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ARTICLE

Most people would use cell phones despite an emergency request for a pause

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Abstract
In three between-subject experiments, involving a total of 3180 participants, the majority of respondents indicated that during a weather emergency they would continue to use high bandwidth functions after receiving a text message requesting only emergency use. Projected excess demand for bandwidth could bring down the cellular communication network in the affected area. Messages incorporating an appeal to altruism, the incentive of a reduced phone bill, and the disincentive of an imminent collapse of the network for 24 hours all had no effect on intentions to use high bandwidth functions. Younger respondents and male respondents were less compliant than older respondents and female respondents. Their responses imply that an increasing number of individuals view even a brief separation from their cell phone as an existential threat that overrides other concerns including empathy for people in life-threatening circumstances.

Keywords: altruism; compliance; alerts; cell phone use; public alert and warning systems; emergencies; disasters

Introduction

Altruistic behaviors may arise spontaneously out of concern for others or may be elicited by requests, emotional appeals, or the perception of social norms. Common goods, such as clean water or electrical power, may be constrained in temporary or prolonged emergencies such as drought or extreme temperatures, necessitating appeals for changed consumption. What kind of messaging effectively elicits altruistic reduction of use of a common good?

In an emergency, alerts may be broadcast to the general public to provide essential information and encourage mass action in order to save lives. However, in order for

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these programs to be effective, the alerts must arrive and be influential when they are received. This article reports a behavioral threat to the entire alert system.

Today, 96% of Americans own a cellular phone (Pew Research Center, 2019). In disasters, the use of cell phones for calls and other functions often rises to a level that overwhelms the cell towers transmitting the calls, causing system failure. This impedes emergency response efforts because calls for assistance cannot get through (Marchetti, 2010; Miranda *et al.*, 2016). The causal role of excess demand on network failure is well documented by the experiences of fans in stadiums, who found that they could not all use their phones simultaneously (Friday, 2020). The increase in cell phone traffic in an emergency has been documented by its effect on twitter. Analysis of over 13 million Twitter posts before, during, and after Hurricane Sandy (Pourebrahim *et al.*, 2019), in the coastal areas most affected, found that volume of unique messages and users peaked shortly before first landfall and again, more dramatically, during the impact.

This situation has recently grown worse because an emergency can now elicit not only a frenzy of understandable but non-essential calls and social media posts, but also photo and video uploads that demand very high bandwidth. Even though emergency responders may have access to dedicated wireless spectrum that is independent of cell phone spectrum, the search and rescue efforts in recent disasters included volunteers using cell phones to save lives (Wax-Thibodeaux, 2017). Consequently, limiting cell phone use to essential needs in emergencies is important.

Emergencies alter both network capacity and demand, in opposite directions. Physical damage to towers degrades the network, reducing its capacity (Allen, 2012; Alonso *et al.*, 2014) causing network failure (Suciu, 2013; Chakchouk, 2015). However, the more important factor determining whether the capacity of a system will be exceeded is demand, because cell phone networks are constructed under the assumption that less than 100% of the local population will attempt cell phone use at the same time so any event that elicits widespread simultaneous cell phone use threatens to exceed the capacity of the system.

The most important factor in demand on a cell tower is the bandwidth requirements of the functions that consumers attempt to use. Texting requires so little processing capacity that 100% of users texting would not exceed the capacity of the network. Voice calls require more than 10 times the capacity needed for text. Uploading pictures (Asheralieva and Mahata, 2014), requires more than 1000 times the capacity needed for voice calls. Uploading video requires more than 10 times the capacity needed for pictures (Asheralieva and Mahata, 2014).

However, system failures due to excess demand in the pre-cell phone era, in Washington D C in 1963 immediately after the Kennedy assassination (Manchester, 1967) and in New York City in 1965 during a black out (New York Times, 1965; Daugherty, 2015), demonstrate that if a sufficient number of users pick up the phone, phone calling alone is sufficient to overwhelm system capacity. The orders of magnitude greater requirements of photos and videos imply that the percent of photo takers or video watchers or recordings is a small percent of the number of callers required to overwhelm the system.

The purpose of this study was to determine whether an alert would induce phone users to refrain from all activities that threatened the system; calls, photos and videos,

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in order to insure that it was available for emergency relief. Therefore, compliance was treated as a dichotomous variable. If a phone user reported that they would make a call, take a photo, or view or take a video after an alert they were categorized as noncompliant. Otherwise, they were categorized as compliant.

Questions about compliance with alert messages have focused exclusively on alert messages that warn an individual of a threat to their person (Bean *et al.*, 2015; Reuter *et al.*, 2017; Tana *et al.*, 2017). Previous messages asked recipients to take self-protective actions such as leaving a danger zone (Casteel and Downing, 2016) or taking shelter (Wood *et al.*, 2018). When Wood *et al.* (2018) presented participants with four such alert warnings, in face-to-face interviews, the participants reported they would most likely be compliant with the longest and most informative alert. Sadiq *et al.* (2023) performed a comprehensive review of experimental studies of the effectiveness of alerts. Overall, they found that the wording of the alert influenced compliance. For example, Jauernic and Broeke (2017) studied how U.S. responded to and perceived tornado warnings. They found that myths about tornadoes negatively influenced the perceptions of risk of undergraduates at a university in Nebraska. Consequently, it was common among students to seek confirmatory information about tornado risk before seeking shelter, and some students said they would not seek shelter after receiving a warning. Gutter *et al.* (2018) examined the relationship between severe weather watches for thunderstorms tornados and a particularly dangerous situation (PDS) tornado. Unfortunately, the response required, stopping the ongoing activity and seeking shelter, was negatively correlated with the level of risk described in the alert. They suggested that the likelihood of an outcome may influence compliance and more severe weather conditions are less likely than less severe conditions. Compliance was somewhat improved when alerts were sufficiently long to contain detailed, impactful language about the emergency. Casteel (2018) found that individuals had higher sheltering intentions when the warning contained stronger impact language. Rehman *et al.* (2020) examined the impact of text message alerts on miners' evacuation decisions and found that the alert message content, such as more detail about how urgent the situation was, increased the likelihood of miners evacuating.

This study addressed compliance with an emergency alert request to refrain from non-emergency cell phone use during a disaster. This request was different from other emergency alerts in one significant way. Many alerts, whether instructing someone to shelter in place or evacuate, ask the recipient to perform an action for their own benefit. Refraining from cell phone use is done to benefit others by keeping the lines of communication open. In this case, motivation for compliance is altruistic, rather than self-protective.

Weather emergencies were chosen because they are common, annual events and their effects often include damage to the power grid and communications infrastructure that has in the past led to communications blackouts (Chakchouk, 2015). We conducted three experiments that were similar in method and results. A participant saw an emergency alert requesting that the recipient refrain from all cell phone use except text messaging. The participant was then asked for each of five often-used, high bandwidth functions – navigation, streaming video, social media, recording video, and taking pictures – whether they would use the function after receiving the alert.

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Since the motivation for compliance with the alert request had to be altruistic, a version of the alert request that emphasized the altruistic purpose was included in the study. As mentioned above, previous studies of internet requests had found that altruistic requests produced the same phenomenon as face-to-face requests, including the foot in the door effect, acceding to a small request increases the likelihood that an individual will accede to a larger request from the same source, (Gueguen and Jacob, 2002) and door in the face effect (when a large, even unreasonable request is made, even if the request is rejected, it increases the likelihood that a smaller, reasonable request, will be acceded to), (Eastwick and Gardner, 2008). Research on face-to-face altruistic requests had found that information eliciting altruism (Foehl and Goldman, 1983; Rubin and Shaffer, 1987) increased compliance with the request. Therefore, the initial hypothesis was that alert requests describing the benefits of the altruistic act would elicit high levels of compliance.

Hypothesis

There is no point in ineffective alerts directing the public during an emergency. The purpose of this study was to fill the evidence gap for the effectiveness of alerts. We believed that how an alert was written would affect would affect readers' predictions of their compliance in an actual emergency. Specifically, our hypothesis was that a message highlighting the benefit to others from briefly refraining from cell phone use would increase compliance over a message in which no rationale was provided.

Experiments 1 and 2 examined whether providing a rationale for the alert request and/or an appeal to altruism would increase compliance with an alert. Experiment 3 examined whether incentives or disincentives mentioned in an alert influenced compliance and whether compliance with an alert by a participant was related to their general level of altruistic behavior.

Method

The study was approved by the university Institutional Review Board. The study was not preregistered. To present the three experiments in a clear and concise manner first a general method will be presented, then for each experiment the specific methodological details and results will be presented.

Participants

The population, number, ages, and gender of participants are shown in Table 1. Ethnicity data was not collected. Undergraduates participated in Experiment 1 for course credit. Participants in all other experiments received $.50–$1 for participating online on Mechanical Turk depending on the length of the questionnaire. The Mechanical Turk sample was restricted to the US. Participants had completed at least 500 hits (previous online tasks) with a 95% acceptance rate. A review of the literature indicated that Mechanical Turk surveys provide reliable results similar to in-person studies (Berinsky *et al.*, 2012; Paolacci and Chandler, 2014; Hauser and Schwarz, 2016). For this particular experiment Mechanical Turk was uniquely suitable because we were interested in compliance with broadcast online alert requests.

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Table 1. Number (and percent) of participants in each age range and gender in each experiment

Experiment	Gender	18–25	26–30	31–45	46–70	Total	Population
1		207				207	Undergrad
2	Male	84(17)	132(27)	212(44)	57(12)	485 (54)	MTurk
	Female	61(15)	88(21.5)	170 (42)	88 (2.5)	407(46)	
3	Male	205 (22)	237 (25)	360 (38)	145 (15)	947 (46)	MTurk
	Female	231 (20)	281 (25)	407 (36)	215 (19)	1134 (54)	

Participants who failed the attention check are not included. Gender was not recorded in Experiment 1.

Table 2. Sequence of screens in three experiments

Screen	One	Two	Three
Informed consent statement	x	x	x
Instructions & alert	x	x	x
Question about cell phone use	x	x	x
Attention check		x	x
Gender		x	x
Age		x	x
Two questions on altruism			x
Question on religious observance			x

Procedure

Table 2 shows the sequence of screens that participants saw.

On the first screen of the online survey, participants read the informed consent statement and indicated consent. On the second screen the instructions below were presented along with one of the alerts. The words in the brackets did not appear in the instructions for Experiment 1 but did appear in the instructions for Experiments 2 and 3:

> *The purpose of this study is to ask people like you to predict how they would respond in an emergency[, such as Hurricane Sandy]. Imagine that you have received the following alert on your cell phone. Let us know how you would respond by answering the questions that follow.*

On the same page was a simulated text alert during an emergency asking the reader to refrain from cell phone use. In all experiments participants were randomly assigned to view one of several different alert messages using Qualtrics' randomizing feature. On the subsequent screen the following instructions appeared:

> *Please indicate the cell phone functions that you think you* ***WOULD USE*** *after receiving an emergency alert and request such as the one described above. Please mark any that apply.*
>
> *Using the phone's navigation system*

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Streaming a video on YouTube
Using social media, such as Instagram
Recording a video
Taking a picture

On the subsequent screen, Experiments 2 and 3 contained an attention check, which directs the participant to select a particular response; such as, select *purple* from the alternatives below. If the attention check was failed, the survey was immediately terminated for that participant and the other responses of the participant were not included in the analysis.

Twenty participants in Experiment 2 and 32 participants in Experiment 3 failed the attention check and were excluded from the analysis.

Next, on separate screens, participants were asked to indicate their gender and age in Experiments 2 and 3. Through an oversight, these screens were omitted in Experiment 1.

Finally, in Experiment 3, participants answered three final questions, on three separate screens, that assessed their degree of altruism. Two questions were derived from the Rushton *et al.* (1981) Self-Report Altruism Scale (*I have allowed someone to go ahead of me in a line; I have given blood*). Participants responded on a 1–5 scale from *Never* to *Very Often*. The third question was suggested by Brooks (2006), who found that people who regularly attended religious services reported a higher level of a variety of altruistic activities, including giving blood. The third question (*I attend religious services*) was responded to on a 1–5 scale from *Almost Never* to *Every Week*.

Alerts used in each experiment

The six alerts shown in Experiment 1 are shown in Table 3. All alert messages contained a rationale for the request to refrain for cell phone use. Half of the alerts made an appeal to the altruism of the individual receiving the message. Also, the alerts varied in the specificity of the time interval over which the individual was asked to refrain from most cell phone use. Two of the alerts specified 4 hours, two of the alerts specified until further notice and two alerts did not mention the duration of the period to which the request applied.

The four alerts used in Experiment 2 are shown in Table 4. They varied on whether they provided a rationale for the request, e.g., 'First responders need network capacity to help storm victims', whether they made an appeal to altruism, e.g., 'By reducing non-emergency cell phone use, you help others' and by the length of message.

The six alerts used in Experiment 3 are shown in Table 5. Half of the alerts requested that the recipient refrain from cell phone use (Refrain) and half of the alerts requested that the recipient participate in a voluntary network transmitting text messages (Participate). Two of the alerts made an appeal to altruism (appeal), two of the alerts offered a 50% reduction on the next phone bill for compliance (Reward) and two of the alerts predicted collapse of the network for 24 hours if there was noncompliance (Punishment).

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Table 3. The alert messages presented in Experiment 1 (number of characters)

Appeal	Four hours	Until further notice	No duration specified
Yes	**Alert** Please do not use your cell phone in any way for the next four hours. Due to the hurricane that has struck our community, emergency personnel are having difficulty retrieving stranded and injured survivors and require all broadband bandwidth to contact them rapidly. By refraining from all cell phone use, you are personally assisting the efficient retrieval and aid of these victims. Thank you for your kindness and cooperation. (439)	**Alert** Please do not use your cell phone in any way until further notice. Due to the hurricane that has struck our community, emergency personnel are having difficulty retrieving stranded and injured survivors and require all broadband bandwidth to contact them rapidly. By refraining from all cell phone use, you are personally assisting the efficient retrieval and aid of these victims. Thank you for your kindness and cooperation. (437)	**Alert** Please do not use your cell phone in any way. Due to the hurricane that has struck our community, emergency personnel are having difficulty retrieving stranded and injured survivors and require all broadband bandwidth to contact them rapidly. By refraining from all cell phone use, you are personally assisting the efficient retrieval and aid of these victims. Thank you for your kindness and cooperation. (416)
No	**Alert** Please do not use your cell phone in any way for the next four hours. Emergency services require all broadband bandwidth due to the current weather conditions. Thank you for your cooperation. (201)	**Alert** Please do not use your cell phone in any way until further notice. Emergency services require all broadband bandwidth due to the current weather conditions. Thank you for your cooperation. (199)	**Alert** Please do not use your cell phone in any way. Emergency services require all broadband bandwidth due to the current weather conditions. Thank you for your cooperation. (179)

Table 4. The alert messages presented in Experiment 2 (number of characters)

Alert type	Text
No appeal; no rationale	**Alert** [A hurricane has struck our community!] Do not use your cell phone except to call 911 or to send texts. (74) Words in brackets appeared for 101 of 400 participants who saw the alert.
Appeal; rationale; short	**Alert** Do not use cell phones except to call 911 or to text. First responders need network capacity to help storm victims. By reducing non-emergency cell phone use, you help others. (184)
No appeal; rationale	**Alert** A hurricane has struck our community! Emergency services require all broadband bandwidth In order to reach the maximum number of victims in the shortest amount of time. Please do not use your phone in any way until further notice, except to call 911 or to send text messages. (289)
Appeal; rationale; long	**Alert** A hurricane has struck our community! Emergency services require all broadband bandwidth in order to reach the maximum number of victims in the shortest amount of time. Please do not use your phone in any way until further notice, except to call 911 or to send text messages. By refraining from all cell phone use, you are personally assisting the efficient retrieval and aid of these victims. (405)

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Table 5. The alert messages presented in Experiment 2 (number of characters)

Alert type	Text
Refrain, appeal	**Alert** [You have been identified as a cell phone user in an area where] all available cellular bandwidth needs to be reserved for emergency use. [Will you assist rescue efforts by agreeing to] refrain from cell phone use for the next four hours except to call 911 or to send text messages? Your cooperation can help save lives. (219) Material in brackets appeared in 425 of 625 messages.
Participate, appeal	**Alert** You have been identified as a cell phone user who can serve as a hub in a local area cellular network, by receiving and forwarding text messages from users whose service is compromised. Will you assist rescue efforts by agreeing to use your cell phone for no other purpose than transmitting emergency messages for the next four hours? Respond 'C' to confirm your willingness to assist for a four hour period. Your cooperation can help save lives. (459)
Refrain, reward	**Alert** You have been identified as a cell phone user in an area where all available cellular bandwidth needs to be reserved for emergency use. Will you assist rescue efforts by agreeing to refrain from cell phone use for the next four hours except to call 911 or to send text messages? For your cooperation you will receive a 50% reduction on the basic charge of your next phone bill. (390)
Participate, reward	**Alert** You have been identified as a cell phone user [who can serve as a hub] in a local area cellular network, by receiving and forwarding text messages from users whose service is compromised. Will you assist rescue efforts by agreeing to use your cell phone for no other purpose than transmitting emergency messages for the next four hours? Respond 'C' to confirm your willingness to assist. For your cooperation you will receive a 50% reduction on the basic charge of your next phone bill. (499)
Refrain, punishment	**Alert** You have been identified as a cell phone user in a damage area in which cell phone capacity has been reduced and the system is in damage of failure. Will you preserve the system for rescue efforts by agreeing to refrain from cell phone use for the next four hours except to call 911 or to send text messages? Without your cooperation your local area network may collapse and require up to 24 hours to restore. (422)
Participate, punishment	**Alert** You have been identified as a cell phone user in a damage area in which cell phone capacity has been reduced and the system is in damage of failure. You can preserve capacity in your local area network if you serve as a hub in a local area cellular network, by receiving and forwarding text messages from users whose service is compromised. Will you assist rescue efforts by agreeing to use your cell phone for no other purpose than transmitting emergency messages for the next four hours? Respond 'C' to confirm your willingness to assist. Without your cooperation your local area network may collapse and require up to 24 hours to restore. (654)

Results

As mentioned above, video requires ten times the capacity needed for pictures, which require three orders of magnitude more than voice calls (Asheralieva and Mahata, 2014). Consequently, when compared with the number of simultaneous phone calls required to overwhelm capacity, the use of any one of the high bandwidth functions by a small fraction of that number would put the network at risk. Therefore, a single measure of compliance with the alert request was created that was set to 0, indicating noncompliance with the alert request, if a participant indicated that they would use one or more of the high bandwidth functions after receiving the alert. The measure of compliance was set to 1, indicating compliance, if a participant indicated that

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Table 6. Use of high bandwidth cell phone function after alert

Function	Percent of participants responding they would use function		
	Exp. 1	Exp. 2	Exp. 3
Navigation	30	26	35
Stream video	17	15	12
Social media	35	23	21
Record video	30	29	23
Take picture	48	49	33
Any function	68	62	55

Any Function is the percent of participants who mentioned the use of at least one high bandwidth cell phone function after receiving the alert

none of the high bandwidth functions would be used after receiving the alert. Since, the response was a 0/1 measure, noncompliance versus compliance, logistic regression, which was specifically created for 0/1 response data, was the appropriate analysis procedure. In logistic regression, the odds ratio is computed, which in this study was the relative increase in compliance caused by the experimental treatment compared with the compliance in the control condition. The value of the odds ratio is indicated by Exp(B) in Tables 7–9. When value of Exp(B) is less than 1, the effect of the experimental treatment is so small that it is inconsequential, even if the effect is significant.

Faul *et al.* (2007) describe a method for computing the power of a sample of a specific size for detecting a significant difference for an odds ratio of a specific size. This method was used, employing their G*Power software, to obtain the power values described below. SPSS was used to perform all of the analyses described in this report.

For each high bandwidth function, Table 6 shows the percent of participants who reported they would use that function after receiving the alert. It also shows the percent of participants, 55%–62%, who would not comply with the alert. That is, they would use at least one function.

For Experiment 1, we used logistic regression to predict compliance from the Appeal Content and Time variables. Appeal Content had 2 levels: Simple rationale and appeal to altruism. Time had three levels: Time = 0 when no duration for the interval for refraining from cell phone use was mentioned, Time = 1 when 'until further notice' was the duration of the interval for refraining from cell phone use, and Time = 2 when 'for four hours' was the duration of the interval for refraining from cell phone use. As shown in Table 7, neither Appeal Content nor Time entered the logistic regression equation significantly; however the power for their odds ratios at that sample size was low. There was no more than a 10% chance of detecting significance.

Even if the effects of Appeal and Time were both significant in a larger sample it would remain the case that about two-thirds of college students were noncompliant with the alert request regardless of the wording of the message, as shown in Table 6. Before the experiment was performed, the experimenters were concerned that since it cost a participant nothing to report that they would comply with an emergency alert request, compliance would be uniformly high across conditions. The results were the opposite. Furthermore, this result was obtained despite an attempt to elicit an altruistic

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Table 7. Logistic regression for Experiment 1

Variable	B	S.E.	Wald	df	p	Exp(B)	95% CI
Appeal	−.066	299	049	1	824	.936	5, 1.7
Time				2	866		
Time (1)	077	365	045	1	832	1.080	5, 2.2
Time (2)	213	406	276	1	599	1.238	5, 2.8
Constant	−.819	334	6.015	1	014	441	

Table 8. Logistic regression for Experiment 2

Variable	B	S.E.	Wald	df	p	Exp(B)	95% CI
Rationale	.314	.283	1.228	1	.268	1.368	.7, 2.4
Appeal/altruism	−.367	.178	4.259	1	.039	.693	.5, 1.0
Length	.107	.105	1.041	1	.308	1.113	.9, 1.4
Gender	.107	.141	.571	1	.450	1.112	−.2, .5
Age	.249	.076	10.872	1	.001	1.283	1.1, 1.5
Constant	−1.599	.315	25.677	1	.000	.202	

response by cuing a recent experience of many of the participants, who had hardship during the occurrence of a recent hurricane. The hurricane closed the campus for a week, destroyed thousands of homes and left many areas without power for days. The various appeals mentioned a hurricane, to cue the vivid experience. This made the high level of noncompliance especially surprising.

Experiment 2 broadened both the age range and size of the sample. Participants were recruited from Americans enrolled on Mechanical Turk. For Experiment 2, three independent variables characterized message content: appeal, rationale, and length. Appeal = 0 when there was no appeal to altruism and appeal = 1 when there was an appeal to altruism. Rationale = 0 when no rationale for the alert request was included and rationale = 1 when a rationale was provided. Length = 1 to 4, indicated relative length among the four alerts, from shortest to longest. Gender and age described the participants.

Parameter values for the logistic regression are shown in Table 8. Only age and appeal (to altruism) entered the equation significantly. As the confidence interval for Exp(B) in Table 8 indicates, only the odds ratio for age was large enough to be meaningful.

As shown in Figure 1 (top), younger participants were less likely to be compliant than older participants. As shown in Figure 1 (bottom), consistent with the value of Exp(B), even though the effect of appeal was significant, appeal did not have a consistent or large enough effect to be meaningful. Only participants older than 45 were more likely to be compliant with a message making an appeal to altruism and this effect was not large. Regardless of the message, compliance was below 40% for participants no older than 45 years old and at or below 50% for participants above 45 years old regardless of whether the alert message contained an appeal to altruism. The effect of

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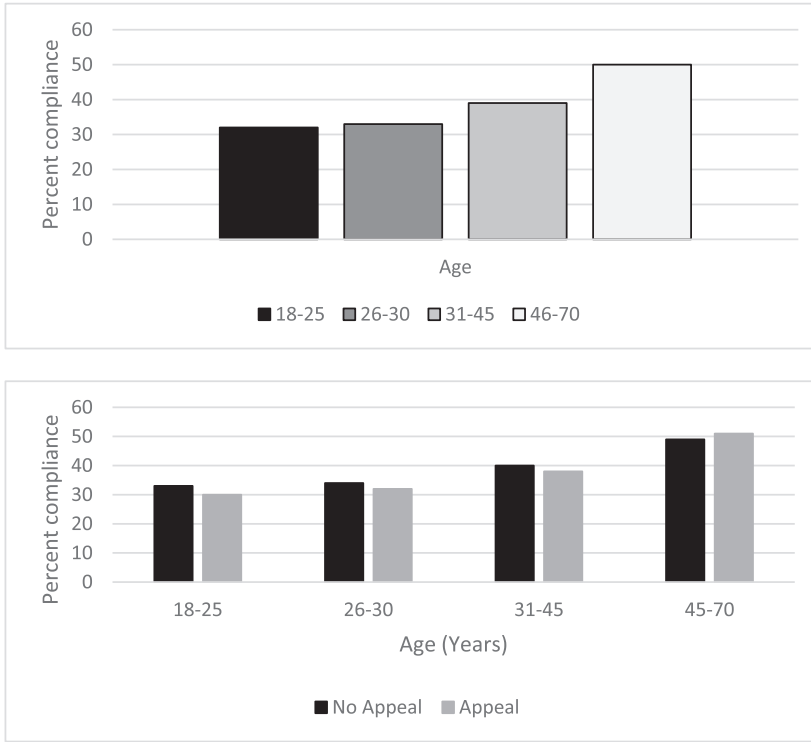


Figure 1. The effect of age (top) and age × appeal to altruism (bottom) on compliance in Experiment 2.

age was significant and the confidence interval was that as age increased, the increase in compliance was in a range from 10% to 50%.

The power of Experiment 2 to detect an odds ratio of 1.3 was only 50% and less for smaller odds ratios. Consequently, in a larger sample the effects of rationale, length, and gender may have been significant. However, the low power is as much an effect of the small odds ratio as the sample size. Again, if the sample size were increased to the point at which insignificant small odds ratios were significant, it would still be the case that these variables did not produce meaningful differences in Compliance. Compliance varied from 32% for the youngest participants to 50% for the oldest participants. For all participants, it was 38%.

Two possible explanations for the results were tested in Experiment 3. The habit hypothesis is that individuals suffer from anxiety when they try to refrain from habitual cell phone activities so that they knew they would continue to engage in these activities even when asked to refrain. (Rosen *et al.*, 2012).

The habit hypothesis was tested in two ways. First, the alert message contained either a personal incentive for compliance with the alert, a 50% reduction on the next phone bill, or a disincentive for noncompliance, loss of service in the short term. Insensitivity to reward has been used as the definition of habitual behavior (Knowlton and Patterson, 2018). If cell phone activity were habitual then the contingent consequences would be

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ineffective. Second, if individuals are noncompliant because they are unable to stop using their cell phones, then they may be more compliant with a request requiring them to use their cell phones, such as a request to forward text messages to individuals in their local area.

The lack of empathy hypothesis is that today many individuals, especially young people, do not have empathy for strangers. To determine the general level of empathy for strangers, participants were asked two questions about their frequency of altruistic acts: letting a stranger go ahead of them in line and giving blood. Participants were also asked how frequently they attended religious services because altruistic behavior had been found to be positively correlated with attendance at religious services (Brooks, 2006). Responses to the three questions were uncorrelated, as confirmed by a Cronbach's alpha of .06.

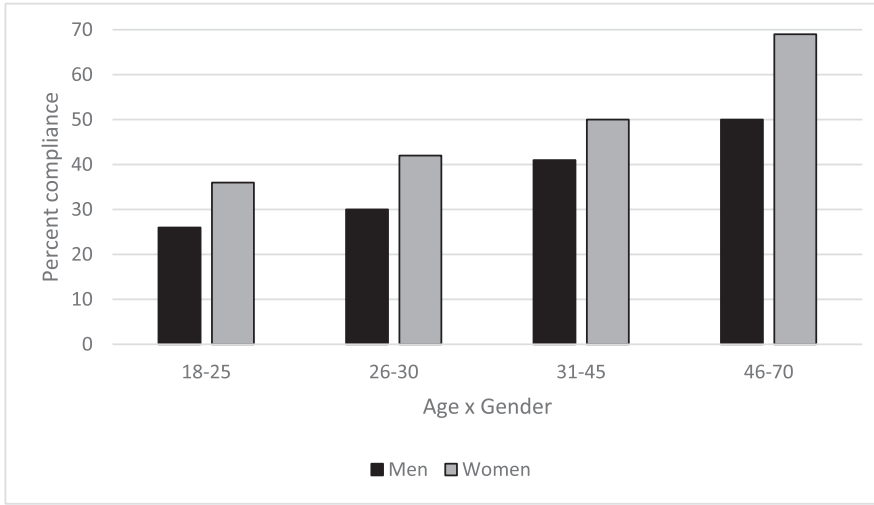
The seven independent variables used in a logistic regression analysis to predict the dependent variable Compliance were semantic features of the alerts and demographic features of the participants. The categorical variable Action described different requested changes of cell phone use: Action = 1 when the message request was to refrain from cell phone use and Action = 2 when the message request was to participate in a text message forwarding network. The categorical variable Consequence described different prompts for compliance in the alert message: Consequence = 1 when there was an appeal to altruism, Consequence = 2 when the incentive of a 50% reduction in the next phone bill was offered and Consequence = 3 when the disincentive of a collapse of the network for 24 hours was threatened.

Three of the variables were the self-reported frequencies of various behaviors of the participants: Line Deference was the reported frequency of permitting someone to go ahead of them in line. Blood Donation was the reported frequency that the participant gave blood. Religious Attendance was the reported frequency with which the participant attended religious services.

The results of the logistic regression analysis are shown in Table 9. Neither Action nor Consequence entered the equation significantly. This time, power of the sample varied from .82 for the smallest effect to .99 for the largest effect. Therefore, consistent with the results of the previous experiments, the wording of the alert messages had little or no effect on compliance. The five variables encoding participant characteristics and behaviors all entered the equation significantly. The effects of these variables are shown in Figure 2. Women were less likely to use a high bandwidth cell phone function following an alert than men and older participants were less likely to use a high bandwidth cell phone function following an alert than younger participants. Participants who were more likely to let someone go ahead of them in line were less likely to use a high bandwidth cell phone function following an alert. However, as shown in Figure 2, participants who had *never* given blood were less likely to use a high bandwidth cell phone function following an alert and participants who did *not* attend religious services were less likely to use a high bandwidth cell phone function following an alert!

The results were consistent with the findings of the previous experiments that over 50% of respondents would use a high bandwidth cell phone function after receiving an alert message during an emergency asking them to refrain from all cell phone

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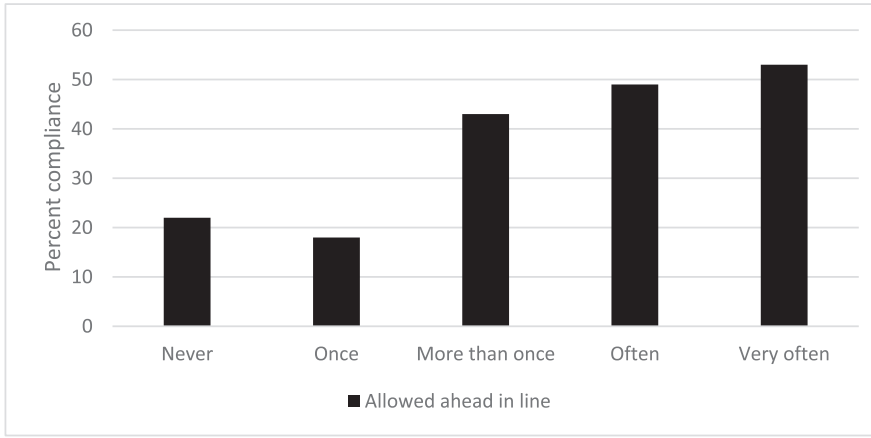


Figure 2. Results of Experiment 3. The effect of age × gender (top) on compliance. the relationship of willingness to let someone ahead in line (second), willingness to give blood (third), and frequency of attendance at religious service on compliance.

use except text messaging. Older and female participants were more compliant than younger or male participants.

Discussion

These results are surprising and dispiriting. Humans are the most social creatures that have ever existed and that is the reason that humans dominate their world (Tomasello, 2009). The advantages of social organization, hence of coordinated social action, were

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Table 9. Logistic regression for Experiment 3

Variable	B	S.E.	Wald	df	p	Exp(B)	95% CI
Action	.098	.095	1.069	1	.301	1.103	−9, 1.3
Consequence			3.289	2	.193		
Consequence (1)	−.091	.184	.245	1	.620	.913	.6, 1.3
Consequence (2)	.143	.142	1.008	1	.315	1.153	.9, 1.5
Gender	.446	.095	22.094	1	.000	1.562	1.3, 1.9
Age	.376	.048	61.183	1	.000	1.457	1.3, 1.6
Line altruism	.308	.060	26.333	1	.000	1.361	1.2, 1.5
Blood donation	−.175	.039	19.528	1	.000	.840	.8, .9
Religious attendance	.175	.033	28.052	1	.000	1.191	1.1, 1.3
Constant	−3.494	.354	97.708	1	.000	.030	

the engine that drove the rapid increases in human cognitive ability over the past three million years, initiated the invention of modern language, the adoption of technology, and the growth in the size of the human social group from the family to the tribe to the community to the society (Dunbar, 2013; Dunbar and Sutcliffe, 2013). One form of social behavior that reduces mortality is altruism. Altruism benefits everyone one individual at a time. For someone who lives alone, an injury that temporarily impedes hunting or food gathering is life threatening. For everyone who lives in a community practicing mutual care, such an injury is a temporary annoyance.

Nevertheless, when people of today's society were asked whether they would refrain from personal cell phone use for a few hours in order to keep open lines of communication during a life-threatening emergency, most indicated that they would not do so.

One benign explanation is that respondents were inaccurate in predicting their actual response in an emergency. Lapiere (1934) is a precedent for this. However it involved a face-to-face social situation as well as the opportunity for financial gain; in contrast, the decision to follow the instructions of an alert is anonymous and provides no immediate benefit to the respondent. Furthermore, Lapiere (1934) demonstrated that people are not always accurate in predicting their social behavior. It did not demonstrate a general tendency towards pro-social behavior. Lapiere (1934) found that few motel desk clerks who reported they would deny a room to Chinese–American travelers actually did so, thus under predicting a pro-social behavior, In contrast, Ferrari and Leippe (1992) found that few students who reported an intention to donate blood at an imminent blood drive actually did so, thus over predicting a pro-social behavior. Hence, the Lapiere (1934) finding was specific to its circumstances.

A second explanation is that a text message is an ineffective method of eliciting feelings of altruism, hence of altruistic behavior.

Hein *et al.* (2015) found that empathy for strangers resulted from personal contact with strangers. Together, the results of the three experiments indicated that the lack of personal contact implicit in internet contact resulted in a reduction in empathy for strangers known only through the internet, hence a reduction in compliance with a request for an altruistic response.

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Furthermore, Gugeguen and Jacob (2002A) found that an email from a student to fellow students soliciting an altruistic action was more effective when it contained a picture of the solicitor and Gugeguen and Jacob (2002B) found the email was ineffective when sent to strangers. Therefore, text messages may be less effective than face to face requests in eliciting altruistic behavior for some individuals (Guadagno and Cialdini, 2007; Guadagno *et al.*, 2013).

A third explanation is that cell phone activity has become habitual to the point that most individuals cannot conceive of ceasing cell phone activity for even a short period of time. The failure to find an effect of consequences on compliance is consistent with the habit hypothesis that most cell phone users are unwilling to refrain from cell phone use regardless of the outcome for themselves or for others (Knowlton and Patterson, 2018). Not only does nearly everyone have a cell phone, evidence is accumulating that many individuals make use of cell functions often and compulsively. A survey of Americans (Asurion, 2018) found that Americans check their phones an average of 80 times a day while on vacation, with some checking their phone more than 300 times each day. A survey of U.S. teens found that 72% of teens said they often or sometimes check for messages or notifications as soon as they wake up, while roughly 40% say they feel anxious when they do not have their cell phone with them (Pew Research Center, 2018). Overall, 56% of teens associated the absence of their cell phone with at least one of these three emotions: loneliness, being upset or feeling anxious. For some users, cell phone use is virtually continuous so that distracted walking has become a public health problem (Mourra *et al.*, 2020). Twenty percent of Americans reported they would rather give up shoes, 33% reported they would rather give up sex, and 70% reported they would rather give up alcohol for a week then give up their cell phone for a week (TelNav, 2011). A survey that used an international sample found similar results (Money Talks, 2015). Furthermore, problematic cell phone use is associated with narcissism (Casale and Banchi, 2020), which is consistent with the noncompliance with the request to refrain from cell phone use.

A fourth explanation may be that many individuals doubt the likelihood of the severity of oncoming weather event even when the severity is explicitly stated in an alert when an event of that severity is outside of their personal experience. There is some evidence supporting this hypothesis from other studies of weather alerts (Jauernic and Broeke, 2017; Gutter *et al.*, 2018). However, most of alerts in Experiment 1 mentioned a hurricane and many of the participants in the experiment had personally experienced the effects of a devastating hurricane. Yet these alerts did not elicit heightened compliance.

The lack of willingness to join a text messaging network during an emergency shows that merely allowing participants to use their cell phones for some purpose, i.e., text messaging, is not sufficient for them to refrain from other functions. It is specific functions of the cell phone use, rather than cell phone use in general, that is habitual. There may be both social factors such as fear of missing out (Fabris *et al.*, 2020; Muller *et al.*, 2020; Wolniewicz *et al.*, 2020), and cognitive factors, such as impulsivity (Chen *et al.*, 2020), that influence the development of the habitual use of different cell phone functions.

Yet another factor may reflect a societal vulnerability arising from needs for coordinating activities – individual decisions and behaviors – that are not compelled by

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law and enforced by surveillance and sanctions. An individual may correctly assume that their action will have a minuscule effect on a collective outcome and depend on others to make cooperative decisions for the greater good. Ullmann-Margalit (1976) points out that a societal expectation of some individual sacrifice or inconvenience for achievement or maintenance of a collective good – a cooperation norm – is vulnerable to free-riding. Smartphones were introduced to consumers with limited features in 1994. As multiple functions have become available on phones – navigation, purchasing, job application, job interviewing, quiz and test taking among many – norms around constant access to phones and their functions, that are not necessarily pathological, may have emerged.

As shown in Figure 2, willingness to refrain from cell phone use was positively correlated with willingness to let someone into a line ahead of them, suggesting that compliance with the alert message was related to some other altruistic behaviors. However, letting someone in line is the least effortful and burdensome of the three behaviors surveyed. The responses to the other two questions assessing altruism complicate the picture. Participants who never gave blood and participants who seldom or never attended religious services were more compliant with the alert message than participants who gave blood or who attended religious services more often. Participants who attended religious services were more likely to give blood, $\chi^2(16) = 80$, $p < .001$ so this sample was representative (Brooks, 2006). We are at a loss to explain these results.

However, regardless of the willingness to perform other altruistic tasks, most individuals were noncompliant with the request to refrain from cell phone use. As shown in Figure 2, across all levels of the other altruistic activities queried 50% or more of the participants reported that they would use a high bandwidth cell phone function in an emergency despite a request to refrain from it.

Cell phone activity may be the activity that humans are least likely to give up. By creating a compelling virtual social network, cell phones may have severed social activity from its usual benefits by compelling humans to engage in a virtual social network at the cost of the wellbeing of actual humans (Brooks, 2022).

Perhaps, despite the entreaty from the alert, participants believed that their personal use of a high bandwidth activity would not make a meaningfulness difference on the load of the network and this rationalization justified what would be rationalized as a limited use of a high bandwidth activity. If this the case then an alert might be effective if it included the message, 'during this critical time, when the network is highly stressed by the storm, photos and videos from even a small number of cell phones may overwhelm the network so the compliance of every single individual in the affected area is important.'

The fact that the requested behavior did not benefit the participant initially seems to put the situation outside the discussion of Ullmann-Margalit (1978; 1990) on how norms resolve social interactions in which gain for one side produces loss for the other side. However, ever since Wilson (1975) raised the question of the evolutionary value of altruism, as mentioned at the beginning of this discussion, it has become clear that altruism has great value as a social insurance policy. At the cost of a short-term cost to the individual performing the altruistic act, the act establishes a norm that provides assurance to the individual that they would receive the same help if needed (Dunbar, 2013; Dunbar and Sutcliffe, 2013). As shown in Figure 2, altruistic behavior was more

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common in situations other than refraining from high band-width cell phone functions. Why should this be the case? Perhaps it is because another norm has already been established. This is that when something unusual occurs spontaneously, good or bad, one records it on their cell phone. Extreme storm activity is rare and dramatic, which may create social pressure for a record that is difficult to resist on the basis of a text alert.

Whatever the ultimate reason for the low level of compliance, the results of this study demonstrate that the effectiveness of an alert cannot be assumed so both laboratory, and, if possible, field testing is required to determine its effect.

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