responsibility to reciprocate sacrifices of healthcare workers (Message #6, β = 0.60, p_{holm} < .0001), importance of following guidance of public health officials (Message #15, β = 0.59, p_{holm} < .0001), the speed of transmission (Message #8, β = 0.48, p_{holm}< .001), the story of an identifiable victim (Message #7, β = .35, p_{holm} < .02), and protecting the vulnerable (Message #0, β = .34, p_{holm} < .03). (Table 1)

Many messages were rated as less persuasive than the control, including messages using: political party framing by referencing President Trump (Message #19, β = -1.33, p_{holm}< .0001), religious framing (Message #12, β = -1.3 p_{holm}< .0001), and patriotism framing (Message #5, β = -0.62 p_{holm}< .0001). Surprisingly, messages that emphasized these typically conservative values were also less persuasive than the control among conservatives.

Table 1*: Messages that Outperformed Control in Merged Analysis of Studies 1 and 2*

Message Number	**Text**	**Effect size, Study 1**	**Effect size, Study 2**	**Effect size, Merged Analysis**
6	Doctors, nurses, and other health care workers are working around the clock, risking their lives to care for patients with the coronavirus. Working long hours in highly infectious environments, many of them are falling ill. As our health care workers put their lives on the line, we can do our part simply by staying home and limiting physical contact with others.	0.60 *** (0.11)	0.39** (0.094)	0.54*** (0.067)
15	Public health officials tell us that we must slow the spread of the coronavirus so numbers of sick people don't overwhelm our doctors, nurses, and hospitals. If we don't slow the spread, cases will increase rapidly, suddenly spiking beyond what the health care system can handle. We all can do our part to slow the spread by staying inside and avoiding contact with others when we must go out. If we take action to slow the spread now, we will save lives.	0.59*** (0.11)	0.21 (0.094)	0.46*** (0.067)
7	A few weeks ago, Fiona was a healthy 26-year-old with no medical complications. Then she suddenly came down with a bad cough and a feeling like she could not breathe. She tested positive for COVID-19, and is now hospitalized, receiving oxygen from a ventilator, and fighting for her life. This could be any of us. Please stay home and protect yourself against this virus!	0.35* (0.11)	0.19 (0.095)	0.32*** (0.067)

0	The sick, elderly, and immuno-compromised need our help. We all have a choice: If we go out, we risk the lives of others. But by staying home we can protect those most likely to be harmed. Stay home to protect those who are vulnerable!	0.34* (0.11)	0.17 (0.095)	0.29 *** (0.066)
8	On average, each person passes on the coronavirus to 2 to 3 people, who then pass it on to more people, and so on. If you break a chain of transmission, you can single-handedly save lives and prevent the suffering of potentially dozens of people. Stay home as much as you can, and break the transmission chain!	0.48*** (0.11)	-0.02 (0.092)	0.29*** (0.067)

All reported p-values are adjusted using the Holm correction for multiple hypothesis testing.
* p < .05; ** p < .01; *** p < .001

One limitation is that at the time this study was fielded, most Americans were already complying with social distancing guidelines (Murad, 2020). It is possible that people who were already complying might find different messages convincing than people who are not, and the latter population is of greatest interest.

Study 2

Study 2 relied on the same protocol as Study 1, with two exceptions. First, only participants who were not highly compliant with public health behaviors were included to reduce ceiling effects and identify which messages were persuasive to low-compliers. Second, we added 7 additional messages from related studies and 25 crowdsourced messages from participants in Study 1. See Supplementary Materials for all included messages.

Method

Participants

A total of 998 participants from Lucid (851 participants) and Mechanical Turk (147 participants) completed the survey from April 16 - May 1, 2020. At this point in time, the number of new COVID-19 per day cases in the US was plateauing (CDC, 2020). We expanded the sample platform to Lucid because of reports that participants on Mechanical Turk were seeing a large number of studies related to COVID-19, and we had concerns about

oversaturation. Using G*Power, we found that 150 participants per pairwise comparison would be needed to detect an effect of Cohen's d = 0.3 (95% power, alpha = 0.05). Because each participant would see 9 treatment messages and the control, our target sample was 933.

We noted attention may have been an issue, so we only allowed participants to enter the study who passed a simple attention check (see Supplementary Materials). Of the 7,658 participants who began the survey, 6,268 passed this check.

We also sought to include only participants who were not highly compliant with public health guidelines. Before allowing participants to take the full survey, participants indicated how often they engaged in six behaviors that were widely recommended to prevent the spread of coronavirus. We aimed to identify the approximately 20% of the population lowest in compliance. A brief pilot test led us to only allow participants that met at least five of the following six criteria: washed hands fewer than 10 times per day, cleaned surfaces fewer than 3 times a day, left the house for non-essential reasons at least once in past week, and marked less than 50 on a scale of 1 (*Never*) - 100 (*Extremely often*) for how frequently they kept six feet away from others, wore a face mask, and avoided touching their face when they left their home (See Supplementary Materials).

Among those who began the study, this filter excluded all but 998 participants (54% male; median age = 42; 25% liberal, 20% moderate, 55% conservative).

Crowdsourced Messages

In Study 1, we collected 600 messages written by participants. Two independent coders indicated the persuasiveness of each message on a scale of 1 (*Not convincing at all*) to 7 (*Extremely convincing*), and distinctiveness from existing messages on a scale of 1 (*Almost identical*) to 7 (*Extremely distinct*). To identify potentially persuasive messages that were distinct

from Study 1 messages, we calculated the weighted average of these two items ($0.4 * Rating_{persuasiveness} + 0.6 * Rating_{distinctiveness}$), and included the 25 messages with the highest average score as treatment messages in Study 2. Distinct framings included emphasizing personal responsibility for harm (e.g. "your actions may cause people to get sick and die,"), and explaining how preventative behaviors would speed recovery and help us "get back to normal." (See Supplementary Materials.)

Procedure

The procedure was modified only slightly from Study 1. Here, all participants saw the control message and nine randomly selected treatment messages, instead of 10 randomly selected messages. Each treatment message was seen 148-173 times.

Results

The most persuasive message was Message #6, which emphasized a civic obligation to protect healthcare workers (β = 0.39, p_{holm} < .01). This was also the most persuasive message in Study 1. The second most persuasive message overall was Message #15, which emphasized the need to follow guidelines of public health officials. However, this effect was insignificant when using the Holm adjustment for p-values (β = 0.21, $p_{unadjusted}$ = .03, p_{holm} = .9). (Table 1)

None of the crowdsourced messages were significantly more persuasive than the control message. Many messages were significantly less persuasive than the control, including messages that place the COVID-19 pandemic as the "challenge of our times" (Message #33, β = -0.74, p_{holm}< .0001) or something that "historians will look back on" (Message #38, β = -0.60, p_{holm}< .0001).

We also conducted a combined analysis, merging data from Studies 1 and 2, and adding a dummy variable to indicate study (Table 1, Figure 1).

Discussion of Studies 1 and 2

There was a strong correlation between top messages in Studies 1 and 2, even though the studies were fielded several weeks apart on different populations. However, in Study 2, the effect size of the most persuasive messages was much smaller. In both studies, the most persuasive message emphasized civic responsibility towards healthcare workers. This message was highly persuasive to both conservatives and liberals. Overall, the more persuasive messages emphasized how staying at home protects others, including hospital workers, the elderly and vulnerable, and even young people who may seem at low risk. One message that was persuasive in Study 1 but not in Study 2 was Message #8, which explained the speed of viral transmission. This may because by the time the second study was in field, the speed of transmission was already known, so the message did not serve to correct misperceptions (Lammers et al., 2020).

In both studies, the more persuasive messages emphasized the positive results of staying home, such as "slowing the spread" or "saving lives." Many less persuasive messages emphasized negative consequences, like being "cited for a misdemeanor," contracting this "disgusting" disease, or "killing" others. This is consistent with research finding that gain-framed messages are more effective than loss-framed messages for encouraging behaviors that prevent disease (O'Keefe & Jensen, 2006).

However, the majority of the messages in Study 2 were less persuasive than the control message. Across both studies, appeals to traditionally conservative values, such as religion (Message #12), purity (Message #2), or the Republican party (Message #19) were also unconvincing, even to conservatives.

Messages that highlighted collective action or national identity, such as analogies to war (Message #4), the need to "stick together" (Message #10), or social proof based on other Americans staying home (Message #20) were all less persuasive than the control. This may be because in individualistic cultures like the United States, messages emphasizing collectivism may be less persuasive (Sherman et al., 2011).

Techniques from the crowdsources messages, such as emphasizing personal responsibility for severe harm (Message #46) or encouraging people to take action to "get back to normal" (Message #53) were not more persuasive than the control message.

Overall, we find that participants think the majority of messages are either less persuasive or equally persuasive to a control message that does not use a deliberate persuasive technique.

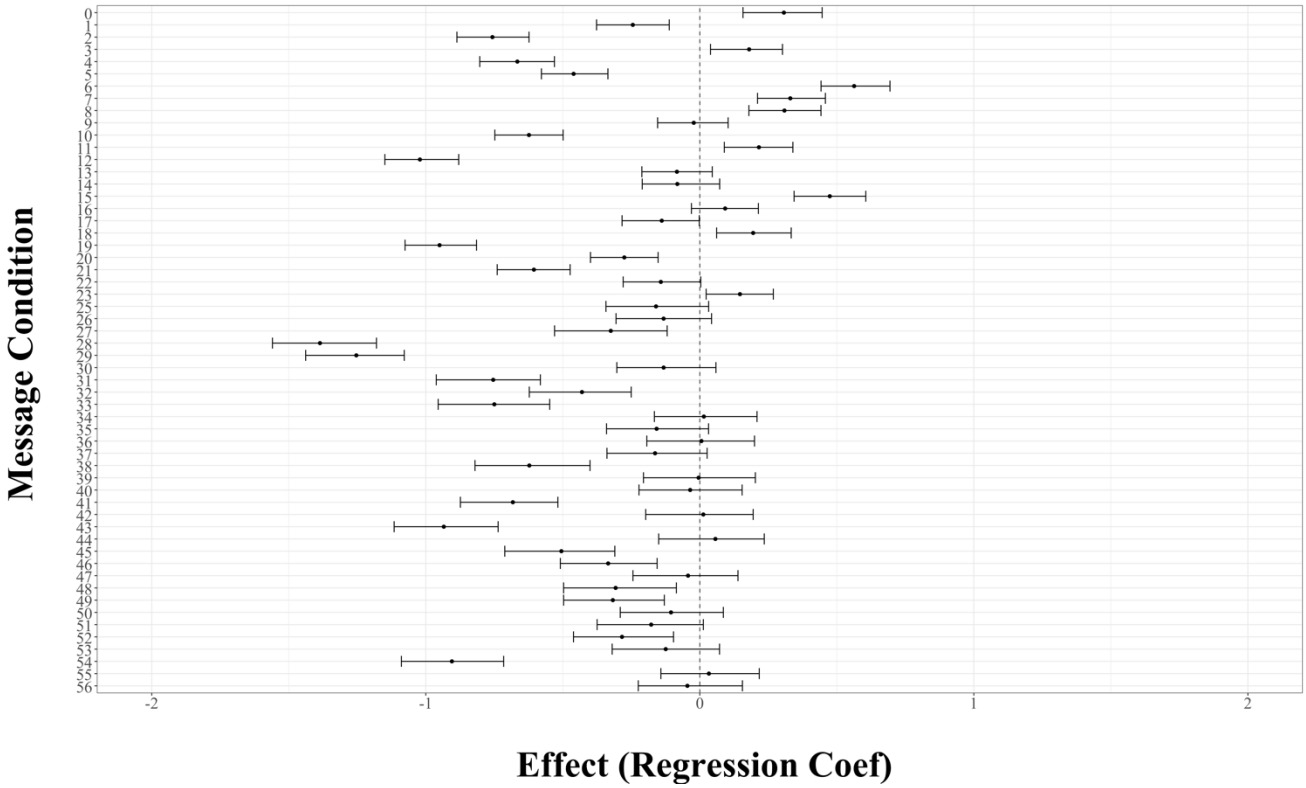

Figure 1*: Effect Size of Messages Relative to Control in Merged Analysis of Studies 1 and 2. (95% confidence intervals)*

Study 3

In this study, we test whether the top four messages from the previous studies cause people who are not fully compliant to change their behaviors. The study was pre-registered (See https://osf.io/eqr4w/).

Method

Design and Participants

This was a 6-condition, between-subjects study, with 4 treatment messages compared to an active control message and a null control (no message). The four treatment messages were the messages that were significantly more persuasive than the control in the merged analysis of Studies 1 and 2, and more persuasive than the control in Study 2, which focused on non-compliers (Messages #6, #7, #15, and #0). We made light edits to bring messages up to date.

We used G*Power to calculate that 250 participants per condition would allow us to detect an effect size of Cohen's d = 0.3 (Power = 80%, alpha = 0.05). Therefore, we targeted a sample size of 1500.

The study was in field from May 22-23, 2020. This was the beginning of Memorial Day weekend – the number of new COVID-19 cases reported per day had been decreasing in the previous weeks (CDC, 2020), and some states were beginning to loosen restrictions (Iati, 2020). Participants were recruited from Lucid, and 5180 participants began the survey. After excluding participants who failed the same attention check as in Study 2, 4149 remained.

Only low and mid-level compliers with public health guidelines qualified to complete the survey. That is, people who reported engaging in at least two of the six behaviors listed in Study 2. We opened up the filter because there were not large differences between messages convincing to low compilers and the full population. 1767 participants passed this filter.

Following pre-registered exclusion criteria, we excluded participants who failed a simple attention check at the end of the survey. There was no differential attrition based on this exclusion. This left 1627 participants. (48% male, median age = 47, 42% conservative, 30% moderate, and 28% liberal).

Procedure

Change in intended behaviors. After reading the message, participants indicated how often they intended to engage in the same six behaviors in the upcoming days that they were asked about earlier (staying at home, wearing a mask, etc.). The items were on the same scale as the filter questions but were about intended future behaviors instead of past behaviors (see Supplementary Materials). We took the difference between participants' intended behaviors and past behaviors on each of the six items and normalized each one. The main dependent variable was the average of these six normalized difference scores. We chose this variable because we wanted to measure whether the message caused people to take more precautionary behaviors in the future than they did in the past.

Results

We ran two multiple linear regressions with the average normalized difference score across the six behaviors as the outcome variable. In the first model, the null control was the reference group. The controls were 1) normalized measures of age, income, and 2) dummy variables for education level and race/ethnicity. Compared to the null control, all four messages and the active control message caused an increase in intentions to comply with public health guidelines (Table 2).

Second, we ran our pre-registered analysis. This was the same model, but without the null control, and using the active control as the reference group. Following our pre-registration, we

excluded participants who spent less than two seconds reading the message to account for inattentive participants. None of the four messages caused a significantly greater increase in preventative behaviors intentions than the active control (Table 2).

Table 2: *Regression from Study 3, Aggregate Difference Score as Outcome*

Variable	**Model 1** **Null control as reference group**	**Model 2** **Active control as reference group**
Active control	0.106* (.046)	--
Message 6	0.081. (.046)	0.0098 (.052)
Message 7	0.165*** (.045)	0.080 (.050)
Message 15	0.159*** (.046)	0.0695 (.053)
Message 0	0.159*** (.047)	0.0337 (.053)
Normalized Age	-0.0159 (.014)	-0.024 (.017)
Male	-0.142*** (.027)	-.125*** (.033)
Education: HS or less	0.0783* (0.038)	0.091. (.048)
Education: Some college	0.033 (.034)	0.028 (.042)
Education: Postgraduate	-.004 (.045)	-0.025 (.055)
Race: Asian	0.077 (.060)	0.079 (.076)
Race: Black	0.212*** (.047)	0.292*** (.063)
Race: Hispanic	0.125** (.058)	0.159* (.080)
Race: Other	0.142 (.09)	0.152 (.10)
Income	-4.0e-08 (2.8e-07)	9.2e-08 (3.52e-07)
R-squared	0.042	0.041
Number of observations	1627	1072

. p < .1; * p < .05; ** p < .01; *** p < .001
Standard errors are shown in parentheses.

Discussion

While participants who read any message reported significantly greater increases in preventative behaviors than those in the null control condition, no messages were significantly more persuasive than the active control. Message #7 (identifiable victim) had the largest effect, though it was not significant.

One possible reason for these null results is that we ran the study at the start of Memorial Day weekend, when many states were relaxing their shelter-in-place orders (Iati et. al., 2020). The messages may have seemed contradictory to "reopening" messaging prevalent at the time. In addition, Message #6 may not have seemed reliable. Several participants expressed suspicion that health care systems were in fact heavily impacted at that time, commenting that "most hospitals have empty beds" and "if it is true, why are these same people being laid off?" One implication is that the shifting nature of the pandemic may mean that certain messages are persuasive at certain points in time, but not others.

Study 4

We next modified Study 3 to be more in line with prevailing public health guidelines at the time. The study was pre-registered (See https://osf.io/eqr4w/).

Method

Design and Participants

This was a 5-condition study, comparing four treatment messages to an active control message. We adapted Messages #6, #7, #15, and #0 to call for three new behaviors instead of asking people to stay home: physically distancing from others, wearing a mask, and washing hands after returning home (See Supplementary Materials for message text).

We fielded the study on Mechanical Turk from June 29 – July 1, 2020. At this point, the number of new COVID-19 cases per day has increased beyond the prior peak in April. Using G*Power, we found that a sample of at least 1,530 would allow us to detect a small effect size of Cohen's d = 0.25 (Power = 80%, alpha = 0.05).

We excluded participants who failed the same attention checks as in Study 3. We also excluded participants who were highly compliant with the three behaviors in the message. Participants reported how often they engaged in the three behaviors when they last left their place of residence, on a scale from 0 (*Never*) to 100 (*Extremely often*). We allowed participants to enter the study whose average on these three items was less than or equal to 93 out of 100. We chose this criterion because based on pilot data suggesting 50-60% of respondents would qualify.

3,058 unique respondents began the survey. 1,666 passed the early attention check and the filter for low compliers. Of those, 1,531 (58% male, median age of 34, 43% conservative, 37% liberal, 19% moderate) passed the end attention check. There were no significant differences in attrition between conditions because of this exclusion.

Procedure

The procedure was similar to that of Study 3, but with new items before participants read the messages to measure respondent's skepticism towards COVID-19.

Skepticism of COVID. Before reading the messages, participants answered two items on scales ranging from 0 (*Strongly disagree*) - 100 (*Strongly agree*) measuring how skeptical people were about the severity of COVID-19 (e.g. "Most people are overreacting to COVID-19.") (α = 0.93).

Difference Score. After reading the messages, participants indicated how often they intended to engage in the three behaviors listed in the message the next time they left their place

of residence. We calculated the difference between the intended actions and reported past actions for each activity, and the main dependent variable was the average of these three differences (Mean = 5, Median = 7).

Results

We ran the same regression model as in Study 3 to identify which messages caused a greater increase in intentions to engage in preventative behaviors. The most persuasive message was Message #6 (β = 2.47, p = .02), though the effect size was small. No other messages were significantly more persuasive than the active control (Table 3).

Most of the effect was driven by individuals low in skepticism about COVID-19. Among participants with skepticism rating below 50, those who viewed Message #6 (β = 3.49, p = .03) and Message #15 (β = 3.08, p = 0.05) reported a greater increase in intentions to comply. There was no significant effect of any message among participants with skepticism scores greater than 50.

Discussion

Message #6, which was most persuasive in Studies 1 and 2, was significantly more persuasive than the control message. There are several reasons why results of Study 4 may have differed from Study 3. First, the messages called for more relevant behaviors, whereas Study 3 messages may have contradicted other information respondents were receiving. Second, cases were rising when Study 4 was in field (CDC, 2020), so it may have seemed more realistic that hospitals could be overwhelmed.

Study 5

Given the different effects in Study 3 and 4, we conducted a replication of Study 4, featuring only Message #6 and the active control. This study was also pre-registered (See https://osf.io/eqr4w/).

Method

Design and Participants

This study used a two-condition, between-subjects design. Otherwise, the procedure was the same as Study 4. We expected a small effect size, so using G*Power, we found that 620 participants would allow us to detect an effect size of Cohen's d = 0.2 (80% power, alpha = 0.05).

The study was fielded on Mechanical Turk from July 14-15, 2020, when then number of new COVID-19 cases reported per day was increasing rapidly(CDC, 2020). Of the 1212 participants who began the survey, 648 passed the filter, 597 responded correctly to the end attention check, and 568 spent over 2 second reading the message. There was no differential attrition between conditions after excluding participants (52% male, median age = 34, 46% conservative, 36% liberal, 18% moderate).

Results and Discussion

Using the same multiple linear regression as Study 4, Message #6 was not significantly more persuasive than the control (Table 3).

Though we conducted the study under nearly identical conditions approximately two weeks later, we did not find a significant effect of Message #6 on increase in intentions to comply. This may be because the earlier evidence for Message #6 were false positives. Alternatively, other changes in the world -- e.g., rising political polarization in views of

preventative behaviors, crystallization of Americans' views of the pandemic -- may have led this message to no longer cause an increase in intentions to engage in preventative behaviors in this study paradigm.

Table 3: *Regression from Study 4 and 5, Difference Score as Outcome*

Variable	**Study 4**	**Study 5**
Message 6	2.47* (1.08)	-0.765 (0.89)
Message 7	0.52 (1.07)	--
Message 15	1.76 (1.08)	--
Message 0	1.11 (1.08)	--
Normalized Age	-0.21 (0.328)	2.82 (0.5)
Gender: Male	-1.44* (0.69)	-2.64** (0.91)
Education: HS or less	2.7* (1.25)	1.45 (1.64)
Education: Some college	2.35** (0.85)	1.00 (1.15)
Education: Post-graduate	0.66 (0.94)	1.27 (1.27)
Race: Asian	2.56* (1.25)	1.41 (1.57)
Race: Black	0.584 (1.12)	1.12 (1.41)
Race: Hispanic	0.62 (1.77)	3.96 (1.73)
Race: Other	-1.92 (3.07)	4.84 (5.35)
Income	-6.24e-06 (7.99e-06)	2.5e-6 (9.4e-6)
R-squared	**0.01**	**0.003**
Number of observations	**1427**	**568**

* p < .05; ** p < .01, *** p < .001
Standard errors are shown in parentheses.

General Discussion

Across three between-subjects tests of the effects of four short messages, we find that changes in framing do not significantly affect participants' intentions to increase compliance

with public health guidelines. This is likely because of the density of the information environment surrounding COVID-19. Coronavirus was in the news constantly for five months and was impacting the lives of almost every American. In this saturated information environment, differences in framing of one short message may not be not strong enough to be persuasive.

Message #6, which emphasized civic responsibility to reciprocate sacrifices made by healthcare workers, was rated most persuasive in Studies 1 and 2 out of 24 and 56 messages, respectively. It also showed a small effect in Study 4. However, critically, it did not show an effect in a pre-registered replication study. We can only speculate as to why this message was not more consistently persuasive. As above, we speculate that it may not have been a true effect, or it may have been a true effect that was very sensitive to a changing environment. It is also possible that it was a true effect early in the pandemic, but now no short messages are persuasive due to crystallization of views. This is consistent with a study (Jordan et al., 2020) finding an effect of prosocial messages early in the pandemic, but it did not replicate several weeks later.

Types of people find short messages convincing

Our results also suggest that there are certain types of individuals for whom reading any short message outlining key behaviors for preventing the spread of COVID-19 is convincing. We found that women reported greater increases in intentions to comply after reading any message than men, and that liberals more than conservatives. Also, people who were skeptical of the severity of COVID-19 were, on average, less persuaded by any short message (See Supplementary Materials). However, these results may have been due to social desirability bias.

Limitations

A major limitation is that we tested very short messages in a dense information environment. A more vivid delivery of one or more of the messages, in-person delivery through a one-on-one conversation (Broockman & Kalla, 2016), or receiving the message from a credible source (Turner et al., 1987) might have been more persuasive than the short, decontextualized message studied here. Also, we relied on self-reports of intended and past behaviors. Despite our care to include active controls in all studies, our dependent variable may still be susceptible to social desirability bias.

A third limitation is that the pandemic affected different regions of the country at different points in time, and health guidelines varied substantially by region. It is possible that some messages caused an increase in intentions to engage in preventative behaviors in certain regions at certain times, but not others. For example, messages emphasizing the potential for hospitals to become overcrowded may have been plausible in a region where hospitalizations were increasing, but implausible in another region where hospitals were laying off staff. Our studies were not powered to analyze regional differences.

Conclusion

Throughout the months we ran these experiments, public health guidelines, the spread of the disease, and public opinion changed rapidly. The number of known COVID-19 cases in the United States increased by over 3 million; the number of deaths due to COVID-19 tragically increased to over 140,000. Some states instituted stay-at-home order early on, some later in the pandemic, and some never did. Wearing a face mask was at first discouraged, then recommended by the CDC, and continuously politicized throughout the following months. Some Governors made it mandatory to wear a face covering, some Governors banned cities from requiring face

coverings. In the midst of running the studies, millions of Americans participated in Black Lives Matter protests that formed what may be the largest movement, in terms of number of people participating, in US history (Buchanan et al., 2020). The studies in this paper provide a snapshot of the effects of public health messaging during such a rapidly changing, global pandemic.

Across five studies conducted throughout five months of the coronavirus pandemic, results on the persuasiveness of message frames were inconsistent. We generally found that the highest performing message highlighted reciprocity towards healthcare workers, but this effect did not replicate in the final study. It is possible that messages that are more vivid, more frequent, or from more credible sources would be more effective at increasing intentions to engage in preventative behaviors. These findings suggest that short messages are largely incapable of affecting compliance in the advanced stages of the pandemic.

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