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WEA Messages: Impact on Physiological, Emotional, Cognitive and Behavioral Responses

June 2016

Homeland Security

Science and Technology

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Prepared for
Department of Homeland Security
Science and Technology Directorate, First Responders Group to support the Wireless Emergency Alerts (WEA) Research, Development, Test and Evaluation Program

Acknowledgements

We would like to thank our sponsor, the Department of Homeland Security, Science and Technology Directorate, for supporting this research. We greatly appreciate Program Manager Denis Gusty and his team for their support, direction and advice. In addition, we would like to extend our gratitude to Dr. Dennis Mileti and Dr. Michele Wood from the START project for sharing your expertise with us. Furthermore, we would like to thank the members of the research team for their countless hours of hard work and dedication to this project.

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HSSAI Publication Number: RP10-68-04

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Executive Summary

Effective alerts and warnings during a disaster protects people and saves lives. Over the past decade, mobile communication technologies have become ubiquitous. Disaster and emergency messages sent directly to end users has emerged as a promising new practice. In particular, short message service (SMS) text message formats have emerged as a modality that is both practical and popular as the majority of Americans now use smartphones. In regards to Department of Homeland Security (DHS) wireless emergency alerts (WEAs), these messages are pushed out through commercial mobile carriers to customers who are located geographically near the hazard, and newer smartphones are 'WEA enabled.'

While the WEA system and other SMS or text-based warning systems and messages are coming online rapidly in governmental agencies, universities and other organizational settings, research about how these systems work has been sparse. We do not have adequate data about how people act and react when they receive WEA messages in real time. This information is key to designing messages that work with the current technology, as well as take account of typical human responses to threat messages, otherwise known as the stress response or the 'fight or flight' reaction. To address unanswered questions, this research was funded as part of an initiative by DHS Science and Technology Directorate (S&T).

The major goal of this research is to test how recipients process short WEA disaster warning messages. In a series of laboratory experiments in which participants received simulated warning messages on a smartphone, we measured psychophysiological, emotional, cognitive and behavioral responses of recipients. We conducted experiments on a young (18-26 year old) audience who are part of the wired generation — assuming they are adept in regards to mobile device use and literacy, representing an audience who should be most likely able to process and use these messages to inform subsequent disaster response actions.

Major issues addressed in this study include the following:

- The impact of receiving simulated WEA messages on psychophysiological arousal;
- Relative effectiveness of different WEA message lengths (90, 160, 280 characters) and message content;
- Behaviors observed among recipients of initial simulated WEA messages;
- The role of personal characteristics, emotions, cognitions and perceptions among recipients of WEA messages;
- How physiological arousal, emotions, perception and behavior interface with the text message and current mobile device technology; and
- Difference in response received in a social rather than a solitary context.

Study methods included a series of social psychological experiments. The study sample was comprised of undergraduate and graduate students between the ages of 18 and 26 who were attending a large urban university. Once recruited into the study, recipients came to a laboratory and were connected with MindWare technology that monitors physiological functioning. They then received WEA messages on a mobile device with either an active shooter or explosion

scenario on their campus. Physiological measures were comprised of skin conductance, cardiac activity and arterial pressure. Personal characteristics, emotions, cognitions, perceptions and behaviors were measured using surveys, observations and qualitative interviews.

Major findings include:

- WEA SMS text messages do have a significant impact on physiological arousal, emotional response, cognitive processing and behavior.
- The most reliable physiological indicator was skin conductance response (SCR).
- A message of 160 characters is more impactful than a 90 character message, but there is no clear gain with messages that are 280 characters.
- The most effective message length is the amount of characters that can fit onto the mobile device screen of the recipient in the first alert notification. In new phones, this is 160 characters, while it is 90 characters in older phones.
- Because of the stress response, most recipients only read a few words of text before enacting a more general scan of their immediate environment, and most do not go into the application itself.
- Moreover, recipients only remember a few key words. Important words or guidance must be articulated at the beginning of the message, not buried at the end, and must be specific.
- Many recipients clicked off the messages, and many did not believe the messages were credible.
- People in groups were more likely to talk to one another about the messages after they received them.
- However, a larger number of people in all study conditions actually did nothing when they received the messages, and most people (96 percent) did not click on the embedded Uniform Resource Locator (URL).

Recommendations include the following:

- Short concise concrete images and messages of 160 characters are sufficient.
- Use social marketing campaigns and education to teach people what the DHS WEA technology is and how to use it.
- Build a brand that people trust.
- Create pre-event messages templates that are up-to-date and accessible.
- Build capacity for other organizations to build successful disaster and alert warning systems.

1. Background

A major goal of this research project is to assess the degree to which short disaster warning messages from official sources transmitted on mobile devices using text or SMS WEA messages are able to elicit psychophysiological and emotional responses from recipients. Such responses represent 'arousal,' also known as a 'stress response,' and under conditions of threat are seen to be a key factor directly linked to people's propensity to act.

Current research was conducted to support the many efforts over the past decade to integrate warning and alert messages about disasters into new technological formats, specifically cellular and digital platforms usually delivered to users with mobile devices (National Academy of Sciences, 2010; FEMA, 2014; Bean et al., 2016). Specifically, WEA message content and platforms represent new communication technologies that can reach large groups of individuals or populations in a short amount of time. This reflects changes in access to this technology as the majority of Americans now own smartphones that are, by design, enabled to carry WEA text messages (Smith, 2015).

Adoption of these new technologies has occurred more quickly than research on best practices for using these types of communication modalities. Thus, how to best use these communication methods to help people navigate emergencies or disasters is still being determined. Research presented contributes to this endeavor. It represents a series of experiments undertaken to show how people immediately process and respond to warning information transmitted by WEA-enabled smartphones. Additionally, qualitative data collected also provides insights about study participants' perceptions of these new warning tools.

This study is one of many studies that DHS S&T funded on WEA smartphone technology. It sought to answer the following research questions:

- What is the impact of hypothetical vs. real WEA messages on psychophysiological arousal?
- Controlling for hypothetical vs. real WEA messages, what is impact of psychophysiological responses on self-reported fear?
- What is the impact of WEA messages of different lengths and with different content on psychophysiological arousal?
- Does belief in the message moderate changes in psychophysiological responses among those exposed to WEA messages of different length and content?
- Does psychophysiological response, length of WEA messages and message content influence self-reported fear?
- What is the impact of a WEA SMS received in a solitary setting compared to those received in settings with other people present?
- Does psychophysiological response and social context of receiver influence self-reported fear?

- Does WEA SMS message length, message content or the social context in which messages are received influence observed behaviors?
- Does belief in the message or emotional response to the message moderate observed behaviors after the receipt of a simulated WEA SMS message?
- Do personal characteristics moderate observed behaviors after the receipt of a simulated WEA SMS message?
- What are people's knowledge, awareness and familiarity with SMS alert messages?
- What are barriers or facilitators for responding to simulated WEA text messages?

It should be noted that these questions have evolved slightly from original project aims. This is due both to the iterative nature of research in which findings from one set of experiments or observations inform subsequent research methods and questions. Additionally, interactions with project officers, as well as other research teams, were used to generate the specific research protocols conducted.

In this report, we will briefly review relevant literature about alerts and warnings with most attention placed on current mobile or digital systems, describe our research methods, and then present results followed by a discussion of recommendations for both research and practice.

2. Literature Review

Over the past two decades, there has been a major shift regarding how individuals receive and process information that has to do with their health and wellbeing. The development of personal computers and then the internet in the latter part of the 20th century allowed digital content to be widely distributed, changing how we get much of our health information. In the 21st century, introduction of wireless internet linked to mobile devices, and the uptake of those devices by the majority of Americans, paved the way for ubiquitous and omnipresent digital connectivity, again with major implications for sending and receiving information linked to health and wellbeing (Smith, 2015).

In the context of disaster alerts and warnings, these shifts in communication technology and the migration to cellular and digital platforms have developed rapidly over the past ten years. Specifically, traditional warning and alert systems have used broadcast media, shortwave media, sirens and alarms, and landline telephones, as well as print and interpersonal media, to disseminate alerts and warnings. These practices emerged from the need to communicate information about natural disasters and weather advisories quickly to large populations.

Following '9/11,' there was a great deal of consolidation in terms of both the content and types of messages that were considered important to communicate in crisis or emergency situations, and an all hazards approach to official warnings was undertaken. Thus, now warning systems carry messages not only about natural disasters, but also large-scale manmade events, such as industrial accidents, terrorist events, major disease outbreaks or toxic hazards. In this context, many practices emerged in regards to crafting of actionable messages in crises, but generally formats considered were longer, such as newscasts, news articles, websites, fact sheets, press releases, video, blogs, etc. (Reynolds, 2014; California Department of Health Services, 2011), not shorter or 'terse' text or social media messages. As we have migrated to mobile with all hazards warnings and alerts, whether using text or social media formats, messages now are counted by character length rather than word count, which created the impetus to assess message content and formats more closely. Specifically, while tweets and SMS texts can go up to 140 and 160 characters respectively, original (WEA) character lengths were as short as 90 characters, which clearly restricts what one can say and how effective the messages will be.

While short formats or text messages have been found to be highly effective in health and patient education and social marketing campaigns with very targeted messages for specific populations (National Academy of Sciences, 2010), this represents a very different context than alerts and warnings, which typically must broadcast general messages for diverse populations in proximity to a threatening event. There is a great deal of research on the overall effectiveness of more traditional alert warning systems on populations that has been reviewed extensively (Mileti and Sorenson, 1990; Sorenson, 2000), but research on how to best craft the messages for optimal response for terse or short messages received in crisis situations is insufficient (National Academy of Sciences, 2010; Bean et al. 2016).

The most glaring gap in regards to the study of the impact of terse warning messages is a lack of research on the audience's immediate response to messages. What we know in communication research is that people often ignore messages and if they do not respond to messages soon after

they are received, the likelihood the information the messages convey will be processed and used is low (McGuire, 1972; 1978). Thus, in public health or marketing campaigns, the audience is subjected to multiple exposures over time to increase the probability of exposure, recall and acceptance. However, in the context of advisories, alerts and warnings, the time frame for which the message is valid is often compressed, and missing the message may have dire consequences for the intended recipient. Hence, testing how and if the information is immediately processed and the factors that are linked to those processes becomes salient.

One reason these immediate responses have not been well researched is because often research on advisories, alerts and warnings has occurred in naturalistic settings using retrospective observations or surveys, which often take place days or weeks after people have actually received the messages (Sorenson, 2000). Again, many might miss the message, and what they felt or thought when they first received the message might not be recalled. That is, because in threatening or emergency situations people by their nature use intuitive or reactive information processing systems due to arousal or stress response, rather than more controlled or logical thinking (Evans and Frankish, 2009; Kahneman, 2011), which may not always be recalled days later and may lead to biased perceptions and actions. Assessing how well people attend to short SMS warning messages in simulated scenarios immediately after receiving them using experimental methods will address this issue and also test whether initial responses in turn lead to conscious emotions, thoughts or actions.

In the following pages, we will first review selected research linked to warnings generally considered and how they might impact initial arousal and information processing functions. Then we will review recent empirical studies, some funded by DHS, that assess short or terse mobile message formats for warnings specifically.

2.1 Warnings, Psychological Arousal and Information Processing

Research on the relationship between warning message content and a personal response suggests a number of key factors may contribute to the effectiveness of WEA communication, factors that were considered in the design of the research. An underlying assumption is that first a message must be comprehended by the recipient, leading to changes in arousal and affective physiology, which in turn determines feelings — cognitions that may lead to a behavioral response. These ideas are based on a long trajectory of research in social psychology and psychology.

Upon receiving a disaster alert, an early physiological emotional response (e.g., as measured via facial electromyography, galvanic skin response or increased heartbeat) to potential danger is necessary to compel action (Hijcak, Molnar, George, Bolger, Koola, and Nahas, 2007), although it may not be sufficient to do so. Thus, hearing or seeing a warning message is a necessary precondition for both adaptive physiological and emotional responses and ultimately behavior. As for other types of health and social issues, those who are more sensitized to an issue either through direct or vicarious personal experience are more likely to hear warning messages, as well as those who feel more vulnerable about being impacted.

Next, the recipient must understand a warning message and understand what to do in order to demonstrate adaptive behavioral responses. The closer to a disaster/hazard area that a person is, the more likely they are to understand a warning message. Thus, vague messages with generic

instructions and unclear locus are less effective than those that are specific or provide concrete images (Turner, 1983). Dual coding theory also suggests that concrete images or visuals are much more evocative than abstract ideas (Paivo, 1990). Additionally, if the message is familiar and if the message comes from a familiar source, the more likely the receiver is to believe it and respond to it (Mileti and Fitzpatrick, 1992).

In general, people must believe in a warning message to respond effectively to it, and that belief will determine the event's potency to elicit an emotional response (Davis, Gross, and Ochsner, 2011). A person is more likely to believe a warning message if the sender and source of the message is credible, especially when that source is a local entity (Mileti and Beck 1975; Turner, 1983). Also, the closer a person is to the hazard/disaster area, the more likely they are to believe and respond to a warning message.

If messages provide real actionable solutions that are specific and concrete to which people can respond, they will be more likely to respond to them (Mileti, and Fitzpatrick. 1993; Greene et al. 1981; Quarantelli, 1984). This follows a basic health behavior change precept: do not set the bar of action too high. The more informative guidance a person receives in a warning message, the more likely they are to respond to it. But it is normal for persons to not comply immediately with a warning; confirmation and verification of the warning should be expected and people will seek out additional information sources to do so.

Generally, it has been found that negative aspects of a message more strongly impact viewers than the positive aspects of a message (Baumeister, Bratslavsky, Finkenauer, and Vohs, 2001). People tend to resonate with negative information and may respond more specifically and effectively with a negative message than a positive message (Levin, Schneider, and Gaeth, 1998; Witte, 2001). Generally, alerts and warnings are considered negative as there is an implied threat. The basic notion that has emerged is that for some, fear is effective and useful in that it can increase emotional engagement in the persuasion process (Witte, 2001). The issue, however, is always the degree of threat implied in a risk communication message. That is, negative messages and the heightened attention they elicit among receivers may nevertheless dominate one's psychological and physiological response to the message (O'Keefe and Jensen, 2007), which can lead to defensive responses as opposed to proactive responses (Witte, 2001).

Message recipients are often influenced by those in their immediate social network. If those around them are responding, then they will also respond; but often they take their cue from the emotional reactions of those around them, and doing so may invite complications. In the presence of others, people tend to suppress the outward expression of their feelings of alarm or distress (Tobin, Graziano, Vanman, and Tassinary, 2000) and to down-regulate the affective physiological response that would be adaptive. Doing so inhibits the strength of one's emotional experience to a distressing event (Davis, Senghas, and Ochsner, 2009) and is likely to derail proactive behaviors. Moreover, people tend to underestimate the emotional reactions of others (Jordan, Monin, Dweck, Lovett, John, and Gross, 2011). Consequently, the mere presence of others can compromise one's appropriate decoding of warning messages and actions during emergency situations (Latane and Darley, 1970; Latane and Rodin, 1969), especially when both situations and appropriate responses are somewhat ambiguous (Clark and Word, 1972).

Thus, prior research suggests that these factors will be crucial for the successful utilization of WEA to promote appropriate responses. Furthermore, these impacts occur immediately upon receiving threat information by changing bodily arousal and emotional physiology, and these factors cascade to alter message processing and the implementation of adaptive actions. Moreover, WEA reaches people in social environments that can either amplify or inhibit reaction and action. We propose to perform the first study on this immediate set of responses triggered by WEA messages, how it leads to action, and how varying message content, message length and social setting influence these outcomes.

2.2 Research on Short or Terse Warning Messages on Mobile Devices

Given the newness of the use of terse or short messages for disaster warnings, research on disaster text messages has been limited. Because it has been in existence longer, there is more research about the social media message formats such as Twitter or Facebook than there is about official text messaging formats for warning people of imminent disasters (Hughes and Palen, 2009). However, whether officially transmitted or spontaneous, social media formats such as tweets are a somewhat different format than WEA SMS texts, as one has to opt in to use them (i.e., download the application). The social media platforms are only used by a percentage of the population and their use may be more sporadic than texting, which many use as an everyday utility, such as email or phone messages (Bean et al., 2016). In a positive light, they can be relayed to others quickly, conversations or chats can be visible to those who are connected through hashtags or monikers, and they can be mapped geographically (Sutton, Spiro, and Johnson et al., 2014).

Moreover, distribution modalities are divergent between tweets and WEA text messages. WEA texts can be received as long as the mobile device has the capacity, the application is not turned off and the person is in the geographic locale. For a tweet to be received, an individual has to have the application downloaded to either be linked to a hashtag or the sender, implying a more restricted receiver network, and while mobile devices are the preferred modality for receiving, they can also be accessed on other devices. Given these differences, we will review text messaging warning literature here rather than social media warnings more generally in the interests of time and space. However, a similar shortcoming in this literature, as in the text messaging literature, is that many of the studies are done in more naturalistic settings, and findings tend to be more descriptive of the content of the communication or how it was disseminated rather than the impact on the end user (Choi, 2012; Sutton, Spiro and Johnson et al., 2014).

The most comprehensive study to date for the testing of WEA messages is the DHS-funded *Comprehensive Testing of Imminent Threat Public Messages for Mobile Devices* by the National Consortium for the Study of Terrorism and Responses to Terrorism, hereafter to be referred to as the START project (Bean et al, 2014). This extensive report on short WEA types of messages explored how to maximize the effectiveness of those messages to evoke behavioral response. Shorter message formats constrained to 90 or 140 characters were tested using experimental and survey research methods that took their cue from established research findings about effective warnings and alerts, as well as message protocols requiring WEA message content to be ordered as: hazard, location, time, guidance and source. The START findings suggest that for short WEA

messages a better order of information is: source, guidance, hazard, location and time. In particular, for these studies using hypothetical alerts, START project findings suggest that WEA type of messages are optimized if the basic message tells people what to do (guidance), why they need to do it (hazard or threat) and when (timing). In the START findings, location and source of the message were processed later in the transmission.

START also found that inclusion of elements such as a high information map increased the impact of the message, but generally found these shorter messages to be less effective than longer messages. Other findings were that message content needed to be concrete or specific with regard to time and location, acronyms were misunderstood and should be avoided, and that generally people are familiar with the WEA text messaging system; therefore, they highly recommend better marketing of this system. Finally, another conclusion of the START research was that shorter messages of 90 and 140 characters were less effective at stimulating 'protective action-taking behavior' than a 1380 character message, as people tended to use heuristics or pre-existing belief systems about hazards to decode or interpret shorter messages. One publication coming from this work moreover suggests that respondents often found short or terse warning messages as confusing, difficult to believe and impersonal, as well as inducing fear (Bean et al., 2016). As we suggest, fear inducement is not necessarily a negative attribute of warning messages.

While the START project did exhaustive research and testing with regard to message length and the order of contents for three scenarios (active shooter, radiological hazard and tsunami), one major shortcoming of the START research was that for the WEA messages tested, context for the testing of their impact was mainly hypothetical rather than real and the type of outcome measures were self-reported emotions, cognitions and behaviors. Hence, lack of findings or unclear findings in this report about the impact of 'fear' on arousal or behavior could be anticipated because self-reported fear or anxiety could have been attenuated by the fact that messages received did not simulate a real scenario with actual texts. The other issue is the contention that longer 1380 character messages were preferable. The issue is that text messages are generally constrained to 160 characters in length, thus if messages are in that format (rather than, for example, websites, blogs or emails) it is hard to know if such a message could be distributed via a WEA platform.

In addition to experimental research on WEA messages, the START project also gathered qualitative results about people's perceptions of short WEA messages. Survey research among residents of Boulder, Colorado, was conducted to determine if they had received actual WEA messages during the Boulder flood that occurred in September 2013. Survey research findings after that event suggested 41 percent remembered getting the first message; about 15 percent read it when they got it; 20 percent read it within 30 minutes; and about one third of the population eventually read it, but some not until a day later. There were many reasons for levels of uptake — residents may not have had WEA-enabled mobile devices, may not have had their phones with them when they received the message, and, as in any crisis event, there are competing channels and messages. The important finding here is that during the Boulder flood people did respond to WEA texts associated with WEA alert tones and were aware of these new risk communication methods. However, the capability of testing how effective messages were in motivating responses was limited due to survey methods used, as well as issues with recall bias

of people remembering feelings, thoughts and actions in a crisis context. Understanding response rates in this crisis context is important and shows that when exposed to a tone and a text message, people do take notice (Bean, et al., 2014).

While there are many articles that address the technical and engineering aspects of developing such systems, with the exception of the START project, there are few published empirical studies about text-enabled alert warning messages that assess the interface between these systems and audience perceptions, needs and responses. A number of studies have been conducted in university settings, as these organizations have been early adopters of this technology given recent high profile events like mass trauma and school shootings, as well as large student populations who use mobile devices. Generally, these are opt-in systems dependent on having people's mobile phone numbers. One study at the Missouri University of Science and Technology found in two tests of their system that only 51 percent and 58 percent of campus audiences responded correctly, suggesting the need for better education and accurate contact information (Gulum and Murray, 2009). Another study used qualitative techniques at a mid-Atlantic university to assess student and faculty perceptions of a university based alerting system using text messages. They found that people generally were open to the system, but were more likely to use the system to respond to those threats that were likely to affect them, with location of the threat being of high importance. Participants noted constraints in the system, lag time between the event and getting the message, incomplete follow up messages, and messages not being explicit enough about the threat and what to do in an actual emergency. Also, students wanted more information about signing up for the service. A system adopted by Virginia Tech University after a 2007 mass shooting on campus is described as focusing messages on three elements: (1) the nature of the incident; (2) the location where the incident has occurred; and (3) the action to be taken. It is noted that developing message content is complex and it is difficult to create messages that satisfy all audience members (National Research Council of the National Academy of Science (2010, pp. 16–20)).

In sum, while there is a growing literature base concerning terse or short messages for disaster warnings, there is still much that is unknown. Much of what is known is based on survey research, hypothetical risk or retrospective accounts of risk, qualitative studies or content analysis of warning messages. Studies of immediate response in simulated conditions are lacking, and no studies have looked at the basic arousal or psychophysiological responses to these types of emergency risk communications.

3. Methods

In this study, we conducted a series of four randomized laboratory experiments (see Table 1) with young adults aged 18–26 who were students at a large public university to test the degree to which simulated WEA SMS text messages on mobile devices with disaster scenarios had an impact on student responses measured by psychophysiological measures of arousal, self-reports of beliefs, attitude, cognitions and emotions, and observed behaviors linked to the messages. Our goal was to test immediate responses to those messages and determine the degree to which arousal lead to specific emotional response or behaviors. A rationale for studying this population was that they represent a population of 'digital natives' who are heavy users of digital communication and most likely to carry and use mobile devices; hence, if these text messages for disasters are effective, this would be a prime population in which these methods of risk communication should work. In addition, after the experiments, we collected qualitative data about student perceptions and opinions of the messages they received in this new modality.

Table 1: Research Questions

Research Questions	Exp 1	Exp 2	Exp 3	Exp 4	Qualitative
What is the impact of hypothetical vs. real WEA messages on psychophysiological arousal?	✓				
Controlling for hypothetical vs. real WEA messages, what is the impact of psychophysiological responses on self-reported fear?	✓				
What is the impact of WEA messages of different lengths and with different content on psychophysiological arousal?		✓		✓	
Does belief in the message moderate changes in psychophysiological responses among those exposed to WEA messages of different length and content?		✓		✓	
Does psychophysiological response, length of WEA messages and message content influence self- reported fear?		✓		✓	
What is the impact of a WEA SMS received in a solitary setting compared to those received in settings with other people present?			✓		
Does psychophysiological response and social context of receiver influence self-reported fear?			✓		
Does WEA SMS message length, message content or the social context in which messages are received influence observed behaviors?		✓	✓	✓	
Does belief in the message or emotional response to the message moderate observed behaviors after the receipt of a simulated WEA SMS message?		✓	✓	✓	
Do personal characteristics moderate observed behaviors after the receipt of a simulated WEA SMS message?		✓	✓	✓	

Research Questions	Exp 1	Exp 2	Exp 3	Exp 4	Qualitative
What are people's knowledge, awareness and familiarity with SMS alert messages?					✓
What are barriers or facilitators for responding to simulated WEA text messages?					✓

3.1 Experimental Protocols

3.1.1 Experiment 1: Real vs. Hypothetical

In Experiment 1, we tested the possibility that psychophysiological responses might differ for a message about an explosion on campus that was hypothetical compared to one that appeared to be real. Participants were randomly assigned to one of two conditions. In both conditions, participants received a wireless emergency alert indicating that there was an explosion on campus. This message was 90 characters long. In the first condition, participants were told that this emergency was a hypothetical situation. That is, participants were told in advance that the emergency message was not real. In the real condition, participants were sent a wireless emergency alert that they believed to be real. For participants in the real condition, they were told the message was not real and was part of the experiment after the study concluded.

Table 2: Experiment 1 Study Design

Hazard Type (IV)	**Simulation Type (IV)**	
Explosion	Hypothetical	Real
	90 characters	90 characters
Subjects (N=98)	50	48

3.1.2 Experiment 2: Message Length and Content

In Experiment 2, we tested whether psychophysiological responses differed because of message length (90 or 160 characters) or message content (explosion or shooter). Participants were randomly assigned to one of four conditions. In all four conditions, participants received a wireless emergency alert indicating that there was either an explosion or a shooter on campus. This message was either 90 characters or 160 characters long. In each condition, participants were sent a wireless emergency alert that they believed to be real. After the study concluded, participants were told the message was not real and was part of the experiment.

Table 3: Experiment 2 Study Design

Hazard Type (IV)	**Character Length (IV)**		**Subjects (N=150)**
Explosion	90	160	39/38
Shooter	90	160	33/40

3.1.3 Experiment 3: Individual vs. Dyad

In Experiment 3, we tested whether psychophysiological responses differed because of the social context in which messages were received. Participants were randomly assigned to one of two conditions. In both conditions, participants received a wireless emergency alert indicating that

there was an explosion on campus. This message was 90 characters long. In the first condition, participants were alone in the room when they completed the experiment. In the second condition, participants completed the experiment in dyads. In this dyad condition, participants received the emergency alert message at the same time. After the study concluded, the participants were told the message was not real and was part of the experiment.

Table 4: Experiment 3 Study Design

Hazard Type (IV)	Simulation Type (IV)		Subjects (N=164)
Explosion	Individual	Dyad	54/110

3.1.4 Experiment 4: Message Length and Content

In Experiment 4, we tested whether psychophysiological responses differed because of message length (160 or 280 characters) or message content (explosion or shooter). Participants were randomly assigned to one of four conditions. In all four conditions, participants received a wireless emergency alert indicating that there was either an explosion or an active shooter on campus. This message was either 160 characters or 280 characters long. In each condition, participants were sent a wireless emergency alert that they believed to be real. After the study concluded, the participants were told the message was not real and was part of the experiment.

Table 5: Experiment 4 Study Design

Hazard Type (IV)	Character Length (IV)		Subjects (N=102)
Explosion	160	280	25/23
Shooter	160	280	31/23

3.2 Data Collection Procedures

Participants were from a large public university. Some students were recruited from a university subject pool and received course credit if they volunteered to be in the study. To increase study recruitment during summer months, we also advertised in a university newspaper and posted fliers across campus to recruit undergraduate or graduate students either in regular or summer sessions. The students who volunteered were given a small incentive.

Participants were asked to arrive at the psychology lab at specified times. Prior to being enrolled in the study, volunteers were screened for eligibility. If the volunteers were eligible, they were given Institutional Review Board documents to read and sign. If they were not eligible, they were thanked and told they were not eligible for the study. Then, eligible participants were seated at a computer work station where they were connected to sensors using MindWare equipment and software. This procedure took 15 minutes.

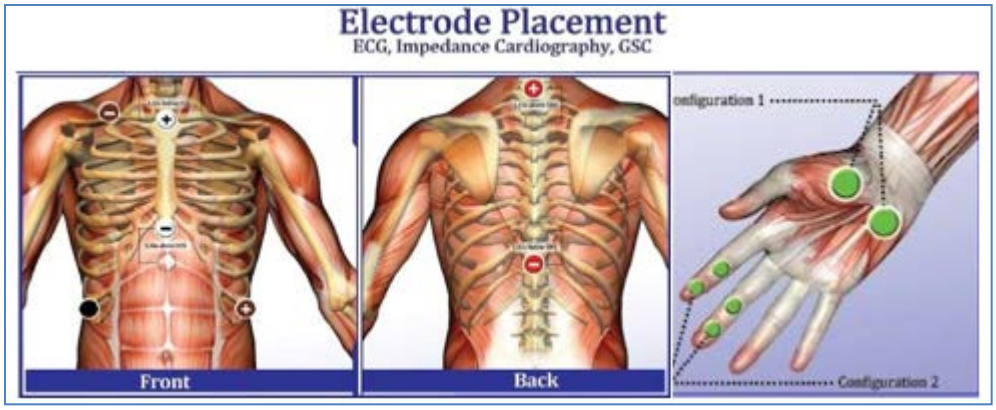

Figure 1: Electrode Placement

Participants were also asked to leave their own mobile devices in another room during the experiment and were loaned a study cell phone. Participants were randomly assigned to conditions depending on the experiment for which they were recruited. They were not provided any details as to the theoretical nature of the research and were told that they were participating in a social psychology experiment testing people's ability to multitask, while engaged in a computer activity through physiological, emotional, cognitive and behavioral measures.

All participants who consented to participating in the study were then given a self-administered, online pre-test questionnaire to assess psychological attributes (dispositional optimism, pessimism, attitudes and beliefs, personal resiliency), emotional state and demographic information. Following pre-testing, participants were asked to begin a face rating task on the computer and then four minutes into the task were asked to begin reading a news article on the study cell phone. After four minutes into the task, the experimenter sent a WEA notification message (SMS or text) to the study cell phone that was provided to the participant. Messages are depicted below (Figure 2).

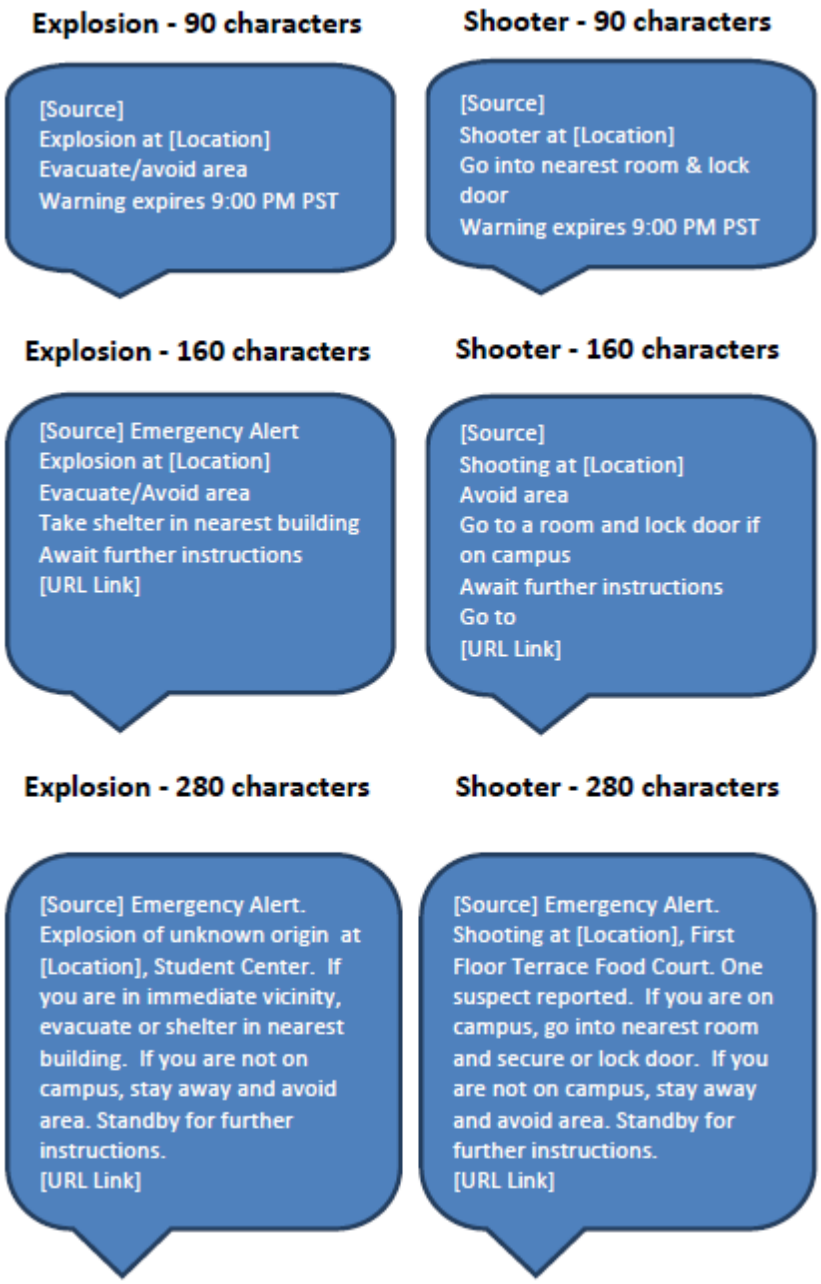

Figure 2: Simulated WEA Messages
(Source, Location and URL Link have been de-identified)

As the participants were conducting these activities and receiving the alert message notification, we monitored continuously for indicators of (1) skin conductance, (2) heart rate, and (3) blood pressure. For heart rate (a measure of general arousal), two disposable sensors were placed on the participant's torso with conductive gel – one on the collarbone and one on the hipbone. These sensors detect electrical signals that indicate each heartbeat. For skin conductance (a measure of anxiety), the index is sweatiness of a person's palms. To measure this, two disposable sensors

were attached with a conductive gel to the lower part of participants' non-dominant hand, directly below the wrist. These sensors detect sweat on the palms. The procedure for monitoring responses lasted no longer than 15-20 minutes. For all physiological methods, we captured a baseline measurement (2 minutes) prior to the experimental manipulation and then recorded electrodermal activity, cardiac activity and blood pressure throughout the participant receiving and reading the message. Physiological recordings stopped if the participant made a verbal indication regarding the message or after 60 seconds had elapsed.

During this monitoring process, the participants' behavioral responses were observed to determine their immediate action and reactions to experimental stimuli, including whether the participant did nothing, talked to the research staff, shared the information or searched for further information via URL links embedded in the message. After the experiment was completed, the participants were given a self-administered online post-test questionnaire to assess psychological attributes (self-efficacy), emotional state, understanding of the message, belief in the message and personalizing of the message.

Because student participants did not receive full information about the study prior to their participation, they were debriefed about the study hypotheses at the end of the experiment. A series of debriefing questions were asked by the experimenters that included:

1) What did you think about the experiment?
2) Can you tell me step-by-step what went through your mind once you received the message?
3) Did you think the message was real? Why or why not?
4) What made you decide to alert the research assistant?
5) What made you decide to talk to your neighbor?
6) What made you decide to continue with the activity?
7) What things stood out the most from the message?
8) Did the message need more information or less information? If so, what would you like to have seen?
9) Did you click on the URL link? Why or why not?
10) How much time did you spend looking at the message?
11) Do you have any other thoughts or comments that you would like to share with us?

Because the students shared a great deal of interesting insights about their experience in the study, as well as their experience with other disaster warning systems, we used these interviews as our qualitative findings. The debriefing interviews were undertaken with a select sample of individuals. The interviews were approximately 15 minutes.

Table 6: Physiological and Self Report Measures

PRE-TEST	DURING	POST-TEST
Sociodemographics	Electrodermal (EDA) a) Skin Conductance Responses (SCR) b) Skin Conductance Level (SCL)	Positive and Negative Affect
Optimism/Pessimism	Blood Pressure (BP) Mean Arterial Pressure (MAP)	State Anxiety
Belief in a Dangerous World	Cardiovascular Activity a) Cardiac Interbeat Interval (IBI) b) Heart Rate (HR)	Understanding, Belief, Personalizing, Emotions to the Message (START measures)
Trait Anxiety	-	Self-Efficacy
Personal Resiliency	-	Disaster Experience
-	-	Trauma Experience
-	-	Trust in Government Response to a Disaster

3.2.1 Psychophysiological Measures

EDA / Skin Conductance

Electrodermal activity (EDA) was measured using the MindWare physiological suite (MindWare Technologies LTD; Gahanna, Ohio) with best practices guiding the study's procedures (Boucsein, et al., 2012). In order to capture EDA activity, we placed two electrodes on the thenar and hypothenar areas of the palm on the participants' left hand. Measurements were assessed with a BioNex 8 Slot Chassis and data were collected with BioLab Acquisition Software (Version 3.0.13). Data pre-processing was conducted using the MindWare Electrodermal Activity software suite (version 3.1.25) after all participants were run, and included amplifying the signal by 10x and passing it through a 1 Hz low pass filter in order to remove movement artifacts.

For EDA, we investigated two different measures. First, we investigated the immediate impact of the message by measuring event-related skin-conductance responses (SCR). We defined the SCR as the first peak following participants receiving the message. Second, we investigated the overall impact of the message by looking at participants' overall skin conductance level (SCL) change from pre to post message. For both measures, we expected participants to show higher EDA activity following the message.

Blood Pressure

We measured blood pressure (BP) using the Continuous Noninvasive Blood Pressure and Hemodynamics (CNAP) Monitor 500, which has a blood pressure monitor that attaches to the wrist of the participants' dominant hand. We used the Mindware Blood Pressure Variability software suite (version 3.0.25) to calculate mean arterial pressure (MAP). In order to measure MAP scores, we subtracted the last 30 seconds of the baseline period from the 30 seconds following the message being sent. Higher scores on this measure reflect more MAP reactivity and serves as another measure of stress.

Cardiovascular Activity

We assessed two separate measures for cardiovascular activity — the cardiac interbeat interval (IBI) and the heart rate (HR). These measures were assessed using a 3-lead configuration with electrodes placed on the left rib cage and right clavicle, and the ground electrode on the right rib cage. These electrodes were connected to a Mindware Impedance Cardiography unit. For data processing, we used Mindware's Impedance Cardiography software modulate (version 3.0.25). The IBI is a measure of the time (in milliseconds) between R-peaks (the highest amplitude value) within the electrocardiography (ECG) signal, and HR was defined as the number of beats per minute.

3.2.2 Baseline Measures

Items were measured using standardized scales unless otherwise specified.

Sociodemographic Measures

To assess personal characteristics, we used standardized indicators of age, gender, highest level of education completed, ethnicity, language preferences and disability. For a complete set of tables with study sample characteristics, please see Appendix B.

Dispositional Optimism vs. Pessimism

We used the Life Orientation Scale (revised) (Scheier, M. F., Carver, C. S., and Bridges, M. W., 1994) to measure optimism versus pessimism on a 10-item scale. Of the 10 items, three items measure optimism, three items measure pessimism and four serve as fillers. Respondents rated on a 5-point Likert scale.

Attitudes and Beliefs

This variable was measured using Altemeyer's (1988) Belief in a Dangerous World Scale. This 12-item scale measures the extent to which one believes the world is dangerous, in which one must frequently protect oneself from physical harm. Respondents rated on a 5-point Likert scale.

State-Trait Anxiety

We used Spielberger's State-Trait Anxiety Inventory (STAI) 20-item scale. The scale consists of items that ask how a person currently feels and reflects situational factors that may influence anxiety levels. The essential qualities evaluated by the STAI-Anxiety scale are feelings of apprehension, tension, nervousness and worry. Respondents rate on a 4-point Likert scale.

Personal Resiliency

This variable was measured using the Connor-Davidson Resilience Scale (CD-RISC). The scale is comprised of 25 items, each rated on a 5-point scale (0–4), with higher scores reflecting greater resilience.

3.2.3 Outcome Measures

Positive and Negative Affect (PANAS)

We used the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), which consisted of 20 items, 10 of which measured positive affect and the other 10 measured negative affect.

Understanding of the Message/Belief in the Message /Personalizing the Message/Emotions to Message

These items were all adapted from the START research protocol (Bean et al., 2014).

Understand the Message

This was based on eight Likert-scaled items that assessed the degree to which participants understood the message, including hazards, risk, guidance and location.

Belief in the Message

This was based on two Likert-scaled items that assessed the degree to which participants believed the threat was real and should follow the instructions in the message.

Personalize the Message

This was based on seven Likert-scaled items that asked the degree to which participants believed they or those in their immediate social network were at risk for harm because of the event described in the message.

Emotional Response to the Message

Emotions were measured by asking subjects to rate their agreement with the statement, "This message made me feel…" This stem was followed by 12 emotions: "scared," "tense," "confused," "shocked," "nervous," "sad," "outraged," "terror-struck," "anxious," "fearful," "angry" and "sympathetic." All 12 answers were rated on 10-point scales where '1' represented "not at all" and '10' represented "extremely." These 12 emotions were presented to subjects in random order (Bean et al., 2014). Items related to the emotion of fear were used to generate a sub-scale of the original emotions scale. Factor analysis was conducted to identify the START fear emotions sub-scale used for each study (See *Appendix B, Table 14*).

Self-Efficacy

This was measured by five Likert-scaled items asking people about their ability to protect themselves and others in disaster (Eisenman et al., 2009).

Disaster Experience

This was measured by asking respondents whether they have ever experienced a natural, intentional or manmade disaster, followed by 18 items asking about experience with specific types of disasters. The questions were adapted from a survey developed in the Building

Effective Public Health Community and Faith-based Partnerships for Disaster Readiness study (Glik et al., 2011).

Trauma Experience

This was measured by five items asking people if they ever experienced a physical, psychological or emotional injury from a disaster (Eisenman et al., 2009).

Trust in Government Response to a Disaster

This measure was adapted from the Public Health Disaster Trust Scale and used three Likert scaled items from the original four item scale to assess the degree to which respondents believe or trust messages from official governmental sources (Eisenman et al., 2012).

Observed Behaviors

In Experiments 2, 3 and 4, during the experimental procedure, a laboratory assistant used an observational checklist to note if participants manifested any behaviors that could be observed in the time after they received the WEA message and the completion of the experiment. The six behaviors measured at the nominal level were: "Do nothing," "Alert RA," "Click URL," "Seek information from the web," "Immediately click off message" and "Talk to another person."

Data Analysis

A number of analytical tools were used to assess quantitative findings. In addition to preliminary analyses using univariate and bivariate methods, multivariate methods, such as analysis of covariance, ordinary least squares regression and logistic regression, were used to address research questions. Also, multi-item scales were assessed for reliability and validity using standard procedures**.** With regard to difference scores reported for all physiological measures, we calculated a change from the baseline score by taking the last 30 seconds of the baseline period and subtracting that value from the 30 seconds after receiving the message. This difference score served as our assessment of increasing or decreasing physiological measurement. We chose to use a 30 second pre- and post-interval given ethical constraints of the experiment. Participants often reacted to the emergency alert within the first 60 seconds of receiving the message in a manner that required the experimenter to intervene (e.g., asked if the message was real, became visibly nervous and asked the experimenter what to do) and sometimes they physically reacted to the message in a way that produced significant movement of artifacts (e.g., began moving in the seat or moving their heads).

4. Findings

4.1 Experiment 1: Real vs. Hypothetical Conditions

In Experiment 1, we investigated the effect of condition (hypothetical vs. real) on physiological outcomes. We then explored the degree to which physiological arousal predicted emotions related to fear. We also analyzed behavioral findings. We recognize the statistical analyses and concepts may be hard to follow, therefore we first present a simpler explanation of overall findings for this experiment. Immediately following is a more detailed analysis. See Section 3, "Methods," for a description of variables.

Physiological Measures

In summary, we investigated the effect of condition (hypothetical vs. real) on physiological outcomes. In most cases, participants showed increased physiological response to receiving a message with SCR and SCL higher compared to baseline. Contrary to our hypotheses, we did not see an increase in MAP or HR; however, we also did not see a significant decrease compared to baseline. There was an unexpected increase in IBI relative to baseline (contrary to our hypothesis). However, taking into account the other physiological measures, we can generally conclude that receiving a message leads to higher physiological arousal.

A broad overview of our results in relation to our condition effects indicates participants did not show consistently stronger physiological arousal in the real condition relative to the hypothetical condition. There were significant differences due to condition for SCR and this remained significant when using belief in the message as a covariate. However, this effect was inconsistent across the other measures of physiological arousal.

Physiological Measures Linked Emotional Self-Report

In terms of self-report fear emotions, the pattern of results suggests that the real condition did not produce greater self-report fear emotions relative to the hypothetical condition. This aligns with the inconsistent findings in the physiological data. Again, the results here are puzzling in that participants in the hypothetical condition reported greater mean scores on fear related items relative to individuals in the real condition.

The results from these analyses suggest that none of the physiological measures accounted for greater variability in self-report fear emotions. That is, none of the physiological variables (SCR, SCL, MAP, IBI, HR) were significant predictors of self-report fear emotions over and above the impact of our condition variable. However, there was a significant interaction of SCL and condition on self-report fear emotions. Thus, for these measures it can be argued that it added predictive power to our analyses.

EDA – Skin Conductance Response

We first assessed whether SCR increased above baseline as a function of being sent the message. This analysis serves as our manipulation check in that we believed being sent the message should increase SCR activity. As predicted, SCR (M = 1.01, SE = .178) was significantly different from zero, $t(69) = 5.695$, $p < .001$, indicating that participants' SCR increased as a function of being

sent the message. Please note that participants' data were excluded in cases where there was an experimenter, a participant or equipment error (n = 35) or if the signal during data processing was unreadable (n = 9).

Next, we investigated the impact of condition (hypothetical vs. real) on SCR values. An independent samples t-test on SCR indicated a statistically significant difference between the hypothetical condition (M = 0.88, SE = 0.14) and real condition (M = 1.90, SE = 0.33), $t(68) = -2.163$, $p = 0.040$ (see Figure 3). This finding indicates that the real condition led to greater SCR activity compared to the hypothetical condition.

Finally, we ran an analysis of covariance (ANCOVA) to see if there were significant differences in SCR values between groups (hypothetical vs. real) with belief in the message as a covariate. After including belief as a covariate, there were no longer significant differences between groups (hypothetical vs. real), $F(1, 57) = 0.015$, $p = 0.902$. This suggests that belief in the message accounted for a large portion of the relationship between condition and SCR.

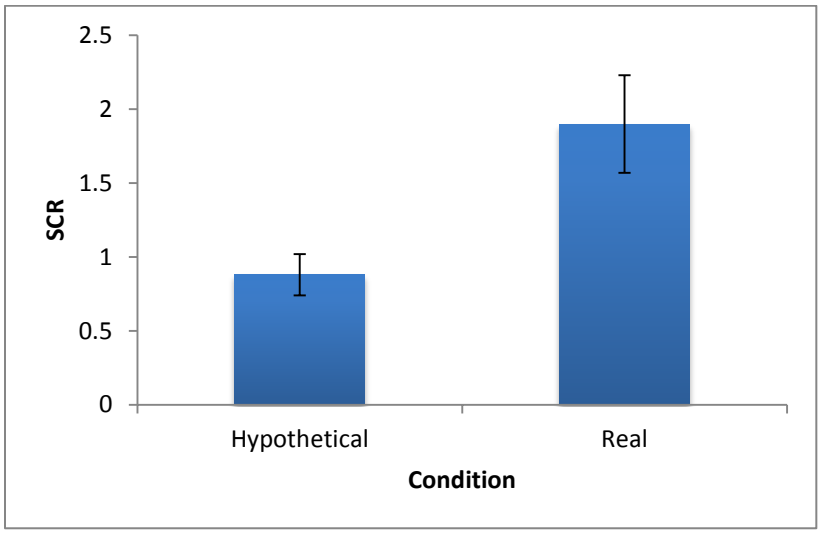

Figure 3: Mean SCR Scores for Hypothetical vs. Real Conditions

EDA – Skin Conductance Level

Next, we assessed participants overall SCL level pre- and post-message. We excluded participants who had poor signals as assessed during data pre-processing (n = 31), and cases where there was experimenter, participant or equipment error (n = 9). We hypothesized that participants' SCL will increase as a function of being sent the message and *that believing the message was real will lead to greater SCL activity*.

As with SCR, we first analyzed whether sending participants a message increased their overall SCL compared to the baseline period. A one-way t-test against zero revealed that indeed participants' SCL (M = 10.27, SE = 1.13) increased as a function of being sent the message, $t(73) = 9.084$, $p < 0.001$.

Next, we assessed the influence of condition (hypothetical vs. real) on SCL values. An independent samples t-test on SCL indicated the hypothetical condition produced a greater SCL response (M = 10.38, SE = 1.59) than the real condition (M =10.14, SE = 1.63); however, this difference was not significant, $t(72) = 0.101$, $p = 0.920$ (see Figure 4). Thus, there were no significant differences in SCL level between the hypothetical and the real condition.
Lastly, we ran our condition analyses with belief in the message as a covariate. We again saw that the difference between the hypothetical condition and the real condition was not significant, $F(1, 60) = 0.005$, $p = 0.944$.

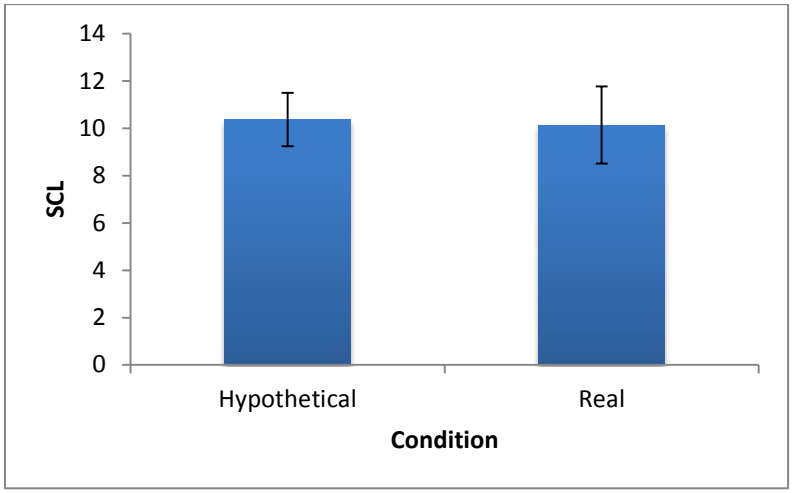

Figure 4: Mean SCL Scores for Hypothetical vs. Real Conditions

MAP - Mean Arterial Pressure

We excluded participants who had poor signals as assessed during data pre-processing (n = 6) and participants who did not follow instructions (n = 2). In accordance with our hypothesis, we tested whether, regardless of condition, participants' MAP reactivity scores increased from baseline as a function of being sent the message. We saw no significant change in MAP scores ($M = 1.73$, SE = 1.44) from zero, $t(76) = 1.20$, $p = 0.233$. This null finding, while unexpected, indicates participants' MAP scores did not significantly differ from baseline following the message being sent. Next, we assessed whether MAP scores differed as a function of condition (hypothetical vs. real). An independent samples t-test revealed no significant differences between the hypothetical condition (M = 0.85, SE = 0.77) and the real condition (M = 2.56, SE = 2.70), $t(75) = -0.591$, $p = 0.557$ (see Figure 5).

As with previous analyses, we also ran the same tests above with belief in the message as a covariate. Again, we found no significant differences between groups (hypothetical vs. real), $F(1, 160) = 0.259$, $p = 0.613$.

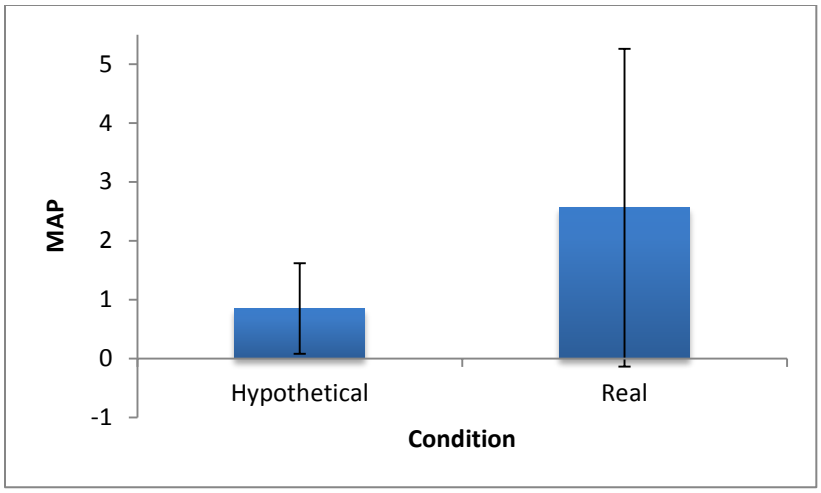

Figure 5: Mean MAP Scores for Hypothetical vs. Real Conditions

IBI - Cardiac Interbeat Interval

We excluded participants with an extreme IBI value (+3 SD away from the mean; n = 1) along with participants who had poor signals as assessed during data pre-processing, cases where there was experimenter, participant or equipment error, and when participants did not follow instructions (n = 36). We first-tested the hypothesis that, regardless of condition, participants' IBI should decrease (that is, the time between R-peaks should be shorter) following the message being sent. Contrary to this hypothesis, there was a significant increase in IBI values (M = 5.896, SE = 6.80) from zero, $t(72) = 0.868$, p = 0.388, indicating the message did not have a significant impact on IBI. We then assessed whether IBI differed as a function of condition (hypothetical vs. real). An independent samples t-test on IBI indicated no significant differences between the hypothetical condition (M = 11.89, SE = 9.35) and the real (M = 0.67, SE = 9.80) condition, $t(71) = 0.822$, p = 0.414 (see Figure 6). This finding indicates that the real condition did not lead to decreased IBI relative to the hypothetical condition. We conducted the same analyses with belief in the message as a covariate and found no significant differences between the hypothetical condition and the real condition, $F(1, 55) = 0.130$, p = 0.720.

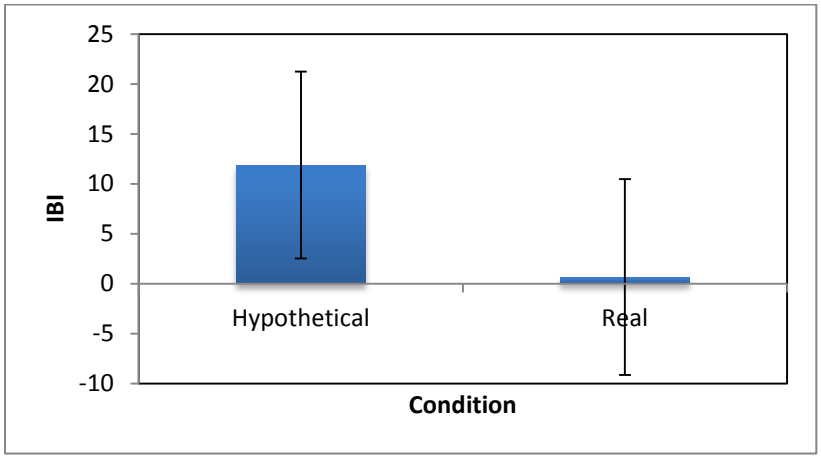

Figure 6: Mean IBI Scores for Hypothetical vs. Real Conditions

HR - Heart Rate

We excluded participants who had poor signals as assessed during data pre-processing (n = 27), and cases where there was experimenter, participant or equipment error (n = 9). Again, we tested whether, regardless of condition, participants' HR increased as a function of being sent the message. We saw no significant change in HR (M = -1.30, SE = 1.08) from zero, $t(64) = -1.199$, p = 0.235. This null finding, while unexpected, indicates participants' HR did not significantly differ from baseline following the message being sent. Next, we assessed whether HR differed as a function of condition (hypothetical vs. real). An independent samples t-test revealed no significant differences between the hypothetical condition (M = -0.19, SE = 1.55) and the real condition (M = -2.52, SE = 0.33), $t(63) = 1.078$, p = 0.285 (see Figure 7).

As with previous analyses, we also examined results with belief in the message as a covariate. There, again, were no significant differences between the hypothetical condition and the real condition, $F(1,48) = 2.763$, p = 0.103.

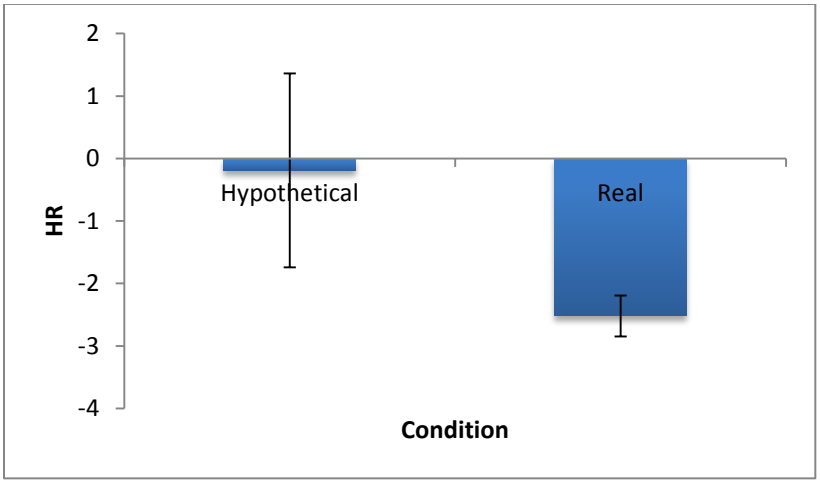

Figure 7: Mean HR Scores for Hypothetical vs. Real Conditions

4.1.1 Condition Effects on Self-Report Measures

Emotions (START - Fear Items)

We tested whether there were significant differences due to condition (hypothetical vs. real) on the emotions reported after the message was received. We excluded participants who did not follow instructions (n = 2), as well as participants who did not answer the emotions questions (n = 20). An independent samples t-test revealed no significant differences between the hypothetical condition (M = 4.39, SE = 0.39) and the real (M = 3.96, SE = 0.33) condition, $t(87) = -0.840$, p = 0.403. This result with regard to condition (hypothetical vs. real) aligns with our physiological data that suggests there is no difference between conditions. However, surprisingly, we see slightly greater self-reported fear emotions in the hypothetical condition compared to the real condition.

As with the physiological measures, we also used belief in the message as a covariate for self-reported emotions. When covarying our participants' belief in the message, we still saw no

significant differences between the hypothetical condition and the real condition, $F(1, 79) = 0.783$, $p = 0.379$.

Physio Predicting Self-Report Emotions (START - Fear Items)

We were also interested in seeing whether our physiological measures predicted self-report START fear emotion responses. We first ran a correlation between our physiological measures and START fear emotions. The overall pattern of results indicates no significant correlations between START fear responses and any of our physiological measures.

Table 7: Pearson Correlations between START Emotions and Physiological Responses

	SCR	SCL	MAP	IBI	HR
START Fear Emotions	-.100	-.045	.054	-.026	.065

Note. *Significant correlation (p < .05)

4.1.2 Regression with Physiological Measures and Condition as Predictors

Multiple regression analyses were conducted to examine the relationship between the various physiological measures and condition for self-reported START fear emotion responses. We regressed START fear emotion responses onto physiological measures (each measure in a separate analysis), condition (hypothetical vs. real) and the respective interactions.

SCR - Skin Conductance Response

First, for SCR, the first step of the regression looked at the main effects for SCR and condition on START fear emotions. Together, these predictors did not account for a significant amount of variance in the model, $F(2,59) = 1.234$, $p = 0.298$, $R^2 = 0.040$. In terms of main effects, there was no significant main effect for condition (hypothetical vs. real), $B = -0.836$, $SE = 0.615$, $t(59) = -1.360$, $p = 0.179$, and no significant main effect for SCR, $B = -0.090$, $SE = 0.199$, $t(59) = -0.454$, $p = 0.651$. The inclusion of two-way interactions in Step 2 did not significantly increase the amount of variance accounted for, $\Delta R^2 = 0.299$, $F(1, 58) = 1.097$, $p = 0.299$. In addition, the two-way interaction between message condition and SCR was not significant, $B = 0.533$, $SE = 0.509$, $t(58) = 1.047$, $p = 0.299$.

SCL - Skin Conductance Level

The main effects only model for SCR was not significant, $F(2,62) = 0.531$, $p = 0.591$, $R^2 = 0.017$. There was no significant main effect for condition (hypothetical vs. real), $B = -0.564$, $SE = 0.582$, $t(62) = -0.967$, $p = 0.337$, or for SCL, $B = -0.010$, $SE = 0.0031$, $t(62) = -0.334$, $p = 0.0739$. For Step 2, there was a significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = 0.073$, $F(1, 61) = 4.888$, $p = 0.031$. Furthermore, there was a significant two-way interaction between condition (hypothetical vs. real) and SCR, $B = 0.132$, $SE = 0.060$, $t(61) = 2.211$, $p = 0.031$.

MAP - Mean Arterial Pressure

The main effects only model for MAP was not significant, $F(2,64) = 0.359$, $p = 0.700$, $R^2 = 0.011$, with no significant main effect for condition (hypothetical vs. real), $B = -0.661$, $SE = 0.657$, $t(64) = -0.725$, $p = 0.471$, or for MAP, $B = 0.010$, $SE = 0.021$, $t(64) = 0.480$, $p = 0.633$.

For Step 2, there was no significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = .010$, $F(1, 63) = 0.613$, $p = 0.437$. There was also no significant two-way interaction between message condition and MAP, $B = 0.083$, $SE = 0.103$, $t(63) = 0.783$, $p = 0.437$.

IBI - Cardiac Interbeat Interval

The main effects only model for IBI was not significant, $F(2,59) = 0.038$, $p = 0.963$, $R^2 = 0.036$. There was no significant main effect for condition (hypothetical vs. real), $B = -0.115$, $SE = 0.606$, $t(59) = -0.189$, $p = 0.850$. The main effect for IBI was also not significant, $B = -0.001$, $SE = 0.005$, $t(59) = -0.224$, $p = 0.823$. The amount of predicted variability was not significantly different when including the two-way interaction, $\Delta R^2 < 0.001$, $F(1, 58) = 0.243$, $p = 0.624$. The two-way interaction was not significant, $B = 0.005$, $SE = 0.011$, $t(58) = 0.493$, $p = 0.624$.

HR - Heart Rate

The overall main effects model for HR was not significant, $F(2,51) = 0.998$, $p = 0.376$, $R^2 = 0.038$. There was no significant main effect condition (hypothetical vs. real), $B = 0.872$, $SE = 0.655$, $t(51) = -1.331$, $p = 0.189$. There was no significant main effects for HR, $B = 0.007$, $SE = 0.036$, $t(51) = 0.204$, $p = 0.839$. The amount of predicted variability was not significantly greater when including the two-way interactions, $\Delta R^2 = 0.007$, $F(1, 50) = 0.361$, $p = 0.551$. Furthermore, there was no significant two-way interaction between condition and HR, $B = 0.007$, $SE = 0.036$, $t(51) = -0.601$, $p = 0.551$.

4.2 Experiment 2: Message Content and Length (90/160 characters) Conditions

In Experiment 2, we investigated the effect of two conditions, content (shooter, explosion) and message length (90 characters, 160 characters) on physiological outcomes. We then explored the degree to which physiological arousal predicted the emotion of fear and analyzed behavioral findings. We recognize the statistical analyses and concepts may be hard to follow, therefore, we first present a simpler explanation of overall findings for this experiment. Immediately following is a more detailed analysis. See the Methods section for a description of variables.

Physiological Measures

In summary, we investigated the effect of message length (90 vs. 160 characters) and message content (explosion or shooter) on physiological outcomes. In most cases, participants showed increased physiological response to receiving a message with SCR, SCL and MAP higher compared to the baseline. Contrary to our hypotheses, we did not see an increase in IBI or HR; however, we also did not see a significant decrease compared to the baseline. Thus, we can generally conclude that receiving a message led to higher physiological arousal.

A broad overview of our results in relation to our condition effects indicates participants showed strongest physiological arousal to longer 160 character messages with content about a shooter scenario. Indeed, there were marginally significant differences due to message length for both SCR and SCL when using belief in the message as a covariate. Our pattern of results also indicates that the 160 character message about a shooter led to the highest physiological arousal in terms of SCR, SCL, IBI and HR. While these changes were not always statistically significant,

this pattern across multiple physiological measurements would indicate that the 160 character message regarding a shooter produced the greatest physiological change.

Physiological Measures Linked to Emotional Self-Report

In terms of self-report fear emotions, the pattern of results suggests that both the 90 and 160 character shooter messages produced greater self-report fear emotions compared to the explosion message. This aligns with the idea that a shooter compared to an explosion produces a greater fear emotion and threat response. Our results also indicate that while message length did not appear to have a great effect within the shooter condition (perhaps due to a ceiling effect), the 160 character message produced greater self-report fear emotions than the 90 character message when the message was about an explosion.

The results from these analyses suggest that some physiological measures accounted for greater variability in self-report fear emotions. For instance, SCL and MAP were significant predictors of self-report fear emotions over and above the impact of our condition variable. In these cases, greater physiological arousal led to increases in self-report fear emotion responses. Thus, for these two measures, it can be argued that they added predictive power to our analyses. We found one three-way interaction with IBI and condition effects. The main finding indicated that message length for the explosion message interacted with IBI to produce different slopes. This effect, however, was isolated within participants who had high IBI values, which does not align with the hypothesis that IBI should decrease as physiological arousal increases, making the interpretation of this result less clear. Overall, while slightly inconsistent, the results from this analysis suggest that physiological measurements (in this case SCL and MAP) are significant predictors of the variance in the self-report fear emotions.

Behavioral Measures

In this experiment, after receipt of the WEA message, most participants did nothing. The most typical behavior was talking to the research assistant or clicking on the URL. Content of the message did not seem to be associated with behavior; however, longer messages (160 characters) were linked to more information seeking. As noted above, longer messages especially regarding the shooter scenario were linked to greater physiological arousal. While these findings suggest this message length is more effective than a shorter 90 character message, the findings are weak and suggestive only because the numbers are small. Moreover, belief in the message and self-reported fear were not significantly linked to observed behaviors.

EDA – Skin Conductance Response

Participants' data were excluded in cases where the participant did not follow instructions (n = 2). We first assessed whether SCR increased above baseline as a function of being sent the message. This analysis serves as our manipulation check in that we believed being sent the message should increase SCR activity. As predicted, SCR (M = 2.00, SE = 0.203) was significantly different from zero, $t(114) = 9.821$, $p < 0.001$, indicating that participants' SCR increased as a function of being sent the message.

Next, we investigated the impact of message length (90 or 160 character) and content (shooter or explosion) on SCR values. There were no significant main effects of message length, $F(1, 111) =$

2.441, $p = 0.121$, $\eta^2 = 0.022$, or message content, $F(1, 111) = 0.400$, $p = 0.529$, $\eta^2 = 0.004$. In addition, there was no significant interaction between message length and content, $F(1, 111) = 0.535$, $p = 0.466$, $\eta^2 = 0.005$ (see Figure 8 for means).

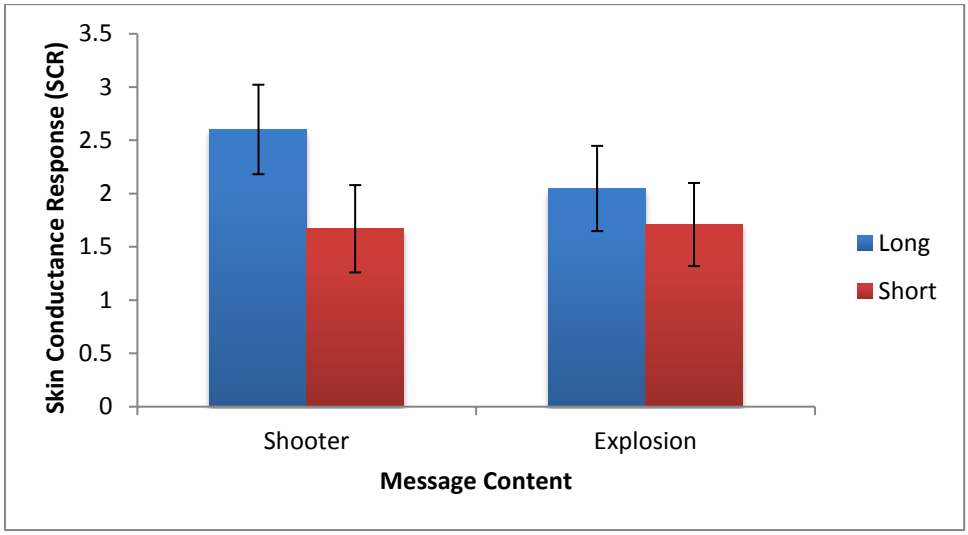

Figure 8: Mean SCR Scores for Message Content and Length Conditions

Finally, we ran the analyses above with belief in the message as a covariate.[1] The use of belief as a covariate produced a marginally significant main effect of message length, with participants who read the 160 character message showing greater SCR increases ($M = 2.40$, $SE = 0.31$) compared to those who read the 90 character message ($M = 1.56$, $SE = 0.31$), $F(1, 97) = 3.630$, $p = 0.060$, $\eta^2 = 0.036$. There was no main effect for message content, $F(1, 97) = 0.055$, $p = 0.814$, $\eta^2 = 0.001$. There was also no significant two-way interaction, $F(1, 97) = 1.108$, $p = 0.295$.

EDA – Skin Conductance Level

Next, we assessed participants' overall SCL level pre- and post-message. We excluded participants who had poor signals as assessed during data pre-processing ($n = 5$) and cases in which the participant did not follow instructions ($n = 2$). We hypothesized that participants' SCL will increase as a function of being sent the message and *that longer message length will lead to greater SCL activity*. As with SCR, we first analyzed whether sending participants a message increased their overall SCL compared to the baseline period. A one-way t-test against zero revealed that indeed participants' SCL ($M = 2.44$, $SE = 0.28$) increased as a function of being sent the message, $t(111) = 8.778$, $p < 0.001$.

We examined the impact of message length and content on SCL values by conducting ANOVA tests. There was a marginally significant main effect of message with participants who read the

[1] Before using belief in the message as a covariate, we first tested whether there were significant differences across conditions with regard to participants' belief in the message. We do not hypothesize that our conditions should influence this result and thus hope to use belief as a moderator for our other analyses. Our results indicated no significant effects of either length, $F(1,134) = 0.995$, $p = 0.320$ or content, $F(1,134) = 0.555$, $p = 0.457$, nor a significant interaction, $F(1,134) = 1.204$, $p = 0.274$. Since belief in the message did not systematically differ as a function of our conditions, we can use this as a moderator of our physiological and emotional self-report variables.

160 character message (M = 2.92, SE = 0.39), showing higher SCL levels than those who read the 90 character message (M = 1.96, SE = 0.40), $F(1, 108) = 3.007$, $p = 0.086$, $\eta^2 = 0.027$. There was no main effect of message content, $F(1, 108) = 0.720$, $p = 0.398$, $\eta^2 = 0.007$. Furthermore, there was no significant two-way interaction, $F(1, 108) = 0.002$, $p = 0.967$, $\eta^2 < 0.001$.

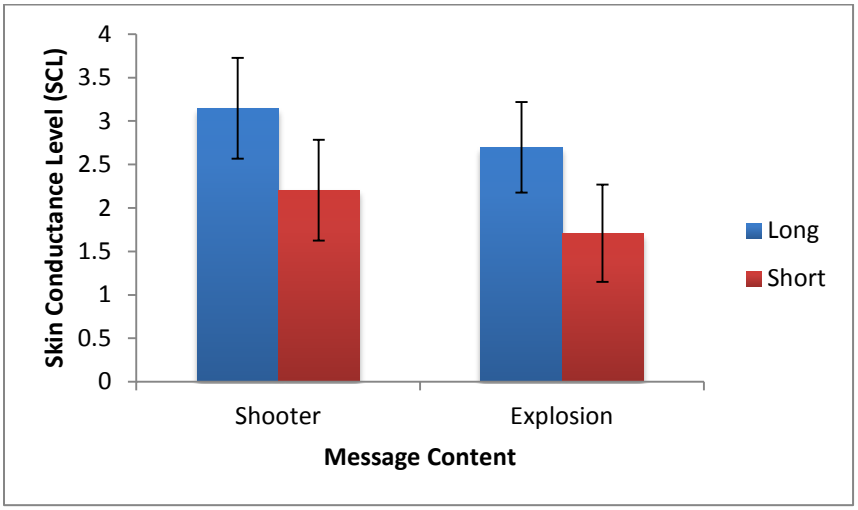

Figure 9: Mean SCL Scores for Message Content and Length Conditions

Next, we ran our condition analyses with belief in the message as a covariate. There was again a marginally significant main effect of message length with participants who read the 160 character message (M = 3.16, SE = 0.42), indicating greater SCL responses than those who read the 90 character message (M = 1.96, SE = 0.45), $F(1, 94) = 3.819$, $p = 0.054$, $\eta^2 < 0.039$. There were no significant main effects for message content, $F(1, 94) = 1.143$, $p = 0.288$, $\eta^2 < 0.039$. There was also no significant two-way interaction, $F(1, 94) = 0.001$, $p = 0.979$, $\eta^2 < 0.001$.

MAP - Mean Arterial Pressure

We excluded participants who had poor signals as assessed during data pre-processing (n = 8) and participants who did not follow instructions (n = 4). In accordance with our hypothesis, we found MAP reactivity scores (M = 0.98, SE = 0.31) increased from baseline following the message being sent, $t(102) = 3.159$, $p = 0.002$.

We assessed the degree to which message length and content impacted MAP reactivity. Results revealed no significant main effect in terms of message length, $F(1, 99) = 2.463$, $p = 0.120$, $\eta^2 = 0.024$, nor a significant main effect due to message content, $F(1, 99) = 0.410$, $p = 0.523$, $\eta^2 = 0.004$. These main effects, however, were qualified by a marginally significant interaction, $F(1, 99) = 3.017$, $p = 0.085$, $\eta^2 = 0.030$. *We decomposed this interaction by investigating the effect of message length for the shooter and explosion messages separately.* Contrasts revealed no significant difference of message length in the shooter content condition, $F(1, 99) = 0.580$, $p = 0.448$, $\eta^2 = 0.006$ (Long: M = 1.12, SE = 0.66; Short: M = 1.79, SE = 0.59). There was, however, a marginally significant difference of message length in the explosion condition, $F(1, 99) = 2.932$, $p = 0.090$, $\eta^2 = 0.029$, with participants who read the 160 character explosion message showing greater MAP reactivity (M = 1.219, SE = 0.60) than participants in the 90 character explosion message condition (M = -0.25, SE = 0.61). Indeed, MAP reactivity values in

the 90 character explosion message did not significantly differ from zero, $t(25) = 0.595$, $p = 0.595$, indicating no physiological response to the explosion short message.

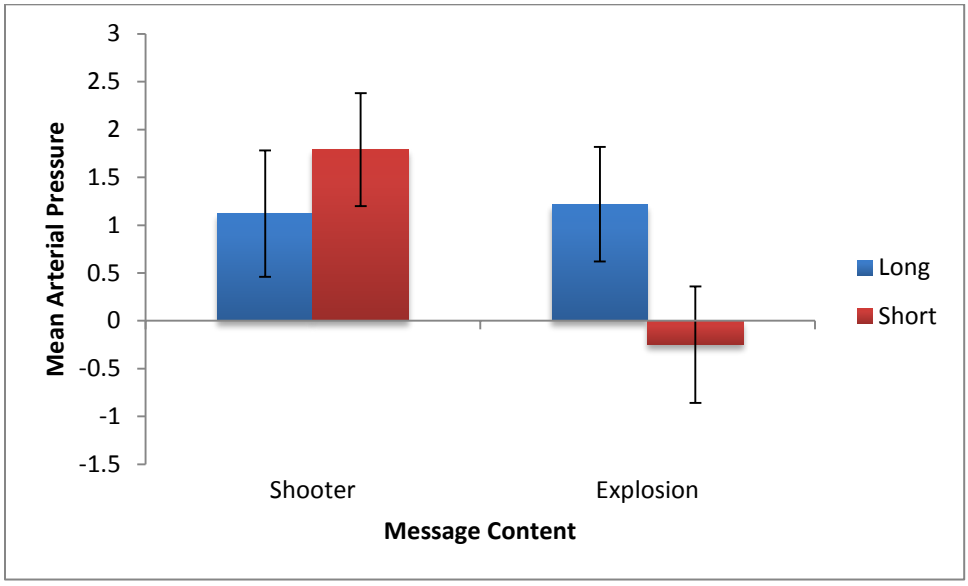

Figure 10: Mean MAP Scores for Message Length and Content Conditions

As with previous analyses, we also ran the same tests above with belief in the message as a covariate. The only change between the models with belief as a covariate and those without was that the marginally significant interaction was no longer significant, $F(1, 86) = 2.519$, $p = 0.116$, $\eta^2 = 0.028$.

IBI - Cardiac Interbeat Interval

First, we excluded participants with an extreme IBI value (+3 SD away from the mean, $n = 1$) along with participants who did not follow directions ($n = 2$). Next, we tested the hypothesis that regardless of condition, participants' IBI should decrease (that is, the time between R-peaks should be shorter) following the message being sent. Contrary to this hypothesis, we saw no significant change in IBI values ($M = 3.45$, $SE = 7.53$) from zero, $t(110) = 0.458$, $p = 0.648$, indicating the message did not impact IBI.

Furthermore, an analysis of variance (ANOVA) testing for differences across our conditions revealed no significant main effects for message length, $F(1, 107) = 1.377$, $p = 0.243$, $\eta^2 = 0.013$, nor for message content, $F(1, 107) = 0.715$, $p = 0.400$, $\eta^2 = 0.007$. There was also no significant two-way interaction, $F(1, 107) = 1.194$, $p = 0.426$, $\eta^2 = 0.004$.

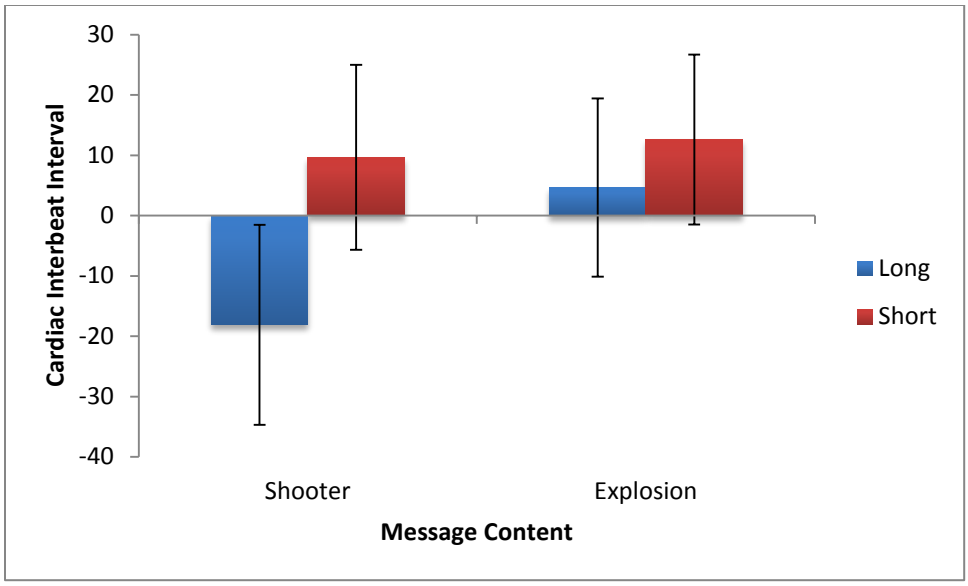

Figure 11: Mean IBI Scores for Message Content and Length Conditions

We conducted the same analyses with belief in the message as a covariate and found no significant main effects for message length, $F(1, 95) = 1.812$, $p = 0.181$, $\eta^2 = 0.019$, and message content, $F(1, 95) = 0.415$, $p = 0.521$, $\eta^2 = 0.004$. There was also no significant two-way interaction, $F(1, 95) = 0.933$, $p = 0.337$, $\eta^2 = 0.010$.

HR – Heart Rate

We excluded participants who were +3 SD away from the mean ($n = 1$) and participants who did not follow instructions ($n = 2$). Again, we tested whether, regardless of condition, participants' HR increased as a function of being sent the message. In line with the null finding from the IBI analysis, we saw no significant change in HR ($M = 0.55$, $SE = 0.60$) from zero, $t(110) = 0.920$, $p = 0.360$. This null finding, while unexpected, indicates participants' HR did not significantly differ from baseline following the message being sent. Results revealed no significant main effects for message length, $F(1, 107) = 0.342$, $p = 0.560$, $\eta^2 = 0.001$, or main effects of message content, $F(1, 107) = 1.187$, $p = 0.278$, $\eta^2 = 0.011$. There was also no evidence of a two-way interaction, $F(1, 107) = 0.085$, $p = 0.771$, $\eta^2 = 0.001$.

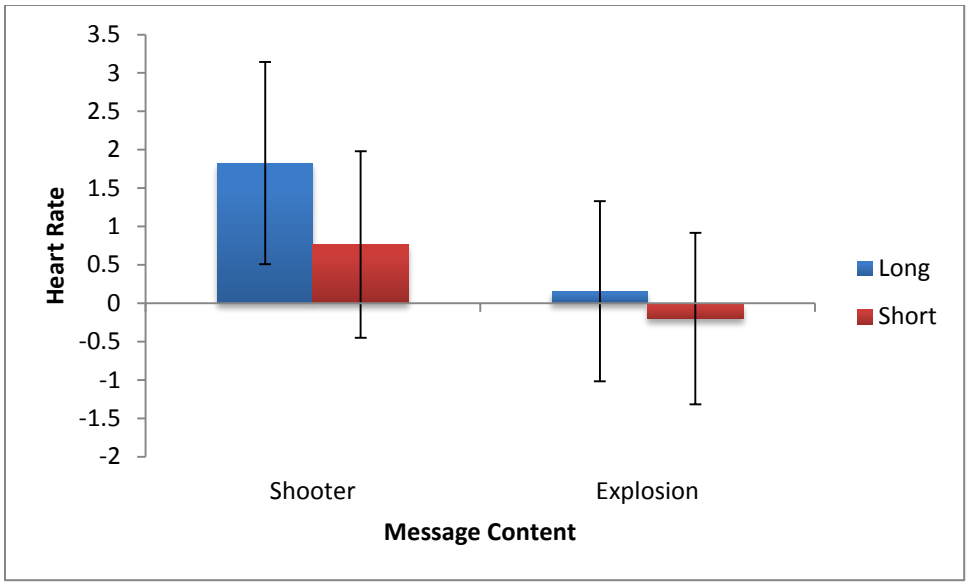

Figure 12: Mean HR Scores for Message Content and Length Conditions

As with previous analyses, we also examined results with belief in the message as a covariate. Again, there was no main effect of message length, $F(1, 95) = 0.538$, $p = 0.465$, $\eta^2 = 0.006$, or a main effect of message content, $F(1, 95) = 0.438$, $p = 0.510$, $\eta^2 = 0.005$. There was also no significant two-way interaction, $F(1, 95) = 1.008$, $p = 0.318$, $\eta^2 = 0.010$. This, along with the null findings from IBI, suggests that cardiovascular measures did not fully capture participants' responses to the message.

Emotions (START - Fear Items)

We tested whether there were significant differences due to length, content or an interaction between length and content on the emotions reported after the message was received. We excluded participants who did not follow instructions ($n = 2$), as well participants who did not answer the emotions questions ($n = 3$). Results from the ANOVA indicated a marginally significant main effect of message length, $F(1, 144) = 3.876$, $p = 0.051$, $\eta^2 = 0.026$, with participants who read the 160 character message indicating more emotional fear response ($M = 4.93$, $SE = 0.33$) than those who read the 90 character message ($M = 4.00$, $SE = 0.34$).

There was also a main effect of message content, $F(1, 144) = 17.115$, $p < 0.001$, $\eta^2 = 0.106$, with participants who read the shooter message indicating greater emotional fear response ($M = 5.44$, $SE = 0.34$) than those who read the explosion message ($M = 3.49$, $SE = 0.33$). These two main effects were qualified by a marginally significant interaction between message length and content, $F(1, 144) = 3.127$, $p = 0.079$, $\eta^2 = 0.021$. We chose to investigate this two-way interaction by looking at the effect of message length within the shooter message and within the explosion message. Simple main effect analyses indicated participants who read the long explosion message reported greater emotional fear response ($M = 4.37$, $SE = 0.47$) compared to those who read the short explosion message ($M = 2.60$, $SE = 0.46$), $F(1, 144) = 7.297$, $p = 0.008$, $\eta^2 = 0.048$. There was no simple main effect of message length in the shooter condition, $F(1, 144) = 0.019$, $p = 0.890$, $\eta^2 < 0.001$, with relatively equal levels of emotional fear response between the long ($M = 5.49$, $SE = 0.47$) and short ($M = 5.39$, $SE = 0.50$) messages.

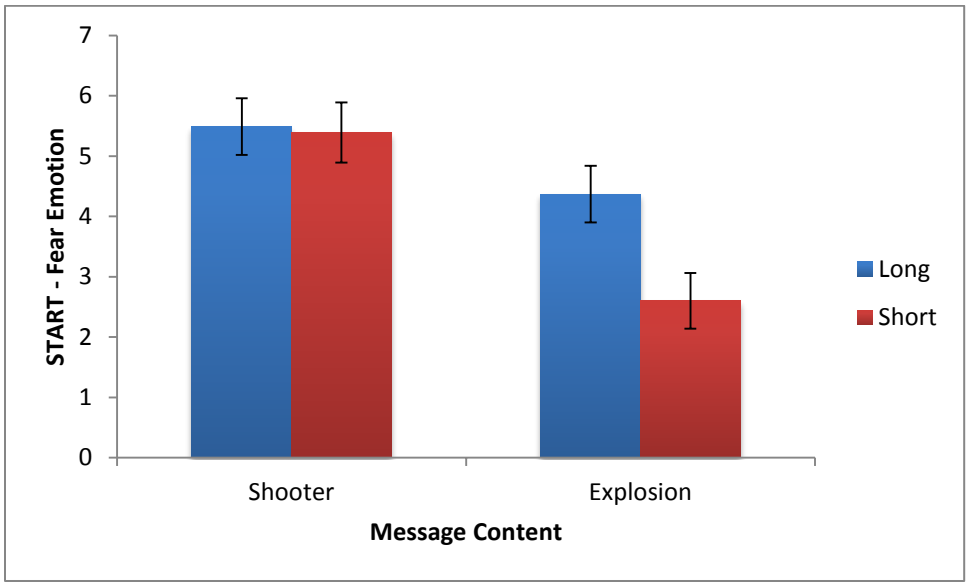

Figure 13: Mean START Fear Emotions Scores for Message Content and Length Conditions

As with the physiological measures, we also used belief in the message as a covariate for self-reported emotions. With belief as a covariate, we find no significant main effect of message length, $F(1, 131) = 2.131$, $p = 0.147$, $\eta^2 = 0.016$. The main effect of message content, however, remains significant, $F(1, 131) = 17.805$, $p < 0.001$, $\eta^2 = 0.120$, with participants who read the shooter message indicating more emotional fear response ($M = 5.59$, $SE = 0.32$) than those who read the explosion message ($M = 3.73$, $SE = 0.30$). There remained no significant two-way interaction, $F(1, 131) = 1.439$, $p = 0.232$, $\eta^2 = 0.011$.

Regressions with Physio, Conditions & Interactions

We were also interested in seeing whether our physiological measures predicted self-report START fear emotion responses. We first ran a correlation between our physiological measures and START fear emotions. The overall pattern of results is mixed with some physiological response (e.g., SCI, MAP and HR) showing a moderate correlation with self-report fear emotions, while others showed no significant correlation (e.g., SCR and IBI).

We then conducted a multiple regression analysis by regressing physiological measures (each measure in a separate analysis), message length (*160* or *90* characters), message content (*explosion* or *shooter*) and all interactions onto self-report fear emotion responses. We built the regression in a step-wise manner, including main effects, two-way interactions and, finally, the three-way interaction.

With regard to SCR, the first step of the regression looked at the main effects of message length, message content and SCR on self-report fear emotions. Together, these predictors accounted for a significant amount of variance in the regression model, $F(3,112) = 9.129$, $p < 0.001$, $R^2 = 0.201$. In terms of main effects, there was a marginally significant main effect for message length, $B = 1.030$, $SE = 0.534$, $t(112) = 1.930$, $p = 0.056$, and a significant main effect for message content, $B = 2.519$, $SE = 0.530$, $t(112) = 4.753$, $p < 0.001$. There was no significant

main effect for SCR, $B = 0.059$, $SE = 0.122$, $t(112) = 0.482$, $p = 0.631$. The inclusion of two-way interactions in Step 2 did not significantly increase the amount of variance accounted for, $\Delta R^2 = 0.040$, $F_{change}(3, 106) = 1.871$, $p = 0.139$. In addition, all two-way interactions were not significant, p's > 0.05. In Step 3, we added the three-way interaction between message content, length and SCR; however, this also did not significantly increase the accounted variability, $\Delta R^2 = 0.010$, $F_{change}(1, 105) = 1.448$, $p = 0.232$, and the three-way interaction was not significant ($p = .232$). In sum, we found no significant main effect of SCR or significant interactions with SCR. The two condition variables (message length and message content) essentially reveal the effects of condition on self-reported fear emotions as analyzed above.

The main effects only model for SCL was significant, $F(3, 106) = 10.32$, $p < 0.001$, $r^2 = 0.226$, with significant main effects for message length, $B = 1.356$, $SE = 0.549$, $t(106) = 2.469$, $p = 0.015$, and message content, $B = 2.379$, $SE = 0.545$, $t(106) = 4.366$, $p < 0.001$. There was also a marginally significant main effect for SCL, $B = 0.167$, $SE = 0.093$, $t(106) = 1.786$, $p = 0.077$, such that for each one point increase in SCL, there was a subsequent 0.167 point increase in self-report fear emotions. For Step 2, there was no significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = 0.036$, $F_{change}(3, 103) = 1.699$, $p = 0.172$; however, there was a significant two-way interaction between message length and message content, $B = -2.388$, $SE = 1.097$, $t(103) = -2.178$, $p = 0.032$. Again, this interaction is redundant to a degree as it demonstrates the above finding with self-report fear emotions this time controlling for the influence of SCL. Finally, in Step 3, there was also no significant increase in the amount of predicted variability, $\Delta R^2 = 0.011$, $F_{change}(1, 102) = 1.572$, $p = 0.213$, and the three-way interaction was not significant, $p = 0.213$.

The main effects only mode for MAP was significant, $F(3,96) = 7.462$, $p < 0.001$, $R^2 = 0.189$, with marginally significant main effects for message length, $B = 0.949$, $SE = 0.568$, $t(96) = 1.667$, $p = 0.099$. There were also significant main effects for message content, $B = 1.987$, $SE = 0.575$, $t(96) = 3.454$, $p = 0.001$, as well as MAP, $B = 0.200$, $SE = 0.090$, $t(96) = 2.212$, $p = 0.029$. The main effect for MAP indicates that for each one point increase in MAP, there was a 0.200 increase in self-report fear emotions. For Step 2, there was a significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = 0.067$, $F_{change}(3, 93) = 2.807$, $p = 0.044$. From all the two-way interactions, there was a marginally significant two-way interaction between message length and message content, $B = -2.241$, $SE = 1.148$, $t(93) = -1.952$, $p = 0.054$, again replicating the previous impact of conditions on self-report fear emotion. There was no significant increase in the amount of predicted variability when including the three-way interaction, $\Delta R^2 = 0.010$, $F_{change}(1, 92) = 1.210$, $p = 0.274$, with no significant three-way interaction, $p = 0.274$.

The main effects only model for IBI was significant, $F(3, 105) = 7.374$, $p < 0.001$, $R^2 = 0.174$. There was a significant main effect for message content, $B = -2.408$, $SE = 0.548$, $t(105) = -4.390$, $p < 0.001$. The main effect for message length was trending, but not significant, $p = 0.094$, while the main effect of IBI was not significant, $p = 0.933$. The amount of predicted variability was significantly different when including the two-way interactions, $\Delta R^2 = 0.064$, $F_{change}(3, 102) = 2.869$, $p = 0.040$. The only significant two-way interaction was between message length and content, $B = -2.474$, $SE = 1.088$, $t(102) = -2.274$, $p = 0.025$; however, all other two-way interactions were not significant, p's > 0.05. Finally, there was a significant increase in the

amount of variability explained when including the three-way interaction, $\Delta R^2 = 0.050$, $F_{change}(1, 101) = 7.155$, $p = 0.009$, indicating a significant three-way interaction, $B = 0.039$, $SE = 0.015$, $t(101) = 2.675$, $p = 0.009$. To break this three-way interaction down, we investigated the two-way interaction of IBI within the shooter and explosion conditions separately. These results revealed that when isolating on the shooter condition, neither the main effects nor the two-way interaction models accounted for a significant amount of variability, $F(2, 45) = 0.565$, $p = 0.572$ and $F(3, 44) = 0.398$, $p = 0.755$. We do, however, find that in the explosion condition, the main effects model predicted a significant amount of the variability, $F(2, 58) = 4.271$, $p = 0.019$, with a significant main effect for message length, $B = 1.872$, $SE = 0.666$, $t(58) = 2.812$, $p = 0.007$. Furthermore, the two-way interaction increased the amount of variability explained, $\Delta R^2 = 0.162$, $F_{change}(1, 57) = 12.981$, $p = 0.001$, with the two-way interaction between message length and IBI significant, $B = -0.036$, $SE = 0.010$, $t(57) = -0.3603$, $p = 0.001$.

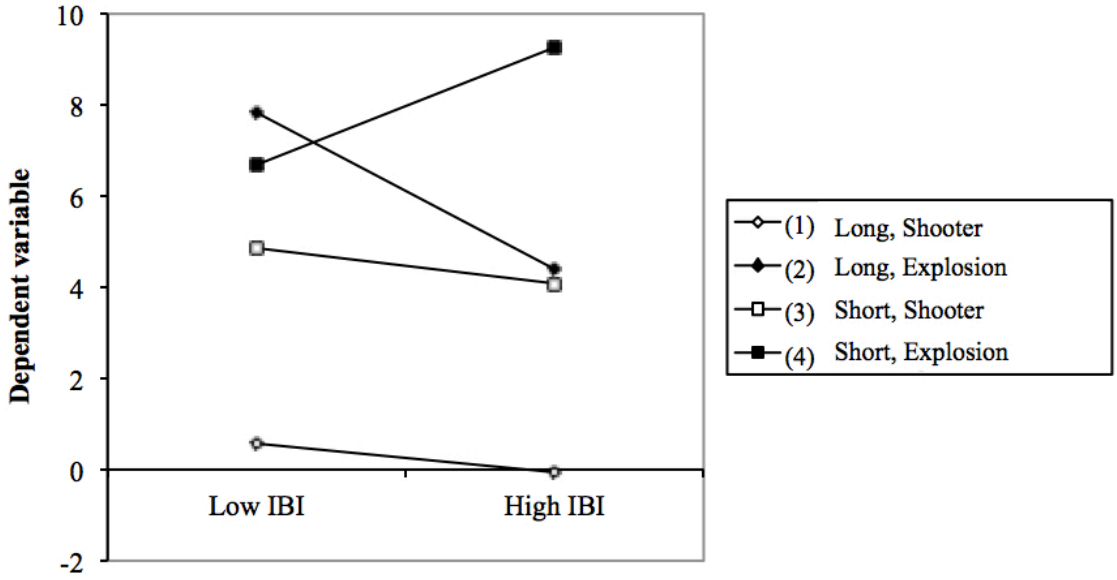

Figure 14: Two-Way Interaction between Message Length and IBI

The overall main effects model for HR was significant, $F(3, 105) = 8.504$, $p < 0.001$, $R^2 = 0.195$. There was a significant main effect for message content, $B = 2.319$, $SE = 0.543$, $t(105) = 4.273$, $p < 0.001$. There was no significant main effect for message length, $p = 0.113$, or HR, $p = 0.097$. The amount of predicted variability was not significantly greater when including the two-way interactions, $\Delta R^2 = 0.033$, $F_{change}(3, 102) = 1.442$, $p = 0.235$. Regardless, there was a significant two-way interaction between message length and content, $B = -2.177$, $SE = 1.087$, $t(102) = -2.003$, $p = 0.048$. Again, this two-way interaction reflects the interaction found above between message length and message content, while controlling for HR. Lastly, the inclusion of the three-way interaction also did not significantly increase the amount of variability explained by the model, $\Delta R^2 = 0.019$, $F_{change}(1, 101) = 2.574$, $p = 0.112$, and the three-way interaction was not significant, $p = 0.112$.

Behavioral Response

For this experiment, the distribution of behaviors observed for participants showed that three behavioral responses were most likely. Most people did nothing (75-89 percent). A few alerted

the research assistant (RA) (12-24 percent) or clicked the URL (0-16 percent). In this experiment, no one sought more information on the web or clicked off the message. The only behavior that varied significantly across conditions was clicking the URL, which was more likely in longer messages.

Table 8: Experiment 2 – Bivariate Analysis: Behaviors by Experimental Condition

	Explosion Short	**Explosion Long**	**Shooter Short**	**Shooter Long**	**Significance**
	(N = 39)	**(N = 38)**	**(N = 33)**	**(N = 40)**	
Behavior	**N (%)[a]**	**N (%)[a]**	**N (%) [a]**	**N (%)[a]**	**p[b]**
Do nothing					
Yes	35 (89.74)	28 (75.68)	28 (84.85)	34 (85.00)	0.408
No	4 (10.26)	9 (24.32)	5 (15.15)	6 (15.00)	
Alert RA					
Yes	5 (12.82)	9 (24.32)	6 (18.18)	6 (15.00)	0.578
No	34 (87.18)	28 (75.68)	27 (81.82)	34 (85.00)	
Click URL					
Yes	0 (0.00)	6 (16.22)	0 (0.00)	1 (2.50)	0.002*
No	39 (100.00)	31 (83.78)	33 (100.00)	39 (97.50)	
Seek information from web					
Yes	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A
No	39 (100.00)	37 (100.00)	33 (100.00)	40 (100.00)	
Immediately click off message					
Yes	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A
No	39 (100.00)	37 (100.00)	33 (100.00)	40 (100.00)	

[a] Reported percentages are column percentages; may not sum up to 100 due to rounding
[b] p-value from chi-square test (or Fisher's Exact)
* $p \leq 0.05$

We then conducted a logistic regression analysis regressing experimental condition (explosion short, explosion long, shooter short, shooter long), age, gender, language preference, belief in the message and self-reported fear emotions onto two behaviors: (1) Do nothing, and (2) Alert RA. There were no significant associations between predictor variables and behaviors in this analysis, meaning none of the factors measured had any influence on whether someone took action or not.

4.3 Experiment 3: Individual vs. Dyad

In Experiment 3, we investigated the effect of condition (individual vs. dyad) on physiological outcomes. We then explored the degree to which physiological arousal predicted the emotional fear response and analyzed behavioral findings. We recognize the statistical analyses and concepts may be hard to follow; therefore, we first present a simpler explanation of overall findings for this experiment. Immediately following is the more detailed analysis. See the Methods section for description of variables.

Physiological Measures

In summary, we investigated the effect of condition (individual vs. dyad) on physiological outcomes. In two cases, participants showed increased physiological response to receiving a message with SCR and SCL higher compared to the baseline. Contrary to our hypotheses, we did not see an increase in MAP, IBI or HR; however, we also did not see a significant decrease compared to the baseline. Thus, we can generally conclude that receiving a message led to higher physiological arousal.

A broad overview of our results in relation to our condition effects indicates participants did not show consistently stronger physiological arousal in the individual condition relative to the dyad condition. There were marginally significant differences due to condition for SCL, and this remained marginally significant when using belief in the message as a covariate. However, the pattern of results was inconsistent across the other measures of physiological arousal.

Physiological Measures Linked to Emotional Self-Report

In terms of self-report fear emotions, the pattern of results suggests that the dyad condition did not produce greater self-report fear emotions relative to the individual condition. This aligns with the inconsistent findings in the physiological data. While the mean scores are in the predicted direction such that individuals in the dyad condition showed greater mean self-reported fear responses relative to the individual condition, this difference was not significant.

The results from these analyses suggest that none of the physiological measures accounted for greater variability in self-report fear emotions. That is, none of the physiological variables (SCR, SCL, MAP, IBI, HR) were significant predictors of self-report fear emotions over and above the impact of our condition variable. Furthermore, there were no significant interactions of physiological measures and condition on self-report fear emotions. Thus, for these measures it can be argued that it did not add predictive power to our analysis.

Behavioral Measures

For Experiment 3, individuals vs. dyads, while more people took action, findings are somewhat ambiguous. The large proportion of participants in the dyad condition that spoke to the other person suggests that people in social groups are likely to communicate with others, which may have as much to do with the social context as with the message. On the other hand, in terms of other actions, individuals were slightly more likely to act than those in dyads, which would be predicted by theories of self-regulation of arousal in groups. However, some of those actions, such as clicking off the message, are not as proactive as talking with the research assistant. Clearly, believing the messages to be true was important as a predictor of taking action in this group of participants.

EDA – Skin Conductance Response

Participants' data were excluded in cases where there was experimenter, participant or equipment error, or if the signal during data processing was unreadable (n = 29). We first assessed whether SCR increased above baseline as a function of being sent the message. This analysis serves as our manipulation check in that we believed being sent the message should increase SCR activity. As predicted, SCR (M = 1.50, SE = 0.145) was significantly different

from zero, $t(134) = 10.327$, $p < 0.001$, indicating that participants' SCR increased as a function of being sent the message.

Next, we investigated the impact of condition (individual vs. dyad) on SCR values. An independent samples t-test on SCR indicated that the dyad condition produced a greater SCR response ($M = 1.51$, $SE = 0.194$) than the individual condition ($M = 1.47$, $SE = 0.22$); however, this difference was not significant, $t(131) = -0.143$, $p = 0.886$ (see Figure 15*)*. This finding indicates that the dyad condition did not lead to significantly greater SCR activity compared to the individual condition.

Finally, we ran an ANCOVA to see if there were significant differences in SCR values between groups (individual vs. dyad) with belief in the message as a covariate. Again, there was no significant difference between groups (individual vs. dyad), $F(1, 130) = 0.015$, $p = 0.902$.

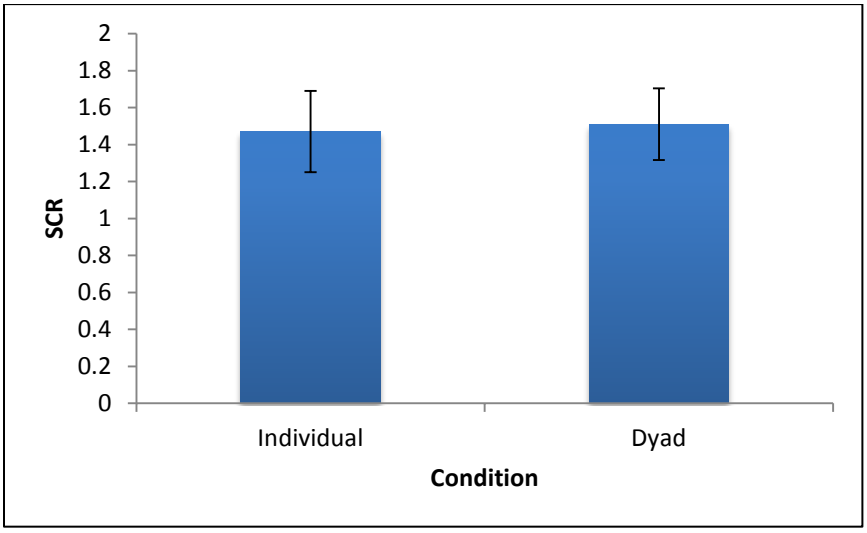

Figure 15: Mean SCR Scores for Individual vs. Dyad Conditions

EDA – Skin Conductance Level

Next, we assessed participants' overall SCL level pre- and post-message. We excluded participants who had poor signals as assessed during data pre-processing, cases where there was experimenter, participant or equipment error, or when participants did not follow instructions ($n = 29$). We hypothesized that participants' SCL would increase as a function of being sent the message and *that being in a dyad would lead to greater SCL activity*. As with SCR, we first analyzed whether sending participants a message increased their overall SCL compared to the baseline period. A one-way t-test against zero revealed that indeed participants' SCL ($M = 2.23$, $SE = 0.20$) increased as a function of being sent the message, $t(143) = 11.330$, $p < 0.001$.

Next, we assessed the influence of condition (individual vs. dyad) on SCL values. An independent samples t-test on SCL indicated the dyad condition produced a greater SCL response ($M = 2.47$, $SE = 0.25$) than the individual condition ($M = 1.71$, $SE = 0.30$), and this difference was marginally significant, $t(142) = -1.816$, $p = 0.071$ (see Figure 16*)*. Thus, the dyad condition produced marginally higher SCR values compared to the individual condition.

Lastly, we ran our condition analyses with belief in the message as a covariate. We again saw that the difference between the dyad condition (M = 2.47, SE = 2.46) and the individual condition (M = 1.71, SE = 2.05) was marginally significant, $F(1, 141) = 3.352$, $p = 0.069$.

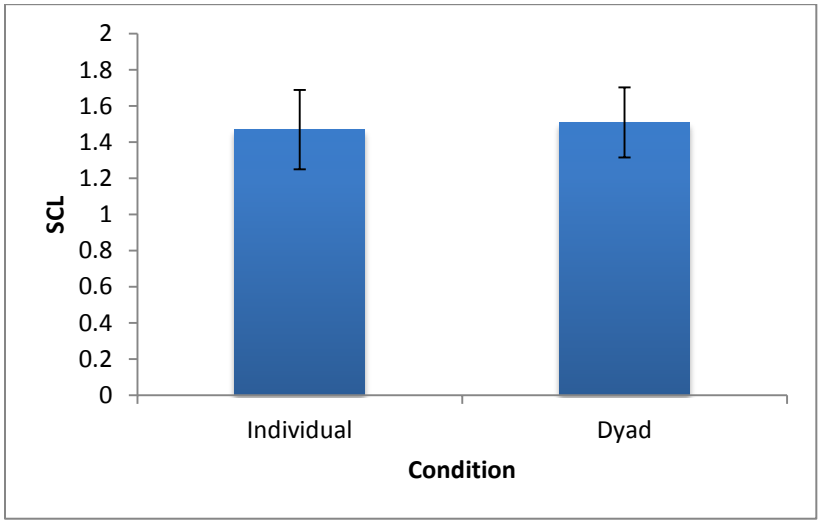

Figure 16: Mean SCL Scores for Individual vs. Dyad Conditions

MAP - Mean Arterial Pressure

Participants' data were excluded in cases where there was experimenter, participant or equipment error (n = 83). We also excluded participants with poor signals as assessed during data pre-processing or who did not follow instructions (n = 4). In accordance with our hypothesis, we found MAP reactivity scores (M = 1.01, SE = 0.23) increased from the baseline following the message being sent, $t(134) = 4.313$, $p < 0.001$.

We next assessed the degree to which condition (individual vs. dyad) impacted MAP reactivity. An independent samples t-test revealed no significant differences between the dyad condition (M = 0.91, SE = 0.26) and the individual (M = 1.21, SE = 0.47) condition, $t(133) = 0.609$, p = 0.544 (see Figure 17*)*. As with previous analyses, we also ran the same tests above with belief in the message as a covariate. Again, we found no significant differences between groups (individual vs. dyad), $F(1, 132) = 0.345$, $p = 0.552$.

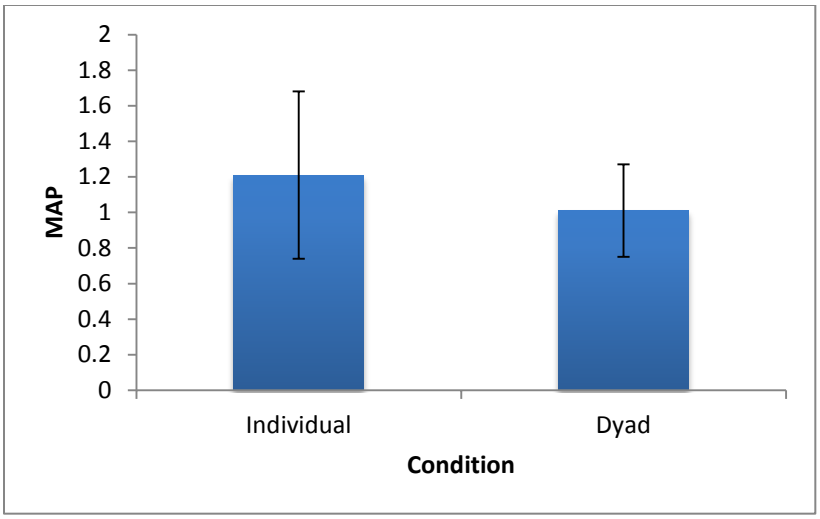

Figure 17: Mean MAP Scores for Individual vs. Dyad Conditions

IBI - Cardiac Interbeat Interval

We excluded participants with an extreme IBI value (+3 SD away from the mean; n = 1) along with participants who had poor signals as assessed during data pre-processing, cases where there was experimenter, participant or equipment error, or when participants did not follow instructions (n = 14). We first tested the hypothesis that, regardless of condition, participants' IBI should decrease (time between R-peaks should be shorter) following the message being sent. Contrary to this hypothesis, there was not a significant decrease in IBI values (M = 14.00 SE = 11.03) from zero, $t(140) = 1.269$, $p = 0.207$, indicating the message did not impact IBI.

We then assessed whether IBI differed as a function of condition (individual vs. dyad). An independent samples t-test on IBI indicated no significant differences between the dyad (M = 13.83, SE = 13.81) condition and the individual (M = 14.30, SE = 18.46) condition, $t(140) = 1.314$, $p = 0.191$ (see Figure 18). This finding indicates that the dyad condition did not lead to decreased IBI relative to the individual condition. We conducted the same analyses with belief in the message as a covariate and found no significant differences between the dyad condition and the individual condition, $F(1, 137) = 0.463$, $p = 0.497$.

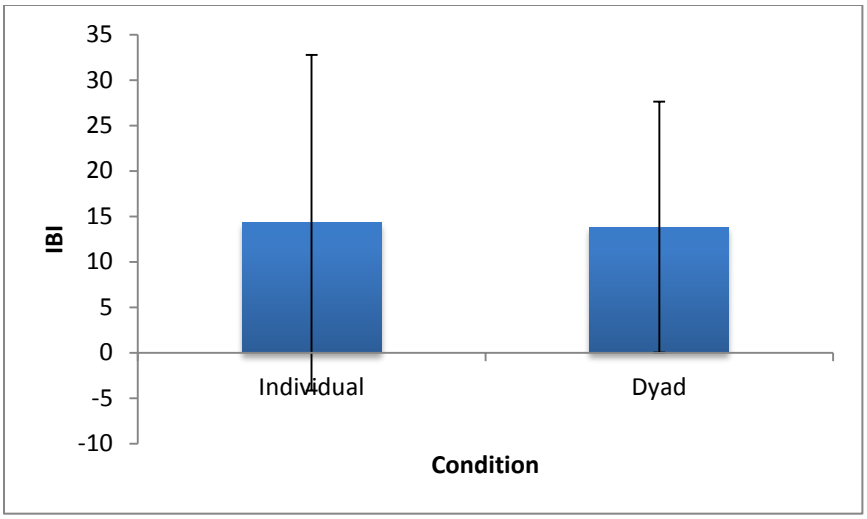

Figure 18: Mean IBI Scores for Individual vs. Dyad Conditions

HR - Heart Rate

We excluded participants with an extreme HR value (+3 SD away from the mean; n = 3) along with participants who had poor signals as assessed during data pre-processing, cases where there was experimenter, participant or equipment error, or when participants did not follow instructions (n = 14). Again, we tested whether, regardless of condition, participants' HR increased as a function of being sent the message. Contrary to this hypothesis, a one way t-test against zero revealed that participants' HR decreased (M = -2.43, SE = 0.678) as a function of being sent the message, $t(140) = -3.56$, $p < 0.001$. This finding indicates participants' HR did significantly differ from the baseline following the message being sent. Next, we assessed whether HR differed as a function of condition (individual vs. dyad). An independent samples t-test on HR indicated no significant differences between the dyad (M = -2.76, SE = 0.815) condition and the individual (M = -1.77, SE = 1.225) condition, $t(138) = 0.684$, $p = 0.495$ (see Figure 19). This finding indicates that the dyad condition did not lead to significantly increased HR relative to the individual condition.

As with previous analyses, we also examined results with belief in the message as a covariate. There was no significant differences between the dyad condition and the individual condition, $F(1,140) = 0.198$, $p = 0.657$.

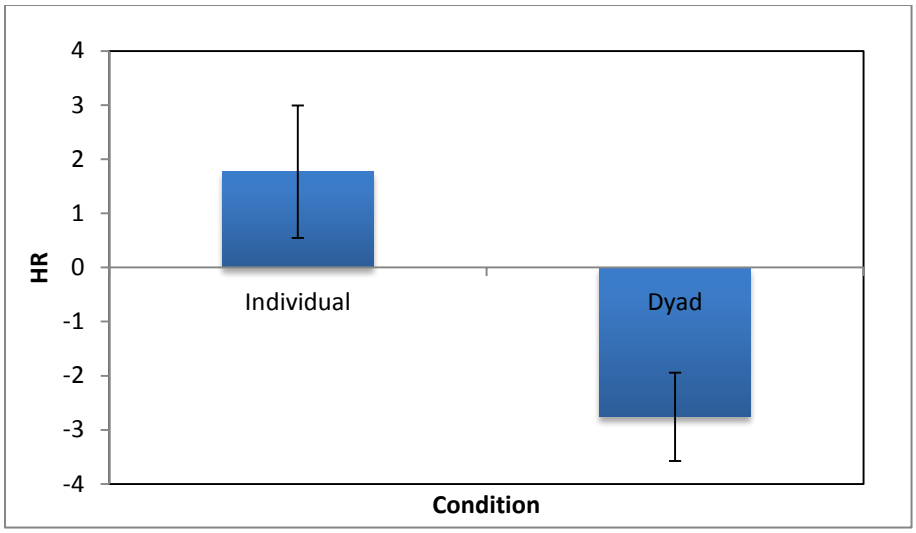

Figure 19: Mean HR Scores for Individual vs. Dyad Conditions

4.3.1 Condition Effects on Self-Report Measures

Emotions (START - Fear Items)

We tested whether there were significant differences due to condition (individual vs. dyad) on the emotions reported after the message was received. We excluded participants who did not follow instructions (n = 2), as well participants who did not answer the emotions questions (n = 8). An independent samples t-test revealed no significant differences between the dyad (M = 4.40, SE = 0.224) condition and the individual (M = 4.30, SE = 0.29) condition, $t(162) = -0.266$, p = 0.791. This result with regard to condition (individual vs. dyad) aligns with our physiological data that suggests no difference between conditions; furthermore, we see slightly greater self-reported fear emotions in the dyad condition compared to the individual condition.

As with the physiological measures, we also used belief in the message as a covariate for self-reported emotions. When covarying out participants' belief in the message, we still saw no significant differences between the dyad condition and the individual condition, $F(1, 160) = 0.302$, $p = 0.583$.

Physio Predicting Self-Report Emotions (START - Fear Items)

We were also interested in seeing whether our physiological measures predicted self-report START fear emotion responses. We first ran a correlation between our physiological measures and START fear emotions. The overall pattern of results indicates no significant correlations between START fear responses and any of our physiological measures.

Table 9: Pearson Correlations between START Emotions and Physiological Responses

	SCR	**SCL**	**MAP**	**IBI**	**HR**
START Fear Emotions	-.100	-.124	.015	.107	-.042

Note: Significant correlation (p < .05)

Regression with Physiological Measures and Condition as Predictors

Multiple regression analyses were conducted to examine the relationship between the various physiological measures and condition for self-reported emotion START fear emotion responses. We regressed START fear emotion responses onto physiological measures (each measure in a separate analysis), condition (individual vs. dyad) and the respective interactions.

SCR - Skin Conductance Response

To address SCR, the first step of the regression looked at the main effects for SCR and condition on START fear emotions. Together, these predictors did not account for a significant amount of variance in the model, $F(2, 129) = 0.745$, $p = 0.477$, $R^2 = 0.011$. In terms of main effects, there was no significant main effect for condition (individual vs. dyad), $B = -0.185$, $SE = 0.432$, $t(129) = -0.429$, $p = 0.668$ and no significant main effect for SCR, $B = -0.137$, $SE = 0.121$, $t(129) = -1.135$, $p = 0.259$. The inclusion of two-way interactions in Step 2 did not significantly increase the amount of variance accounted for, $\Delta R^2 = 0.004$, $F(1, 128) = 0.541$, $p = 0.463$. In addition, the two-way interaction between message condition and SCR was not significant, $B = 0.208$, $SE = 0.283$, $t(128) = 0.736$, $p = 0.463$.

SCL - Skin Conductance Level

The main effects only model for SCR was not significant, $F(2, 140) = 1.119$, $p = 0.329$, $R^2 = 0.016$, with no significant main effects for condition (individual vs. dyad), $B = 0.076$, $SE = 0.408$, $t(140) = 0.185$, $p = 0.853$, or for SCL, $B = -0.121$, $SE = 0.081$, $t(140) = -1.495$, $p = 0.137$. For Step 2, there was no significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = 0.001$, $F(1, 139) = 0.089$, $p = 0.766$. Furthermore, there was no significant two-way interaction between message condition and SCR, $B = 0.056$, $SE = 0.189$, $t(139) = 0.298$, $p = 0.766$.

MAP - Mean Arterial Pressure

The main effects only model for MAP was not significant, $F(2,132) = 0.067$, $p = 0.935$, $R^2 = 0.032$, with no significant main effects for condition (individual vs. dyad), $B = -0.134$, $SE = 0.412$, $t(132) = -0.325$, $p = 0.746$ or for MAP, $B = 0.011$, $SE = 0.072$, $t(132) = 0.154$, $p = 0.878$. For Step 2, there was no significant increase in the amount of predicted variability when adding the two-way interactions, $\Delta R^2 = 0.014$, $F(1, 131) = 1.881$, $p = 0.173$. Furthermore, there was no significant two-way interaction between message condition and MAP, $B = -0.197$, $SE = 0.143$, $t(131) = 1.372$, $p = 0.173$.

IBI – Cardiac Interbeat Interval

The main effects only model for IBI was not significant, $F(2, 139) = 0.905$, $p = 0.407$, $R^2 = 0.013$. There was no significant main effect for condition, $B = 0.180$, $SE = 0.406$, $t(139) = 0.444$, $p = 0.658$. The main effect for IBI was also not significant, $B = 0.001$, $SE = 0.001$, $t(139) = 1.234$, $p = 0.219$. The amount of predicted variability was not significantly different when including the two-way interaction, $\Delta R^2 < 0.001$, $F(1, 138) = 0.001$, $p = 0.970$. The two-way interaction was not significant, $B < 0.001$, $SE = 0.003$, $t(138) = 0.037$, $p = 0.970$.

HR - *Heart Rate*

The overall main effects model for HR was not significant, $F(2, 139) = 0.254$, $p = 0.776$, $R^2 = 0.004$. There was no significant main effect condition (individual vs. dyad), $B = 0.212$, $SE = 0.409$, $t(139) = 0.510$, $p = 0.611$. There was no significant main effect for HR, $B = -0.012$, $SE = 0.026$, $t(139) = -0.473$, $p = 0.637$. The amount of predicted variability was not significantly greater when including the two-way interactions, $\Delta R^2 = 0.001$, $F(1, 138) = 0.138$, $p = 0.710$. Furthermore, there was no significant two-way interaction between condition and HR, $B = -0.020$, $SE = 0.053$, $t(138) = -0.372$, $p = 0.710$.

Belief

We tested whether there were significant differences across conditions with regard to participants' belief in the message. We did not hypothesize that our conditions should influence this result and thus hoped to find that belief in the message did not differ as a function of condition. Our results indicated no significant effects of condition, $t(161) = 0.679$, $p = 0.498$. These results confirmed the hypothesis that belief in the message should not differ as a function of condition, as we would want participants to believe the message regardless of condition.

Behavioral Response

For this experiment, the distribution of behaviors observed for participants showed a greater repertoire of behavioral responses among participants. The most typical behavior was to do nothing, with 50 percent of individuals in the individual condition and 39 percent in the dyad condition responding in this way. As in other experiments, only a minority of participants actually did anything. 'Talk to other person' was the most typical behavior with 51.82 percent of people in the dyad condition. However, for all the other behaviors there was very low uptake, with those in individual condition more likely to alert the RA (p = 0.006) or click off the message (p = 0.014) compared to those in the dyad condition.

Table 10: Experiment 3 – Bivariate Analysis: Behaviors by Experimental Condition

	Individual	**Dyad**	**Significance**
	(N = 54)	**(N = 110)**	
Behavior	**N(%)[a]**	**N(%)[a]**	**p[b]**
Do nothing			
Yes	27 (50.00)	43 (39.09)	0.184
No	27 (50.00)	67 (60.91)	
Alert RA			
Yes	12 (22.22)	8 (7.27)	0.006*
No	42 (77.78)	102 (92.73)	
Click URL			
Yes	3 (5.56)	4 (3.64)	0.568
No	51 (94.44)	106 (96.36)	
Seek information from web			
Yes	2 (3.70)	3 (2.73)	0.665
No	52 (96.30)	107 (97.27)	

Immediately click off message			
Yes	11 (20.37)	8 (7.27)	0.014*
No	43 (79.63)	102 (92.73)	
Talk to other person			
Yes	--	57 (51.82)	--
No	--	53 (48.18)	
[a] Reported percentages are column percentages; may not sum up to 100 due to rounding [b] p-value from chi-square test (or Fisher's Exact) * $p \leq 0.05$			

We conducted a logistic regression analysis, regressing experimental condition (individual vs. dyad), age, gender, language preference, belief in the message and self-reported fear emotions onto three behaviors: (1) Do nothing, (2) Alert the RA, and (3) Immediately click off message. Findings showed that people in dyads were less likely to talk to an RA ($p < 0.05$) and were less likely to click on the message ($p < 0.01$). People who did not believe in the message were more likely to do nothing ($p < 0.05$).

4.4 Experiment 4: Message Content and Length (160/280 characters) Conditions

In Experiment 4, we investigated the effect of two conditions, content (shooter, explosion) and message length (160 characters, 280 characters) on physiological outcomes. We then explored the degree to which physiological arousal predicted emotional fear response and analyzed behavioral findings. We recognize the statistical analyses and concepts may be hard to follow, therefore we first present a simpler explanation of overall findings for this experiment. Immediately following is a more detailed analysis. See the Methods section for a description of variables.

Physiological Measures

In summary, we investigated the effect of message length (160 vs. 280 characters) and message content (explosion or shooter) on physiological response outcomes. As in the previous experiments, results indicated that participants showed an increased physiological arousal response to receiving a message with SCR, SCL and MAP higher compared to baseline and IBI or HR not showing a significant increase or decrease compared to baseline. Again, from these results, we can generally conclude that receiving a message led to higher physiological arousal in our participants with some qualifications regarding our cardio measures.

In terms of our condition effects, a broad overview of our results indicates participants showed strongest physiological responses to both the 160 character message and 280 character message about a shooter. Specifically, our results show that while SCR and SCL did not show condition effects, the 160 character and 280 character messages produced the largest responses, respectively. Our results also indicate that MAP scores were the highest for 280 character shooter messages. Finally, IBI and HR both showed the greatest physiological response to the 160 character messages about shooters, with the difference for HR reaching statistical significance. While most results were not statistically significant (except our finding with HR), the overall pattern suggests a mixed case for shifting from 160 to 280 character messages. In general, the effect of moving from 160 to 280 character messages produced minimal returns, as

SCL and MAP were the only two physiological measurements in which 280 character messages about a shooter produced higher physiological arousal responses. Indeed, some measurements showed greater physiological arousal responses to the 160 character message about a shooter (SCR, HR and IBI). Overall, it appears there are diminished returns from moving to 280 character messages.

Physiological Measures Linked to Emotional Self Report

For self-report fear emotions, our results indicated that participants reported greater emotional fear response after reading about the shooter compared to the explosion message, replicating the results found in Experiment 2. In addition, both the 160 and 280 character shooter messages produced high self-report fear emotions. Interestingly, the 160 character message about an explosion appeared to engender greater self-report fear emotions, suggesting that 280 character messages may not necessarily produce greater self-report fear emotion responses.

The results from these analyses suggest that some physiological measures accounted for greater variability in self-report fear emotions. For instance, SCR and IBI were significant predictors of self-report fear emotions over and above the impact of our condition variables. In these cases, greater physiological arousal led to increases in self-report fear emotion responses. Thus, for these two measures, it can be argued that they added predictive power to our analyses. Overall, while slightly inconsistent, the results from this analysis suggest that physiological measurements (in this case SCR and IBI) are significant predictors of the variance in the self-report fear emotions.

Behavioral Measures

Behavioral findings for Experiment 4 are also more suggestive than definitive. Here, the longer messages (160 and 280 characters) did not seem to elicit any more action than shorter messages and these respondents exhibited a great deal of doing nothing and clicking off the message. Here, lack of English inhibited behavior, English speakers were at a slight advantage in regards to being proactive, and belief in the message also played a role, albeit inhibiting response more than facilitating it.

EDA – Skin Conductance Response

Participants' data were excluded in cases where there was an experimenter, a participant equipment error (e.g., dead electrode) (n = 23), or if the signal during data processing was unreadable (n = 2). We first assessed whether SCR increased above the baseline as a function of being sent the message. This analysis serves as our manipulation check in that we believed being sent the message should increase SCR activity. As predicted, SCR (M = 1.08, SE = 0.15) was significantly different from zero, $t(76) = 7.173$, $p < 0.001$, indicating that participants' SCR increased as a function of being sent the message.

Next, we investigated the impact of message length (160 or 280 character) and content (shooter or explosion) on SCR values. An ANOVA on SCR indicated no significant difference between the 160 (M = 1.22, SE = 0.21) and 280 (M = .88, SE = 0.23) character messages, $F(1, 73) = 1.186$, $p = 0.280$, $\eta^2 = 0.016$. In addition, there was no significant difference between shooter (M = 1.12, SE = 0.22) and explosion (M = 0.99, SE = 0.22) content, $F(1, 73) = 0.180$, $p = 0.673$, η^2

= 0.002, and no significant interaction between message length and content, $F(1, 73) = 0.578$, $p = 0.450$, $\eta^2 = 0.008$.

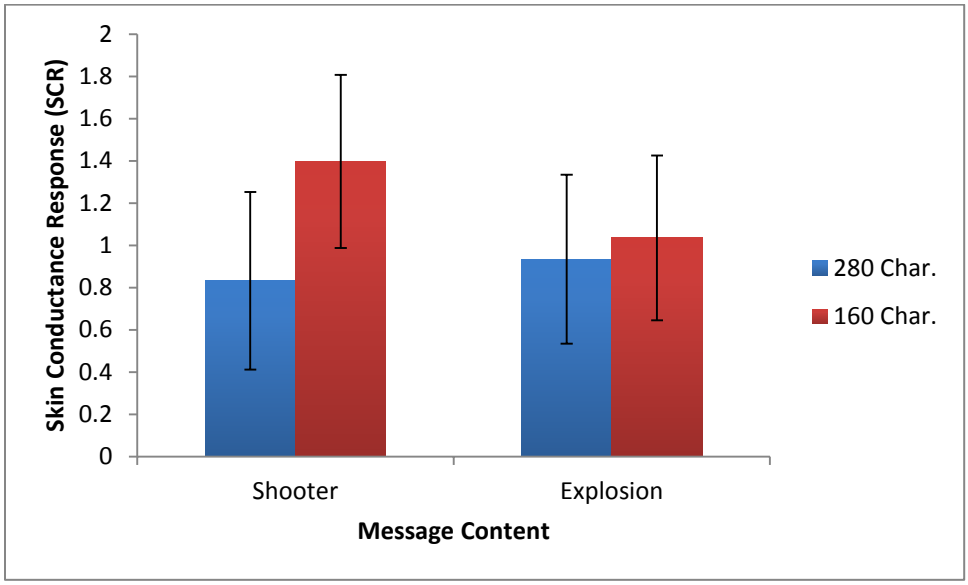

Figure 20: Mean SCR Scores for Message Content and Length Conditions

EDA – Skin Conductance Level

Next, we assessed participants' overall SCL level pre- and post-message. We excluded participants who had poor signals as assessed during data pre-processing ($n = 3$). As with SCR, we first analyzed whether sending participants a message increased their overall SCL compared to the baseline period. A one-way t-test against zero revealed that participants' SCL ($M = 2.331$, $SE = 0.30$) increased as a function of being sent the message, $t(76) = 7.660$, $p < 0.001$.

Next, we assessed the impact of message length and content on SCL values. Results revealed no significant main effect of message length with 160 ($M = 2.11$, $SE = 0.42$) and 280 ($M = 2.60$, $SE = 0.45$) character messages eliciting similar SCL responses, $F(1, 73) = 0.636$, $p = 0.428$, $\eta^2 = 0.009$. There was also no main effect of message content with shooter ($M = 2.65$, $SE = 0.44$) and explosion ($M = 2.07$, $SE = 0.43$) showing no significant differences, $F(1, 73) = 0.840$, $p = 0.362$, $\eta^2 = 0.009$. The two-way interaction was also not significant, $F(1, 73) = 0.427$, $p = 0.516$, $\eta^2 < 0.006$.

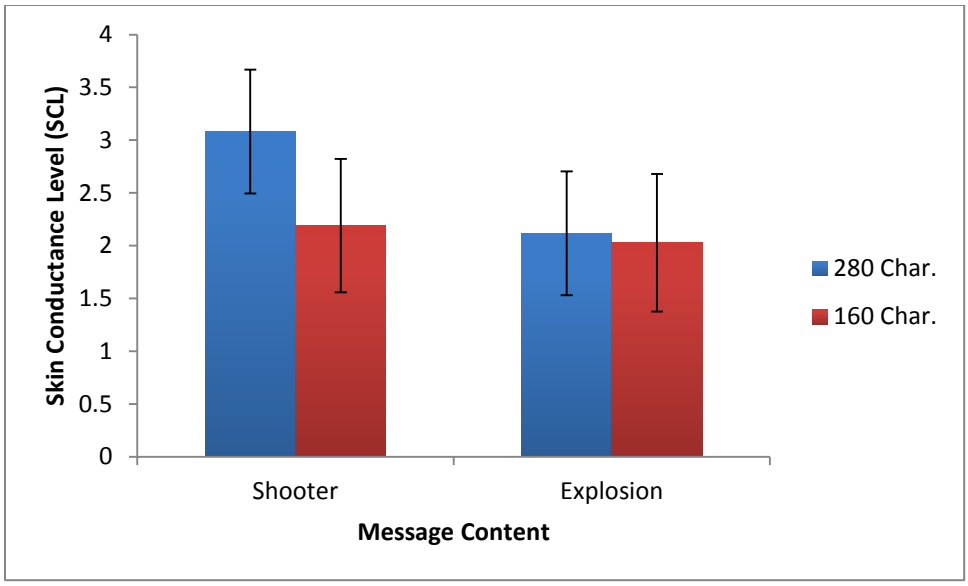

Figure 21: Mean SCL for Message Content and Length Conditions

MAP - Mean Arterial Pressure

We excluded participants who had poor signals as assessed during data pre-processing (n = 6). In accordance with our hypothesis, we found MAP reactivity scores increased from the baseline (M = 1.23, SE = 0.34) following the message being sent, $t(95) = 3.578$, p = 0.001. We next assessed the degree to which message length and content impacted MAP reactivity. Results revealed no significant difference in terms of message length with 160 (M = 0.79, SE = 0.47) and 280 (M = 1.72, SE = 0.51) character messages showing similar responses, $F(1, 92) = 1.502$, p = 0.223, η^2 = 0.016. There was also no significant difference due to message content with shooter (M = 1.68, SE = 0.48) and explosion (M = 0.83, SE = 0.50) messages showing no significant difference, $F(1, 92) = 1.794$, p = 0.184, η^2 = 0.019. Finally, there was also no significant two-way interaction, $F(1,92) = 0.039$, p = 0.843, $\eta^2 < 0.001$.

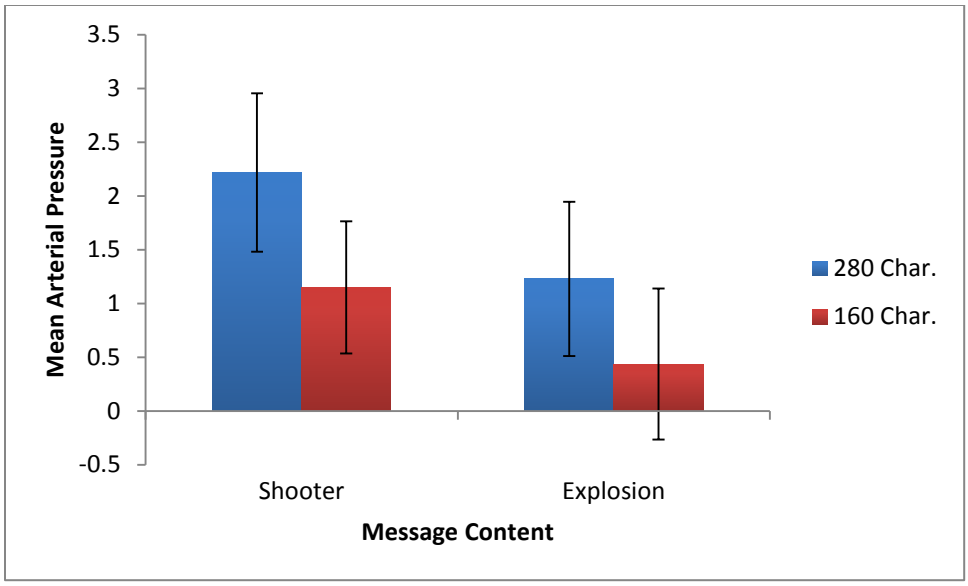

Figure 22: Mean MAP Scores for Message Content and Length Conditions

HR – Heart Rate

We excluded participants who had poor signals during data pre-processing (n = 10), as well as participants with values that exceed three SD away from the mean (n = 1). Contrary to hypotheses, we found no significant increase or decrease in HR following the message being sent (M = 0.54, SE = 0.57), $t(90) = 0.344$, $p = 0.344$. We next assessed the degree to which message length and content impacted HR. Results revealed no significant main effect in terms of message length, $F(1, 87) = 0.451$, $p = 0.503$, $\eta^2 = 0.005$. There was also no significant main effect of message content, $F(1, 87) = 1.781$, $p = 0.186$, $\eta^2 = 0.020$. There was, however, a significant two-way interaction, $F(1, 87) = 4.803$, $p = 0.031$, $\eta^2 = 0.052$. In constructing the interaction, we found no significant effect of message length, as the explosion condition with participants who read the 280 character message (M = 0.54, SE = 1.13) had similar HR increases as those who read the 160 character message (M = -1.15, SE = 1.10), $F(1, 87) = 1.152$, $p = 0.286$, $\eta^2 = 0.013$. Within the shooter condition, participants who read the 280 character message (M = -0.42, SE = 1.18) showed a lower HR increase compared to those who read the 180 character message (M = 2.77, SE = 1.04) and this difference was significant, $F(1, 87) = 4.111$, $p = 0.046$, $\eta^2 = 0.045$.

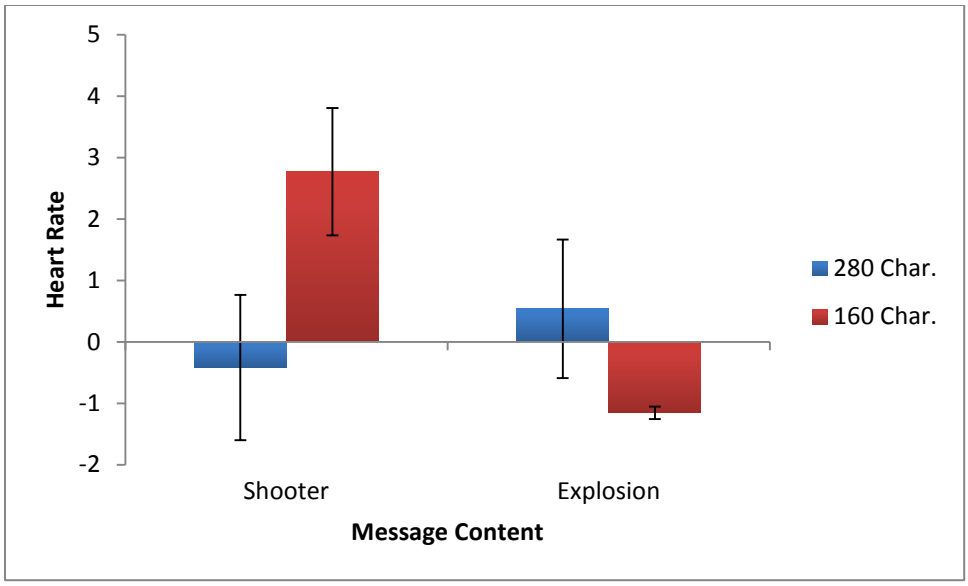

Figure 23: Mean HR Scores for Message Content and Length Conditions

IBI – Cardiac Interbeat Interval

We excluded participants who had poor signals during data pre-processing (n = 10), as well as participants with values that exceed three SD away from the mean (n = 3). We found no significant increase or decrease across all conditions for IBI (M = -4.51, SE = 6.36) following the message being sent, $t(85) = -0.709$, p = 0.480. We next assessed the degree to which message length and content impacted IBI. Results revealed no significant difference in terms of message length with 160 (M = -4.96, SE = 8.59) and 280 characters (M = -3.90, SE = 9.46) eliciting small, but negligible, decreases in IBI, $F(1, 82) = 0.007$, p = 0.934, $\eta^2 < 0.001$. There was also no significant main effect of message content with shooter messages (M = -14.060, SE = 9.18) and explosion messages (M = 5.20, SE = 8.89), $F(1, 82) = 2.272$, p = 0.136, $\eta^2 = 0.027$, although the pattern of results, with shooter reducing IBI, fits the hypotheses. There was also no significant two-way interaction, $F(1, 82) = 0.743$, p = 0.391, $\eta^2 = 0.009$.

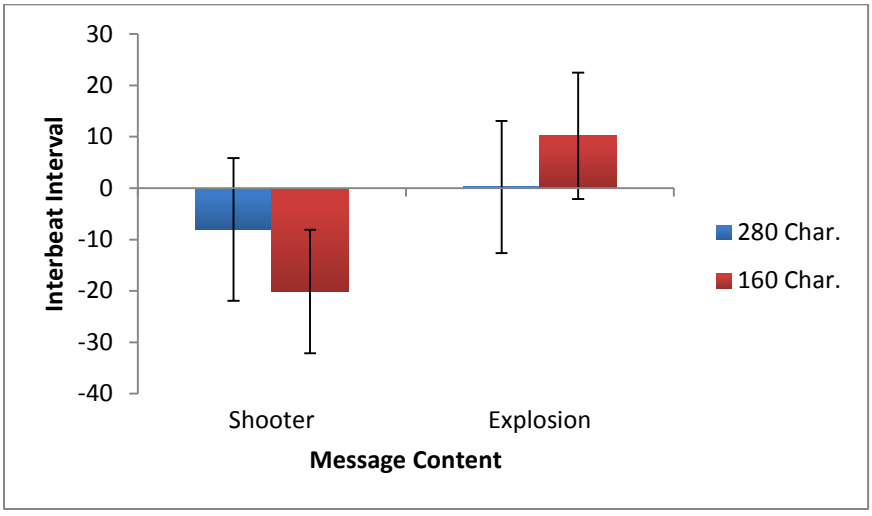

Figure 24: Mean IBI Scores for Message Content and Length Conditions

Belief in the Message

We tested to see whether there were significant differences across conditions and the two-way interaction regarding belief in the message. If not, we could use belief in the message as a covariate. Unexpectedly, an ANCOVA on belief in the message revealed a main effect of message content, $F(1, 97) = 6.411$, $p = 0.013$, $\eta^2 = 0.062$, with participants who read the shooter message ($M = 6.18$, $SE = 0.49$) reporting more belief in the message than those who read the explosion message ($M = 4.38$, $SE = 0.51$). There was no main effect for message length, $p = 0.807$, and no two-way interaction, $p = 0.155$. This condition difference precludes the ability to use belief in the message as a covariate in the analyses above.

Emotions (START - Fear Items)

We tested whether there were significant differences due to length, content or an interaction between length and content on the emotions reported after the message was received. There was a significant main effect of message content, $F(1, 97) = 5.079$, $p = 0.026$, $\eta^2 = 0.061$, with participants who read the shooter message indicating greater fear ($M = 4.66$, $SE = 0.40$) than those who read the explosion message ($M = 3.36$, $SE = 0.41$). There was no significant main effect of message length, $F(1, 97) = 0.423$, $p = 0.517$, $\eta^2 = 0.004$, with the 160 ($M = 4.20$, $SE = 0.39$) and 280 character ($M = 3.82$, $SE = 0.43$) eliciting similar fear responses. There was also no significant interaction, $F(1, 97) = 1.140$, $p = 0.288$, $\eta^2 = 0.012$.

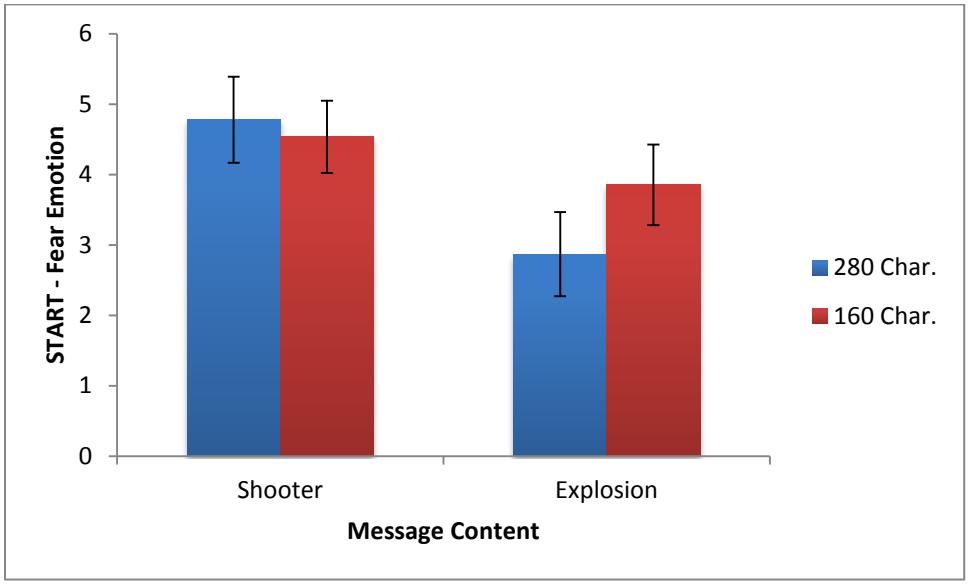

Figure 25: Mean START Fear Emotions Scores for Message Content and Length Conditions

Regressions with Predictors of Physio; Condition; Interaction (3-way)

We conducted a multiple regression analysis by regressing physiological measures (each measure in a separate analysis), message length (*280* or *160* characters), message content (*explosion* or *shooter*) and all interactions onto START fear emotion responses. We built the regression in a step-wise manner, including main effects, two-way interactions and, finally, the three-way interaction.

With regard to SCR, the first step of the regression looked at the main effects for message length, message content and SCR on START fear emotions. Together, these predictors accounted for a significant amount of variance in the regression model, $F(3, 73) = 3.504$, $p = 0.020$, $R^2 = 0.126$. In terms of main effects, there was no significant main effect for message length, $B = -0.807$, $SE = 0.652$, $t(76) = -1.238$, $p = 0.220$. There was, however, a significant main effect for message content, $B = 1.322$, $SE = 0.645$, $t(76) = 2.048$, $p = 0.044$. There was also a significant main effect for SCR, $B = -0.575$, $SE = 0.246$, $t(76) = -2.336$, $p = 0.022$. This effect indicates that for each one-point increase in SCR, self-report fear emotion responses decreased by 0.575 points. The inclusion of two-way interactions in Step 2 did not significantly increase the amount of variance accounted for, $\Delta R^2 = 0.015$, $F_{change}(3, 70) = 0.412$, $p = 0.745$. In addition, all two-way interactions were not significant, p's > 0.05. In Step 3, we added the three-way interaction between message content, length and SCR. This, again, did not lead to a significant increase in the accounted variability, $\Delta R^2 = 0.018$, $F_{change}(1, 69) = 1.505$, $p = 0.224$, and the three-way interaction was not significant ($p = 0.224$).

For SCL, the first step in the regression did not account for a significant amount of variance in the regression model, $F(3, 73) = 0.989$, $p = 0.403$, $R^2 = 0.039$. No main effects were significant, p's > 0.05. This pattern continued with the two-way interactions and the three-way interaction, with neither model reaching significance in terms of accounting for greater variability $\Delta R^2 = 0.033$, F_{change} (3, 70) = 0.839, $p = 0.477$ and $\Delta R^2 = 0.023$, F_{change} (1, 69) = 1.760, $p = 0.189$, respectively. No higher order interactions were significant, p's > 0.05.

MAP followed a similar pattern as SCL. The first step in the regression did not account for a significant amount of variance in the regression model, $F(3, 75) = 0.533$, $p = 0.661$, $R^2 = 0.021$, and no main effects were significant, p's > 0.05. Neither the two-way nor the three-way interaction models accounted for a significant amount of variability, $\Delta R^2 = 0.094$, F_{change} 3, 72) = 2.534, $p = 0.064$ and $\Delta R^2 = 0.017$, F_{change} (1, 71) = 1.378, $p = 0.244$, respectively. There was a marginally significant two-way interaction between MAP and message length, $B = -0.471$, $SE = 0.225$, $t(72) = -1.991$, $p = 0.050$; however, no other interactions were significant, p's > 0.05.

IBI also showed a similar pattern as SCL and MAP. The first step in the regression did not account for a significant amount of variance in the regression model, $F(3, 82) = 2.091$, $p = 0.108$, $R^2 = 0.071$. There was a marginally significant main effect for IBI, $B = -0.010$, $SE = 0.005$, $t(82) = -1.880$, $p = 0.064$, so that for each one-point increase in IBI, participants' self-report fear emotions decreased by 0.010 points. The two-way interaction model accounted for marginally more variance, $\Delta R^2 = 0.075$, $F_{change}(3, 79) = 2.301$, $p = 0.084$, with a marginally significant message length by message content interaction term, $B = 2.287$, $SE = 1.237$, $t(79) = 1.849$, $p = 0.068$, which is reflected in the analysis above on self-report fear emotion. The model with the three-way interaction did not significantly increase the amount of accounted for variance, $\Delta R^2 = 0.001$, $F_{change}(1, 78) = 0.087$, $p = 0.769$, and the three-way interaction was not significant, $p > 0.05$.

HR followed a similar pattern as IBI, SCL and MAP. The first step in the regression did not account for a significant amount of variance in the regression model, $F(3, 87) = 1.404$, $p = 0.247$, $R^2 = 0.046$, and no main effects were significant, p's > 0.05. The two-way interaction model did account for a significantly greater amount of variability, $\Delta R^2 = 0.087$, $F_{change}(3, 84) =$

2.807, $p = 0.045$; however, only the message length by message content interaction was significant, $B = 2.419$, $SE = 1.208$, $t(84) = 2.002$, $p = 0.048$, which is reflected in the analysis above on self-report fear emotion. The model with the three-way interaction did not significantly increase the amount of accounted for variability, $\Delta R^2 < 0.001$, $F_{change}(1, 83) = 0.032$, $p = 0.858$, and the three-way interaction was not significant, $p > 0.05$.

Behavioral Response

Behavioral patterns for this experiment showed slightly more variation than in the similar Experiment 2 with shorter messages. Here, participants showed that three behavioral responses were most likely. These were 'Do nothing' (35-52 percent), 'Alert RA'(13-38 percent) and 'Immediately click off message' (21-35 percent). Only one person in all four conditions opted to 'Click URL.' Generally, the condition did not predict behavior suggesting no difference in processing of 160 and 280 character messages, with one exception — those who got the 160 character shooter messages were more likely to alert the RA, but this was a marginal difference ($p < 0.05$). The majority of participants did nothing; however, unlike the shorter messages seen in Experiment 2, more people did something, again suggesting longer text messages evoke more action.

Table 11: Experiment 4 – Bivariate Analysis: Behaviors by Experimental Condition

	Explosion Short	**Explosion Long**	**Shooter Short**	**Shooter Long**	**Significance**
	(N = 25)	**(N = 23)**	**(N = 31)**	**(N = 23)**	
Behavior	**N (%)[a]**	**N (%)[a]**	**N (%)[a]**	**N (%)[a]**	**p[b]**
Do nothing					
Yes	13 (52.00)	11 (47.83)	11 (35.48)	12 (52.17)	0.547
No	12 (48.00)	12 (52.17)	20 (64.52)	11 (47.83)	
Alert RA					
Yes	4 (16.00)	3 (13.04)	12 (38.71)	3 (13.04)	0.050*
No	21 (84.00)	20 (86.96)	19 (61.29)	20 (86.96)	
Click URL					
Yes	0 (0.00)	0 (0.00)	1 (3.23)	0 (0.00)	0.510
No	25 (100.00)	23 (100.00)	30 (96.77)	23 (100.00)	
Seek info from web					
Yes	0 (0.00)	0 (0.00)	0 (0.00)	1 (4.35)	0.325
No	25 (100.00)	23 (100.00)	31 (100.00)	22 (95.65)	
Immediately click off message					
Yes	8 (32.00)	8 (34.78)	8 (25.81)	5 (21.74)	0.747
No	17 (68.00)	15 (65.22)	23 (74.19)	18 (78.26)	

[a] Reported percentages are column percentages; may not sum up to 100 due to rounding
[b] p-value from chi-square test (or Fisher's Exact)
* $p \leq 0.05$

For the logistic regression analysis, we regressed experimental condition (explosion short, explosion long, shooter short, shooter long), age, gender, language preference, belief in the message and self-reported fear emotions onto three behaviors: (1) Do nothing, (2) Alert RA, and (3) Immediately click off message. There were no significant differences in behaviors by experimental condition of message length or content. Speaking a language other than English at home was positively associated with doing nothing (OR = 4.78, $p < 0.010$, CI (1.57, 14.51)). Speaking English at home was positively associated with talking with the RA (OR = 5.19, $p < 0.06$, CI (0.97, 27.9)), but these were very wide confidence intervals, hence marginally significant.

Additionally, for these participants, clicking off the message was influenced by belief in the message (OR = 0.76, $p < 0.010$, CI (0.62, 0.92)), meaning that lower belief predicted higher likelihood of clicking off the message; however, again this was only marginally significant.

5. Qualitative Findings

Qualitative findings were analyzed using a grounded theory approach. Interviews were transcribed by a professional transcription service and by student workers. We identified five themes. Each of the themes are detailed and described with supporting quotes in the following paragraphs.

Assessing Threat and Proximity to Threat

The theme of assessing threat and proximity to threat was constructed to reflect participants' initial reactions and response to first receiving the WEA message with the location of threat being of utmost importance. Several participants noted that in their initial response to the alert, their location and how close they physically were to the actual threat was their first and foremost concern. In understanding participants' assessment of threat, one interviewee said:

"When I first saw it I was worried. I was kind of scared because of what it said. A lot of people I know are there right now. So it was kind of scary. And after that I guess I started thinking about how close [location of event] was. It took 2 minutes to get here so I was like oh…I was pretty worried. And because the way the message was phrased it sounded pretty serious. A shooting happened. You've got to lock yourself in the room. So I thought it was pretty serious. I was tense and worried."

In reference to proximity to threat, another interviewee said, *"I think the fact that it was really nearby [location of event] area. So I figured if it were real it would definitely concern me considering the proximity."* Similarly, another participant said, *"I think I just felt that it was far away enough. Thinking about it, it's kind of close, I figured I would be okay, there would be enough buffer between here and there…"*

Skimming the Message

In terms of information processing, we also found that people do not read the initial alert message and may simply ignore or skim the message. After the interviewer asked, "How many times did you read the message?" one interviewee said, *"The first time I skimmed it, the second time I think I tried to process where exactly it was where exactly I was and the third time was just clarification."*

The theme of skimming the message emerged several times with participants definitively stating that *"I just skimmed some of the message."* Another person said, "*The whole thing I probably didn't read it once."* One noted, *"I probably skimmed it both times. But the second time, I read it more thoroughly."*

A participant summarized their initial response to the message by saying, *"So I didn't read the whole message, well I just saw the whole message, but the moment I saw shooting at* [location of event] *and avoid area I just stopped reading. I just automatically started thinking who do I know that's in* [location of event] *right now."* One simply said, *"I didn't think it was shooting because I didn't read the rest of it. Maybe I should have."*

Words that Stood Out in the Message

In relation to people not reading the initial message thoroughly, we found that one or two words stood out upon people's processing of the message. In other words, they do not read the whole message. Often they just pick out key words, suggesting shorter is better. After being asked by the interviewer, what components stood out in the message, several responded with the following, *"Definitely shooting at* [location of event]. *And locking yourself in the room. That is pretty much it."*Another person said, "*It gave me the location of the shooting. It told me what to do if I were on campus versus if I were not on campus."* Another participant said, "*Explosion and immediate vicinity, stay away."* One participant summarized by saying all they read: *"Just shooting at* [location of event]. *I think that's the only thing I read."* One respondent said, *"Shooting…. Lock the door and then I didn't really see the link, so yeah.*"

URL Link Not Important

Another theme emerging from how people process the information and important factors in the message content indicate that the URL link embedded in the message is not important. Participants were asked if they noticed the URL link in the message or why they did not click on it. Several of our participants summarized this by stating that, "*I didn't have time. It was just that message that shocked me. I didn't think about the rest. Because it's a shooting. I don't know. You get nervous and then you forget about the other things. Like once I saw the message, I just immediately saw shooting, and that's the word that stood out the most."* Another person stated, *"I'm not sure if I did notice the link. It seems fairly frequently whenever you see a message like this there is always a link involved. And it's just background instead of being pertinent to the whole situation if that makes sense."*

Another interviewee simply stated, *"I didn't look at it. I just saw the top part. It just said emergency. I didn't read the whole message."* Another person said, "*I'm not sure if I did notice the link."* Similarly, another participant said, "*I didn't look at the link very much when I first received it. It was not until I looked for the second or third time that I noticed it*." Another person responded with, *"I guess I just sort of didn't notice it at all. Like it's common that I see links in emails and the relevant information is there. I don't see why I would need a link or something like that."*

Desensitization to the Message

By nature, people use their intuitive or reactive information processing capacity when responding to emergencies. However, we observed a high number of participants demonstrating a lack of response to the message. We observed several people immediately turning off the alert message or simply ignoring the message.

When probed by the interviewer, participants began to describe this notion of being desensitized to alert warning systems. After being asked why they ignored the message, one person responded, *"I don't know because I feel that you get that a lot because of the Amber Alerts. I'll eventually read it and I am pretty calm during situations."* Another person suggests the frequent test messages they receive has desensitized them to any warning alerts. Similarly, another person explains, "*I feel like in past experiences, when I have gotten [warning alerts], it's always a false alarm.*"

6. Discussion

Our findings suggest a number of salient points regarding how people, in our case young adults, respond immediately to WEA type messages delivered over mobile devices in real time that warn them about a local, but simulated, (shooter or explosion) event on the campus of a large urban university. The goal was to mimic a real event to understand the interface between this new warning platform and how this impacts information processing about that message by taking into account physiological, behavioral, emotional and cognitive responses, as well as the communication technology itself.

Results of the series of studies completed under this contract suggest that WEA SMS text messages do have an impact on physiological arousal, emotional response, cognitive processing and behavior. Results suggest that people do respond to these messages as a threat, messages do impact people's levels of physiological arousal or stress response, which is a precursor to a fight or flight behavioral response, and people do have an emotional fear response. The most reliable physiological indicator was SCR. Subsequently, the recipients did look at and appraise the message, which in turn resulted in some very specific patterns of behavior. Clearly, the tone accompanying the messages had some impact on participants' stress response, as seen by the fact that the general trend for all respondents was to have an increase in physiological response right after getting the message.

One of the most important findings is the effect of message length. A message of 160 characters is more impactful that a 90 character message, but there is no clear gain with messages that are 280 characters. There are a number of considerations in this finding. First, is the technology itself; mobile phones that are WEA-enabled have the WEA notification come up on the screen. Our results suggest that the most effective message length is the amount of characters that can fit onto the mobile device screen of the recipient in the first alert notification. Because of the WEA technology, even on a locked screen, the message comes up with the tone. With the newer phones, the screen can show up to 160 characters, while older phones can show up to 90 characters. This means the most important information needs to come first because often times the recipient does not click onto the application, even though the message received may be incomplete.

When it is the first message, the recipient skims it. The essential information has to be in this first notification with no more than 160 characters. Moreover, as we just suggested, our recipients did not click on the application.

The logical question is "why would recipients not immediately click on the application?" One reason may have been that in the context of our study it was not their personal phone and they were under the impression that they were in a multi-tasking study, which could inhibit action. However, inaction may also have to do with the nature of a stress response. As the physiological state shifts, your peripheral vision narrows and we then focus on what is automatic, intuitive and instinctive behavior. Recipients are paying less attention to the device as they pay more attention to the message itself, including the veracity, the source, and how and if to follow guidance given.

As their physiological state shifts, their focus was first on the message itself, then on a more general threat appraisal mode. They may be paying less attention to the device and giving more attention to the message, trying to understand if it is true, where it is coming from, whether it is from a credible source, and how and if to follow guidance given. Another reason for shorter messages is that in this state of heightened arousal or anxiety, they may not process information in the same way; they may take shortcuts or prioritize. Message skimming means picking out key words or phrases. In this study, recipients picked out the most important key words that had to do with hazard, location and guidance.

Finally, there are cultural issues and learned behaviors. We live in a media saturated world and people have learned with digital media techniques to deal with information overload. People with a highly saturated media diet have become used to short or terse message formats, and have also learned to read them quickly to prioritize information. Particularly for young adults, texting is akin to talking. It also suggests that concrete and specific words will be stickier, a technique well known in marketing and popular journalism. Of interest, the words that they remembered were the concrete words. This is also supported by dual coding theory, which suggest that words that evoke visual images are much more resonant than words that do not (Paivo,1990).

In Experiment 3, we found that when people are around others, people turn to each other to discuss the message, manifesting what Mileti calls milling behavior: using social networks to get more information to validate if the information is true. With regard to the other common behavior of not manifesting any observable behavior, there are a number of explanations that are speculative. One possibility is that they were internally processing the warning. This internal processing could have been detected with concentration tasks as part of the study. For a number of people, the message was potentially spam, hoax or a phishing scam. This makes sense, as in a media saturated culture, people are desensitized or suspicious of texts of unknown origin. What is interesting is that they continued to not respond or react even though they did experience physiological stress. Regardless, these messages did evoke a response, which is actually a positive finding, thus the messages are breaking through the clutter initially. In future experiments, we would have measures to understand information processing.

Another finding was the degree to which people talked about the relevance of the message scenario for them personally, mainly gathered in qualitative data. That is, as in the START results and as has been found consistently in research on alerts and warnings, people personalize the message. In the case here, this was actualized through their understanding of where the event occurred and the degree to which they were personally affected or at risk. (Bean et al, 2014; Mileti and Sorenson, 1990). Thus, in their own personal threat appraisal, location became a paramount concern. Unlike the START program, we found location of the event more important than time. This may be due to the nature of events we studied (shooter and explosion), which are unanticipated and quickly evolving. Time may be a more important element in weather-related events that are predictable (tornadoes, storms, tsunamis, wildfires, hurricanes). This also has to do with the messages being the initial warning rather than follow up warnings.

One other finding is that people did not click on the embedded URL. When asked why in qualitative results, many people said they did not even notice the link, which is related to the major issue that in a stress response people have difficulty reading a message.

In Experiment 1, hypothetical message vs. a real message, results trended in the direction hypothesized. That is, we hypothesized that real messages would evoke greater response than hypothetical messages. However, due to relatively small numbers, we did not attain actual statistical significance. For Experiment 3, individuals vs. dyads, we did not find differences between two conditions with regard to physiological response. Hypotheses about down regulation of stress responses were not supported in this context.

The most reliable measures of physiological response were skin conductance measures. Cardiac activity and blood pressure were less reliable. Of the self-report measures, the indicators from the START project, emotions, understanding the message, belief in the message and personalization of the message were far superior to our standardized measures of anxiety, personality and disaster experience for predicting or moderating response or behavior observed. The other set of measures that were useful were the observed behaviors of participants in the experiments and their subjective thoughts, opinions and impressions of their experimental experience and the technology gathered through qualitative methods post experiment. Thus, this report focused mainly on those measures and data analyses that were the most significant.

6.1 Study Limitations

The study has a number of limitations. We only studied young adults aged 18–26 years of age who were enrolled in a large public urban university. The conditions simulated were real-time localized events with rapid onset and response requirements, rather than slowly developing and predictable conditions, such as many weather related events. Thus, there was a very limited time frame for people to react or act, and because participants were tethered to MindWare machinery for documenting psychophysiological response, their behavioral repertoire was limited. Moreover, because of ethical considerations, we had to distance them from their own mobile devices as we did not want them calling or texting members of their social network. Another issue was that we could not separate the impact of the tone from the message itself. Each may have evoked a response; considered together, we are making an assumption that they reinforced the perception of a threat scenario. Moreover, study sessions were relatively short so we could only assess immediate responses and behaviors.

That study participants are people we considered ‘digital natives’ and were all mainly English speaking can be considered a limitation, as we were not able to test these messages in population segments with lower language skills, who are older, or who are less familiar with digital technology where WEA messages may have a very different impact. On the other hand, this could also be seen as a study strength, as they are an audience that should be able to respond most adeptly to this type of communication.

Another limitation is that we were not able to use repeat messages in this context. In real events, messages are sent serially, and information changes over time as the nature of the event unfolds. This may have altered responses, especially if studied over a longer time frame. However, in most rapidly developing disaster scenarios where outcomes are uncertain, states of heightened arousal and anxiety are sustained over time and people often continue to have some difficulty

processing verbal messages and taking action; thus, despite the short time frame of our studies, our data do conform to what other studies have found.

6.2 Conclusions

Using mobile devices to communicate disaster alerts and warnings is a good use of these platforms, which are robust, widely distributed and can be programmed to reach people in high risk locations. Our studies suggest these methods work for initial warning messages in a disaster and that we have a good idea about how to craft attention-getting, readable, useful and actionable messages. Moreover, these messages are getting through to people even in a media saturated social and communication environment. The challenge is to get people to believe these messages, especially if they come from a source or a 'brand' they may not be familiar with. That is, they understand the message, but they do not necessarily believe them. Better dissemination of information and education about the DHS WEA system and other systems coming online in the near future is the next big challenge for these disaster warning methods. Another challenge is to understand how people respond to and process subsequent messages, and if formats should change over time.

Recommendations

1. People who are stressed do not process information well, so concise, concrete images and messages of 160 characters are sufficient.
2. Longer messages are not necessarily better for initial text warning messages. Messages of 280 characters do not confer any advantage over 160 characters in these initial warning messages.
3. Messages of 90 characters are not ideal because they may not have room for specific descriptions of essential message elements.
4. Public education is important to teach people what the DHS WEA technology is and how to use it. As the START project notes: "Campaigns and education on WEA alerts could increase both rates of use, as well as belief in the system and can ultimately improve public response and protective behaviors."
5. Build a brand that people trust. If people know what a WEA alert is, then they will be more likely to trust it, believe it is true and follow guidance. To build a brand identity, creation then marketing of the brand must occur.
6. We suggest that DHS and partners create pretested pre-event message templates for initial warning notification using SMS for different hazards and or disaster events. These templates need to be readily available for first responders and other WEA alerting agencies so they can quickly edit with specific event detail in the event of an emergency.
7. There has been no research on the second generation of WEA messages. The first generation of messages occurs when the disaster first occurs. Everything reported in this study is relevant to the first alert message. We recommend that research be conducted on second and third generation WEA messages, that is, messages communicated during the event. We need to identify which message lengths, format and content are ideal, especially in rapidly evolving scenarios.

8. Generate and publish guidelines, manuals or best practice toolkits for organizations, such as universities or local governments, who are creating internal warning systems for their members or constituents based on research and practice.
9. Frame WEA text messages as part of a comprehensive system of warning tools that also include emails, robo-calls, social media feeds, video sharing website updates and news media feeds.
10. Future research: use mobile survey methods to assess reactivity to WEA messages in real time events.

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Appendix A: Questionnaires from Laboratory Experiments

Pre-Test Questionnaire

Survey identification number: [___|___|___|___]

INSTRUCTIONS:
You are being asked to complete a series of questions about your feelings, attitudes and beliefs.
Please answer all questions by selecting the corresponding response.
The questionnaire will take 15-20 minutes to complete.
Your participation is voluntary. All information provided is kept completely confidential.
We will never share your information with anyone.

QUESTIONS		Responses and Codes
SECTION 1. OPTIMISM/PESSIMISM		
To begin, we will start with questions about your feelings. Please be as accurate as you can throughout. Try not to let your response to one statement influence your responses to other statements. There are no "correct" or "incorrect" answers. Answer according to your own feelings, rather than how you think "most people" would answer.		
101.	In uncertain times, I usually expect the best.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
102.	It's easy for me to relax.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
103.	If something can go wrong for me, it will.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
104.	I'm always optimistic about my future.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
105.	I enjoy my friends a lot.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
106.	It's important for me to keep busy.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
107.	I hardly ever expect things to go my way.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
108.	I don't get upset too easily.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
109.	I rarely count on good things happening to me.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot
110.	Overall, I expect more good things to happen to me than bad.	1……..…..…..2……..3.....4.....5 I agree a lot I agree a little I neither agree nor disagree I disagree a little I disagree a lot

SECTION 2. BELIEF IN A DANGEROUS WORLD		
For each of the following statements, please indicate how much you agree with the statement.		
111.	It seems that every year there are fewer and fewer truly respectable people, and more and more persons with no morals at all who threaten everyone else.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
112.	Although it may appear that things are constantly getting more dangerous and chaotic, it really is **not** so. Every era has its problems, and a person's chances of living a safe, untroubled life are better today than ever before.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
113.	If our society keeps degenerating the way it has been lately, it's liable to collapse like a rotten log and everything will be in chaos.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
114.	Our society is **not** full of immoral and degenerate people who prey on decent people. News reports of such cases are grossly exaggerating and misleading.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
115.	The "end" is **not** near. People who think that earthquakes, wars and famines mean God might be about to destroy the world are being foolish.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
116.	There are many dangerous people in our society who will attack someone out of pure meanness, for no reason at all.	1……..…..……2…….……..3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree

117.	Despite what one “hears about crime in the street," there probably is **not** any more now than ever before.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
118.	Any day now, chaos and anarchy could erupt around us. All the signs are pointing to it.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
119.	If a person takes a few sensible precautions, nothing bad will happen to him. We do **not** live in a dangerous world.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
120.	Every day, as our society becomes more lawless, a person's chances of being robbed, assaulted, and even murdered go up and up.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
121.	Things are getting so bad, even a decent law-abiding person who takes sensible precautions can still become a victim of violence and crime.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree
122.	Our country is **not** falling apart or rotting from within.	1……..…..…..…….2…….…….3.....4.....5 Strongly Agree Disagree Neither Agree Nor Disagree Agree Strongly Disagree

SECTION 3: TRAIT ANXIETY FOR ADULTS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe you generally feel.

123.	I feel pleasant.	1……..…..…..…….2…….…….3.....4 Not at all Somewhat Moderately so Very much so
124.	I feel nervous and restless.	1……..…..…..…….2…….…….3.....4 Not at all Somewhat Moderately so Very much so
125.	I feel satisfied with myself.	1……..…..…..…….2…….…….3.....4 Not at all Somewhat Moderately so Very much so
126.	I wish I could be as happy as others seem to be.	1……..…..…..…….2…….…….3.....4 Not at all Somewhat Moderately so Very much so
127.	I feel like a failure.	1……..…..…..…….2…….…….3.....4 Not at all Somewhat Moderately so Very much so

128.	I feel rested.	1……..……..2……..3….....4 Not at all Somewhat Moderately so Very much so
129.	I am calm, cool, and collected.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
130.	I feel that difficulties are piling up so that I cannot overcome them.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
131.	I worry too much over something that doesn't matter.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
132.	I am happy.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
133.	I have disturbing thoughts.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
134.	I lack self-confidence.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
135.	I feel secure.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
136.	I make decisions easily.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
137.	I feel inadequate.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
138.	I am content.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
139.	Some unimportant thoughts run through my mind and bothers me.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
140.	I take disappointments so keenly that I can't put them out of my mind.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
141.	I am a steady person.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
142.	I get in a state of tension or turmoil as I think over my recent concerns and interests.	1……..…..…..……2……..3.....4 Not at all Somewhat Moderately so Very much so
SECTION 4: PERSONAL RESILIENCY		
For each item, please circle the corresponding response that best indicates how much you agree with the following statements as they apply to you over the last **<u>month</u>**. If a particular situation has not occurred recently, answer according to how you think you would have felt.		
143.	I am able to adapt when changes occur.	0……..…..1……....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
144.	I have at least one close and secure relationship that helps me when I am stressed.	0……..…..1……....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time

145.	When there are no clear solutions to my problems, sometimes fate or God can help.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
146.	I can deal with whatever comes my way.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
147.	Past successes give me confidence in dealing with new challenges and difficulties.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
148.	I try to see the humorous side of things when I am faced with problems.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
149.	Having to cope with stress can make me stronger.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
150.	I tend to bounce back after illness, injury, or other hardships.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
151.	Good or bad, I believe that most things happen for a reason.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
152.	I give my best effort no matter what the outcome may be.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
153.	I believe I can achieve my goals, even if there are obstacles.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
154.	Even when things look hopeless, I don't give up.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
155.	During times of stress/crisis, I know where to turn for help.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
156.	Under pressure, I stay focused and think clearly.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
157.	I prefer to take the lead in solving problems rather than letting others make all the decisions.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
158.	I am not easily discouraged by failure.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
159.	I think of myself as a strong person when dealing with life's challenges and difficulties.	0……..…..1……..2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time

160.	I can make unpopular or difficult decisions that affect other people, if it is necessary.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
161.	I am able to handle unpleasant or painful feelings like sadness, fear, and anger.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
162.	In dealing with life's problems, sometimes you have to act on a hunch without knowing why.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
163.	I have a strong sense of purpose in life.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
164.	I feel in control of my life.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
165.	I like challenges.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
166.	I work to attain my goals no matter what roadblocks I encounter along the way.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
167.	I take pride in my achievements.	0……..…..1…….....2.....3……4 Not true at all Rarely true Sometimes true Often true True nearly all the time
SECTION 5: DEMOGRAPHICS		
168.	What is your gender?	Male Female
169.	What is your age?	_____
170.	What is your ethnicity?	White/Caucasian African American Hispanic/Latino Asian American/Pacific Islander Other (specify) _____ Prefer not to answer
171.	What languages are spoken in your home?	English Spanish Both Spanish and English Other (specify) _____ Prefer not to answer
172.	What languages do you mainly speak at home?	English Spanish Both Spanish and English Other (specify) _____ Prefer not to answer

173.	What language do you speak with friends?	English Spanish Both Spanish and English Other (specify) _____ Prefer not to answer
174.	Are you limited in any way in any activity because of physical, mental or emotional problems?	YES/NO DON'T KNOW Prefer not to answer
175.	Do you have any health problems that require you to use special equipment such as a cane, a wheelchair, a special bed, or a special telephone?	YES/NO DON'T KNOW PREFER NOT TO ANSWER
176.	What is the highest level of education you have completed and received credit for?	High school 1st Year College (Freshman) 2nd Year College (Sophomore) 3rd Year College (Junior) 4th Year College (Senior) (BA/BS) 5th Year Graduate school (please specify) _____

Post-Test Questionnaire

Survey identification number: [___|___|___|___]

INSTRUCTIONS:
You are being asked to complete a series of questions about your feelings, attitudes and beliefs. Please answer all questions by selecting the corresponding response.
The questionnaire will take 15-20 minutes to complete.
Your participation is voluntary. All information provided is kept completely confidential. We will never share your information with anyone.

QUESTIONS		Responses and Codes
SECTION 1. POSITIVE AND NEGATIVE AFFECT		
Indicate to what extent you feel this way right now OR indicate the extent you have felt this way during the experiment.		
101.	Interested	1……..…..……2…….…..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely

	QUESTIONS	Responses and Codes
102.	Distressed	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
103.	Excited	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
104.	Upset	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
105.	Strong	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
106.	Guilty	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
107.	Scared	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
108.	Hostile	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
109.	Enthusiastic	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
110.	Proud	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
111.	Irritable	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
112.	Alert	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
113.	Ashamed	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
114.	Inspired	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
115.	Nervous	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
116.	Determined	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
117.	Attentive	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
118.	Jittery	1……..……2……..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely

	QUESTIONS	Responses and Codes
119.	Active	1……..…..……2……..…..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
120.	Afraid	1……..…..……2……..…..3.....4.....5 Very slightly or not at all A little Moderately Quite a bit Extremely
	SECTION 2: UNDERSTANDING OF THE MESSAGE	
	Rate your level of agreement with the following statement:	
121.	The message helped me understand what to do.	1……..2……..…..3.....4.....5 Strongly Disagree Disagree Neither agree or disagree Agree Strongly Agree
	Rate your level of understanding of the following statements: **After reading this message, I understand:**	
122.	What happened.	1…. ……..…….10 Do not understand Fully understand
123.	The risks.	1…. ……..…….10 Do not understand Fully understand
124.	What to do to protect myself.	1…. ……..…….10 Do not understand Fully understand
125.	What location is affected.	1…. ……..…….10 Do not understand Fully understand
126.	Who the message is from.	1…. ……..…….10 Do not understand Fully understand
127.	When I am supposed to take action to protect myself.	1…. ……..…….10 Do not understand Fully understand
128.	How long I am supposed to continue taking action to protect myself.	1…. ……..…….10 Do not understand Fully understand
	SECTION 3: BELIEF IN THE MESSAGE	
	After reading this message, did you believe that….	
129.	An emergency occurred.	1…. ……..……..…….10 Do not believe Believe
130.	You should follow the instructions as directed in the text message.	1…. ……..……..…….10 Do not believe Believe
	SECTION 4: PERSONALIZING THE MESSAGE	
	How likely are each of the following statements? **In receiving this message, I thought that…**	
131.	I might become injured.	1…. ……..…….10 Not very likely Very likely
132.	People I know might become injured.	1…. ……..…….10 Not very likely Very likely

	QUESTIONS	Responses and Codes
133.	People I don't know might become injured.	1…. ……..……10 Not very likely Very likely
134.	I might die.	1…. ……..……10 Not very likely Very likely
135.	People I know might die.	1…. ……..……10 Not very likely Very likely
136.	People I do not know might die.	1…. ……..……10 Not very likely Very likely
137.	The message was meant for me.	1…. ……..……10 Not very likely Very likely
SECTION 4. EMOTIONS TO MESSAGE		
The message made me feel….		
138.	Sad	1…. ……..……10 Not at all Extremely
139.	Anxious	1…. ……..……10 Not at all Extremely
140.	Terror-struck	1…. ……..……10 Not at all Extremely
141.	Nervous	1…. ……..……10 Not at all Extremely
142.	Outraged	1…. ……..……10 Not at all Extremely
143.	Shocked	1…. ……..……10 Not at all Extremely
144.	Sympathetic	1…. ……..……10 Not at all Extremely
145.	Angry	1…. ……..……10 Not at all Extremely
146.	Tense	1…. ……..……10 Not at all Extremely
147.	Fearful	1…. ……..……10 Not at all Extremely
148.	Confused	1…. ……..……10 Not at all Extremely
149.	Scared	1…. ……..……10 Not at all Extremely
SECTION 5: SELF-EFFICACY		
Please indicate how strongly you agree or disagree with the statements below.		
150.	I am confident that I can protect myself in the event of a disaster.	1……..…..……2……..……3.....4.....5 Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree
151.	I am confident that I can protect others in the event of a disaster.	1……..…..……2……..……3.....4.....5 Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

	QUESTIONS	Responses and Codes
152.	I would be able to follow suggested actions successfully during a major disaster.	1……..…..…..…….2……..……..3.....4.....5 Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree
153.	I am confident I can be of help to my neighbors or community in the event of a disaster.	1……..…..…..…….2……..……..3.....4.....5 Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree
154.	I would be able to obtain information about actions to protect myself and others during a major disaster.	1……..…..…..…….2……..……..3.....4.....5 Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree
SECTION 6: DISASTER EXPERIENCE		
155.	Have you ever experienced a natural, intentional or man-made disaster?	YES / NO
	Have you ever experienced a natural, intentional or man-made disaster such as…	
156	No disaster experience…	YES / NO
157.	Hurricane	YES / NO
158.	Tornado	YES / NO
159.	Flood	YES / NO
160.	Wildfire	YES / NO
161.	Earthquake	YES / NO
162.	Extreme heat or cold	YES / NO
163.	Tsunami	YES / NO
164.	Landslide/ mudslide	YES / NO
165.	Avalanche	YES / NO
166.	Volcanic eruption	YES / NO
167.	Disease outbreak	YES / NO
168.	Industrial accident	YES / NO
169.	Transportation accident	YES / NO
170.	Nuclear/radiological accident	YES / NO
171.	Infrastructure failure (e.g. bridge collapse)	YES / NO
172.	Environmental health problem/pollution	YES / NO
173.	Terrorism /civil unrest /war	YES / NO
174.	Other (specify)	YES / NO
SECTION 7: TRAUMA EXPERIENCE		

	QUESTIONS	Responses and Codes
175.	Have you ever had a physical injury as a result of a disaster?	1……2……3.....4 Never No injuries Mild Injuries Serious injuries experienced a disaster
176.	Has any close member ever had a physical injury as a result of a disaster?	1……..2…….....3.....4 Never No injuries Mild Injuries Serious injuries experienced a disaster
177.	Have you experienced any emotional or psychological injuries as a result of a disaster?	1……..…2……..3.....4 Never No injuries Mild Injuries Serious injuries experienced a disaster
178.	Have you ever had to evacuate your location or leave your home and stay somewhere temporarily or permanently because of a disaster?	YES/NO
179.	Have you ever had to shelter in place (to take immediate shelter where you are) because of a disaster?	YES /NO MAYBE
SECTION 8: TRUST IN GOVERNMENT RESPONSE TO A DISASTER		
During a major disaster, how confident are you that government agencies would:		
180.	Protect the health of yourself, family and neighbors?	1……..… .2…….....3.....4 Very sure Somewhat sure Not too sure Not at all sure
181.	Treat you fairly regardless of your age, race, ethnicity, or the neighborhood you live?	1……..….2……..….....3.....4 Very sure Somewhat sure Not too sure Not at all sure
182.	Give you and members of the public honest and credible information?	1……..….2……...3.....4 Very sure Somewhat sure Not too sure Not at all sure
SECTION 9: STATE ANXIETY FOR ADULTS		
Rate your level of agreement with the following statements:		
183.	I feel calm	1……..…...……2……..3.....4 Not at all Somewhat Moderately so Very much so
184.	I feel secure	1……..……2……..3.....4 Not at all Somewhat Moderately so Very much so
185.	I am tense	1……..……2……..3.....4 Not at all Somewhat Moderately so Very much so
186.	I feel strained	1……..……2……..3.....4 Not at all Somewhat Moderately so Very much so
187.	I feel at ease	1……..……2……..3.....4 Not at all Somewhat Moderately so Very much so

	QUESTIONS	Responses and Codes
188.	I feel upset	1……..……2……..……..3…....4 Not at all Somewhat Moderately so Very much so
189.	I am presently worrying over possible misfortunes	1……..…..…..2……..……..3.....4 Not at all Somewhat Moderately so Very much so
190.	I feel satisfied	1……..…... .2……..……..3.....4 Not at all Somewhat Moderately so Very much so
191.	I feel frightened	1……..……2……..……..3.....4 Not at all Somewhat Moderately so Very much so
192.	I feel comfortable	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
193.	I feel self-confident	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
194.	I feel nervous	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
195.	I am jittery	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
196.	I feel indecisive	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
197.	I am relaxed	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
198.	I feel content	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
199.	I am worried	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
200.	I feel confused	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
201.	I feel steady	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so
202.	I feel pleasant	1……..…...…2……..……..3.....4 Not at all Somewhat Moderately so Very much so

Appendix B: Experiment 2 Sample Descriptive Data

Means for Figures for Experiment 2

Figure 8: Mean SCR Scores for Message Content and Length Conditions
S-L = 2.602, SE = .42
S-S = 1.670, SE = .41
E-L = 2.048, SE = .40
E-S = 1.71, SE = .39

Mean SCR Scores for Message Content and Length Conditions with belief in the message as a covariate[2]
S-L = 2.673, SE = .44
S-S = 1.379, SE = .46
E-L = 2.106, SE = .42
E-S= 1.738, SE = .43

Figure 9: Mean SCL Scores for Message Content and Length Conditions
S-L = 3.146, SE = .58
S-S =2.205, SE = .58
E-L = 2.697, SE = .52
E-S = 1.709, SE = .56

Mean SCL Scores for Message Content and Length Conditions with belief in the message as a covariate[3]
S-L = 3.497, SE = .632
S-S = 2.277, SE = .650
E-L = 2.820, SE = .555
E-S = 1.634, SE = .631

Figure 11: Mean IBI Scores for Message Content and Length Conditions

[2] Before using belief in the message as a covariate, we first tested whether there were significant differences across conditions with regard to participants' belief in the message. We do not hypothesize that our conditions should influence this result and thus hope to use belief as a moderator for our other analyses. Our results indicated no significant effects of either length, $F(1,134) = .995$, $p = .320$, or content, $F(1,134) = .555$, $p = .457$, nor a significant interaction, $F(1,134) = 1.204$, $p = .274$. Since belief in the message did not systematically differ as a function of our conditions, we can use this as a moderator of our physiological and emotional self-report variables.

[3] Ibid.

S-L = -18.120, SE = 16.590
S-S = 9.661, SE = 15.311
E-L = 4.669, SE = 14.774
E-S = 12.595, SE = 14.064

Mean IBI Scores for Message Content and Length Conditions with belief in the message as a covariate[4]
S-L = -22.903, SE = 17.551
S-S = 14.783, SE = 16.490
E-L = 3.406, SE = 15.528
E-S = 9.401, SE = 15.404

Figure 12: Mean HR Scores for Message Content and Length Conditions
S-L = 1.825, SE= 1.317
S-S = .765, SE= 1.216
E-L = .156, SE= 1.173
E-S = -.198, SE= 1.117

Mean HR Scores for Message Content and Length Conditions with belief in the message as a covariate
S-L = 2.301, SE= 1.372
S-S = .083, SE= 1.289
E-L = .173, SE=1.214
E-S = .529, SE= 1.204

Figure 13: Mean START Fear Emotions Scores for Message Content and Length Conditions with belief in the message as a covariate
S-L = 5.647, SE = .43
S-S = 5.532, SE = .48
E-L = 4.316, SE = .43
E-S = 3.140, SE = .44

[4] Before using belief in the message as a covariate, we first tested whether there were significant differences across conditions with regard to participants' belief in the message. We do not hypothesize that our conditions should influence this result and thus hope to use belief as a moderator for our other analyses. Our results indicated no significant effects of either length, $F(1,134) = .995$, $p = .320$, or content, $F(1,134) = .555$, $p = .457$, nor a significant interaction, $F(1,134) = 1.204$, $p = .274$. Since belief in the message did not systematically differ as a function of our conditions, we can use this as a moderator of our physiological and emotional self-report variables.

Appendix C: Additional Experimental Findings and Statistical Results

Table 12: Belief in the Message

≥ 5 coded as "Believed the emergency occurred"

Study	Proportion who believed the emergency occurred
1	55/89= 0.62
2	90/150= 0.60
3	101/164= 0.62
4	56/102= 0.55

Table 13: Cronbach's Alpha for Self-Report Measures

	Experiment 1 (*N*=98)	**Experiment 2 (*N*=150)**	**Experiment 3 (*N*=164)**	**Experiment 4 (*N*=102)**
Pre-test Measures				
Life Orientation Test	0.75	0.74	0.71	0.70
Belief in a Dangerous World	0.84	0.78	0.80	0.76
Trait Anxiety Inventory (STAI Q21-Q40)	0.87	0.88	0.89	0.91
Personal Resiliency	0.92	0.89	0.91	0.86
Post-test Measures				
Positive affect	0.85	0.87	0.86	0.85
Negative affect	0.76	0.82	0.86	0.84
Belief in the message	0.93	0.87	0.87	0.74
Emotions (START-Fear items)	0.95	0.96	0.96	0.95
Self-Efficacy	0.75	0.84	0.83	0.75
Trust in Government	0.72	0.69	0.80	0.82
State Anxiety (STAI Q1-Q20)	0.93	0.93	0.92	0.93

Table 14: Cronbach's Alpha for Emotions sub-scale
(START- Fear items)

Experiment	Items	Cronbach's Alpha
1	anxious terror-struck nervous tense fearful scared	0.95
2	anxious terror-struck nervous shocked tense fearful scared	0.96
3	anxious terror-struck nervous shocked tense fearful scared	0.96
4	anxious terror-struck nervous shocked fearful scared	0.95

Table 15: Unadjusted associations between demographic characteristics and experimental condition

	Experiment 1			Experiment 2					Experiment 3			Experiment 4				
	Hypothetical (N = 50) N (%)[a]	Real (N = 48) N (%)[a]	p[b]	Explosion Short (N = 39) N(%)[a]	Explosion Long (N = 38) N(%)[a]	Shooter Short (N = 33) N(%)[a]	Shooter Long (N = 40) N(%)[a]	p[b]	Individual (N = 54) N (%)[a]	Dyad (N = 110) N (%)[a]	p[b]	Explosion Short (N = 25) N (%)[a]	Explosion Long (N = 23) N (%)[a]	Shooter Short (N = 31) N (%)[a]	Shooter Long (N = 23) N (%)[a]	p[b]
Characteristic																
Gender																
Male	15 (30.00)	10 (20.83)	0.298	9 (23.08)	10(26.32)	7(21.21)	11 (27.50)	0.920	19 (35.19)	34 (30.91)	0.582	8 (32.00)	9 (39.13)	17 (54.84)	9 (39.13)	0.351
Female	35 (70.00)	39 (79.17)		30 (76.92)	28 (73.68)	26 (78.79)	29 (72.50)		35 (64.81)	76 (69.09)		17 (68.00)	14 (60.87)	14 (45.16)	14 (60.87)	
Age	19.10 (1.11)	19.23 (1.40)	0.614	19.64 (1.44)	19.66 (1.28)	19.45 (1.23)	19.85 (1.92)	0.739	20.85 (3.27)	20.12 (2.42)	0.107	20.84 (2.72)	21.13 (4.45)	21.45 (4.18)	20.70 (3.51)	0.888
Race/Ethnicity																
White	19 (38.00)	17 (36.17)	0.852	11 (28.21)	13(34.21)	5 (15.15)	19 (50.00)	0.017*	11 (20.37)	23 (21.30)	0.892	4 (16.00)	2 (8.70)	11 (35.48)	5 (21.74)	0.112
Non-White	31 (62.00)	30 (63.83)		28 (71.79)	25 (65.79)	28 (84.85)	19 (50.00)		43(79.63)	85 (78.70)		21 (84.00)	21 (91.30)	19 (61.29)	18 (78.26)	
Highest level of education																
High school	21 (42.00)	17 (35.42)	0.526	12 (31.58)	9 (23.68)	13 (39.39)	15 (37.50)	0.626	7 (13.46)	24 (22.43)	0.351	6 (24.00)	8 (34.78)	7 (22.58)	6 (26.09)	0.252
1st and 2nd year college	26 (52.00)	25 (52.08)		18 (47.37)	22 (57.89)	15 (45.45)	15 (37.50)		26 (50.00)	52 (48.60)		5 (20.00)	3 (13.04)	8 (25.81)	10 (43.48)	
3rd year and 4th year college	3 (6.00)	6 (12.50)		8 (21.05)	7 (18.42)	5 (15.15)	10 (25.00)		19 (36.54)	31 (28.97)		9 (36.00)	10 (43.48)	15 (48.39)	6 (26.09)	
Limited in any way in any activity because of a physical, mental or emotional problem?																
Yes	0 (0.00)	3 (6.25)	0.038*	3 (7.69)	0 (0.00)	5 (15.15)	4 (10.26)	0.285	1 (1.89)	4 (3.77)	0.957	1 (4.00)	2 (8.70)	3 (9.68)	0 (0.00)	0.644
Maybe	7 (14.00)	2 (4.17)		2 (5.13)	3 (7.89)	1 (3.03)	3 (7.69)		7 (13.21)	15 (14.15)		4 (16.00)	1 (4.35)	2 (6.45)	2 (8.70)	
No	43 (86.00)	41 (85.42)		34 (87.18)	34 (89.47)	27 (81.82)	32 (82.05)		45 (84.91)	86 (81.13)		18 (72.00)	18 (78.26)	24 (77.42)	21 (91.30)	
Prefer not to answer	0 (0.00)	2 (4.17)		0 (0.00)	1 (2.63)	0 (0.00)	0 (0.00)		0 (0.00)	1 (0.94)		2 (8.00)	1 (4.35)	2 (6.45)	0 (0.00)	
Have any health problems that require use of special equipment, such as a cane, a wheelchair, a special bed, or a special telephone?																
Yes	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	0 (0.00)	1 (2.50)	1.000	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0.424
Maybe	0 (0.00)	0 (0.00)		1 (2.56)	0 (0.00)	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	
No	49 (98.00)	47 (97.92)		38 (97.44)	38 (100.00)	33 (100.00)	39 (97.50)		54 (100.00)	105 (100.00)		24 (96.00)	22 (95.65)	31 (100.00)	23 (100.00)	
Prefer not to answer	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)		0 (0.00)	1 (4.35)	0 (0.00)	0 (0.00)	
Have you ever experienced a natural, intentional, or man-made disaster?																
Yes	15 (30.00)	21 (43.75)	0.181	10 (25.64)	18 (47.37)	13 (39.39)	12 (30.00)	0.191	19 (35.19)	39 (35.45)	0.973	11 (44.00)	10 (43.48)	12 (38.71)	5 (21.74)	0.394
No	34 (68.00)	27 (56.25)		29 (74.36)	20 (52.63)	20 (60.61)	28 (70.00)		35 (64.81)	71 (64.55)		14 (56.00)	13 (56.52)	19 (61.29)	17 (73.91)	

[a] For continuous variables Mean (SD) are reported; Percentages are column percentages; may not sum up to 100 due to rounding

[b] p-value from t-test (ANOVA test) for continuous predictors and chi-square test (Fisher's Exact) for categorical predictors

* p< 0.05 from t-test (ANOVA test) or chi-square (Fisher's exact) test

Overall, randomization was successful in creating comparable groups. In Experiments 3 and 4, unadjusted associations suggest there were no significant differences in demographic characteristics between experimental conditions at baseline. A significant unadjusted association was found between limitations due to physical, mental, or emotional problems and experimental condition (p=0.038) in Experiment 1, and between race/ethnicity and experimental condition (p=0.017) in Experiment 2.

Table 16: Unadjusted associations between languages spoken and experimental condition

	Experiment 1			Experiment 2					Experiment 3			Experiment 4				
	Hypothetical (N = 50) N (%)[a]	Real (N = 48) N (%)[a]	p[b]	Explosion Short (N = 39) N(%)[a]	Explosion Long (N = 38) N(%)[a]	Shooter Short (N = 33) N(%)[a]	Shooter Long (N = 40) N(%)[a]	p[b]	Individual (N = 54) N (%)[a]	Dyad (N = 110) N (%)[a]	p[b]	Explosion Short (N = 25) N (%)[a]	Explosion Long (N = 23) N (%)[a]	Shooter Short (N = 31) N (%)[a]	Shooter Long (N = 23) N (%)[a]	p[b]
Languages																
Languages spoken in home																
English																
Yes	33 (66.00)	35 (72.92)	0.515	30 (76.92)	26 (68.42)	24 (72.73)	28 (70.00)	0.850	37 (68.52)	68 (61.82)	0.401	13 (52.00)	15 (65.22)	21 (67.74)	14 (60.87)	0.659
No	17 (34.00)	13 (27.08)		9 (23.08)	12 (31.58)	9 (27.27)	12(30.00)		17 (31.48)	42 (38.18)		12 (48.00)	8 (34.78)	10 (32.26)	9 (39.13)	
Spanish																
Yes	3 (6.00)	2 (4.17)	1.000	1 (2.56)	2 (5.26)	0 (0.00)	0 (0.00)	0.355	4 (7.41)	1 (0.91)	0.041*	1 (4.00)	1 (4.35)	0 (0.00)	0 (0.00)	0.573
No	47 (94.00)	46 (95.83)		38 (97.44)	36 (94.74)	33 (100.00)	40 (100.00)		50 (92.59)	109 (99.09)		24 (96.00)	22 (95.65)	31 (100.00)	23 (100.00)	
Both English and Spanish																
Yes	7 (14.00)	10 (20.83)	0.372	6 (15.38)	5 (13.16)	5 (15.15)	6 (15.00)	0.992	4 (7.41)	17 (15.45)	0.214	2 (8.00)	5 (21.74)	4 (12.90)	3 (13.04)	0.609
No	43 (86.00)	38 (79.17)		33 (84.62)	33 (86.84)	28 (84.85)	34 (85.00)		50 (92.59)	93 (84.55)		23 (92.00)	18 (78.26)	27 (87.10)	20 (86.96)	
Other																
Yes	18 (36.00)	8 (16.67)	0.030*	13 (33.33)	12 (31.58)	17 (51.52)	11 (27.50)	0.161	22 (40.74)	52 (47.27)	0.430	16 (64.00)	11 (47.83)	10 (32.26)	6 (26.09)	0.031*
No	32 (64.00)	40 (83.33)		26 (66.67)	26 (68.42)	16 (48.48)	29 (72.50)		32 (59.26)	58 (52.73)		9 (36.00)	12 (52.17)	21 (67.74)	17 (73.91)	
Prefer not to answer																
Yes	1 (2.00)	0 (0.00)	1.000	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	N/A	1 (4.00)	0 (0.00)	1 (3.23)	2 (4.35)	1.000
No	49 (98.00)	48 (100.00)		39 (100.00)	38 (100.00)	33 (100.00)	40 (100.00)		54 (100.00)	110 (100.00)		24 (96.00)	23 (100.00)	30 (96.77)	22 (95.65)	
Languages mainly spoken at home																
English																
Yes	32 (64.00)	37 (77.08)	0.156	26 (66.67)	28 (73.68)	19 (57.58)	26 (65.00)	0.558	36 (66.67)	71 (64.55)	0.789	11 (44.00)	13 (56.52)	24 (77.42)	16 (69.57)	0.059
No	18 (36.00)	11 (22.92)		13 (33.33)	10 (26.32)	14 (42.42)	14 (35.00)		18 (33.33)	39 (35.45)		14 (56.00)	10 (43.48)	7 (22.58)	7 (30.43)	
Spanish																
Yes	5 (10.00)	2 (4.17)	0.436	2 (5.13)	1 (2.63)	1 (3.03)	2 (5.00)	1.000	1 (1.85)	6 (5.45)	0.428	0 (0.00)	2 (8.70)	0 (0.00)	0 (0.00)	0.098
No	45 (90.00)	46 (95.83)		37 (94.87)	37 (97.37)	32 (96.97)	38 (95.00)		53 (98.15)	104 (94.55)		25 (100.00)	21 (91.30)	31 (100.00)	23 (100.00)	
Both English and Spanish																
Yes	4 (8.00)	5 (10.42)	0.738	3 (7.69)	4 (10.53)	1 (3.03)	3 (7.50)	0.706	6 (11.11)	8 (7.27)	0.408	2 (8.00)	3 (13.04)	1 (3.23)	3 (13.04)	0.494
No	46 (92.00)	43 (89.58)		36 (92.31)	34 (89.47)	32 (96.97)	37 (92.50)		48 (88.89)	102 (92.73)		23 (92.00)	20 (86.96)	30 (96.77)	20 (86.96)	
Other																
Yes	13 (26.00)	6 (12.50)	0.091	12 (30.77)	8 (21.05)	13 (39.39)	10 (25.00)	0.350	17 (31.48)	38 (34.55)	0.696	13 (52.00)	8 (34.78)	7 (22.58)	6 (26.09)	0.107
No	37 (74.00)	42 (87.50)		27 (69.23)	30 (78.95)	20 (60.61)	30 (75.00)		37 (68.52)	72 (65.45)		12 (48.00)	15 (65.22)	24 (77.42)	17 (73.91)	
Prefer not to answer																
Yes	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	1 (3.03)	0 (0.00)	0.220	0 (0.00)	0 (0.00)	N/A	1 (4.00)	0 (0.00)	1 (3.23)	1 (4.35)	0.810
No	50 (100.00)	48 (100.00)		39 (100.00)	38 (100.00)	32 (96.97)	40 (100.00)		54 (100.00)	110 (100.00)		24 (96.00)	23 (100.00)	30 (96.77)	22 (95.65)	
Languages mainly spoken with friends																
English																
Yes	44 (88.00)	43 (89.58)	0.804	35 (89.74)	34 (89.47)	32 (96.97)	34 (85.00)	0.400	48 (88.89)	94 (85.45)	0.544	19 (76.00)	20 (86.96)	30 (96.77)	20 (86.96)	0.146
No	6 (12.00)	5 (10.42)		4 (10.26)	4 (10.53)	1 (3.03)	6 (15.00)		6 (11.11)	16 (14.55)		6 (24.00)	3 (13.04)	1 (3.23)	3 (13.04)	
Spanish																
Yes	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A	0 (0.00)	1 (0.91)	1.000	0 (0.00)	1 (4.35)	0 (0.00)	0 (0.00)	0.451

No	50 (100.00)	48 (100.00)		39 (100.00)	38 (100.00)	33 (100.00)	40 (100.00)		54 (100.00)	109 (99.09)		25 (100.00)	22 (95.65)	31 (100.00)	23 (100.00)	
Both English and Spanish																
Yes	4 (8.00)	5 (10.42)	0.738	3 (7.69)	3 (7.89)	0 (0.00)	2 (5.00)	0.384	1 (1.85)	5 (4.55)	0.665	3 (12.00)	1 (4.35)	0 (0.00)	2 (8.70)	0.256
No	46 (92.00)	43 (89.58)		36 (92.31)	35 (92.11)	33 (100.00)	38 (95.00)		53 (98.15)	105 (95.45)		22 (88.00)	22 (95.65)	31 (100.00)	21 (91.30)	
Other																
Yes	5 (10.00)	3 (6.25)	0.715	2 (5.13)	2 (5.26)	3 (9.09)	9 (22.50)	0.059	11 (20.37)	20 (18.18)	0.737	9 (36.00)	3 (13.04)	3 (9.68)	5 (21.74)	0.088
No	45 (90.00)	45 (93.75)		37 (94.87)	36 (94.74)	30 (90.91)	31 (77.50)		43 (79.63)	90 (81.82)		16 (64.00)	20 (86.96)	28 (90.32)	18 (78.26)	
Prefer not to answer																
Yes	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	1 (3.03)	0 (0.00)	0.220	0 (0.00)	0 (0.00)	N/A	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A
No	50 (100.00)	48 (100.00)		39 (100.00)	38 (100.00)	32 (96.97)	40 (100.00)		54 (100.00)	110 (100.00)		25 (100.00)	23 (100.00)	31 (100.00)	23 (100.00)	

[a] For continuous variables Mean (SD) are reported; Percentages are column percentages; may not sum up to 100 due to rounding

[b] p-value from t-test (ANOVA test) for continuous predictors and chi-square test (Fisher's Exact) for categorical predictors

* p< 0.05 from t-test (ANOVA test) or chi-square (Fisher's exact) test

In Experiments 1, 2, 3 and 4, results from unadjusted associations suggest there were no significant associations between languages mainly spoken at home or languages mainly spoken with friends and experimental condition. Few significant associations between languages spoken at home and experimental condition were found in Experiments 1, 3 and 4.

Table 17: Unadjusted associations between pre- and post-test measures and experimental condition

	Experiment 1			**Experiment 2**					**Experiment 3**			**Experiment 4**				
	Hypothetical (N = 50) N (%)[a]	**Real (N = 48) N (%)[a]**	**p[b]**	**Explosion Short (N = 39) N(%)[a]**	**Explosion Long (N = 38) N(%)[a]**	**Shooter Short (N = 33) N(%)[a]**	**Shooter Long (N = 40) N(%)[a]**	**p[b]**	**Individual (N = 54) N (%)[a]**	**Dyad (N = 110) N (%)[a]**	**p[b]**	**Explosion Short (N = 25) N (%)[a]**	**Explosion Long (N = 23) N (%)[a]**	**Shooter Short (N = 31) N (%)[a]**	**Shooter Long (N = 23) N (%)[a]**	**p[b]**
Pre-test self-report measures																
Life Orientation Test	2.29 (0.63)	2.47 (0.81)	0.224	2.47 (0.64)	2.44 (0.70)	2.46 (0.69)	2.13 (0.66)	0.073	2.39 (0.74)	2.43 (0.59)	0.712	2.47 (0.61)	2.36 (0.61)	2.47 (0.70)	2.60 (0.64)	0.728
Belief in a Dangerous World	3.19 (0.55)	3.21 (0.61)	0.887	3.15 (0.61)	3.07 (0.55)	3.26 (0.43)	3.30 (0.53)	0.247	3.25 (0.63)	3.30 (0.502)	0.605	3.29 (0.55)	3.23 (0.49)	3.40 (0.41)	3.25 (0.60)	0.600
Trait Anxiety Inventory	2.05 (0.39)	2.22 (0.49)	0.062	2.10 (0.51)	2.12 (0.47)	2.07 (0.48)	1.94 (0.42)	0.332	2.15 (0.48)	2.11 (0.46)	0.585	2.26 (0.45)	2.07 (0.49)	2.02 (0.63)	2.11 (0.49)	0.374
Personal Resiliency	2.88 (0.48)	2.86 (0.60)	0.877	2.77 (0.48)	2.88 (0.52)	2.84 (0.51)	2.99 (0.44)	0.234	2.77 (0.60)	2.80 (0.50)	0.743	2.67 (0.42)	2.68 (0.30)	2.82 (0.57)	2.77 (0.35)	0.527
Post-test self-report measures																
Positive Affect Score	2.24 (0.64)	2.37 (0.69)	0.332	2.18 (0.59)	2.36 (0.67)	2.56 (0.71)	2.51 (0.89)	0.111	2.44 (0.58)	2.45 (0.81)	0.916	2.39 (0.70)	2.13 (0.49)	2.37 (0.74)	2.36 (0.82)	0.559
Negative Affect Score	1.49 (0.42)	1.59 (0.50)	0.317	1.47 (0.41)	1.66 (0.56)	1.84 (0.63)	1.77 (0.60)	0.031*	2.05 (0.72)	2.00 (0.75)	0.686	1.90 (0.72)	1.60 (0.53)	1.89 (0.65)	1.75 (0.55)	0.286
Belief in the message	5.49 (3.86)	4.91 (3.53)	0.460	4.64 (3.56)	6.32 (3.23)	6.31 (3.18)	6.32 (3.43)	0.083	6.18 (3.16)	5.86 (3.55)	0.578	4.68 (2.95)	4.30 (2.98)	5.55 (3.69)	6.27 (3.51)	0.186
Emotions sub-scale (START- fear items)	4.04 (2.75)	3.68 (2.40)	0.500	2.82 (2.40)	4.37 (2.98)	5.39 (2.72)	5.60 (3.27)	<.001*	5.27 (2.80)	5.51 (3.11)	0.632	3.75 (2.55)	2.81 (2.09)	4.49 (3.47)	4.64 (2.98)	0.114
Self-Efficacy	3.61 (0.62)	3.63 (0.58)	0.915	3.53 (0.72)	3.63 (0.76)	3.56 (0.66)	3.77 (0.75)	0.485	3.53 (0.80)	3.57 (0.70)	0.770	3.40 (0.77)	3.67 (0.57)	3.89 (0.46)	3.52 (0.62)	0.022*
Trust in Government	2.44 (0.65)	2.55 (0.71)	0.433	2.56 (0.63)	2.55 (0.65)	2.74 (0.69)	2.58 (0.62)	0.601	2.59 (0.79)	2.36 (0.70)	0.055	2.67 (0.59)	2.25 (0.66)	2.45 (0.90)	2.44 (0.77)	0.294
State Anxiety	2.16 (0.48)	2.19 (0.57)	0.773	2.04 (0.46)	2.19 (0.56)	2.11 (0.46)	2.20 (0.59)	0.503	2.23 (0.48)	2.21 (0.54)	0.801	2.34 (0.55)	1.88 (0.44)	2.13 (0.55)	2.22 (0.47)	0.018*

[a] For continuous variables Mean (SD) are reported; percentages are column percentages; may not sum up to 100 due to rounding

[b] p-value from t-test (ANOVA test) for continuous predictors and chi-square test (Fisher's Exact) for categorical predictors

* p< 0.05 from t-test (ANOVA test) or chi-square (Fisher's exact) test

At baseline, results from unadjusted associations suggest there were no significant differences in pre-test measures between experimental conditions for Experiments 1, 2, 3 and 4. At post-test, no significant differences were found in post-test measures between experimental conditions for Experiments 1 and 3. In Experiment 2, a global F-test revealed significant differences in mean negative affect scores (p=0.031) and mean emotions sub-scale scores (p<0.001) between experimental conditions. In Experiment 4, significant differences in mean self-efficacy scores were found between experimental conditions.

Table 18: Unadjusted associations between behavior observations and experimental condition

	Experiment 1			Experiment 2					Experiment 3			Experiment 4				
	Hypothetical (N = 50) N (%)[a]	Real (N = 48) N (%)[a]	p[b]	Explosion Short (N = 39) N(%)[a]	Explosion Long (N = 38) N(%)[a]	Shooter Short (N = 33) N(%)[a]	Shooter Long (N = 40) N(%)[a]	p[b]	Individual (N = 54) N (%)[a]	Dyad (N = 110) N (%)[a]	p[b]	Explosion Short (N = 25) N (%)[a]	Explosion Long (N = 23) N (%)[a]	Shooter Short (N = 31) N (%)[a]	Shooter Long (N = 23) N (%)[a]	p[b]
Behaviors																
Do nothing																
Yes	--	--	--	35 (89.74)	28 (75.68)	28 (84.85)	34 (85.00)	0.408	27 (50.00)	43 (39.09)	0.184	13 (52.00)	11 (47.83)	11 (35.48)	12 (52.17)	0.547
No	--	--	--	4 (10.26)	9 (24.32)	5 (15.15)	6 (15.00)		27 (50.00)	67 (60.91)		12 (48.00)	12 (52.17)	20 (64.52)	11 (47.83)	
Alert RA																
Yes	--	--	--	5 (12.82)	9 (24.32)	6 (18.18)	6 (15.00)	0.578	12 (22.22)	8 (7.27)	0.006*	4 (16.00)	3 (13.04)	12 (38.71)	3 (13.04)	0.050*
No	--	--	--	34 (87.18)	28 (75.68)	27 (81.82)	34 (85.00)		42 (77.78)	102 (92.73)		21 (84.00)	20 (86.96)	19 (61.29)	20 (86.96)	
Click URL																
Yes	--	--	--	0 (0.00)	6 (16.22)	0 (0.00)	1 (2.50)	0.002*	3 (5.56)	4 (3.64)	0.568	0 (0.00)	0 (0.00)	1 (3.23)	0 (0.00)	0.510
No	--	--	--	39 (100.00)	31 (83.78)	33 (100.00)	39 (97.50)		51 (94.44)	106 (96.36)		25 (100.00)	23 (100.00)	30 (96.77)	23 (100.00)	
Seek info from web																
Yes	--	--	--	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A	2 (3.70)	3 (2.73)	0.665	0 (0.00)	0 (0.00)	0 (0.00)	1 (4.35)	0.325
No	--	--	--	39 (100.00)	37 (100.00)	33 (100.00)	40 (100.00)		52 (96.30)	107 (97.27)		25 (100.00)	23 (100.00)	31 (100.00)	22 (95.65)	
Immediately click off message																
Yes	--	--	--	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	N/A	11 (20.37)	8 (7.27)	0.014*	8 (32.00)	8 (34.78)	8 (25.81)	5 (21.74)	0.747
No	--	--	--	39 (100.00)	37 (100.00)	33 (100.00)	40 (100.00)		43 (79.63)	102 (92.73)		17 (68.00)	15 (65.22)	23 (74.19)	18 (78.26)	
Talk to other person																
Yes	--	--	--	--	--	--	--	--	--	57 (51.82)	--	--	--	--	--	--
No	--	--	--	--	--	--	--	--	--	53 (48.18)		--	--	--	--	--

[a] For continuous variables Mean (SD) are reported; percentages are column percentagesmay not sum up to 100 due to rounding

[b] p-value from t-test (ANOVA test) for continuous predictors and chi-square test (Fisher's Exact) for categorical predictors

* p< 0.05 from t-test (ANOVA test) or chi-square (Fisher's exact) test

No behavior observations were made for Experiment 1. In Experiment 2, a significant unadjusted association was found between clicking the URL and experimental condition (p=0.002). In Experiment 3, participants in the individual condition were more likely to alert the RA (p=0.006) or immediately click off the message (p=0.014) than those in the dyad condition. In Experiment 4, a significant association was found between alerting the RA and experimental condition (p=0.050).