CAN THREATS AND FEAR FOSTER SECURITY?

COGNITIVE AND EMOTIVE FORCES OF FEAR APPEALS ON INFORMATION SECURITY BEHAVIOR

A Dissertation

Presented to

The Faculty of the C.T. Bauer College of Business

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

By

Vanessa Hoo Durner

August 2018

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For my husband and my parents

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ABSTRACT

Individual users can create vulnerabilities in an organization's information security by carelessness, negligence, and/or noncompliance with security policies and procedures, so it is important for organizations to motivate employees' security behavior. Fear appeals are messages designed to motivate behavioral change by describing a threat associated with a behavior, but existing theories fail to explain how a fear appeal evokes fear and how fear influences behavior. A better understanding of the factors influencing responses to information security fear appeals would help organizations to design security messages in ways that increase their persuasive effectiveness. Therefore, this dissertation offers theoretical and empirical work to expand knowledge about these factors.

This research develops an emotion process model and a behavior process model for fear appeal threats, based on a synthesis of theories from psychology, organizational behavior, and neuroscience. These models were tested in a series of experimental studies to investigate how threat-based message components can drive emotion and cognition to motivate appropriate security behavior. The first study consisted of a lab experiment that manipulated each message component (threat severity, threat vulnerability, and emotional interest) in a separate stimulus to determine its influence on an individual's feeling state. The second study consisted of a lab experiment that manipulated combinations of fear appeal components to determine the influence of their interactions on an individual's feeling state. The results of these experiments indicate that fear appeals influence an individual's feeling state in different ways, depending on the fear appeal's composition. The third study consisted of a field experiment that investigated the degree to which fear appeals motivate individuals to improve their password behavior. The results of this experiment indicate that feeling state fully mediates the relationship between a fear appeal's threat verbalization and an individual's beliefs, where those beliefs subsequently influence attitude, intention, and observed and perceived behavior associated with password use. This dissertation thus provides evidence that security messages can leverage emotion to motivate individuals to perform appropriate security behavior.

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INTRODUCTION

Organizations currently face a substantial, expensive information security problem. In 2016, the cost of a single breach averaged $3.62 million, and the global probability of a data breach involving a minimum of 10,000 records was 27.7 percent (PricewaterhouseCoopers 2015). Individual users can create vulnerabilities in an organization's information security by carelessness, negligence, and willful noncompliance with security policies and procedures. Organizations consequently need to motivate employees' information security behavior, which includes their conscious involvement in protecting information and information systems assets (Straub and Welke 1998).

A fear appeal is a "persuasive message that attempts to arouse the emotion of fear by depicting a personally relevant and significant threat and … (includes) recommendations presented as effective and feasible in deterring the threat" (Witte 1994, p. 114). Organizations can use fear appeals to motivate individuals to change attitudes and behaviors in a variety of areas, including information security. For example, fear appeals have demonstrated the potential to promote individuals' ***intentions*** to: install and run anti-spyware software (Johnston and Warkentin 2010), increase users' data backups (Boss et al. 2015), comply with security policy (Herath and Rao 2009), and decrease password reuse (Jenkins et al. 2014). Recent reviews of the fear appeals literature in this domain have called for studies that model and measure actual security behaviors, not only intentions (Boss et al. 2015, Crossler et al. 2013). In response to this call, this dissertation will model and measure such behaviors.

The impact of a fear appeal is not uniform across individuals due to variations in perceptions of the appeal (Rogers 1983), and empirical research on the effectiveness of information security fear appeals has thus yielded mixed results (Johnston et al. 2015). Therefore, a better understanding of the factors

influencing perceptions of information security fear appeals would help organizations to craft fear appeals in ways that increase their persuasive effectiveness in motivating information security behavior. We offer our model and empirical work to help increase our understanding of these factors.

Most research on fear appeals in the information security domain has focused on examining the relationships among components of the fear appeal's message, perceptions of the message, and behavioral intentions (Johnston and Warkentin 2010). Thus far, this research has "only scratched the surface of the potential of fear as a motivator for security compliance" (Crossler et al. 2013, p. 93). Even though several existing theories related to fear appeals include fear arousal as a construct, they fail to explain how a fear appeal evokes fear and how fear in turn motivates behavior. Therefore, to contribute to a better understanding of the process by which fear appeals motivate information security behavior, we investigate the following research questions:

- *How can information security fear appeals evoke fear?*
- *How can fear influence information security behavior?*

This investigation has the potential to yield several contributions. This investigation can provide evidence of ways to improve information security training and interventions by leveraging the heretofore-overlooked role of emotion in fear appeals. A fear appeal represents a potentially stronger tool for motivating information security behaviors than the mere existence of security policies or manuals, because it is designed to persuade, not just to inform (Boss et al. 2015). Therefore, this research can help organizations effectively employ this valuable information security tool. In addition, this investigation can provide a theoretical basis for using self-report and physiological markers as measurements of fear in information security research.

To reinstitute and clarify the role of fear in information security fear appeals, this dissertation is based on research related to fear appeals, emotions, and behavior. Chapter 2 addresses prior research on fear appeals and information security and describes the theoretical families that form the foundation of fear appeal research, highlighting current gaps in the literature related to information security fear appeals.

Chapter 3 develops a model of the relationships between fear appeal components and an individual's internal emotional experience to explain how information security fear appeals can evoke fear. Chapter 4 then integrates that model with the theory of planned behavior (Ajzen 1991) to provide a model that explains how fear appeals and resulting fear can influence information security behavior. Chapter 5 provides an overview of the methodology used for the subsequent studies. Chapter 6 describes the operationalization, stimuli, experimental procedure, analysis, and results of the pilot study.

Chapters 7, 8, and 9 describe the method, analysis, and results for Studies 1, 2, and 3, respectively. The lab experiment in Study 1 separately manipulated fear appeals' threat-based components to better identify the different roles that they play in terms of eliciting fear individually. The results of Study 1 indicated that threat severity conveyed via text, threat vulnerability conveyed via text, and threat conveyed via image can all separately influence an individual's fear. Another lab experiment in Study 2 expands upon the results of Study 1 by manipulating combinations of a fear appeal's image and text components to identify the combinations that elicit greater fear. The results of Study 2 indicated that the influences on fear of text-based threat severity, text-based threat vulnerability, and image-based threat persist even when those components are combined with each other. Finally, a field experiment in Study 3 manipulates a fear appeal's threat-based components to determine the extent to which fear appeals actually lead to improved information security behavior through their influences on individuals' emotions and (cognitive) beliefs. The results of Study 3 indicated that text-based threat severity, text-based threat vulnerability, and image-based threat do not directly influence individuals' beliefs. Rather, their influences on beliefs were found to be fully mediated by individuals' emotions. Study 3 also found that subjective norm and perceived behavioral control each had a larger effect than attitude had on information security behavioral intention, and that subjects' information security intentions increased perceived security behavior much more than it increased their actual security behavior. Chapter 10 concludes with a discussion of the implications, limitations, and future research associated with this dissertation.

Chapter 2

PRIOR RESEARCH: FEAR APPEALS AND INFORMATION SECURITY BEHAVIOR

Scholars have long theorized about fear as a method of persuasion. Fear appeals essentially represent a form of pathos, one of the three general modes of persuasion codified in the 4th century BC (Aristotle 2004). Pathos encompasses all emotional appeals and depends on putting the audience into a certain frame of mind. Aristotle's two other modes of persuasion are logos, which depends on the proof provided by the words of the speech itself, and ethos, which depends on characteristics of the speaker. Logos appeals to the audience's logical reasoning ability, relying upon facts, anecdotes, and other logic-based evidence. Ethos appeals to the audience's perception of the communicator's character, relying upon the communicator's credibility, competence, and fairness. Aristotle suggests that emotion can be a powerful persuasion device because of human nature. Fear appeals can thus be more compelling than messages that rely solely on logic-based evidence or on the communicator's characteristics, because fear appeals incorporate emotion along with elements of logos and ethos.

In the last 60 years, fear appeal research has focused on how fear-based persuasion motivates specific behaviors. The first part of this chapter focuses on the primary fear appeal theories that developed in the field of psychology, followed by a summary of recent theories of rhetoric and ethics that relate to fear appeal implementation, concluding with a review of information security fear appeals research.

2.1. Fear Appeal Theories

Three theoretical families form the foundation of fear appeal research: drive models, parallel response models and protection motivation theory (Dillard 1994). This section summarizes these major fear appeal theories and reviews the strengths and weaknesses of each.

Unlike prior investigations of fear appeals research in information systems (Anderson and Agarwal 2010, Boss et al. 2015), our review uniquely focuses on the role of fear by differentiating emotion from cognition in fear appeal models. Although Dillard (1994) also reviewed fear in fear appeals research, we expand on his work by including the extended parallel process model, which emerged more recently, and by comparing the strengths and weaknesses of each theory.

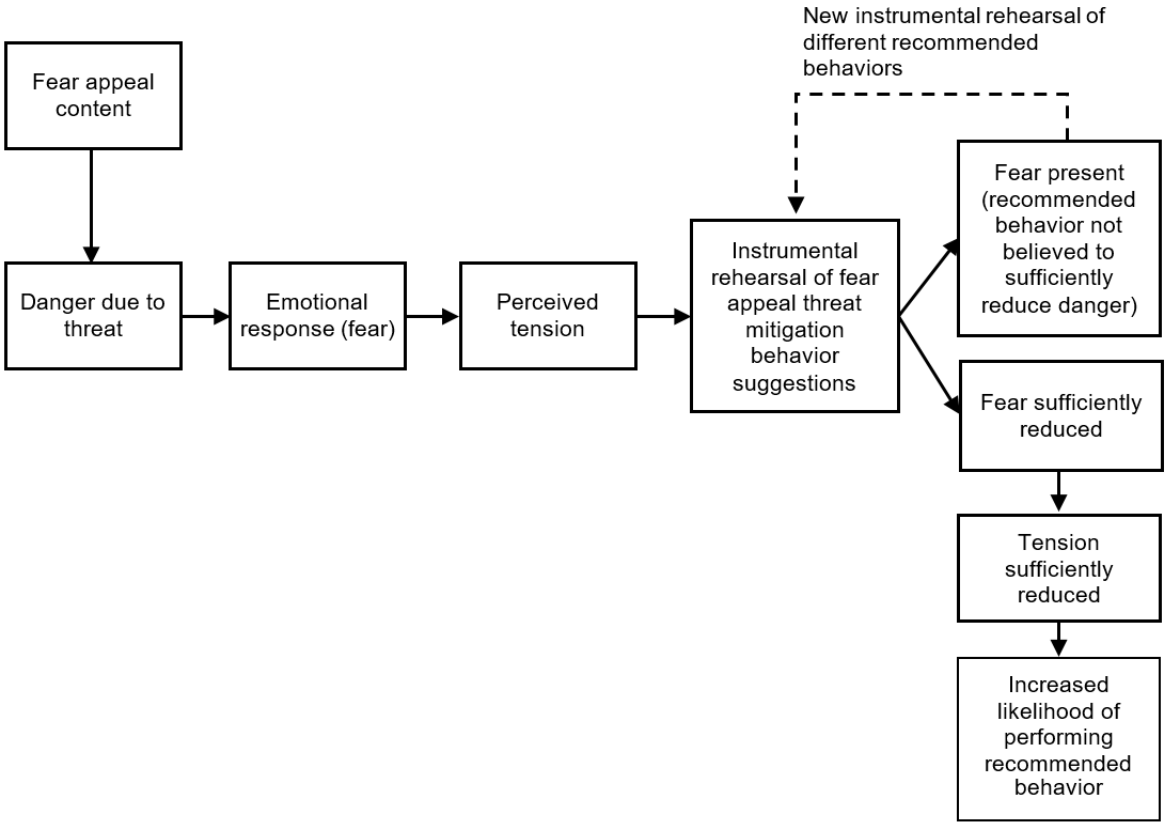
2.1.1. Drive Models

Drive models emerged out of learning theory in the 1950s and 1960s as the first theoretical approach in fear appeals research. In drive models, a drive represents the motivation to reduce an unpleasant state (Dillard 1994). Such drives are fundamental variables that are essential for learning (Miller 1951). As the most prominent fear appeal model of this type (Witte 1992), the fear-as-a-drive (or fear-as-acquired-drive) model (Hovland et al. 1953, Miller 1951) focuses on fear as the unpleasant state that motivates changes in attitude and behavior. Given a particular fear appeal, drive models assume that the fear appeal arouses emotional tension, which increases individuals' motivation to accept the fear appeal's recommended response (Janis and Feshbach 1953).

According to the fear-as-a-drive model (Figure 2.1), a particular danger, such as the threat described in a fear appeal, acts as a stimulus that starts an emotional fear response, producing perceived tension and an associated drive to reduce that tension. A fear appeal also provides cues about appropriate or recommended behavior that can reduce the danger, and thus the tension (Dillard 1994). Individuals perform instrumental rehearsal, which is the silent run through of the recommended behavior that is described in the fear appeal. This rehearsal then reduces or stops the fear response to the degree that the recommended behavior is believed to reduce or eliminate the danger. Because of the inherent reward of tension reduction, a recommended response that reduces fear becomes reinforced, thereby increasing the likelihood that the recommendations will be followed. Therefore, the fear-as-a-drive model proposes that fear reduction, not fear arousal, mediates the effects of a fear appeal on an individual's motivation to perform the recommended behavior (Dillard 1994). In addition, fear reduction can only occur to the extent that fear

arousal has already occurred. When instrumental rehearsal fails to sufficiently reduce fear, individuals rehearse other responses until a sufficient reduction occurs (Dillard 1994).

FIGURE 2.1. Fear-as-a-Drive Model adapted from (Leventhal 1970)
(All arrows indicate a positive impact)



A fear appeal can motivate an individual to perform the recommended behavior when the individual's perception of the threat and intended response aligns with the threat and response conveyed in the fear appeal. However, aggression toward the communicator, defensive avoidance, and inattentiveness to the message may interfere with the effective communication of a fear appeal, and thus may reduce the likelihood that the recommended behavior will be performed (Hovland et al. 1953). For example, the emotional tension caused by the message might become distracting enough to disrupt attention and message comprehension, thereby decreasing the likelihood of message acceptance. This can occur with the "use of strong (fear) appeals... [which can] have the "drastic effect of stimulating the audience to 'turn it off'" (Hovland et al. 1953, p. 94). Because this attention disruption occurs as a response

to emotional tension, as opposed to inattentiveness to the message, the audience's response represents a form of defensive avoidance. Janis' (1967) curvilinear formulation attempts to explain such reactions, and specifies an inverted U-shaped relationship between fear arousal (perceived tension) and intention to adopt the recommended response, with a moderate amount of fear arousal producing the greatest intention to adopt the recommended response.

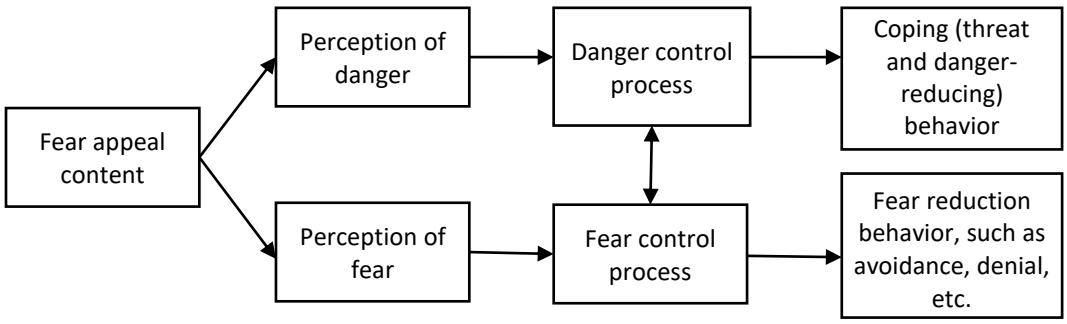
Subsequent fear appeals research rejected drive models because of a lack of support both for the argument that message acceptance occurs when fear is reduced and for the curvilinear formulation (Witte and Allen 2000). The "widely cited conclusion that high fear arousal creates a defensive avoidance reaction which causes high threat to be less persuasive than low threat is not true in most situations" (Higbee 1969, p. 441). Numerous studies since 1970 have failed to find support for the curvilinear formulation as an adequate explanation for high fear treatments resulting in less persuasion (Rotfeld 1988). Also contrary to the drive model, studies found that fear arousal, not arousal reduction, produces the greatest intention to adopt a recommended response (Rogers 1983). Leventhal (1970) points out that in some cases people experience heightened emotional arousal only after successfully coping with immediate danger. For example, drivers contending with an out-of-control vehicle can lack fear while they maneuver their cars only to experience intense fear of the danger after the conclusion of coping efforts.

Despite such shortcomings, Rogers (1975) acknowledges Janis' (1967) contribution of refining research questions through seeking interacting variables (such as efficacy) that might facilitate persuasion instead of asking whether fear facilitates or inhibits attitude change. In other words, the fear-as-a-drive model retains heuristic value by forming a basis for investigating other variables that may interact with fear arousal to influence behavioral intention or behavior change. At the same time, drive models say little about the cognitive or emotional factors underlying reactions to fear appeals. For example, the fear-as-a-drive model fails to explain how fear is actually aroused, other than assuming that fear is learned as a response via classical conditioning (Dillard 1994). Fear appeals research since the 1970s has focused on other models, namely variations of the parallel response model and protection motivation theory.

2.1.2. Parallel Response Model

Leventhal's (1970) parallel response model, also called the parallel process model, attempts to separate the emotional and cognitive aspects of processing fear appeals by proposing that fear appeals initiate two concurrent processes: danger control and fear control (Figure 2.2). In the parallel response model, a fear appeal serves as a stimulus that provides information about a threat associated with a particular danger, which an individual encodes via perceptual cognitive processes (Leventhal 1970). Exposure to a fear appeal initiates a danger control process as a result of an individual's perception of danger and initiates a fear control process by the perception of fear.

FIGURE 2.2. Parallel Response Model adapted from Dillard (1994)
(All arrows indicate a positive impact)



In the danger control process, coping behavioral responses are selected and executed with the aim of reducing or eliminating the danger associated with a threat based on information from the fear appeal as well as from one's own repertoire of coping behaviors. For example, within the danger control process, individuals develop strategies that result in behavior changes to avert the threat, such as brushing one's teeth to prevent tooth decay as suggested by a fear appeal advertisement. In the fear control process, attitudinal and/or behavioral responses are selected and executed with the aim of reducing the unpleasant personal experiences associated with fear, without reducing the danger associated with the threat. Fear control attitudes and/or behaviors include avoidance reactions, distraction, denial, and management of one's own physiology through substances such as alcohol (Dillard 1994). For example, consider a fear appeal that addresses the dangers associated with the flu virus, and suggests getting a flu shot and frequent hand washing. Individuals

perform fear control when they take anxiety medication to manage a fear of being contaminated by germs, while they perform danger control when they get the flu shot and frequently wash their hands.

The parallel response model proposes that message recipients can engage in both fear control and danger control at the same time, and that there may be interactions between the two mental processes in facilitative or disruptive ways (Beck and Frankel 1981, Dillard 1994). Facilitation occurs when fear control promotes danger control (or vice versa). For example, in sport parachuting, fear control is necessary for successful danger control (Fenz and Epstein 1967). In that situation, denial (fear control) facilitates the activities involved in a successful landing (danger control) by removing the distractions associated with fear, making it easier for parachutists to focus. Disruption occurs when fear control impedes danger control (or vice versa). For example, a prior study found that compared to smokers exposed to low or medium fear messages advocating x-rays, fewer smokers took (immediately available) diagnostic x-rays after being exposed to a high fear message advocating x-rays (Leventhal 1970). Leventhal (1970) argues that the intense fear resulted in avoidance (fear control), which disrupted the recommended behavior of taking x-rays (danger control).

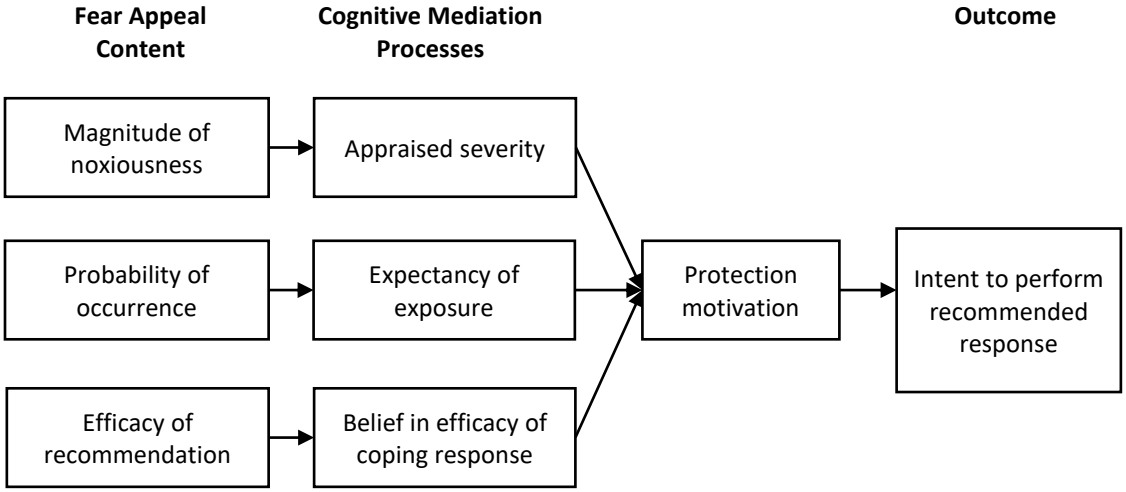
The parallel response model's major contribution is the separation of the emotional (fear control) and cognitive (danger control) aspects of the processing of fear appeals (Dillard 1994). However, the parallel response model does not specify the stimulus conditions that lead to the fear or danger control processes (Beck and Frankel 1981), and the nature of fear in the model is "somewhat vague" (Dillard 1994, p. 299). Subsequent research has also criticized the parallel response model's lack of specificity and testability (Witte and Allen 2000). However, Leventhal (1970) admits that the parallel response model is just a first step toward structuring a theory, and it claims to be nothing more.

2.1.3. Protection Motivation Theory

Protection motivation theory belongs to the class of subjective expected utility models, which assume that individuals choose the course of action that they believe is most likely to lead to their greater net benefit (utility) when considering rewards and punishments (Dillard 1994). Protection motivation theory (Figure 2.3) argues that individuals evaluate a fear appeal's threat based on three components of the

fear appeal: magnitude of noxiousness, probability of occurrence, and efficacy of the recommendation (Rogers 1975).

FIGURE 2.3. Protection Motivation Theory adapted from Rogers (1975)
(All arrows indicate a positive impact)



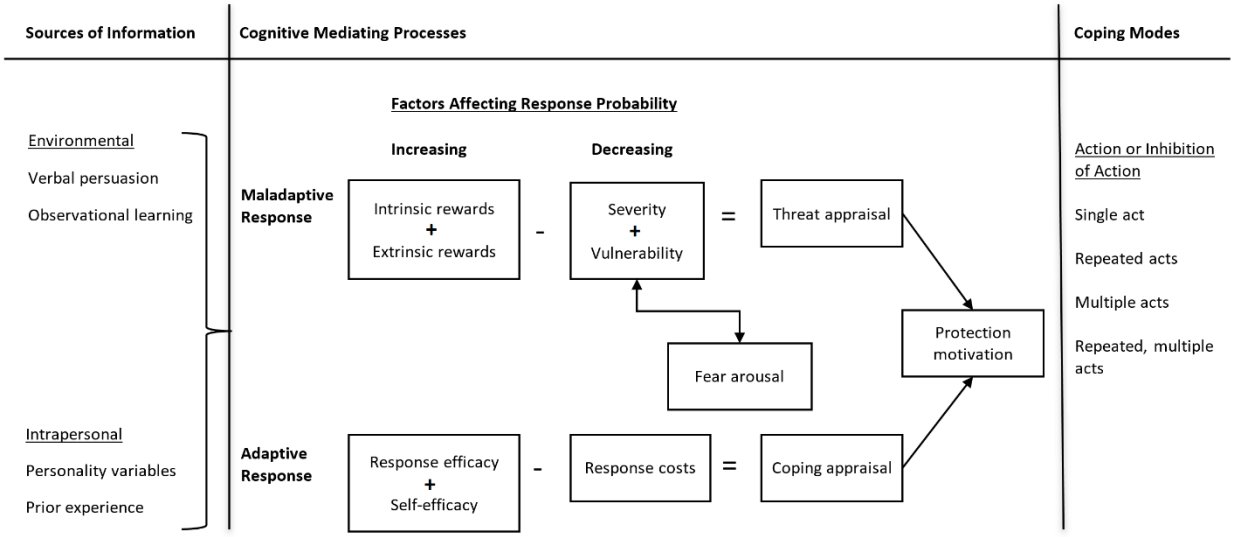
Magnitude of noxiousness is the message component associated with the amount of damage related to a fear appeal's threat. Although magnitude of noxiousness tends to refer to bodily harm, it also can involve intrapersonal and interpersonal threats, such as self-esteem and family or work relationships, respectively (Rogers 1983). Appraised severity is the cognitive process by which an individual estimates a threat's magnitude of noxiousness. Probability of occurrence is the message component associated with the conditional probability that the threat will occur provided that no coping behavior is performed and there is no modification of an existing behavior (Rogers 1983). Expectancy of exposure is the cognitive process by which an individual estimates a threat's probability of occurrence. Efficacy of recommendation is the message component associated with the availability and effectiveness of a coping response that might reduce or eliminate the magnitude of noxiousness and/or probability of occurrence associated with the threat (Rogers 1975). Belief in efficacy of coping response is the cognitive process by which an individual estimates the fear appeal recommendation's ability to reduce appraised severity and/or reduce expectancy of exposure. The three cognitive mediation processes in turn elicit protection motivation, an intervening variable with the typical characteristics of a motive: arousing, sustaining, and directing activity (Rogers

1975). Protection motivation then increases an individual's intention to perform the response recommended by the fear appeal.

Rogers (1983) reformulated protection motivation theory to differentiate between threat appraisal and coping appraisal processes, in addition to incorporating self-efficacy and other factors that influence an individual's behavioral response to a fear appeal. According to this reformulation (shown in Figure 2.4), environmental and intrapersonal sources of information drive an individual's cognitive mediating processes, which subsequently influence the individual's coping modes via protection motivation (Rogers 1983). For example, a fear appeal represents an environmental source of information about a threat that is intended to motivate individuals to follow the fear appeal's recommended response (i.e., coping mode) to mitigate the threat. Protection motivation results from a cognitive mediating process in which an individual considers the threat conveyed in a fear appeal based on several factors that influence the probabilities of adaptive and maladaptive responses. A maladaptive response represents an individual's failure to perform the recommended response, and can be a behavior an individual currently performs, such as drinking excessively, or a behavior that an individual could adopt, such as starting to smoke (Rogers 1983). Two factors increase the probability of a maladaptive response: intrinsic rewards and extrinsic rewards, where intrinsic rewards are rewards obtained when individuals engage in behavior for its own sake and extrinsic rewards are those rewards resulting from, but with no inherent connection to, the behavior itself (Guzzo 1979). Therefore, when maladaptive behavior garners intrinsic rewards such as satisfaction and/or extrinsic rewards such as social approval, this increases an individual's probability of failing to perform the response recommended in a fear appeal. In contrast, the severity of the threat and the vulnerability of an individual to the threat decrease the probability of a maladaptive response (Rogers 1983). Threat severity mirrors the appraised severity construct from Rogers' (1975) original formulation of protection motivation theory, and threat vulnerability is equivalent to the expectancy of exposure construct. People are more likely to continue to engage in maladaptive behavior if the perceived intrinsic and extrinsic rewards associated with performing the behavior are greater than the perceived severity and vulnerability associated with the maladaptive behavior. This is represented in the model by larger threat appraisal values. In the coping appraisal process associated with an adaptive response, response efficacy and self-efficacy increase the

likelihood of adaptive behavior (performing the recommended response) while response costs decrease the likelihood of adaptive behavior. Response efficacy corresponds to belief in efficacy of coping response in the original protection motivation theory, and self-efficacy refers to the belief in the degree that one is capable of performing a behavior (Rogers 1983). Response costs are the negative effects associated with adopting a recommended response, such as inconvenience, monetary costs, or negative side effects. In the coping appraisal process associated with an adaptive response, individuals are motivated to engage in adaptive behavior if response efficacy and self-efficacy together exceed the response costs of performing the behavior. High levels of threat and coping appraisal should decrease maladaptive behaviors and increase adaptive behaviors for "maximum protection motivation" (Rogers 1983, p. 171). Apart from this situation, however, protection motivation theory does not provide explicit mechanisms to explain how threat appraisal and coping appraisal work together to influence protection motivation and subsequent behavior (Witte 1992).

FIGURE 2.4. Revised Protection Motivation Theory adapted from Rogers (1983)
(All arrows indicate a positive impact)



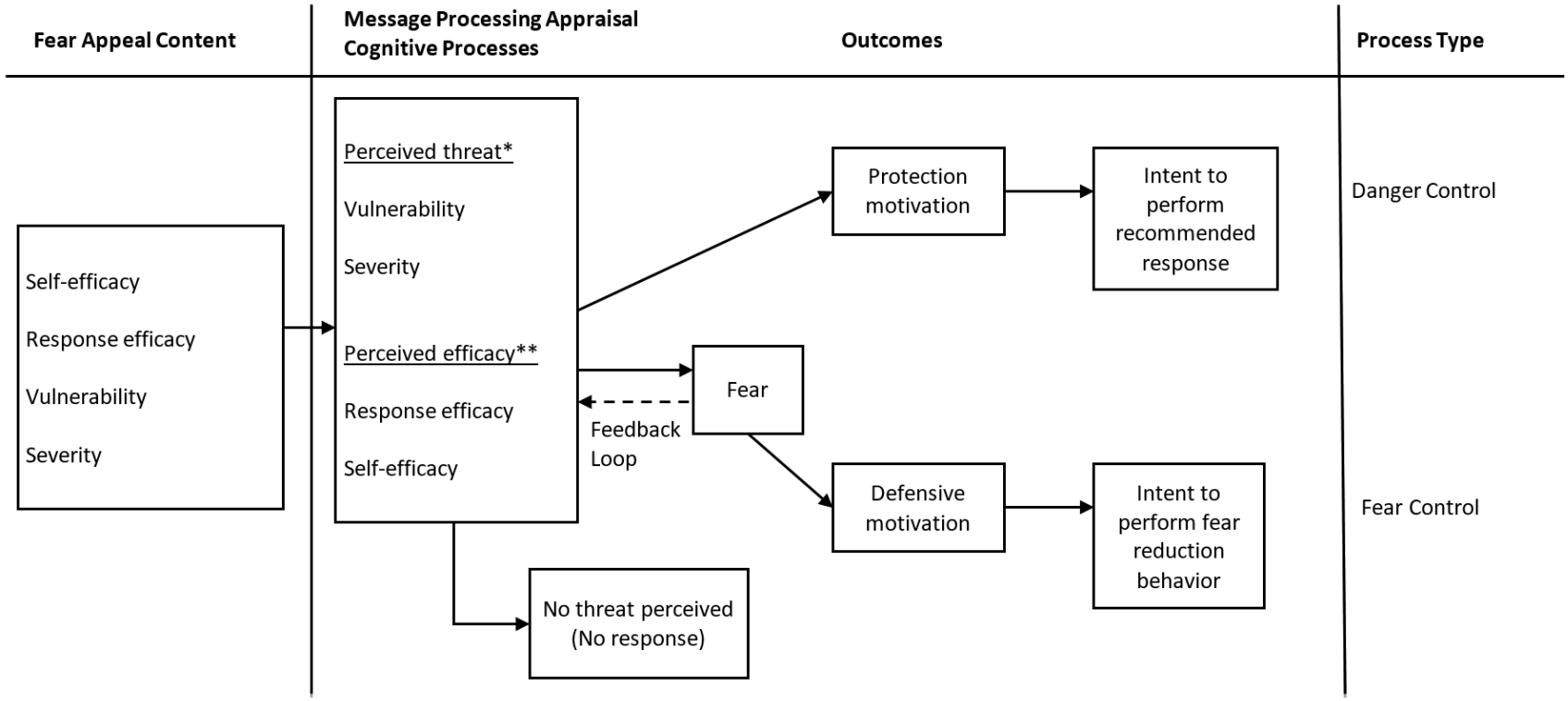
Protection motivation theory has been the most widely applied scientific model in the study of fear appeals, but inconsistencies exist between the revised model's predictions and empirical findings (Ruiter et al. 2014). For example, Witte (1992) describes how the revised model does not explain certain "boomerang" effects found in prior studies (Kleinot and Rogers 1982; Witte 1992), such as when low perceived efficacy, few extrinsic and intrinsic rewards for maladaptive responses, and increasing perceived severity and

vulnerability result in increases in maladaptive behaviors. Finally, protection motivation theory emphasizes the importance of cognitive processes as opposed to "visceral" ones (Rogers 1983, p. 169), in that the cognitive mediating processes initiated by a fear appeal are the only factors that influence an individual's response, and although fear causes and is caused by perceived threat severity, a conceptual definition of fear is not provided (Dillard 1994). Nevertheless, protection motivation theory improves upon earlier fear appeal models by providing a conceptualization of a fear appeal with individual components that facilitate persuasion as well as outlining the cognitive appraisal processes that lead to an individual's response (Rogers 1983).

2.1.4. Extended Parallel Process Model

Although the three theories described above have guided studies in a variety of fields, they have lost contact with the notion of fear (Dillard 1994). Witte's (1992) extended parallel process model (Figure 2.5), builds upon the earlier theories with the parallel response model as its basis, protection motivation theory for explaining when and why fear appeals work, and the drive model for explaining when and why fear appeals fail (Popova 2012). The extended parallel process model, like protection motivation theory, indicates that a fear appeal has several components: self-efficacy (one's ability to perform a response), response efficacy (effectiveness of a response in deterring a threat), vulnerability (one's risk of experiencing a threat), and severity (seriousness of a threat) (Witte 1992). First, individuals appraise a threat based on vulnerability and severity, yielding a perceived threat in terms of perceived vulnerability and perceived severity. If perceived threat is low, there is no motivation to process the message further, whereas high perceived threat evokes fear and motivates action to reduce fear (Witte 1992). Perceived threat increases the likelihood of the second appraisal, which involves perceived efficacy, an individual's thoughts about response efficacy and self-efficacy (Witte 1992). If perceived efficacy is high, individuals follow the danger control process, in which protection motivation increases intent to reduce the threat by adopting the recommended response. If perceived efficacy is low, individuals follow the fear control process, in which defensive motivation leads to message rejection and therefore reductions in fear through avoidance behaviors such as denial, defensive avoidance, or reactance (Witte 1992).

FIGURE 2.5. Extended Parallel Process Model adapted from Witte (1992)



* Perceived threat = 0 leads to no response;
** Perceived efficacy > perceived threat leads to protection motivation, and perceived efficacy < perceived threat leads to defensive motivation

Although the theoretical concepts of the extended parallel process model are reasonably well developed (Popova 2012), several gaps still exist within its literature. Purely cognitive models, such as Rogers' (1975) protection motivation theory, are consistent with danger control. Although danger and fear control are present in the parallel process model (Leventhal 1970) and in the extended parallel process model (Witte 1992), both models imply that protection motivation alone leads to message acceptance and coping behavior (i.e., following recommended behaviors), while defensive motivation alone leads to message rejection and avoidance behaviors. The extended parallel process model also explains neither how threat in a fear appeal evokes fear nor how fear influences defensive motivation. Although the extended parallel process model includes a fear construct, the model indicates that fear arises solely as a result of cognitive message processing appraisals (Witte 1992). Furthermore, the way an individual experiences fear is not explained in the extended parallel process model or any of the other fear appeal theories. Although the extended parallel process model includes fear as a construct, the emotional experience of fear has yet to be fully explored (Witte 2013). Nevertheless, after 20 years, the extended parallel process model is still evaluated favorably in terms of parsimony, appropriateness, validity, and comprehensiveness (Maloney et al. 2011).

The extended parallel process model addresses weaknesses of the earlier fear appeal models and theories by providing clear conceptual definitions and addressing both the success and failure of fear appeals (Maloney et al. 2011, Witte 1994). However, the model has received equivocal empirical support (Popova 2012). Furthermore, this model, like earlier fear appeal models and theories, is predominantly cognitive, without explanations of how individuals experience fear upon exposure to a fear appeal. For example, even though the extended parallel process model includes the fear construct, fear in that model arises solely because of cognitive message processing appraisals. Consequently, the emotional experience of fear has yet to be fully explored in fear appeal theories.

2.2. Fear Appeal Implementation Issues

By employing threats as a method of persuasion, a fear appeal might be associated with argumentum ad baculum, or an appeal to force, in that evoking negative consequences might intimidate

the audience. However, conveying a threatening message is not the same as making a threat. Appealing to fear can be inappropriate when a threat is used to bully someone into compliance or commitment without giving evidence or proper argumentation, known as ad baculum fallacy (Walton 2010). Although information security fear appeals might appear threatening because they convey a message of danger or potential harm, such fear appeals are not threats themselves. In other words, fear appeals typically do not state that the communicator intends to bring about the harmful consequences if the audience does not adopt the recommended response. Therefore, when a fear appeal is used to warn the audience of its predicament based on evidence of the threat's severity and the audience's vulnerability to the threat, as most fear appeals related to information security are, it is not an ad baculum fallacy.

Furthermore, even fear appeals that contain ad baculum fallacies are not necessarily inappropriate. Although logicians have traditionally viewed fear appeal arguments as informal ad baculum fallacies, fallacy theorists have recently presented such arguments as heuristics that constitute a form of practical reasoning that is non-fallacious when assessed against non-deductive standards of argument (Cummings 2012). For example, fear appeals bypass the extensive deliberations surrounding evidence in systematic reasoning, which "satisfies the practical imperative in public health…to institute protective actions in advance of full evidence and knowledge about a health risk" (Cummings 2012, p. 43). In other words, fear appeals that contain ad baculum fallacies can still be practical in addressing health risks, because they serve as a shortcut for motivating protective behavior compared to systematic reasoning, which is slower and more time-consuming. In the same way, it is reasonable for an organization to employ an information security fear appeal that appeals to force, such as threatening an employee's termination for an information security infraction, because the fear appeal allows employees to take protective actions in advance of full evidence and knowledge about a security risk.

The use of threats in fear appeals is nevertheless potentially risky, because an entity that communicates such threats may be perceived as a scaremonger, particularly when such a tactic is not appropriate to the situation (Walton 2010). In general, scaremongering occurs when a message exploits the audience's insecurity or fear (Walton 1996). For example, when the Advertising Standards Bureau

ruled that an advertisement for stroke prevention contained an unjustifiable level of violence for the amount of health information it contained (Pendleton 2012), it essentially classified the advertisement as scaremongering. Fear appeals considered to be scaremongering can still be effective, though they may have negative effects due to the way they convey a threat. Therefore, when scaremongering is a concern, listing the potential negative effects of a fear appeal would be helpful for an implementing manager to decide whether to use the fear appeal. Information security fear appeals also can avoid accusations of scaremongering by including evidence that supports the threat's credibility and the recommended response's feasibility. Such evidence helps to justify the level of danger conveyed by providing information intended to help protect the audience.

In addition to the pragmatic issues described above, the extent to which a fear appeal results in inappropriate or unjustifiable levels of fear for its audience can result in an ethical problem. The ethical effects-reasoning matrix provides a tool to evaluate potential ethical problems at the individual, organizational, and societal levels according to four major ethical reasoning approaches that represent a cross-section of moral principles (Duke et al. 1993). In the ethical effects-reasoning matrix, utilitarianism suggests that an action's consequences for stakeholders are the most important issues in ethical dilemmas, such that ethical actions bring about the greatest good for the most people. The golden rule approach suggests that a person should treat others in the same way he or she would expect to be treated, such that ethical actions emphasize the dignity and respect of others. The Kantian approach suggests that every individual has basic rights, such that each individual should be consulted about actions affecting them for the actions to be ethical (Duke et al. 1993). The enlightened self-interest approach suggests that individual freedom of choice and other personal rights outweigh the rights of others while acknowledging that respect for others facilitates individual self-interest in the long run; ethical actions therefore maximize net benefits for the individual in a way that minimizes detriments to others. Considering different ethical perspectives of a fear appeal can help clarify the potential for ethical issues. In general, evaluating a fear appeal based on ethics entails the consideration of the fear appeal's content, context, and consequences.

2.3. Information Security Fear Appeals Research

Although theories about fear appeals originated in the field of psychology, they have been applied in a wide array of disciplines, including information systems. A growing area of information systems research focuses on investigating fear appeals and information security behavior. Information security behavior refers to an individual's conscious and voluntary involvement in protecting against information security threats (Dinev and Hu 2007). These threats encompass any potential danger or harm related to the confidentiality, integrity, or availability of information (Farahmand et al. 2005).

Fear appeals are particularly applicable to an information security context, in which "both benevolent and malicious messages commonly attempt to elicit fear to motivate the target into action" (Anderson et al. 2016, p. 372). For example, a benevolent security message may attempt to persuade a user to take a protective action such as installing a software patch (Vaniea et al. 2014), whereas a malicious security message may be designed to persuade a user to share account credentials via a phishing e-mail (Guinea et al. 2013). Industry surveys and the academic literature related to behavioral information security both acknowledge that individuals are the "weakest link" in defending against information security threats to an organization (Crossler et al. 2013, p. 91), so fear appeals designed to motivate protective information security behaviors have the potential to strengthen an organization's information security.

Although psychology offers a number of literature reviews and meta-analyses about fear appeals research (De Hoog et al. 2007, Earl and Albarracín 2007, Floyd et al. 2000, Milne et al. 2000, Ruiter et al. 2014, Witte and Allen 2000), the scope of those reviews omits information security research. Most of the related reviews within the information security literature similarly address different scopes of research, such as studies investigating general security messages (Anderson et al. 2016), security policy-related articles (Cram et al. 2017), and behavioral research on information system security (Siponen and Vance 2014). A prior review of information security studies based on protection motivation theory highlights the omission of fear-appeal manipulations and fear measurement and the failure to measure actual protective behaviors in current information security studies (Boss et al. 2015). Because it is possible that recent

research has addressed these gaps, we examined the information security fear appeals literature to determine whether the lack of fear appeal manipulations and the lack of fear and behavior measurements still exist.

2.3.1. Information Security Fear Appeal Treatments

Boss and colleagues (2015) identified two studies based on protection motivation theory (Rogers 1983) that have used information security fear appeal treatments (Johnston and Warkentin 2010; Johnston et al. 2015) and conducted two studies with such treatments themselves. Since then, three recent studies have employed treatments involving information security fear appeals. Johnston and colleagues (2016) manipulated fear appeal components in scenarios shown to respondents to determine each respondent's self-reported intention to violate information security policies. However, the fear appeal components manipulated in this study were presented as situational, scenario-based factors, and thus did not directly address the respondents. Warkentin and colleagues (2016) manipulated the language in security-focused fear appeal stimuli as neutral statements, threat statements, and response statements and used functional magnetic resonance imaging (fMRI) and a survey to evaluate subjects' reactions to each statement. Although the stimuli in this study involved a variety of security threats and associated responses, the statement manipulations focused on types of threats and associated responses, as opposed to the fear appeal components in prevalent fear appeal theories. Finally, a recent study involved showing subjects a series of mixed legitimate business emails and phishing emails to understand users' detection of and coping responses to phishing emails (Wang et al. 2017). Phishing emails essentially represent malicious fear appeals intended to lead recipients to make themselves vulnerable to attacks. Although this study used phishing emails as stimuli, fear appeal components were not directly manipulated.

2.3.2. Fear Measurements

An earlier review of information security research based on protection motivation theory concluded that no relevant study has measured actual fear (Boss et al. 2015), even though "fear-related models…are one of the most dominant theoretical perspectives in behavioral information security research" (Anderson et al. 2016, p. 373). Three recent studies related to information security behavior

have included fear measurements. The first study used a six-item scale to measure self-reported fear, but the items in this scale address global fear, in terms of feelings associated with the security threats to the organization's information and information systems (Posey et al. 2015). This scale thus measures anxiety more than fear, because anxiety is a diffuse, vague sense of apprehension that does not result from a specific threat, while fear is an emotional response to a specific threat (American Psychiatric Association 2013). Thus, the fear scale in this study represents a cognitive "self-assessment of a perspective determined post-stimulus" and does not capture the extent to which fear is realized in its affective form (Crossler et al. 2013, p. 93).

A second study similarly employed a seven-item scale to measure self-reported phishing anxiety, which the authors used in place of fear in their adaption of Witte's (1992) extended parallel process model (Wang et al. 2017). Although subjects were shown a series of mixed phishing and legitimate email messages, phishing anxiety was measured in a survey prior to viewing the stimuli. As explained above, fear is a response to a specific threat or stimulus. As a result, the authors' phishing anxiety measurement does not reflect the fear construct that appears in the extended parallel process model (Witte 1992). Furthermore, social desirability bias, subjectivity bias, common method bias, and people's awareness of their emotion can influence self-reported fear measures (Dimoka et al. 2011; Lopatovska and Arapakis 2011). However, NeuroIS methods have the potential to effectively measure fear (Anderson et al. 2016; Crossler et al. 2013; vom Brocke and Liang 2014).

A recent study measured fear using fMRI tools to evaluate subjects' immediate neural responses to threat, response, and neutral statements (Warkentin et al. 2016). This fear measure improves upon others because it is applied at the moment of fear's occurrence and is not as susceptible to biases associated with self-reported fear (Boss et al. 2015). The authors state that they designed the stimuli to resemble fear appeals typically used in organizational environments but acknowledge that they "favored fMRI precision over a study of exact realism in situ" (Warkentin et al. 2016, p. 205). The lack of ecological validity in this study thus potentially influenced subjects' reactions to the fear appeal stimuli, because subjects' reactions in an MRI machine likely would differ from those in a typical work or

computing environment. Therefore, even though this study included fear measurements, its experimental setting likely influenced subjects' reactions and did not necessarily capture subjects' natural emotional experiences.

2.3.3. Behavior Measurements

Several calls for research have addressed the importance of evaluating real-world information security behaviors, noting that the goal of information security research is to improve those behaviors, not just security intentions (Boss et al. 2015; Crossler et al. 2013). Furthermore, even though many of the theories applied to behavioral information security research assume that behavioral intentions predict behavior (e.g., Rogers 1983), individuals' behavioral intention does not necessarily correspond to their actual behavior (Ajzen et al. 2004). Recent studies have yet to fully address the intention-behavior research gap by measuring observed security behaviors. Some recent studies have used self-reported measures of security behavior (Posey et al. 2015; Thompson et al. 2017), but such studies face the threat of common-method bias (Podsakoff et al. 2003). Since Boss et al.'s (2015) review, no information security studies based on fear appeal theories have measured observable information security behavior.

2.4. Conclusion

Based on an examination of the information security literature related to fear appeals, gaps identified by prior reviews remain (Anderson et al. 2016; Boss et al. 2015; Crossler et al. 2013). Therefore, this dissertation focuses on fear appeals, fear, and behavior constructs from existing theories to develop a better understanding of the relationships among information security fear appeals, fear, and information security behavior. The next two chapters conceptualize these relationships in two models, the emotion process model (Chapter 3) and behavior process model (Chapter 4) for fear appeal threats.

Chapter 3

EMOTION PROCESS MODEL AND ASSOCIATED HYPOTHESES

The use of fear appeals is widespread and assumes that persuasion is enhanced when a fear appeal's targeted individuals are afraid, such that fear leads them to take the fear appeal's protective instructions more seriously (Boss et al. 2015; Rogers 1983; Witte 1992). Although the psychological literature has an "often-admitted difficulty defining fear" (Hamilton 1979, p. 385), fear tends to be described as an emotion aroused when an individual perceives a danger or potential harm that exists in the environment (American Psychiatric Association 2013; Geer 1965; Witte 1998).

Defining emotion is also difficult, despite frequent use of the term in social science research (Scherer 2005). One study classifies 92 different emotion definitions as either affective, cognitive, external stimuli, physiological, emotional/expressive behavior, disruptive, adaptive, multi-aspect (i.e., emphasizing many facets of emotion), or motivational (Kleinginna and Kleinginna 1981). In contrast, Goleman (1995) argues that emotions involve multiple systems, such that an emotion encompasses a feeling and its distinctive thoughts, psychological and biological states, and a range of propensities to act. As an emotion, fear thus involves dynamic yet coordinated appraisals, physiological symptoms, action tendencies (i.e., motivations), facial expressions, and subjective feelings (Scherer 2005).

To clarify the role of fear in fear appeals, we offer conceptualizations of the emotional and behavioral processes that explain how individuals experience fear resulting from threats in information security fear appeals, and how that fear subsequently influences information security behavior. While the emotion process model for fear appeal threats (EPM: Figure 3.1) focuses on the emotional processes, the behavior process model (BPM: Figure 4.1) combines the results determined in the emotion process model with cognitive processes to determine the information security behaviors that result from a fear appeal.

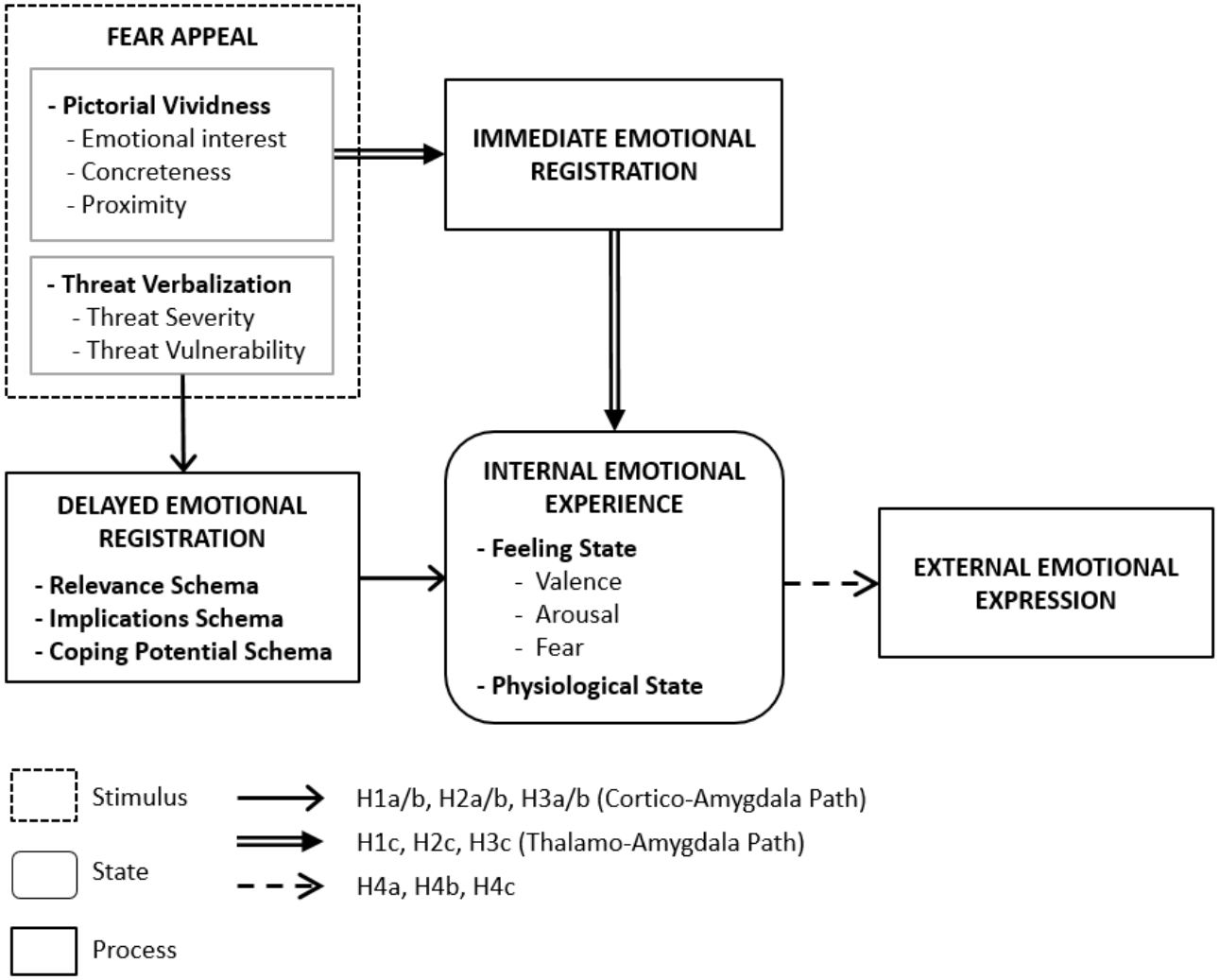
The EPM is based on Elfenbein's (2007) integrated intrapersonal process framework for emotion in organizations (IIPF), a model of fear-processing circuitry from neuroscience (LeDoux 2000), and the extended parallel process model (Witte 1992). The BPM is primarily based on the theory of planned behavior (Ajzen 1991) and the extended parallel process model (Witte 1992).

In accord with Elfenbein (2007), we conceptualize fear as a process involving emotional registration, internal emotional experience, and external emotional expression in response to a stimulus (Figure 3.1). Although many theories of emotion exist (e.g., Scherer 2000), Elfenbein's (2007) IIPF is well suited for this study because it focuses on emotion in organizations, which is our domain of interest, and it is consistent with research on the neural basis of emotion (LeDoux 2000) and in particular, the emotion of fear (Goleman 1995, Scherer 2005). Finally, this framework conceptualizes emotion as an interrelated series of processes that unfold chronologically. This is important because many models tend to treat emotions as static, even though emotions are dynamic responses to an event or entity (Gooty et al. 2009). Including the different steps in the emotion process allows a fine-grained investigation of emotion dynamics. The neuroscientific perspective on emotion explains the subconscious affective processes involved in emotional registration and emotional experience. The EPM includes a cortico-amygdala path and a thalamo-amygdala path to represent the dual neural pathways by which an individual processes emotional information (LeDoux 2000). This perspective is important because a growing body of information security research draws upon neurophysiological measurements of fear (Anderson et al. 2016) for studies that investigate fear appeals.

The EPM, illustrated in Figure 3.1, includes the stimulus (in this case, the fear appeal), emotional registration, emotional experience, and external emotional expression constructs from Elfenbein's (2007) IIPF. The EPM differs from the IIPF in the following ways. (1) Internal emotional experience represents emotional experience from the IIPF, but the term "internal" is added to differentiate it from external emotional expression. (2) Emotional registration is divided into two different constructs, immediate emotional registration and delayed emotional registration, to better represent the two neural pathways by which an individual registers an emotional stimulus, as proposed by neuroscientific research on emotion

(LeDoux 2000). (3) The EPM includes expressive cues within external emotional expression, although Elfenbein (2007) represents these two constructs separately. These constructs were combined to emphasize the role of internal emotional experience (instead of external emotional expression), which also plays an important role in the BPM. (4) Finally, the IIPF's conceptualization of post-emotional responses, including cognitions, action tendencies, and behavior, appears in the BPM as beliefs, behavioral intention, and information security behavior, based on the theory of planned behavior (Ajzen 1991). This was done to represent the associated relationships in greater detail and to allow us to draw from the vast literature associated with Ajzen's theory.

FIGURE 3.1. Emotion Process Model for Fear Appeal Threats



3.1. Fear Appeal

Elfenbein's (2007) IIPF describes the steps that occur in an emotional episode. The emotional episode begins when an individual is exposed to a stimulus, which can be an event that occurs or a salient feature of the environment. In our models, a fear appeal represents a stimulus in the form of a persuasive message about a particular information security threat. An example of a fear appeal is illustrated in Figure 3.2, which represents an alert for individuals who attempt to create a weak password.

FIGURE 3.2. Fear appeal example

A fear appeal conventionally contains four text-based components related to a threat and a response: threat severity, threat vulnerability, response efficacy, and self-efficacy. These aspects of a fear appeal are based on the message components in protection motivation theory (Rogers 1983) and the extended parallel process model (Witte 1992). We adopt Witte's (1992) definitions for these message components. Threat severity refers to the significance or magnitude of a threat conveyed in a fear appeal. For example, the threat severity of the fear appeal in Figure 3.2 is based on the statement that weak passwords "can even lead to identity theft." Similarly, threat vulnerability refers to the degree to which a fear appeal conveys one's likelihood of experiencing a threat. Threat vulnerability in Figure 3.2 is based on the statement that "weak passwords make your information vulnerable to attack". We emphasize the conventionally text-based nature of a fear appeal's threat severity and threat vulnerability with the term "threat verbalization", which refers to the degree of threat conveyed by a fear appeal's text. As threat severity and threat vulnerability increase, the fear appeal has greater threat verbalization.

The other two fear appeal components focus on the fear appeal's recommended response. Response efficacy in a fear appeal describes the effectiveness of the recommended response in deterring a threat. Response efficacy in Figure 3.2 is based on the statement that using a strong password is "an effective way to help protect your identity." In contrast, self-efficacy in a fear appeal refers to one's ability to perform the recommended response. Self-efficacy in Figure 3.2 is based on the statement that "strong passwords are easy to create." Based on the extended parallel process model (Witte 1992), response efficacy and self-efficacy should not have any effect without a perceived threat. Therefore, this dissertation focuses on and manipulates the threat severity and vulnerability components of a fear appeal, leaving response efficacy and self-efficacy to be manipulated in future studies.

3.2. Delayed Emotional Registration

Delayed emotional registration represents one of two parallel intervening processes between a fear appeal stimulus and internal emotional experience. Delayed emotional registration involves an individual's appraisal of and response to an emotional stimulus (a fear appeal). With this relatively delayed cortico-amygdala path, sensory information travels from the thalamus to the neocortex, which is involved in executive control for higher mental functions, through several levels of brain circuits before routing the information to the amygdala (Goleman 1995). Emotional registration through the cortico-amygdala path is therefore delayed because the extra cognitive processing compared to the more direct thalamo-amygdala path (LeDoux 2000), which we describe in section 3.3.

Delayed emotional registration involves subliminal sense-making in a series of rudimentary checks of the stimulus, such as those in Scherer's (2001) sequential check theory of emotion differentiation. Scherer (1984) originally proposed a set of stimulus evaluation checks that underlie an individual's assessment of an emotional stimulus. The number and definition of those checks has evolved over three decades, but the underlying principle for theory building has remained constant, in that the stimulus evaluation (schema) checks are the minimal set of criteria needed to differentiate emotional states (Scherer 2001). These schema checks entail evaluations of the fear appeal's relevance, implications, and coping potential, with results of these evaluations influencing internal emotional experience.

3.2.1. Relevance Schema Check

Scherer defines the relevance schema check as an "evaluation of whether a stimulus deserves further processing because of its bearing on our well-being—as determined by the results of the (novelty, intrinsic unpleasantness, and task pertinence) sub-checks" (Scherer 2013, p. 151). A stimulus is perceived as deserving further processing as it is more novel, more unpleasant, and more task-pertinent. Novelty encompasses evaluations of suddenness, unfamiliarity, and unpredictability, with increasing novelty associated with sudden, unfamiliar, and unpredictable stimuli. For example, the first time an individual is exposed to the fear appeal in Figure 3.2, novelty would be relatively high, thereby increasing relevance, because the fear appeal's appearance would be rather sudden, unfamiliar, and unpredictable. The intrinsic unpleasantness sub-check evaluates the degree to which a stimulus is in itself unpleasant for an individual. For example, a threat is a danger or harm that exists in the environment and thus represents the possibility of something unpleasant (Witte 1992). Because the fear appeal in Figure 3.2 identifies identity theft as a possible danger, its intrinsic unpleasantness is relatively high compared to a stimulus that does not address any danger. The task pertinence sub-check evaluates the degree to which a stimulus is important for an individual's current task goals. For example, if an individual viewed the fear appeal in Figure 3.2 while creating a password, task pertinence would be high, with this level of pertinence increasing the fear appeal's relevance.

3.2.2. Implications Schema Check

The implications schema check evaluates the degree to which a stimulus has positive or negative consequences for an individual. By design, fear appeals focus on negative consequences associated with a threat, so the result of the implications schema check for a fear appeal will tend to be negative. This schema check encompasses the results of the causal attribution, outcome probability, goal or need conduciveness, and urgency sub-checks (Scherer 2001). The causal attribution sub-check evaluates whether an event is caused by an individual's own behavior or someone else's behavior, or by chance. Based on the fear appeal example in Figure 3.2, the event (identity theft) is caused by the use of weak passwords, which should influence causal attribution by increasing the degree to which individuals

attribute the event to their own behavior. In contrast, the outcome probability sub-check involves assessing the likelihood of the event's consequences for the individual. For example, in Figure 3.2, the fear appeal argues that weak passwords make information vulnerable to attack, which should increase outcome probability as perceptions of weak password behavior increase. That is, individuals who believe that their passwords are weak should tend to evaluate the outcome probability of identity theft as high, based on the fear appeal's information. The goal or need conduciveness sub-check evaluates the degree to which the situation's consequences are beneficial or harmful for the individual (Scherer 2001). Because fear appeals describe a threat, goal or need conduciveness will involve evaluating the degree to which the threat's consequences are harmful. For example, the fear appeal in Figure 3.2 should decrease goal or need conduciveness, because the consequences mentioned in the fear appeal (e.g., identity theft) are relatively harmful. Finally, the urgency sub-check evaluates the degree to which the event requires an individual to take quick action, where urgency increases based on relevance, goal/need conduciveness and time pressure (Scherer 2013). For instance, the fear appeal example in Figure 3.2 should result in a relatively high degree of urgency, based on the high relevance and low (i.e., negative) goal or need conduciveness related to the fear appeal's description of the potential negative consequences of using weak passwords.

3.2.3. Coping Potential Schema Check

The coping potential schema check evaluates the degree to which the individual can control and adjust to consequences associated with a stimulus. This schema check includes three sub-checks: control, power, and adjustment (Scherer 2001). The control sub-check evaluates the degree to which an event itself is controllable, while the power sub-check evaluates the individual's own power to exert control over the event's outcome (Scherer 2001). That is, control exclusively refers to the probability that an event can be influenced by any agent, whereas power refers to the likelihood that an individual is able to influence an event. The power sub-check thus represents an individual's initial assessment of self-efficacy in mitigating a threat, whereas the control sub-check represents an individual's evaluation of the extent to which a threat can be influenced at all. Finally, the adjustment sub-check evaluates the degree to which an individual can live with the consequences of a threat. This coping potential sub-check differs from the

control and power sub-checks because it does not focus on the ability to mitigate a threat, but rather on the ability to adjust to the negative consequences in the event that the threat occurs (Scherer 2001). The adjustment sub-check thus involves evaluating the anticipated effort involved in coping with a threat should the threat actually occur. Based on the fear appeal example in Figure 3.2, individuals should evaluate the threat of identity theft as having high control and power, based on the statements that using a strong password is an effective way to help protect one's data against identity theft and that strong passwords are easy to create. At the same time, the threat of identity theft should be associated with many negative consequences, so adjustment should be evaluated as low. Therefore, the efficacy components of our example fear appeal should increase coping potential, while the threat components should decrease coping potential in this schema check.

The implications and coping potential checks in delayed emotional registration are consistent with the efficacy appraisal in the extended parallel process model. Based on appraisals of self-efficacy and response efficacy, when individuals fear a particular threat and register a response that is feasible and that would effectively mitigate the threat, they are motivated to control the danger (Witte 1992). As a result, they focus on strategies to mitigate the threat. However, the response efficacy and self-efficacy described here are not directly conveyed in the fear appeals in this study, based on this study's focus on the threat-based components of a fear appeal.

3.3. Internal Emotional Experience

When an individual registers the sensory information related to a stimulus through delayed emotional registration, internal emotional experience takes place as a (psychological) feeling state and physiological response state (Elfenbein 2007). Feeling state represents an individual's subjective experience of emotion, while physiological state involves the physical changes that accompany emotional experience, such as changes in heart rate.

3.3.1. Feeling State

Prior psychological research has used two major approaches to represent subjective emotional experience: the dimensional approach and the discrete emotions approach (Scherer 2005). As one

example of the dimensional approach, Smith and Ellsworth (1985) propose six different dimensions that distinguish emotions, including pleasantness (i.e., valence), anticipated effort, certainty, attentional activity, responsibility, and control. According to that model, fear is unpleasant, involves high anticipated effort and uncertainty and no consistent attentional activity, with high situational (i.e., low human) control and relatively low self-responsibility (Smith and Ellsworth 1985). However, more recent research suggests that feeling states can be described by their position in a three-dimensional space formed by valence, arousal, and tension (Scherer 2005). Valence differentiates positive from negative feeling states. For example, happiness is a feeling state with positive valence, while fear is a feeling state with negative valence. Arousal (or intensity) describes the magnitude of a feeling state, which, for example, differentiates anger from the more intense rage. Tension refers to the amount of strain, as opposed to relaxation, associated with a feeling state. Because of failures to find consistent empirical support for tension or other dimensions that do not have considerable overlap with arousal, current dimensional theorists typically adopt a two-dimensional model, focusing on valence and arousal (Altenmüller et al. 2013; Scherer 2005).

Prior research using the discrete emotions approach has established six conventional emotional categories that consist of anger, disgust, fear, joy, sadness, and surprise (Ekman et al. 1971). Although fear is an emotion characterized by high negative valence and high arousal, these dimensions do not differentiate fear from related emotions, such as anger and disgust (Scherer 2005). According to Smith and Ellsworth's (1985) dimensions of cognitive appraisal, anger and fear differ in terms of control and uncertainty. Fear is characterized by a sense of *situational* control (beyond any individual's control) and uncertainty, while anger is characterized by a sense of *individual* control and certainty. At the same time, fear and sadness are both characterized by high situational control and uncertainty, although fear tends to be associated with a higher level of uncertainty than sadness (Smith and Ellsworth 1985). Therefore, to accurately conceptualize the feeling state associated fear within internal emotional experience, fear is included within feeling state in addition to the conventional dimensions of valence and arousal.

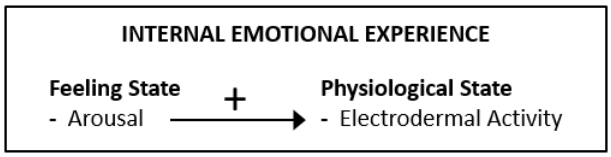
3.3.2. Physiological State

Physiological state markers are biological responses that typically occur in the presence of fear-causing threats, including defensive responses (e.g., muscle freezing), autonomic nervous system responses (e.g., changes in blood pressure and heart rate), and neuroendocrine responses (e.g., release of hormones from the pituitary and adrenal glands) (Goleman 1995). These physiological states are involuntary "innate, species-typical responses… expressed automatically in the presence of (threatening) stimuli" (LeDoux 2003, p. 728). While these physiological states can be measured, they are not necessarily apparent to others. Thus, like feeling state, physiological state is experienced internally.

Just as delayed emotional registration influences feeling state in internal emotional experience via appraisal and reappraisal, delayed emotional registration can also influence an individual's physiological state. When an individual initially registers a threat, the amygdala sends signals to the hypothalamus, midbrain, and brainstem areas, which select and activate autonomic programs into a fight-or-flight response (Misslin 2003). Prior findings suggest that the different elements of an individual's affective physiological response can be classified in terms of valence and arousal. For example, valence ratings tend to be related to heart rate, in that unpleasant stimuli produce more initial heart rate deceleration while pleasant stimuli produce greater peak acceleration (Bradley and Lang 2000). At the same time, factors such as posture, respiratory anomalies, and individual physical differences obscure the correlation between perceived valence and heart rate (Bradley and Lang 2000). In contrast, electrodermal activity (i.e., skin conductance) tends to vary with perceived arousal, such that electrodermal activity is higher when viewing either pleasant or unpleasant stimuli (Bradley and Lang 2000). However, previous research suggests that this relationship is more prevalent in males, as 46% of males showed a significant correlation versus 16% of females (Lang et al. 1993). Thus, within an individual's internal emotional experience, the dimensions of feeling state are related to elements of physiological state (e.g., initial heart rate deceleration should increase as an individual's perceived valence decreases and electrodermal activity should increase as perceived arousal increases), but those relationships can be obscured by individual differences. Therefore, we will empirically explore the potential for a positive relationship

between electrodermal activity and perceived arousal shown in Figure 3.3 below, although we refrain from making any formal hypotheses.

Figure 3.3. Feeling state arousal and electrodermal activity



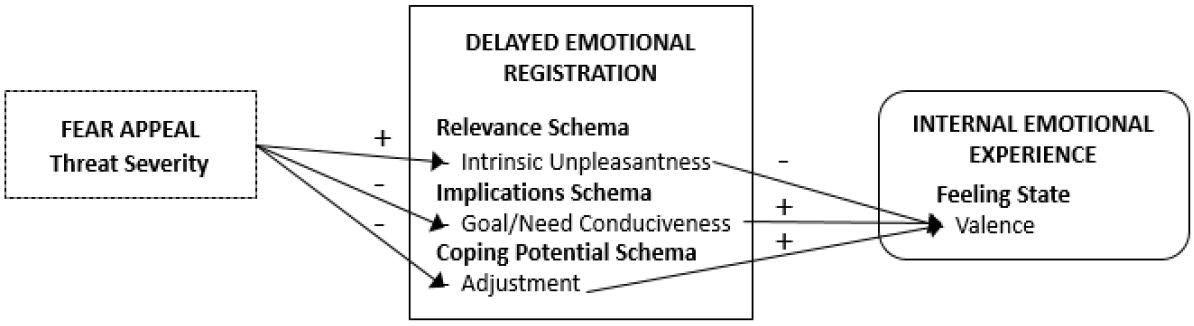
3.3.3. Hypotheses – Effects of Threat Severity on Feeling State

The relevance, implications, and coping potential schema checks in delayed emotional registration should influence an individual's feeling state as the individual evaluates the threat severity content of a fear appeal. A fear appeal's threat severity should increase intrinsic unpleasantness based on the relevance schema check of delayed emotional registration. The intrinsic unpleasantness sub-check evaluates the degree to which a stimulus is in itself unpleasant for an individual. As threat severity in a fear appeal increases, the danger described worsens, resulting in the fear appeal itself becoming increasingly unpleasant. In short, as threat severity increases, the intrinsic unpleasantness of the fear appeal increases. Additionally, as described above, the valence dimension of feeling state differentiates positive from negative feeling states. An intrinsically unpleasant stimulus itself has negative valence, so an increase in intrinsic unpleasantness should decrease the valence dimension (resulting in a larger negative valence) of feeling state in internal emotional experience. For example, a fear appeal with high threat severity would be associated with high intrinsic unpleasantness, which would lead to a more negatively valenced feeling state (such as fear, as opposed, for example, to surprise).

The implications schema also influences an individual's perceived valence. The goal or need conduciveness sub-check evaluates the degree to which the consequences of a fear appeal's threat are negative for the individual, with greater negative consequences leading to perceptions of increasingly negative valence. Therefore, because threat severity implies greater negative consequences it should also decrease perceived valence.

Threat severity in a fear appeal can also influence the coping potential schema by conveying the magnitude of the negative consequences associated with a threat. As threat severity increases, the more difficult it will be for an individual to adjust to the threat if it occurs, thereby decreasing coping potential via the adjustment sub-check, which evaluates the anticipated effort involved in coping with a threat should the threat actually occur. An increase in this anticipated effort should decrease valence, based on the individual's perceived difficulty in living with the threat's negative consequences. Thus, due to effects of fear appeal severity on evaluations of intrinsic unpleasantness, goal/need conduciveness, and adjustment (see Figure 3.4), we offer the following hypothesis.

FIGURE 3.4. Hypothesis 1_a

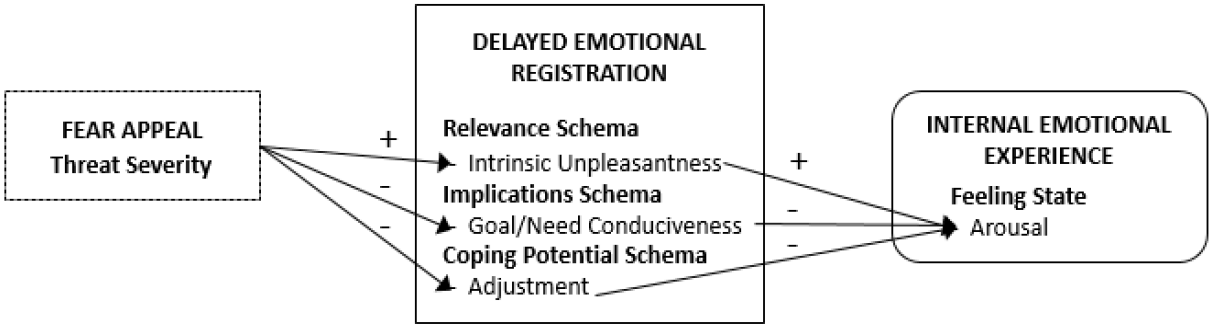


***H1$_a$*. Threat severity in a fear appeal will decrease the valence dimension of feeling state in internal emotional experience.**

Similarly, threat severity should influence perceived arousal through the relevance, implications, and coping potential schema checks of delayed emotional registration (see Figure 3.5). Threat severity conveys the negative consequences associated with a threat, such as the financial cost associated with identity theft. As explained above, threat severity increases relevance based on the intrinsic unpleasantness schema sub-check. Therefore, an increase in relevance due to intrinsic unpleasantness should increase perceived arousal, based on its effects on an individual's well-being. Likewise, threat severity influences implications based on the goal or need conduciveness sub-check. As threat severity increases, goal or need conduciveness should decrease (i.e., negative implications). As explained above, arousal describes the magnitude of a feeling state, which, for example, differentiates anger from the more intense rage. Ceteris paribus, as the consequences are perceived to be worse, arousal should increase.

Threat severity also decreases coping potential based on the adjustment sub-check, which evaluates the anticipated effort involved in coping with a threat if the threat should occur. An increase in anticipated effort should increase arousal, based on the individual's perceived difficulty in living with the threat's consequences. Because threat severity decreases adjustment (i.e., increases the anticipated effort should the threat occur), threat severity should increase perceived arousal based on the coping potential schema. This leads to the following hypothesis.

FIGURE 3.5. Hypothesis 2_a



***$H2_a$*. Threat severity in a fear appeal will increase the arousal dimension of feeling state in internal emotional experience.**

Threat severity should also influence perceived fear through the coping potential schema check of delayed emotional registration (see Figure 3.6). Threat severity decreases coping potential via the adjustment sub-check. As coping potential decreases, an individual anticipates that the amount of effort required to cope with the threat's consequences increases. As explained above, fear can be characterized in terms of the amount of anticipated effort involved in coping with a threat, in addition to several other underlying dimensions (e.g., valence) (Smith and Ellsworth 1985). That is, as the amount of anticipated effort increases, fear should likewise increase. Thus, as coping potential (resulting from the adjustment sub-check) decreases, fear should increase. The relationships between threat severity and the adjustment sub-check of the coping potential schema in delayed emotional registration and the fear dimension of feeling state suggest the following hypothesis:

FIGURE 3.6. Hypothesis 3_a

***H3$_a$*. Threat severity in a fear appeal will increase the fear dimension of feeling state in internal emotional experience.**

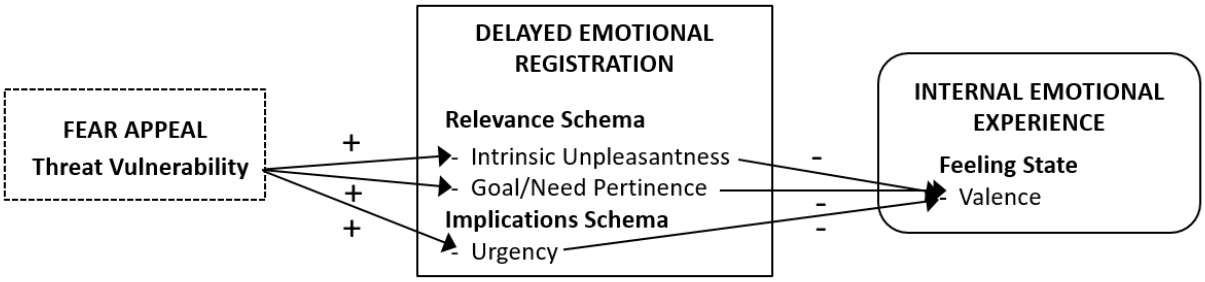
3.3.4. Hypotheses – Effects of Threat Vulnerability on Feeling State

Like the relationship between threat severity and the dimensions of feeling state in internal emotional experience, a fear appeal's threat vulnerability should also decrease perceived valence and increase perceived arousal and fear, based on evaluations of relevance and implications in delayed emotional registration (see Figure 3.7).

As threat vulnerability in a fear appeal increases, the conveyed likelihood of danger or harm increases, and the fear appeal becomes more unpleasant. This increase in intrinsic unpleasantness increases relevance in delayed emotional registration. As threat vulnerability increases, the goal or need pertinence of the fear appeal also decreases, because the fear appeal conveys an increased likelihood of the occurrence of danger or harm for the individual. That is, as the threat's conveyed likelihood increases, individuals should evaluate the threat as increasingly important and relevant. Likewise, as threat vulnerability increases, the urgency (the extent to which an event requires a quick response) associated with the threat for the targeted individual should increase because individuals should feel more compelled to respond quickly to the threat based on the subjective likelihood of the threat's implications. Increases in a fear appeal's threat vulnerability can thus decrease an individual's perceived valence, and increase perceived arousal and fear, based on the increased intrinsic unpleasantness, goal or need pertinence, and urgency in the relevance and implications schema checks in delayed emotional registration.

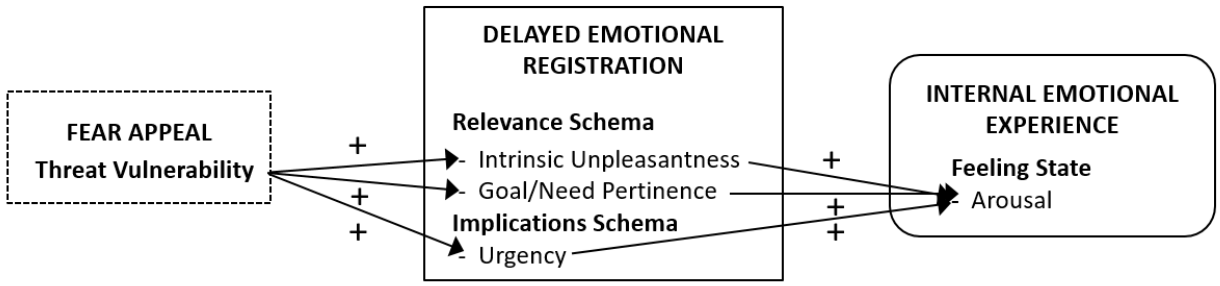
FIGURE 3.7(a-c). Hypothesis 1_b, 2_b, and 3_b

(a)



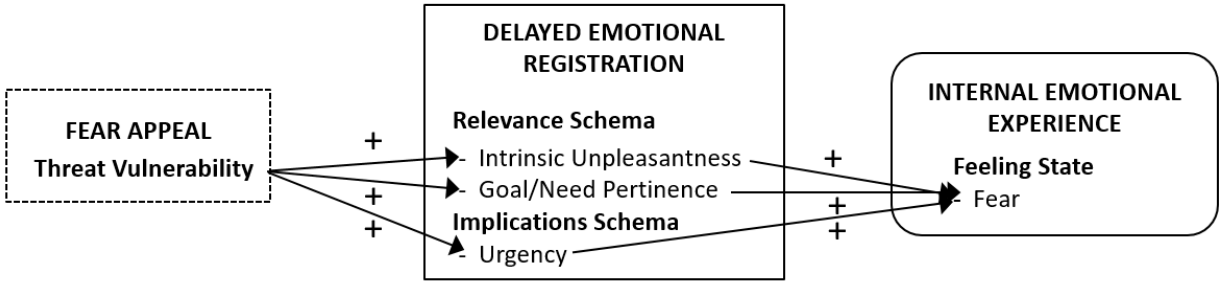
***$H1_b$*. Threat vulnerability in a fear appeal will decrease the valence dimension of feeling state in internal emotional experience.**

(b)



***$H2_b$*. Threat vulnerability in a fear appeal will increase the arousal dimension of feeling state in internal emotional experience.**

(c)



***$H3_b$*. Threat vulnerability in a fear appeal will increase the fear dimension of feeling state in internal emotional experience.**

3.4. Fear Appeal Images

Although fear appeals conventionally have the four text-based rhetorical components described previously, images in a fear appeal also have the potential to elicit fear and influence information security

behavior. Investigating the role of images in fear appeals is important due to an image's capabilities of quickly capturing attention and providing affective cues that help to anchor an individual's emotional response. For example, the minimum viewing time needed for visual comprehension of an image is 13 milliseconds (Potter et al 2014), whereas the minimum time needed to integrate the different processes that lead to visual word recognition is 200 milliseconds (Hauk et al 2006). Thus, individuals can comprehend an image much faster than they can comprehend text. Prior research on attention has also established the pictorial superiority effect, which is the intrinsic tendency of images to capture substantially more attention than text (Pieters and Wedel 2004). Using images in a fear appeal can thus, for example, address security warning disregard (Vance et al. 2014), by quickly capturing attention, conveying a threat, and anchoring emotional responses.

Vividness refers to the extent to which information is "emotionally interesting, concrete and imagery-provoking, and proximate in a sensory, temporal, or spatial way" (Nisbett and Ross 1980, p. 45). Images consist of depicted information, so vividness is an appropriate way to analyze the persuasiveness of images. However, because vividness is a characteristic of information regardless of the information's medium (Taylor and Thompson 1982), we use the term "pictorial vividness" to clarify the scope of this construct in the EPM.

Emotional interest is partially based on the "hedonic relevance of the (depicted) event" to an individual (Nisbett and Ross 1980, p. 45-46), and increases with the degree to which the image is more pleasant (positive) or more unpleasant (negative); thus information about highly negative (or positive) events is more emotionally interesting than information about events that are perceived to be more neutral (Sherer and Rogers 1984). In addition, emotional interest is determined by the degree of an individuals' psychological distance from the image. Psychological distance is based on the different ways in which an object might be removed from the self in the here and now, such as in time, space, and social distance (Trope and Liberman 2010). Information about people or things that are close to an individual (having low psychological distance) are more emotionally interesting than information about people or things that are further removed from the individual (having high psychological distance). Thus, a fear appeal's

illustration of danger *to the individual* can increase an individual's perception of the image's emotional interest due to decreased psychological distance.

For example, Figure 3.2 contains an illustration of a computer-based attack that attempts to gain access to an individual's personal and financial information. The emotional interest of this image will increase with the increased value that an individual places on his or her personal and financial information (increasing the negativity of such an attack), and with the degree of the individual's connection to the target of the attack. Since there are no other individuals in the picture, the degree of connection will be high when the individual presumes he or she is the target.

The concreteness aspect of pictorial vividness refers to the "degree of detail and specificity about actors, actions, and situational context" (Nisbett and Ross 1980, p. 47). Figure 3.2's photorealistic details of the gloved hand breaking through a laptop screen and reaching for a wallet increase the image's concreteness. Finally, the proximity aspect of pictorial vividness refers to the temporal and spatial distance of an image from an individual. Images viewed recently and nearby have greater vividness than images viewed long ago from far away. For example, the image in Figure 3.2 will be more vivid to an individual immediately after it appears.

3.5. Immediate Emotional Registration

According to our conceptualization of fear, exposure to a fear appeal stimulus initiates immediate and delayed emotional registration, which intervene between a stimulus and an individual's internal emotional experience. The immediate emotional registration process involves the thalamus receiving the visual information in a fear appeal and transmitting it across a single synapse to the amygdala (Goleman 1995), which is involved in emotions, emotional behavior, and motivation. This process is represented by the thalamo-amygdala path in Figure 3.1.

With immediate emotional registration taking place exclusively within the amygdala, the associated processing is relatively limited. This is because the thalamo-amygdala path bypasses the sensory neocortex, which is involved with more complete processing of sensory information. As a result, immediate emotional registration uses broad heuristics associated with emotional triggers. As described above, delayed emotional

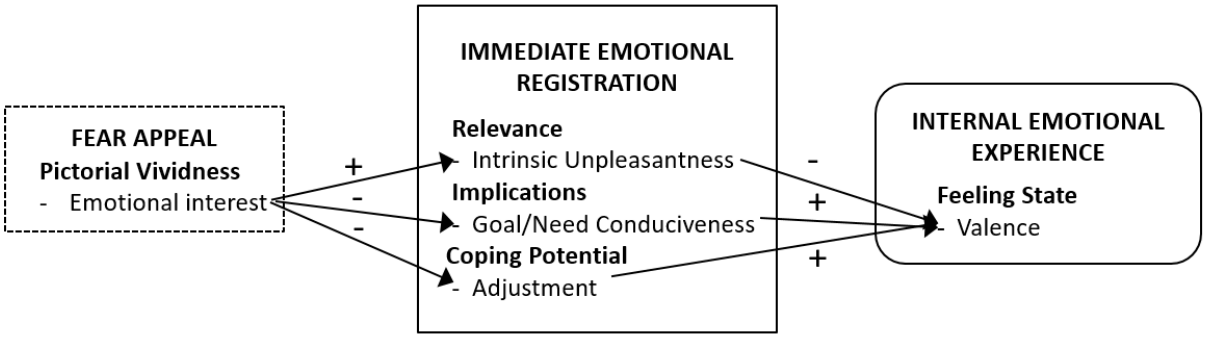
registration involves more in-depth emotional processing via the sensory neocortex and the hippocampus. Because the immediate emotional registration process is relatively quick, individuals' emotional responses can begin in the amygdala before they recognize what they are reacting to or what they are feeling (LeDoux 1998). These dual neural pathways of emotional information explain why an individual's initial reaction to an emotional stimulus might differ from his or her eventual response.

3.5.1. Hypotheses – The Effects of Emotional Interest on Feeling State

As explained above, pictorial vividness increases based on a fear appeal image's emotional interest, concreteness, and proximity. These components of pictorial vividness can influence the implications and coping potential checks by serving as links to an individual's prior experiences with similar threats, and thus yielding goal or need conduciveness and adjustment evaluations from those prior experiences (as opposed to performing new evaluations). That is, a fear appeal's pictorial vividness can build upon an individual's previous emotional experiences, such that the fear appeal's illustration of danger triggers an emotional response based on the individual's previously established implications and coping potential evaluations associated with the danger. The connection to prior experiences with similar threats thus serves as a shortcut for an individual's internal emotional experience, because the resulting feeling state is based upon those prior experiences, as opposed to new sub-check evaluations. For example, a fear appeal image of an attacker reaching for a wallet can connect the fear appeal with other real or imagined theft incidents, which would have established evaluations of high intrinsic unpleasantness, low (i.e., highly negative) goal or need conduciveness and low adjustment. The high relevance, negative implications and low coping potential associated with the fear appeal image should decrease perceived valence and increase perceived arousal and fear in internal emotional experience (see Figure 3.8).

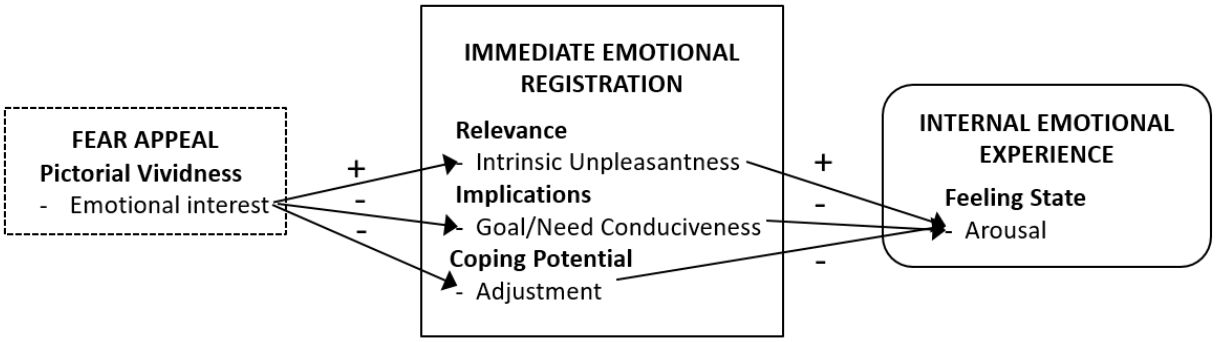
FIGURE 3.8(a-c). Hypothesis 1_c, 2_c, and 3_c

(a)



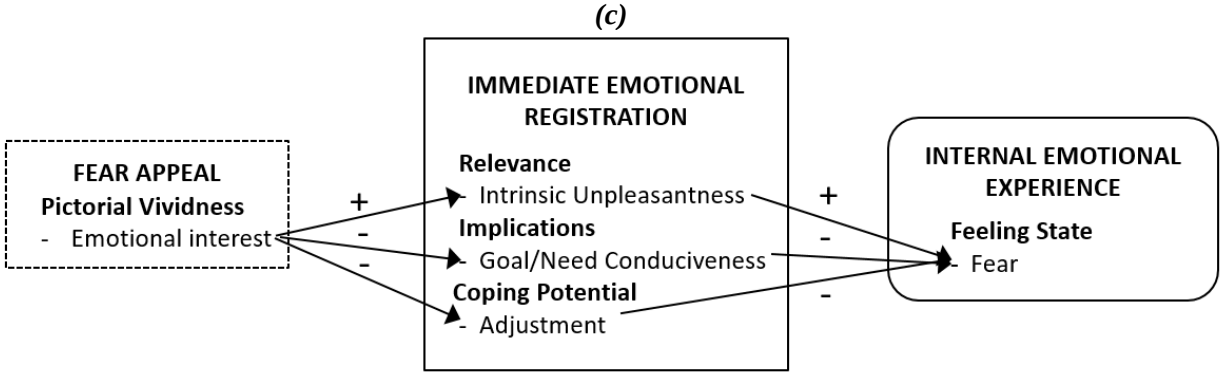
***$H1_c$*. The emotional interest component of pictorial vividness in a fear appeal will decrease the valence dimension of feeling state in internal emotional experience.**

(b)



***$H2_c$*. The emotional interest component of pictorial vividness in a fear appeal will increase the arousal dimension of feeling state in internal emotional experience.**

(c)



***$H3_c$*. The emotional interest component of pictorial vividness in a fear appeal will increase the fear dimension of feeling state in internal emotional experience.**

3.5.2. Initial Appraisal and Reappraisal

Fear appeal images anchor an individual's internal emotional experience by providing an initial appraisal via the relatively quick thalamo-amygdala path, which is a subcortical process for rapid threat detection (LeDoux 1998). Delayed emotional registration then adjusts the initial appraisal (i.e., provides reappraisal) by incorporating cortical processing via the cortico-amygdala path. For instance, when individuals first encounter the fear appeal in Figure 3.2, they might initially feel some fear, as they connect the image to their previously established experiences with theft. When individuals then register the text-based components of the fear appeal (through delayed emotional registration), their feeling states may be adjusted (e.g., decreasing valence, increasing arousal, and increasing fear) as the result of the high threat severity and high vulnerability conveyed by the fear appeal text.

3.6. External Emotional Expression

External emotional expression is the process in which internal emotional experience yields expressive cues that are perceptible to others, which can include visible emotional displays (such as a fearful countenance) and/or audible emotional expressions (such as a gasp or scream). Expressive cues result from feeling and physiological states within internal emotional experience and are moderated by biologically determined affect programs and cultural and individual expressive styles (Elfenbein 2007). Biologically determined affect programs represent the core of expression that is universal and biologically programmed, such as smiling when happy or frowning when upset (Elfenbein 2007). Expressive styles refer to emotional expression that varies across isolated groups, such as rate of speech or body language.

Expressive cues can be important in that they can serve as checks in experimental studies to evaluate fear appeal manipulations as well as providing measures in addition to individuals' perceptions that can be used to evaluate the validity of the feeling state dimensions. For example, the neural circuitry of fear initiates physiological responses, such as increased muscle tension, in the internal emotional experience of fear that can culminate in external emotional expression, such as shaking limbs (Goleman 1995). The extent to which emotional expression is spontaneous versus deliberate is heavily debated (Elfenbein 2007), but a large body of

research indicates that expressions tend to be spontaneous and reflective of internally experienced emotion except when managed with conscious effort (Ekman 1984).

3.6.1. Facial Expressions and Emotion

Ekman's facial action coding system (FACS) serves as a common standard for systematically categorizing the physical expression of emotions, based on observable components of facial movement called action units. The intensity of those facial movements ranges from trace to maximum. Specific combinations of facial movements manifest as microexpressions, which can indicate discrete emotions (Ekman 1984). For example, a microexpression that indicates fear generally involves raised eyebrows and eyelids and a dropped jaw (Ekman and Friesen 1978). In prior studies, facial expressions have consistent correlations with self-reported emotion (Ekman and Rosenberg 2005) and emotion-related physiology (Cohn and Kanade 2007). That is, perceived valence, arousal, and fear within feeling state in internal emotional experience are related to an individual's expressive cues. For example, as the internal emotional experience of fear increases in terms of decreasing valence (i.e. larger negative valence) and increasing arousal, an individual's facial expression may include wide eyes and raised eyebrows.

However, individuals can manage and modify their expressions based on display rules (Elfenbein 2007). Meta-analytical findings suggest that factors such as geographic, national, and social boundaries shape emotional dialects similar to linguistic dialects, nuancing the manner in which emotions are expressed and understood (Elfenbein and Ambady 2002). For example, social norms for some cultural groups inhibit emotional expression when understanding may disrupt social harmony (Elfenbein and Ambady 2003). As a result, for example, expressive cues related to anger tend to be subtler in Japan than in the United States. For instance, when Japanese participants in a previous study viewed stressful films alone, they displayed expressions of disgust, anger, fear and sadness, whereas they smiled (concealing their negative feelings) when viewing stressful films with an experimenter present (Ekman 1973). At the same time, Americans viewing stressful films displayed the same negative expressions regardless of whether an experimenter was present (Ekman 1973). Display rules are contingent upon social circumstance (Fridlund 1997), so an

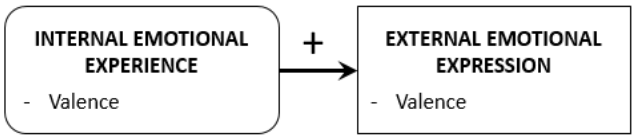
individual's expressive cues upon exposure to a fear appeal are influenced by both internal emotional experience and the circumstances in which the fear appeal is viewed.

3.6.2. Hypotheses – Feeling State and External Emotional Expression

Internal emotional experience should be consistent with an individual's external emotional expression within the bounds created by the individual's pertinent display rules. Based on the established relationship between self-reported emotion and facial expression (Ekman and Rosenberg 2005), each dimension of feeling state in internal emotional experience should be positively correlated with the corresponding element of external emotional expression. That is, an individual's facial expressions should be consistent with his or her feeling state in response to an emotional stimulus (see Figure 3.9).

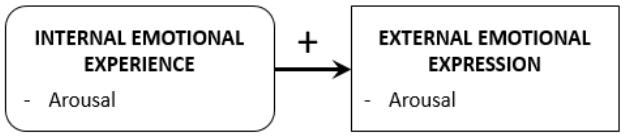
FIGURE 3.9(a-c). Hypothesis 4_a, 4_b, and 4_c

(a)



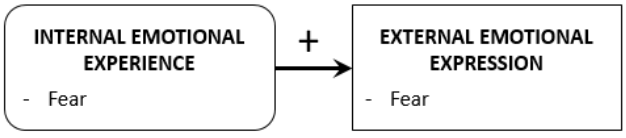
***$H4_a$*. The valence dimension of feeling state in internal emotional experience will be positively correlated with the valence dimension of external emotional expression.**

(b)



***$H4_b$*. The arousal dimension of feeling state in internal emotional experience will be positively correlated with the arousal dimension of external emotional expression.**

(c)



***$H4_c$*. The fear dimension of feeling state in internal emotional experience will be positively correlated with the fear dimension of external emotional expression.**

3.7. Summary

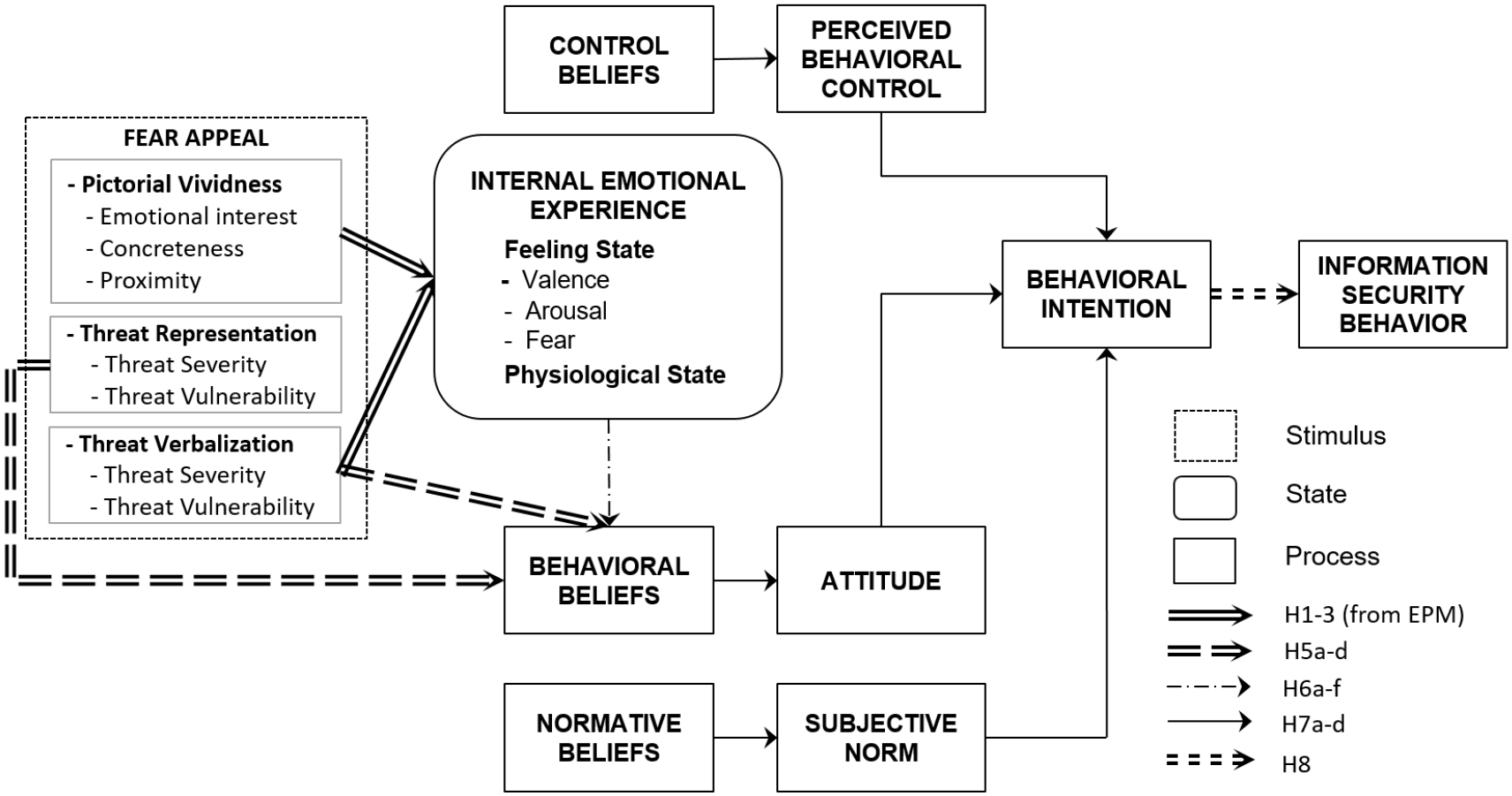
This chapter has described our conceptualization of the emotional processes that explain how individuals experience fear resulting from threats in information security fear appeals. The emotion process model (EPM: Figure 3.1) extends existing fear appeal theories by explaining how threat severity and threat vulnerability in a fear appeal can influence an individual's feeling state based a series of schema evaluations that evaluate the relevance, implications, and coping potential associated with the fear appeal's threat. We integrate multiple theoretical perspectives to demonstrate how a fear appeal initiates immediate and delayed emotional registration, which anchors and adjusts (respectively) an individual's internal emotional experience. We additionally emphasize the importance of fear appeal images by incorporating pictorial vividness as a new fear appeal component that draws attention and influences internal emotional experience via an image's emotional interest, concreteness, and proximity. This chapter also explains how internal emotional experience involves both perceptual and physiological dimensions, in terms of an individual's feeling state and physiological state, and describes how those dimensions relate to an individual's external emotional expression in terms of an individual's facial movements.

Chapter 4

BEHAVIOR PROCESS MODEL AND HYPOTHESES

The behavior process model for fear appeal threats (BPM) combines the results determined within internal emotional experience in our emotion process model with cognitive processes to determine the information security-oriented behaviors that result from a fear appeal. As described earlier, this model extends Ajzen's (1991) theory of planned behavior, which is well suited to this study because it is one of the most influential models for predicting human behavior, it has considerable empirical support, and it has the ability to include emotions as factors that influence beliefs (Ajzen 2011). As described in the Chapter 2 review of fear appeal literature, the extended parallel process model's conceptualization of fear appeal components as antecedents of perceived threat and perceived efficacy can be incorporated into Ajzen's theory to provide a better understanding of the role of cognition in fear appeals. In addition, Elfenbein's (2007) framework includes post-emotional responses (i.e., cognitions, action tendencies, attitudes, and behavior) that fit well within Ajzen's theory. The BPM (see Figure 4.1) therefore includes constructs from the theory of planned behavior, as well as the fear appeal and the internal emotional experience construct from the EPM. The information security behavior construct represents Ajzen's behavior construct, but the term "information security" is added to emphasize the model's scope within the information security domain.

FIGURE 4.1. Behavior Process Model for Fear Appeal Threats



4.1. Behavioral Beliefs

A belief is the "subjective probability of a relation between the object of the belief and some other object, value, concept, or attribute" (Fishbein and Ajzen 1975, p. 131). For example, an individual may believe that a behavior (the object of the belief) is difficult (an attribute). Belief formation occurs as a result of direct experience, inference from some other belief(s), and/or exposure to information (Fishbein and Ajzen 1975).

As a form of persuasive communication, a fear appeal represents a potential source of information designed to influence beliefs. Based on this view of belief formation, a fear appeal is a set of statements in which each describes an element's (e.g., a threat's) causal link to another element (e.g., the threat's severity or vulnerability). For example, the fear appeal in Figure 3.2 contains several belief statements, such as "weak passwords make your information vulnerable to attack". This statement describes the causal link between weak passwords and threat vulnerability. Upon exposure to a fear appeal, an individual forms "proximal beliefs" that correspond to subjective probabilities for each statement in the fear appeal (Fishbein and Ajzen 1975). For example, in Figure 3.2, an individual's proximal belief associated with the statement "weak passwords make your information vulnerable to attack" increases the likelihood that the individual will believe that using weak passwords increases his or her vulnerability to attack. In accord with the theory of planned behavior (Ajzen 1991), the BPM conceptualizes beliefs in terms of behavioral beliefs, control beliefs, and normative beliefs. This chapter first explains behavioral belief and its influence on behavioral intention, followed by similar explanations related to control belief and normative belief.

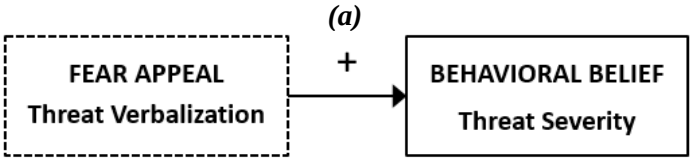
Fear appeals are designed to persuade individuals to adopt a recommended behavior by describing the negative consequences that can occur when the recommended behavior is not performed (Witte 1998). A behavioral belief represents an individual's subjective probability that a behavior will produce a particular outcome (Ajzen 1991). Threat severity belief represents the subjective probability that an outcome will be severe (e.g., identity theft), while threat vulnerability belief represents the subjective probability that an individual currently engages in, or will engage in, the behavior (e.g., using

weak passwords) that can lead to that outcome. Threat severity and threat vulnerability thus represent different behavioral beliefs. Fear appeals can affect an individual's behavioral beliefs both directly, through cognitive evaluation, and indirectly, via emotional appraisal.

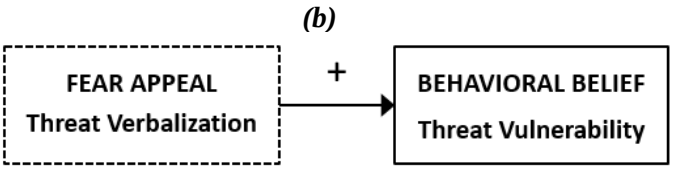
4.1.1. Hypotheses – Threat Verbalization, Threat Representation, and Behavioral Belief

As a fear appeal has increasing threat severity, it conveys the threat's potential to result in increasingly negative outcomes. Likewise, as a fear appeal has increasing threat vulnerability, it conveys an increased likelihood of the threat's occurrence. Each individual evaluates these likelihoods based on prior experience, culture, and personality characteristics, so the same fear appeal may produce different behavioral beliefs for different individuals (Witte 1992). Nevertheless, a meta-analysis of fear appeal studies has found that fear appeals' text-based threat severity and vulnerability significantly increase individuals' beliefs regarding threat severity and vulnerability (Witte and Allen 2000). Although this meta-analysis does not include studies involving information security fear appeals, we expect that the relationships between text-based fear appeal components and associated beliefs will be similar in this context. Because threat verbalization represents a fear appeal's textual description of threat severity and threat vulnerability, an increase in threat verbalization should thus increase an individual's severity belief, as well as an individual's vulnerability belief (see Figure 4.2).

FIGURE 4.2(a-b). Hypotheses 5_a and 5_b



***$H5_a$*. Threat verbalization in a fear appeal will increase an individual's threat severity belief.**



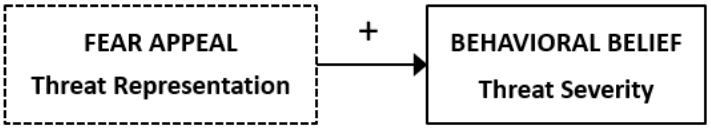
***$H5_b$*. Threat verbalization in a fear appeal will increase an individual's threat vulnerability belief.**

A fear appeal image can also influence an individual's behavioral beliefs. Fear appeal images are rich sources of information, and an individual's exposure to a fear appeal image is a sensory event. Cortical processing allows neural responses to reflect the significance (as opposed to the surface properties) of sensory events and to initiate cognitive and behavioral outcomes (Mesulam 1998). Thus, an individual's cognitions about a fear appeal image can serve as a basis for his or her behavioral beliefs. Threat representation represents the degree to which a fear appeal image conveys the danger associated with a threat. Threat representation differs conceptually from pictorial vividness, described earlier, in that pictorial vividness involves the elements of a fear appeal image that are related to an individual's emotional response (e.g., emotional interest), whereas threat representation involves elements of a fear appeal image that are related to an individual's rational response. That is, a fear appeal image can provide information about a threat in addition to potentially influencing an individual's internal emotional experience. Threat representation in a fear appeal can convey the magnitude (severity) and likelihood (vulnerability) of the fear appeal's threat through illustrations of the threat's negative consequences and targets, respectively. Thus, in a manner similar to threat verbalization, threat representation can influence behavioral beliefs associated with threat severity and threat vulnerability.

For example, Figure 3.2 contains an illustration of a computer-based attack that attempts to gain access to an individual's personal and financial information. Threat severity associated with this image will increase with the increased value that an individual places on his or her personal and financial information (increasing the negative consequences of such an attack). By illustrating the severity associated with a threat, threat representation in a fear appeal can thus increase an individual's severity belief (see Figure 4.3). Similarly, threat vulnerability associated with this image will increase with the degree that the individual feels that he or she is the target of the attack. Since there are no other individuals in the picture, his or her vulnerability will tend to be high because it appears that the target is the individual him-or-herself. By illustrating the vulnerability associated with a threat, threat representation in a fear appeal can thus increase an individual's vulnerability belief (see Figure 4.3).

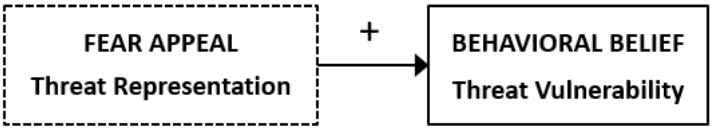
FIGURE 4.3(a-b). Hypotheses 5_c and 5_d

(a)



***$H5_c$*. Threat representation in a fear appeal will increase an individual's threat severity belief.**

(b)



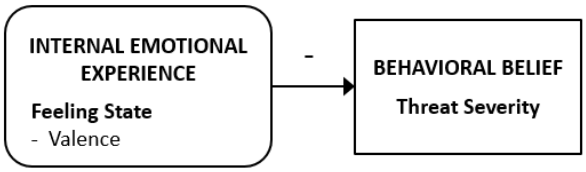
***$H5_d$*. Threat representation in a fear appeal will increase an individual's threat vulnerability belief.**

4.1.2. Hypotheses – Feeling State and Behavioral Belief

An individual's internal emotional experience upon exposure to a fear appeal provides an indirect path that can influence behavioral beliefs. According to Ajzen (2011), emotions can influence the beliefs that are salient in a given situation and the strength and "evaluative connotations" of those beliefs (p. 1116). Although people can hold many beliefs relevant to a given behavior, they can only attend to a small number at any given moment (Miller 1956). These salient beliefs represent the "prevailing determinants of a person's intentions and actions" (Ajzen 1991, p. 189). Individuals tend to focus on mood-congruent beliefs, such as when in a positive mood evaluating the consequences of a behavior more favorably and judging favorable events as more likely to occur (Forgas et al. 1984). For example, individuals in a negative mood were more likely to report unfavorable beliefs about smoking compared to individuals in a positive mood (McKee et al. 2003). Feeling state valence should have a similar effect on severity and vulnerability beliefs. That is, a negatively valenced feeling state should predispose individuals to believe that a threat (which is a negative event) is more serious and more likely to occur (see Figure 4.4).

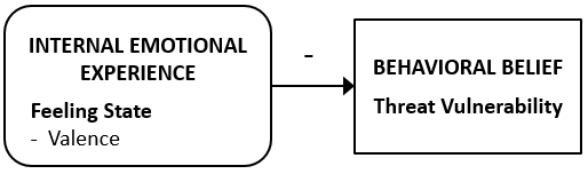
FIGURE 4.4(a-b). Hypotheses 6_a and 6_b

(a)



***$H6_a$*. Decreased valence in internal emotional experience will increase an individual's threat severity belief.**

(b)

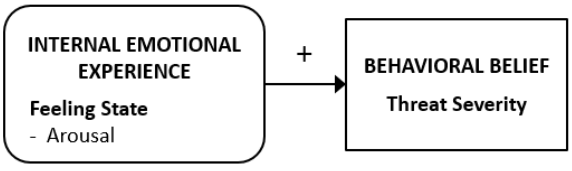


***$H6_b$*. Decreased valence in internal emotional experience will increase an individual's threat vulnerability belief.**

Arousal and fear can also influence threat severity and threat vulnerability beliefs, because they represent information about the individual's reaction to the fear appeal's threat. This internal emotional experience acts as a heuristic (Frijda 1986), such that increased arousal and fear inform the individual that a fear appeal's threat is serious enough and likely enough to matter to the individual. As explained above, individuals tend to focus on mood-congruent beliefs (Forgas et al. 1984), and emotions can influence the strength and salience of beliefs (Ajzen 2011). Thus, increasing arousal and fear can lead individuals to believe that threats are more serious and more likely to occur (see Figure 4.4).

FIGURE 4.4(c). Hypotheses 6_c

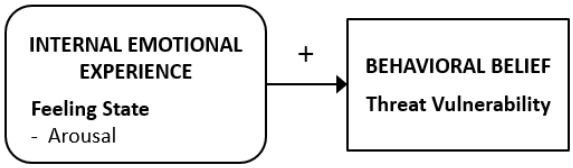
(c)



***$H6_c$*. Arousal in internal emotional experience will increase threat severity belief.**

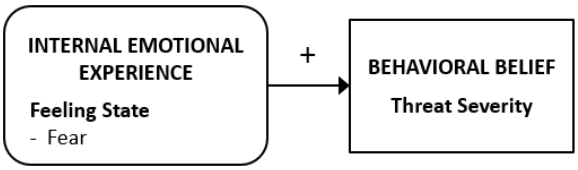
FIGURE 4.4(d-f). Hypotheses 6_d-6_f

(d)



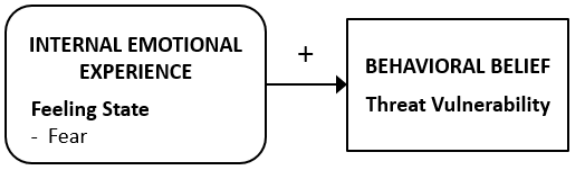
$H6_d$. **Arousal in internal emotional experience will increase threat vulnerability belief.**

(e)



$H6_e$. **Fear in internal emotional experience will increase threat severity belief.**

(f)



$H6_f$. **Fear in internal emotional experience will increase threat vulnerability belief.**

4.2. Attitude

An individual's intention to perform a behavior can have three determinants, according to the theory of planned behavior: attitude toward the behavior, subjective norm, and perceived behavioral control. Although the relative importance and weights of these determinants tend to vary (Ajzen 2005), an information security fear appeal can influence all three. This section discusses attitude and its influence on behavioral intention, along with the influence of behavioral beliefs on behavioral intention via attitude, followed by similar discussions related to subjective norm and perceived behavioral control.

Attitude refers to an individual's positive or negative evaluation of the consequences of performing a behavior (Ajzen 1991). An individual's evaluation of any object follows reasonably from his or her beliefs about the object (Ajzen 2005), such that an individual's attitude regarding the threat in a

fear appeal emerges from behavioral beliefs (e.g., regarding threat severity and threat vulnerability). As explained above, fear appeals can influence these beliefs by conveying information about a threat.

4.2.1. Behavioral Beliefs and Attitude

The positive relationship between behavioral beliefs and attitude in the theory of planned behavior (Ajzen 1991) indicates that behavioral beliefs should mediate the relationship between fear appeal components and attitude toward the recommended response. A behavioral belief is based on a causal link between the object of the belief and another element, such as an attribute, object, or event (Fishbein and Ajzen 1975), where the element linked to the object has a positive or negative value for an individual. This subjective value contributes to an individual's attitude in direct proportion to the strength of the individual's behavioral belief (Ajzen 2005). For example, an individual's attitude regarding the threat in a fear appeal is based on the strength and subjective evaluation of his or her severity belief and vulnerability belief. When threat severity and threat vulnerability beliefs are strong (high severity and vulnerability), the individual's attitude toward the threat will be unfavorable, based on the undesirable elements associated with the threat. This relationship is consistent with the extended parallel process model (Witte 1992), which conceptualizes attitude in terms of message acceptance (which is a positive attitude toward the recommended response) and message rejection (which is a negative attitude toward the recommended response). A meta-analysis of fear appeals research has shown that manipulating threat severity and threat vulnerability in fear appeals results in greater positive attitude toward the recommended response (Witte and Allen 2000). That is, as threat severity and threat vulnerability increase in a fear appeal, individuals increasingly evaluate the fear appeal's recommended response as positive.

Attitude also influences behavioral intention, according to the theory of planned behavior (Ajzen 1991). Generally, intentions are "evaluatively consistent with attitudes that derive reasonably from accessible beliefs about the behavior" (Ajzen 2005, p. 30). That is, individuals generally intend to perform a behavior if they hold favorable attitudes about it, where attitudes are based on individuals' salient beliefs about the behavior. Thus, as an individual's attitude about a behavior becomes more

favorable (i.e., increases), the individual's intention to perform the associated behavior also increases. At the same time, as an individual's attitude becomes more unfavorable (i.e., decreases), the individual's intention to perform the associated behavior decreases. Therefore, for problematic behaviors associated with a fear appeal's threat (such as using weak passwords), an unfavorable attitude should decrease an individual's intention to perform the problematic behavior and increase intention to perform appropriate behavior (such as using strong passwords). Attitudes tend to correlate well with behavioral intention for a wide range of behaviors. Across several meta-analyses, the mean correlation between attitude and intention ranges from 0.45 to 0.60 (Ajzen 2005).

4.2.2. Hypotheses – Behavioral Belief, Attitude, and Behavioral Intention

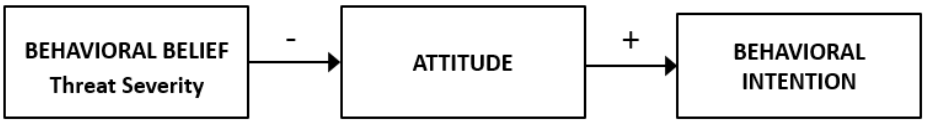
An individual's intention to perform a behavior depends on attitude, perceived behavioral control, and subjective norm, according to the theory of planned behavior (Ajzen 1991). Hypotheses 7_a and 7_b address threat severity and threat vulnerability, respectively, as specific behavioral beliefs, while hypotheses 7_c and 7_d focus on generalized control beliefs and normative beliefs. These hypotheses reflect our model's focus on the threats in a fear appeal.

As explained above, a behavioral belief represents the subjective probability that a behavior will produce a particular outcome (Ajzen 1991). An individual's behavioral beliefs can influence his or her attitude about a behavior. Beliefs regarding threat vulnerability represent the subjective probability that an individual's continued or future behavior (e.g., using weak passwords) will have a negative outcome, while beliefs regarding threat severity represent the subjective probability that the outcome will be increasingly bad (e.g., identity theft).

Also, as explained above, attitude refers to an individual's positive or negative evaluation of the consequences of performing a behavior (Ajzen 1991). As threat severity and threat vulnerability beliefs increase, an individual evaluates the outcomes of a problematic behavior as increasingly negative. This attitude subsequently increases an individual's intention to refrain from the problematic behavior, increasing the individual's information security behavioral intention (see Figure 4.5).

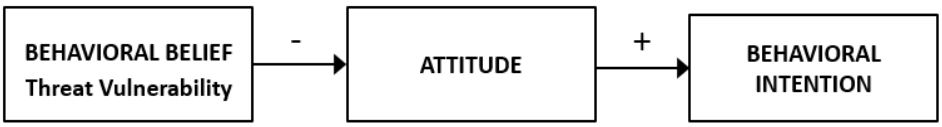
FIGURE 4.5(a-b). Hypotheses 7_a-7_b

(a)



***$H7_a$*. Increased threat severity belief will decrease attitude toward the problematic behavior and thereby increase information security behavioral intention.**

(b)



***$H7_b$*. Increased threat vulnerability belief will decrease attitude toward the problematic behavior and thereby increase information security behavioral intention.**

4.3. Control Beliefs and Perceived Behavioral Control

Control beliefs focus on the presence or absence of factors that facilitate or impede performance of a behavior. That is, a control belief represents the subjective probabilities that facilitating factors will be present and impeding factors will be absent when an individual performs the behavior. These factors may be internal (e.g., knowledge, skills, and abilities) or external (e.g., dependence on technology or others) to the individual. The perceived presence of facilitating factors and absence of impeding factors will increase an individual's perceived control over the associated behavior (Ajzen 1991). Thus, perceived behavioral control refers to an individual's perceived ease or difficulty of performing a behavior, based on all the individual's relevant control beliefs. This construct is based on Bandura's (1977) concept of perceived self-efficacy, which refers to the subjective probability that one is capable of performing a behavior.

Perceived self-efficacy also appears in protection motivation theory (Rogers 1983) and the extended parallel process model (Witte 1992) in terms of an individual's perceived ease of performing the response recommended in a fear appeal. Perceived behavioral control differs from the self-efficacy fear appeal component. That is, self-efficacy in a fear appeal represents the *conveyed* ease or difficulty of

performing a behavior, such as the ease of creating strong passwords, while perceived behavioral control represents an individual's *perceptions* regarding the ease of creating strong passwords. Prior meta-analyses indicate that as self-efficacy conveyed in a fear appeal increases, an individual's perceived behavioral control also increases (Ruiter et al. 2014; Witte and Allen 2000). For example, an individual's beliefs regarding his or her inability to remember passwords may increase the individual's perceived difficulty of creating a strong password (i.e., decrease perceived behavioral control). However, the self-efficacy component of a fear appeal can influence control beliefs by suggesting that an individual has the necessary resources and opportunities needed to perform the recommended response. For instance, the fear appeal example in Figure 3.2 argues that strong passwords are easy to create, and then provides an example of such a password; this can increase an individual's beliefs that he or she can create a strong password.

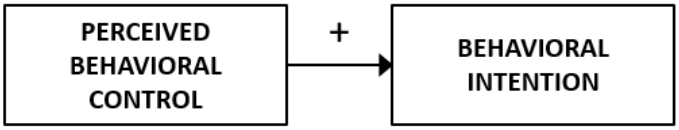
4.3.1. Perceived Behavioral Control and Behavioral Intention

Perceived behavioral control influences behavioral intention, according to the theory of planned behavior (Ajzen 1991). This theory suggests that individuals are more likely to intend to perform a behavior when they believe that they can successfully perform the behavior, based on the perceived probability that facilitating control factors are present (and/or that inhibiting control factors are absent). For example, when an individual strongly believes that it is easier to remember a weak password and harder to remember a strong password, this control belief motivates the use of weak passwords and inhibits the use of strong passwords. Consequently, this individual would not intend to use strong passwords, because of the expectation that he or she could not successfully perform that behavior.

4.3.2. Hypothesis – Perceived Behavioral Control and Behavioral Intention

As perceived behavioral control increases, an individual's intention to perform the associated behavior also increases. Prior studies indicate that perceived behavioral control is positively correlated with behavioral intention for a wide range of behaviors. Across several meta-analyses, the mean correlation between perceived behavioral control and behavioral intention ranges from 0.35 to 0.46 (Ajzen 2005). Taken together, this suggests the following hypothesis (see Figure 4.6).

FIGURE 4.6. Hypothesis 7_c



***H7*$_c$. Perceived behavioral control will increase information security behavioral intention.**

4.4. Normative Beliefs and Subjective Norm

Normative beliefs include an individual's behavioral expectations of referent people or groups who are important to the individual. These beliefs focus on the likelihoods that such referents approve or disapprove of the individual performing a behavior (Ajzen 1991). Organizations can influence normative beliefs by making individuals aware of behavioral expectations through fear appeals. For instance, when the fear appeal in Figure 3.2 is attributed to a particular organization, exposure to the fear appeal should promote the belief that an individual's password strength is important to the organization. Thus, individuals exposed to such a fear appeal should increasingly believe that the organization approves of them using strong passwords.

These beliefs can influence an individual's subjective norm, which refers to the perceived social pressure to engage or not engage in a behavior (Ajzen 1991). When an individual believes that important referent individuals or groups expect him or her to perform a behavior, the perceived social pressure to engage in that behavior increases. Likewise, when an individual believes that important individuals or groups expect him or her to refrain from performing a behavior, the perceived social pressure not to engage in that behavior increases.

4.4.1. Subjective Norm and Behavioral Intention

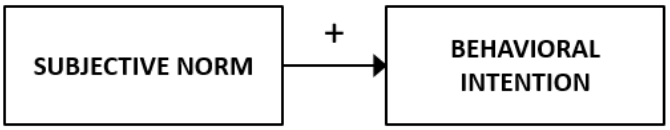
Subjective norm influences behavioral intention, according to the theory of planned behavior (Ajzen 1991). This theory suggests that individuals are more likely to intend to perform a behavior when they experience social pressure to perform the behavior, based on the perceived probability that important referents individuals or groups perform or approve of performing the behavior. For example, when an individual strongly believes that his or her peers (who are important to the individual) use strong

passwords for all their online accounts, this normative belief motivates the individual's own use of strong passwords. Consequently, this individual would intend to use strong passwords, because of the expectation that important referents would approve of him or her performing that behavior.

4.4.2. Hypothesis – Subjective Norm and Behavioral Intention

As the subjective norm increasingly favors performance of a behavior, an individual's intention to perform the associated behavior also increases. Prior studies indicate that subjective norm is positively correlated with behavioral intention for a wide range of behaviors. Across several meta-analyses, the mean correlation between subjective norm and behavioral intention ranges from 0.34 to 0.42 (Ajzen 2005). Taken together, this suggests the following hypothesis (see Figure 4.7).

FIGURE 4.7. Hypothesis 7_d



***$H7_d$*. Subjective norms that favor information security behavior will increase information security behavioral intention.**

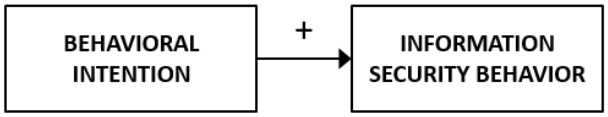
4.5. Hypothesis – Behavioral Intention and Behavior

As explained in Chapter 2, information security behavior encompasses an individual's conscious and voluntary involvement in protecting against information security threats (Dinev and Hu 2007). Because this behavior is conscious and voluntary, it represents a willful behavior, in that individuals can perform or refrain from performing according to their own volition (Ajzen 2005). That is, information security behavior results from an individual's deliberate attempt to perform the behavior. The theory of planned behavior argues that an individual's intention to perform a behavior leads to actual performance of the behavior, given appropriate time and opportunity, assuming the behavior is under the individual's volitional control (Ajzen 2005).

Many studies provide support for the predictive validity of behavioral intention. For instance, a meta-analysis of meta-analyses indicates that intention and behavior have an overall correlation of 0.53 (Sheeran 2002), while meta-analyses focused on various behavioral domains report mean intention-

behavior correlations ranging from 0.44 to 0.56 (Ajzen 2005). These results provide evidence that intentions influence volitional behavior (see Figure 4.8).

FIGURE 4.8. Hypothesis 8



H8. **Information security behavioral intention will increase information security behavior.**

4.6. Summary

This chapter has described a conceptualization of the processes that explain how individuals form and process beliefs resulting from threats in information security fear appeals. This chapter extends existing fear appeal theories by explaining how a fear appeal and an individual's resulting feeling state can influence the individual's performance of a behavior, based his or her beliefs associated with the fear appeal's threat. The behavior process model (Figure 4.1) integrates the emotion process model (Figure 3.1) and the theory of planned behavior (Ajzen 1991) to demonstrate how a fear appeal influences severity and vulnerability beliefs, which increase an individual's positive attitude towards the fear appeal's recommendation. Including feeling state's direct influence on behavioral belief emphasizes the role of emotion in this process upon an individual's exposure to a fear appeal. This chapter also explains how normative and control beliefs can influence subjective norm and perceived behavioral control in the context of information security, and explains how attitude, subjective norm, and perceived behavioral control can increase information security behavioral intention and behavior.

Chapter 5

METHODOLOGY OVERVIEW

A pilot study and three experimental studies were used to test the hypotheses in the emotion process model and behavior process model. This chapter provides an overview of these studies, with details provided in Chapters 6 (Pilot Study), 7 (Study 1), 8 (Study 2), and 9 (Study 3) and in Appendices B, C, D, and E.

5.1. Data Collection

Several data collection methods were used. A survey collected demographic, computer efficacy, and cognitive- versus emotion-based decision-making information. Information security behavior was operationalized in terms of changes in the strength of subjects' passwords. Facial analysis software, Noldus FaceReader, measured expressive cues of fear as subjects viewed the fear appeals. The use of Noldus FaceReader has been validated by several studies (e.g., Brodny et al. 2016; Lewinski et al. 2014). This measurement procedure avoids potential issues associated with measuring emotions based on self-reports and is not as intrusive as other physiological measurements, such as electroencephalograms. A wristband device (Shimmer) was used to measure individuals' physiological states in terms of galvanic skin response (GSR) as subjects viewed the fear appeals and other images shown in the experiment. GSR has been widely used as an index of emotional processing and autonomic activity (Braithwaite and Watson 2015). The wristband device did not interfere with subjects' ability to use a mouse and keyboard. Finally, as part of the experimental task, subjects rated each of a series of images on three dimensions: valence, arousal, and fear, representing subjects' self-reported feeling states.

5.2. Subject Recruitment and Registration

This section presents a summary of subject recruitment and registration for the pilot study and all experiments. The detailed recruitment and registration procedure (including screenshots) is provided in Appendix B.

Subjects were recruited from an undergraduate management information systems class that is required for all undergraduate business students, so the sample drawn from this course includes undergraduates from all business majors. Subjects received extra credit as an incentive for their participation. Participation was voluntary, and individuals used their own computers to sign up for a specific time slot through a link that was provided by their instructor. After subjects clicked on an available time, they were prompted to enter their name and email address to book the selected time slot. In addition, subjects answered questions regarding their computer efficacy, computer anxiety, lay rationalism, and perceived password strength.

The computer efficacy, computer anxiety, and lay rationalism items were included to control for their potential effects on subjects' internal emotional experience and information security behavior (none of the control variables had a significant effect and were thus excluded from analysis). Computer self-efficacy represents the belief of one's capability to use the computer (Barbeite and Weiss 2004). Computer self-efficacy was measured because individuals with little confidence in their ability to use computers may be less inclined to use strong passwords. Likewise, computer anxiety represents the fear of potential negative outcomes associated with using a computer, such as damaging the equipment or looking foolish (Barbeite and Weiss 2004). Computer anxiety was measured because individuals who have computer anxiety may be inclined to perceive and/or show greater fear and arousal and lower valence when exposed to a fear appeal related to information security. Lay rationalism represents the tendency to use reason rather than feelings to guide decisions and actions (Hsee et al. 2015). Lay rationalism was measured because individuals with high lay rationalism may be less motivated by internal emotional experience. Perceived password strength was included to control for the potential effect of perceived password strength on their perceived vulnerability to identity theft that would result from their

using weak passwords. Subjects then received an email that confirmed their reserved time slot. Subjects received another email 24 hours prior to their scheduled time as a reminder of their reserved time slot.

5.3. Overview of Studies

This section provides a summary of each study in this dissertation. Detailed information about these studies is contained in the subsequent chapters and appendices.

5.3.1. Pilot Study (Chapter 6)

The pilot study focused on developing sentences and images associated with identity theft to establish the stimuli for the subsequent studies. Subjects rated images and sentences associated with identity theft to create fear appeal stimuli with low and high levels of threat visualization, threat severity, and threat vulnerability. These levels were determined by subjects' perceived valence, arousal, and fear, and, in addition, their facial expressions and galvanic skin responses while viewing each stimulus. This pilot study was also used to verify that the study protocols proceed as intended, by serving as a practice run of subject recruitment and device set-up and configuration. The pilot study provided an opportunity to identify potential issues with the survey (which captured subjects' perceptions) prior to the full data collection effort. To ensure that subjects understood the instructions and questions, an interview session was conducted following the computer-based survey in the study. This is important because it ensured that subjects were able to follow the instructions and answer the questions without any confusion. Any problems were noted and addressed in accordance with subject feedback.

5.3.2. Study 1 (Chapter 7)

Study 1 focused separately on fear appeals' threat visualization, threat severity, and threat vulnerability to better identify the different roles that they play in terms of eliciting fear. The focus on images alone is important, because images have the potential to elicit strong emotions, yet they remain overlooked as a component of fear appeal models. Likewise, focusing on a fear appeal's threat severity and threat vulnerability separately allows us to better identify the extent to which each threat-based text component of a fear appeal can elicit fear. Subjects participated in the same rating task as those in the pilot study, although graphical (emoticon-based) rating scales were used to measure perceived valence,

arousal, and fear; in addition, the threat severity and threat vulnerability stimuli were modified based on the results of the pilot study. Subjects' galvanic skin responses were not recorded in this study, although Noldus FaceReader data were gathered.

5.3.3. Study 2 (Chapter 8)

Study 2 focused on combinations of a fear appeal's image and text components to identify the combinations of threat visualization and verbalization (which includes threat vulnerability and severity) that elicit greater fear, which thereby can lead to improved information security behavior. The focus on the interaction between images and text is important, because several different relationships can exist between them (Schriver 1997). Therefore, it is important to investigate how images can reinforce or extend the standard threat severity and threat vulnerability components of an information security fear appeal to elicit fear and motivate security behavior. Subjects participated in the same rating task as those in Study 1, although the stimuli were combinations of images and sentences (as opposed to separate image- and text-based stimuli). The rating task was used to measure perceived valence, arousal, and fear, while subjects' galvanic skin response and facial expressions were recorded (galvanic skin response was not included in Study 1 because the group size was greater than the number of instruments available).

5.3.4. Study 3 (Chapter 9)

Study 3 focused on determining the extent to which fear appeals lead to improved security behavior. Up to three months after creating a baseline password (upon registration for the study), subjects were shown a fear appeal treatment that manipulated threat verbalization and threat visualization. This treatment was not shown in a lab, but in each subject's natural computing environment (i.e., on each subject's own computer). After viewing the fear appeal, subjects completed a survey with items related to their perceptions, beliefs, and attitudes associated with the fear appeal's threat and recommended password creation response, along with their intentions to perform the recommended response. After submitting the survey, subjects were prompted to enter a new password to receive credit for their participation and to register for a raffle. Subjects' new passwords were compared to their baseline passwords to determine their changes in information security behavior.

Chapter 6

PILOT STUDY

The pilot study was employed to establish and validate the following:

1. Operationalization of feeling state in internal emotional experience, in terms of fear, valence, and arousal using semantic differential scales, and of physiological state in terms of physiological arousal using subjects' galvanic skin responses.
2. Operationalization of external emotional expression in terms of subjects' expressed valence, arousal, and fear by evaluating subjects' facial expressions.
3. Development of the images employed as stimuli in the experiments to manipulate the emotional interest component of a fear appeal.
4. Development of the text employed as stimuli in the experiments to manipulate the threat severity and threat vulnerability components of a fear appeal.
5. Development of the experimental procedure, including subject recruitment, device set-up and configuration, and data collection.
6. Development of survey items related to individuals' perceptions of threat severity, threat vulnerability, response efficacy, self-efficacy, and response cost associated with passwords and identity theft.

6.1. Operationalization of Internal Emotional Experience

Prior psychological research has used two major methods to measure self-reported emotional experience: the discrete emotions approach and the dimensional approach (Scherer 2005). The discrete emotions approach might prompt subjects to indicate on an ordinal scale the degree to which they experienced a particular emotion (e.g. fear), whereas the dimensional approach involves measuring

subjective feelings based on their underlying dimensions, such as valence and arousal. The results obtained using the discrete emotions approach are highly plausible and easily interpretable, but it is difficult to compare results across studies because they use widely different sets of emotion labels (Scherer 2005). Results based on the dimensional approach are reliable, but this approach makes it difficult to differentiate between emotions that have similar valence and arousal values. For example, anger and fear are both characterized by low valence and high arousal. Therefore, feeling state was operationalized here using three semantic differential scales measuring fear, valence, and arousal, with the fear scale representing the discrete emotions approach and the valence and arousal scales representing the dimensional approach.

The *fear* item was based on a semantic differential scale (unafraid to afraid). The *valence* item consisted of a semantic differential scale (unhappy to happy) based on Bradley and Lang's (1994) Self-Assessment Manikin (but without emoticons). The *arousal* item consisted of a semantic differential scale (excited/agitated to calm) based on Bradley and Lang's (1994) Self-Assessment Manikin (but without emoticons). These valence and arousal items did not employ emoticons to make them consistent with our fear item, for which emoticons were not available.

Finally, Shimmer wristband devices were employed to measure *physiological states of arousal* based on subjects' galvanic skin responses (GSR). GSR has been widely used as an index of emotional processing and autonomic activity (Braithwaite and Watson 2015).

6.2. Operationalization of External Emotional Expression

External emotional expression was operationalized based on analyses of subjects' facial expressions. A video recording of each subject was analyzed using Noldus FaceReader, which calculated measurements of expressed valence, arousal, and fear based on changes in a subject's facial expression using Ekman's (1984) Facial Action Coding System. FaceReader calculated *expressed valence* based on the intensity of expressed positive emotion minus the intensity of expressed negative emotion. FaceReader calculated *expressed arousal* based on the activation values of the 20 action units (Ekman

and Friesen 1978), listed in Table 6.1. FaceReader also calculated *expressed fear* based on the activation values of the seven action units (Ekman and Friesen 1978) noted in Table 6.1.

TABLE 6.1. Action Units Associated with Expressed Arousal and Expressed Fear

Arousal Action Unit	Description
1*	Inner brow raiser
2*	Outer brow raiser
4*	Brow lowerer
5*	Upper lid raiser
6	Cheek raiser
7*	Lid tightener
9	Nose wrinkler
10	Upper lid raiser
12	Lip corner puller
14	Dimpler
15	Lip corner depressor
17	Chin raiser
18	Lip puckerer
20*	Lip stretcher
23	Lip tightener
24	Lip pressor
25	Lips part
26*	Jaw drop
27	Mouth stretch
43 (inverse)	Eyes closed

* action unit also associated with fear

6.3. Stimuli for the Manipulation of Emotional Interest

A set of 20 image-based stimuli were used in this study, including 16 images selected from the International Affective Picture System (IAPS), which is a set of normative emotional stimuli used in experimental investigations of emotion and attention (Lang et al. 2008). In keeping with the usage agreement for the IAPS dataset (Lang et al. 2008), none of the images can be included here. However, the images presented to subjects are like the ones in Figure 6.1.

FIGURE 6.1. Images Similar to International Affective Picture System Stimuli

Moderate arousal
Positive valence
Low fear

Low arousal
Neutral valence
Low fear

High arousal
Negative valence
High fear

The IAPS images were chosen to represent the six conventional categories of emotion from discrete emotion theory (Ekman 1992): fear, surprise, anger, joy, sadness, and disgust, as well as neutral images that evoke little or no emotion, based on the results of Barke (2012) and Mikels and colleagues (2005). The IAPS stimuli are summarized in Table 6.2, including the valence and arousal means (Lang et al. 2008) and the primary emotional category (Barke 2012).

TABLE 6.2. International Affective Picture System Stimuli

Image ID	Description	Valence [a]	Arousal [a]	Category [b]
1111	Snakes	3.25	5.20	Disgust
2345.1	Black eye	2.26	5.50	Anger
2751	Drunk driving	2.67	5.18	Anger
2770	Mask	4.37	5.11	Surprise
2900.1[c]	Crying	2.56	4.61	Sadness
2900.2[c]	Smiling	6.62	4.52	Joy
6250.1[c]	Aimed gun	2.63	6.92	Fear
6250.2[c]	Ice cream	6.32	5.13	Joy
6370	Attack	2.70	6.44	Fear
7009	Mug	5.27	1.27	Neutral
7010	Basket	4.94	1.76	Neutral
7020	Fan	5.05	1.51	Neutral
8160	Rock climbers	5.07	6.97	Surprise
8185	Sky divers	7.57	7.27	Joy
9001	Cemetery	3.10	3.67	Sadness
9390	Dishes	3.67	4.14	Disgust

[a] Means from Lang et al (2008), ranging from 1 to 9 (midpoint 5);
[b] Emotion category from Barke (2012);
[c] Image slightly modified for clarity

Four of the IAPS stimuli were slightly modified to simplify the images. Images 2900.1 and 2900.2 were modified by removing the frowning person who appeared in the background of both images, because subjects were confused by the contradiction between that person's expression and the expression

of the child in each image (sadness and joy, respectively). Additionally, images 6250.1 and 6250.2 were modified to clearly show the face of the person holding the gun and ice cream, respectively, because the face was shadowed in the original.

Four additional image-based stimuli were created for this study to represent different degrees of emotional interest via visual elements that convey dangers associated with identity theft (see Table 6.3). Emotional interest, concreteness, and proximity are the three dimensions of pictorial vividness (see Chapter 3). Concreteness and proximity were held constant for all the image-based stimuli, but emotional interest was manipulated dichotomously (high and low levels). The emotional interest dimension of pictorial vividness increases to the degree that fear appeal images convey greater danger and decrease psychological distance. For example, an image of a gloved hand reaching through a computer screen for a wallet conveys a relatively high degree of danger, based on the privacy violation implied by the hand reaching through the computer screen and the financial cost represented by the hand reaching for the wallet (see Chapter 3).

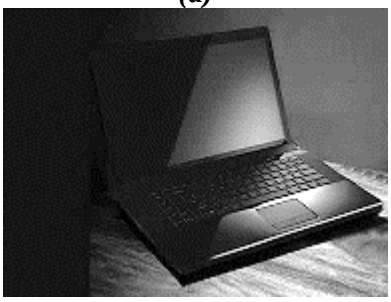
TABLE 6.3. Image-Based Identity Theft Stimuli Created for the Pilot Study

Image ID	Description	Expected Valence	Expected Arousal	Emotional Interest
1001	Computer	Neutral	Low	Low
1002	Wallet and computer	Neutral	Low	Low
1003	Hand and computer	Low	High	High
1004	Hand, wallet, and computer	Low	High	High

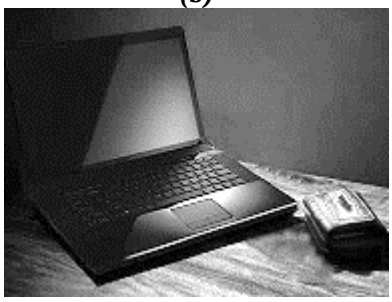
Image 1001 (see Figure 6.2) consisted of a computer to represent very low emotional interest, based on the lack of danger in the image. Image 1002 (see Figure 6.2) included the same illustration of a computer used in image 1001 but added another visual element (a wallet). However, the danger shown in the resulting image is still relatively low, so the overall level of emotional interest in image 1002 remains low.

FIGURE 6.2. Identity Theft Stimuli with Low Emotional Interest

(a) ***(b)***



Stimulus 1001

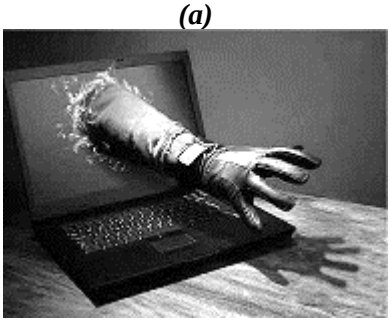


Stimulus 1002

Image 1003 consisted of a gloved hand reaching through a computer screen (see Figure 6.3). Gloved hands breaking through glass may connote theft or the crime of breaking and entering, so the gloved hand reaching through the screen conveys a relatively high degree of danger. Therefore, image 1003 has high emotional interest. Image 1004 (see Figure 6.3) included the same illustration of a gloved hand reaching through a computer screen used in image 1003 but added another visual element (a wallet). Unlike image 1002, incorporating the image of a wallet increases the degree of danger shown, based on the resulting emphasis on the financial cost of the intrusion represented by the image. That is, the gloved hand alone conveys danger, but the gloved hand reaching for a wallet conveys greater danger, and thus has greater emotional interest.

FIGURE 6.3. Identity Theft Stimuli with High Emotional Interest

(a) ***(b)***



Stimulus 1003

Stimulus 1004

Images can elicit emotional responses based on the strong relationship between vision and emotion (Messaris 1997). Because fear appeal images with increasing emotional interest convey threat, we expect emotional interest to increase arousal and fear and to decrease valence (see hypotheses 1_c, 2_c,

and 3_c in Chapter 3). Therefore, the two identity theft images with low emotional interest (1001 and 1002) should have low arousal, low fear and neutral (neither positive nor negative) valence. The identity theft images with relatively high emotional interest (1003 and 1004) should have high arousal, high fear, and low valence.

6.4. Stimuli for the Manipulation of Threat Verbalization

A series of sentences were used for the text-based stimuli in this study, including 11 headlines selected from the Affective Text dataset, which is a set of 1,000 headlines drawn from major newspapers and annotated in terms of valence and emotional category (e.g. fear) (Strapparava and Mihalcea 2007). Affective Text sentences were chosen to represent the six conventional categories of emotion from discrete emotion theory (Ekman 1992): fear, surprise, anger, joy, sadness, and disgust, as well as neutral emotion. One of the sentences (sentence 1036) was slightly modified by replacing an individual's name with the title "VP" because subjects indicated that the name in the sentence significantly influenced their valence response. All of the sentences were displayed in a black Times New Roman font and centered on a white background. The Affective Text stimuli are summarized in Table 6.4.

TABLE 6.4. Affective Text Stimuli

Text ID	Sentence	Valence [a]	Category [b]
545	Two detained in body parts mailing	3.80	Disgust
600	Man rides stationary bike for 85 hours	7.08	Surprise
615	Anger at release of two held over beheading plot	2.28	Anger
767	Bigger, more aggressive rats infesting UK	1.56	Disgust
965	Venezuela, Iran fight U.S. dominance	4.04	Anger
1006	North Africa feared as staging ground for terror	1.44	Fear
1036 [c]	VP starts visit to Japan, Australia	5.64	Neutral
1109	Retinal implants helping blind people see again	8.24	Joy
1117	Scientists tout cocoa's health benefits	7.88	Joy
1230	Vietnamese bank plans IPO listing	5.84	Neutral
1484	Marijuana helps ease HIV nerve pain, study says	6.36	Surprise

[a] Values from Strapparava and Mihalcea (2007), ranging from 1 to 9 (midpoint 5); values below 5 are negatively valenced and those above 5 are positively valenced.
[b] From Strapparava and Mihalcea (2007).
[c] Sentence modified for clarity.

Four additional text-based stimuli were created for this study, using sentences describing threat severity or threat vulnerability related to the information security threat of identity theft, as summarized in

Table 6.5. The sentences with text IDs of 1 and 2 were designed to represent low and high degrees of threat severity. Sentence 1, “Victims pay nothing to resolve identity theft linked to weak passwords,” described the lack of a financial consequence to identity theft to represent low threat severity. In contrast, sentence 2, “Victims pay high legal fees to resolve identity theft linked to weak passwords,” described the high cost of identity theft to represent high threat severity. Sentences with text IDs 3 and 4 were designed to represent low and high threat vulnerability. Sentence 3, “Few identity theft occurrences can be linked to weak passwords,” described the low likelihood of identity theft linked to weak passwords to represent low threat vulnerability. Sentence 4, “Most identity theft occurrences can be linked to weak passwords,” described the high likelihood of identity theft linked to weak passwords to represent high threat vulnerability.

TABLE 6.5. Text-Based Identity Theft Stimuli Created for the Pilot Study

Fear Appeal Component	Text ID	Sentence	Expected Valence	Expected Arousal	Expected Fear
Threat Severity	1	Victims pay nothing to resolve identity theft linked to weak passwords	Neutral	Low	Low
	2	Victims pay high legal fees to resolve identity theft linked to weak passwords	Low	High	High
Threat Vulnerability	3	Few identity theft occurrences can be linked to weak passwords	Neutral	Low	Low
	4	Most identity theft occurrences can be linked to weak passwords	Low	High	High

Threat severity refers to the significance or magnitude of the threat conveyed in a fear appeal, while threat vulnerability refers to the likelihood of experiencing the threat conveyed in a fear appeal. We Threat severity and threat vulnerability should increase arousal and fear and decrease valence (see hypotheses 1_a, 2_a, and 3_a in Chapter 3). Therfore, the identiy theft sentences with low threat severity and low threat vulnerability (1 and 3, respectively) should be characterized by low arousal, low fear, and neutral (neither positive nor negative) valence, while the identity theft sentences with high threat severity and high threat vulnerability (2 and 4, respectively) should be characterized by high arousal, high fear, and low valence.

The set of text-based stimuli also included five other sentences created for this study that described threats related to terrorism, as summarized in Table 6.6. These stimuli were included to divert subjects’ focus from the treatment stimuli’s emphasis on the threat of identity theft. That is, the 11

Affective Text stimuli did not focus on a single subject or threat, whereas all four of the treatment stimuli addressed the threat of identity theft related to weak passwords. Thus, subjects were likely to detect the emphasis on passwords, which had the potential to influence their responses. The terrorism-related stimuli in Table 6.6 were designed to have a form like that of the text-based identity theft stimuli, so that the study's focus on identity theft was masked. One of the Affective Text sentences (1006) was used as the foundation for constructing the terror-related sentences for this study. Because these sentences were not from the Affective Text dataset, prior valence and emotional category values were not available.

TABLE 6.6. Text-Based Terrorism Stimuli Created for the Pilot Study

Text ID	Sentence
5	Anti-terror protesters detained after weekend violence in Houston
6	Terror suspects detained after weekend violence in Houston
7	Terror suspects detained after weekend violence in North Africa
8	Anti-terror protesters detained after weekend violence in North Africa
9	Houston feared as staging ground for terror

6.5. Experimental Procedure

A computer-based rating task, survey, and interviews (in groups of six) were used to collect data. 52 subjects (63% female) were recruited from an undergraduate Management Information Systems course that is required for all undergraduate business students. Subjects were volunteers who received extra credit and entry into a raffle as incentives for participation. The detailed procedure (including screenshots) is provided in Appendix B. The following is a summary of the procedure.

Each subject was directed to an open seat facing a laptop in the lab (Melcher 290G), and each webcam was calibrated so that each subject's facial expressions could be recorded. Laptops were set up so that subject could not see each other's screens, and each laptop displayed an explanation of the task. A GSR wristband was strapped onto each subject. Each GSR device was synchronized to the laptop's system time to sync the GSR data with the timestamps associated with the video recording. Each subject was assigned a unique ID to link his or her video recording, GSR data, and survey responses.

Subjects began the experimental task by clicking "next" on the bottom of the screen. At that point, half of the subjects were shown the image-based stimuli described in section 6.2 (the rest of the

subjects were shown a series of text-based stimuli first, as described below). Prior to each stimulus, a blank screen appeared for five seconds, acting as a buffer between stimuli as recommended by Bradley and Lang (2008). After five seconds, a "next" button appeared on the screen. When subjects clicked this button, an image was displayed along with a "next" button below the image. After clicking "next" again, subjects were shown the image again along with a prompt to indicate how the stimulus made them feel in terms of valence (happy versus unhappy), with a "next" button below the image. As soon as subjects entered a valence rating, a "next" button appeared. After clicking that button, subjects were shown the image and were prompted to indicate how the stimulus made them feel in terms of arousal (calm versus agitated/excited). When subjects entered an arousal rating, a "next" button appeared below the image. After clicking that button, subjects were shown the image along with a prompt to indicate how the stimulus made them feel in terms of fear (unafraid versus afraid). As soon as subjects entered a fear rating, a "next" button appeared below the stimulus on the screen. When subjects clicked this button, they advanced to a blank (buffer) screen as described above. This rating task yielded perceived valence, arousal, and fear. Expressed valence, arousal, and fear (via FaceReader) and physiological arousal (via GSR) measurements were concurrently obtained for both the IAPS and our identity theft images.

Next, half of the subjects were shown the text-based stimuli described above in section 6.2 (while the other subjects were shown images, as described in the previous paragraph). Like the image-rating task described above, subjects were prompted to indicate how each sentence made them feel in terms of valence (happy versus unhappy), arousal (calm versus excited/agitated), and fear (unafraid versus afraid). In addition, their expressed valence, arousal, and fear, as well as physiological arousal, were concurrently measured.

After the rating task, subjects were shown instructions for completing a survey about identity theft. First, subjects were prompted to indicate how the threat of identity theft makes them feel in terms of valence, arousal, and fear. These measurements allowed us to isolate the effect of the threat in general from the effect of the threat-related text and images in this study. (Note that this, and the following

questions could not have been asked earlier because it might act as a cue of the study's focus on identity theft.)

Subjects were then prompted to answer a series of questions about identity theft as it relates to stolen passwords. These questions were intended to determine the minimum financial cost associated with identity theft that would make subjects think identity theft is a *severe* threat. In addition, questions helped determine the minimum likelihood of identity theft linked to weak passwords that would make subjects feel *vulnerable* to identity theft. The responses to these questions were used to create the low and high threat severity and threat vulnerability sentences for subsequent studies. A value three standard deviations above the mean minimum financial cost of identity theft that would make subjects consider identity theft to be a severe threat will represent high threat severity; a value three standard deviations below the mean will represent low threat severity. Likewise, the value three standard deviations above the mean likelihood of identity theft linked to weak passwords that would make subjects feel vulnerable to that threat will represent high threat vulnerability, while the value three standard deviations below the mean will represent low threat vulnerability.

The survey also included questions to be used in the subsequent studies to determine whether any problems existed with wording or comprehensibility. The first set of questions prompted subjects to answer how much they agree or disagree with a set of statements related to a fear appeal's information security threat and response, based on the fear appeal components in protection motivation theory (Rogers 1983) and the extended parallel process model (Witte 1992), as shown in Table 6.7 below.

TABLE 6.7. Pilot Study Survey Items

Item	Statement	Scale	Source
1	The consequences would be **severe** if someone stole my identity by guessing my passwords	Threat severity	Witte et al. 1996
2	The consequences would be **serious** if an identity thief cracked my passwords	Threat severity	Witte et al. 1996
3	If an identity thief obtained my passwords, I would **suffer a lot of pain**	Threat severity	Milne et al. 2002
4	It is **likely** that an identity thief could guess my passwords	Threat vulnerability	Johnston & Warkentin 2010
5	It is **possible** that someone could steal my identity by obtaining my passwords	Threat vulnerability	Johnston & Warkentin 2010

TABLE 6.7 (continued). Pilot Study Survey Items

6	I am **at risk** for an identity thief cracking my passwords	Threat vulnerability	Johnston & Warkentin 2010
7	Using strong passwords is **effective** for preventing identity theft	Response efficacy	Johnston & Warkentin 2010
8	If I use strong passwords, I **lessen** my chances of identity theft	Response efficacy	Milne et al. 2002
9	Using strong passwords is a good way to **reduce** the risk of identity theft	Response efficacy	Milne et al. 2002
10	Strong passwords are **easy** to use	Self-efficacy	Johnston & Warkentin 2010
11	Strong passwords are **convenient** to use	Self-efficacy	Johnston & Warkentin 2010
12	I am able to use strong passwords **without much effort**	Self-efficacy	Johnston & Warkentin 2010
13	If I use strong passwords, they will be **difficult** for me to remember	Response cost	Milne et al. 2002
14	I feel **discouraged** from using strong passwords because it would cause me too many problems	Response cost	Milne et al. 2002
15	The **costs** of using strong passwords **outweigh** the **benefits**	Response cost	Milne et al. 2002

Subjects were then prompted to rate seven emoticons according to how much fear they show (1 = least fear, 7 = most fear). The emoticons (from Unicode, Inc. 2016) were displayed in a random order for each subject to control for potential ordering effects. Two emoticons (neutral face and expressionless face) were selected from Unicode's (2016) face-neutral category, while five others were selected from Unicode's (2016) face-negative category (slightly frowning face, worried face, anguished face, fearful face, face screaming in fear). Subjects' ratings were used to establish the labels that indicate relative amounts of fear in the fear rating scale for subsequent studies. Our fear rating scale thus employed the resulting five emoticons in the appropriate order with the smallest overlap in standard deviations, as shown in Figure 6.4. These fear rating emoticons were used to maintain consistency with the images that serve as labels for the valence and arousal scales in the self-assessment manikin (Bradley and Lang 1994), which were used in subsequent studies.

FIGURE 6.4. Fear Rating Scale

Finally, subjects were prompted to answer demographic questions, including their gender, ethnicity, and university major. After submitting their responses, subjects were shown a message instructing them to raise their hands. At that point, the subjects' GSR devices were disconnected and subjects were interviewed about the rating task and survey. Any confusing or difficult wording was discussed, and then subjects were reminded to keep the details of the study confidential. Before leaving, subjects were instructed to sign out to log their participation.

6.6. Analysis and Results

Subjects' data came from the following sources. (1) Subject's ratings were used for perceived valence, arousal, and fear. (2) Webcam recordings enabled the evaluation of expressed valence, arousal, and fear using FaceReader. Timestamps were recorded via Microsoft SQL Server that logged when the webcam recording started and when each stimulus was displayed; the webcam recordings were saved to each laptop using the WebRTC JavaScript library and then transferred to an external hard drive. (3) Timestamped GSR measurements of arousal were recorded on each Shimmer device's internal SD card and then transferred to an external hard drive using Consensys v0.4.4. (4) Survey responses were recorded via Qualtrics. Each subject's unique participant ID was used to match up the data from these four sources.

6.6.1 Organizing and Transforming the Data

Webcam Recordings. Each subject's webcam recording was loaded into Noldus FaceReader version 7.0 for analysis. The default analysis settings were used (General face model, sample rate every frame, no image rotation, continuous calibration) unless a subject reported his or her ethnicity as East Asian, in which case that subject's face model was changed from General to East Asian. Because FaceReader's General face model is recommended for all other ethnicities, the default face model setting was not changed for subjects who reported their ethnicity as anything other than East Asian. For each subject's FaceReader analysis, the data export settings were changed to include valence and arousal values in addition to the intensities of all facial expressions by emotion category (e.g. fear) every 0.1 seconds. The output of each subject's FaceReader analysis was exported as a spreadsheet file. The times

in the FaceReader output were then transformed based on the recording's start time logged via Microsoft SQL Server to sync the FaceReader data with the stimulus timestamps.

Next, the maximum values of the FaceReader expressed arousal and fear measurements were calculated for each subject during his/her exposure to a stimulus. To correct for inter-individual variance, the maximum values were transformed by dividing the raw FaceReader arousal and fear measurements by each subject's mean FaceReader arousal and fear (respectively). Maximum expressed valence is not the most appropriate statistic for expressed valence, because the negatively valenced stimuli should not be expected to have high expressed valence. Therefore, for each stimulus shown to a subject, both the maximum and minimum expressed valences were calculated. The value the furthest distance from the subject's grand mean for expressed valence was then identified as the valence extreme, and this was selected as the primary measure of expressed valence for each stimulus shown to a given subject. To correct for inter-individual variance, the extreme values were transformed by dividing the raw FaceReader valence measurements by each subject's mean FaceReader valence.

GSR Measurements. Throughout the rating task, each subject's GSR was recorded using a Shimmer wristband device worn on the subject's non-dominant hand to measure his or her physiological arousal. As described above, GSR is a commonly measured manifestation of autonomic nervous system activation that captures the electrical properties of the skin as determined by sweat gland activity. The logged time for each GSR measurement was a Unix timestamp in 0.02 second intervals, so the GSR times did not need to be adjusted to sync with the stimulus timestamps.

There is typically a latency period between stimulus onset and the first significant deviation in the skin conductance response (i.e., GSR) of between one and three seconds (Braithwaite and Watson 2015). GSR changes that occur before this period should not be attributed directly to experimental stimuli. At the same time, prior research suggests that neutral images, positively valenced images, and negatively valenced images have different latency periods (Haney and Euse 1976). Additionally, baseline skin conductance (GSR) is constantly changing within an individual and can differ markedly among

individuals, such that simply averaging across the whole signal is inadequate as a measure because it conflates baseline changes and treatment-related responses (Braithwaite and Watson 2015).

Therefore, instead of using the mean GSR for each stimulus shown to a subject, the analysis used the maximum value of each subject's GSR during his or her exposure to each stimulus. To correct for inter-individual variance, each subject's maximum value for each stimulus was transformed by dividing the raw GSR measurements by the subject's mean GSR, in accordance with Ben-Shakhar (1985).

Linking the Data. After transforming the FaceReader and GSR measurements, the associated measurements were aggregated by stimulus. R version 3.3.1 was used to calculate expressed valence, arousal, and fear (from the FaceReader data) and physiological arousal (from the GSR data) for each stimulus (for a given subject). These values were then linked to the associated ratings and survey responses using each subject's participant ID.

6.6.2. Descriptive Statistics

The descriptive statistics for each stimulus appear in the tables below, with the image-based stimuli in Table 6.8 followed by the text-based stimuli in Table 6.9. In Table 6.8, each image ID indicates the IAPS or treatment (identity theft stimulus) identification number. The IAPS image IDs are consistent with those described in the IAPS data set (Lang et al. 2008). In Table 6.9, each text ID indicates the Affective Text or treatment (identity theft stimulus) identification number of the stimulus. The Affective Text IDs are consistent with those described in the Affective Text data set (Strapparava and Mihalcea 2007).

Each perceived valence item indicates the mean value (calculated across subjects) of how sad (perceived valence = 1) to happy (perceived valence = 9) subjects said they felt in response to the stimulus. Similarly, each perceived arousal mean indicates the mean value of how calm (perceived arousal = 1) to excited or agitated (perceived arousal = 9) subjects said they felt in response to the stimulus. Each perceived fear mean likewise indicates the mean value of how unafraid (perceived fear = 1) to afraid (perceived fear = 9) subjects indicated that they felt in response to the stimulus.

TABLE 6.8. Emotional Response Means for Image-Based Stimuli

	Feeling State (Ratings)			Emotional Expression (FaceReader)			Physiological State (GSR)
Image ID	**Perceived Valence**	**Perceived Arousal**	**Perceived Fear**	**Expressed Valence**	**Expressed Arousal**	**Expressed Fear**	**Physiological Arousal**
1001	5.59	4.02	3.43	-0.40	0.41	0.10	0.86
1002	5.55	4.10	3.71	-0.44	0.43	0.08	0.91
1003	3.04	6.61	6.45	-0.41	0.44	0.11	1.42
1004	2.80	7.08	6.65	-0.38	0.40	0.09	0.86
1111	2.65	7.12	6.84	-0.36	0.38	0.12	0.94
2345.1	1.71	7.39	6.45	-0.37	0.41	0.08	0.88
2751	1.71	7.67	7.24	-0.38	0.39	0.09	0.84
2770	3.86	6.06	6.14	-0.35	0.42	0.08	0.84
2900.1	2.14	6.57	5.59	-0.42	0.40	0.08	0.84
2900.2	7.24	4.49	2.84	-0.34	0.39	0.08	0.85
6250.1	2.33	7.31	7.16	-0.39	0.41	0.06	1.56
6250.2	6.22	5.43	3.67	-0.37	0.41	0.09	0.92
6370	2.41	7.47	7.35	-0.42	0.42	0.08	0.83
7009	5.94	3.71	2.65	-0.34	0.43	0.07	0.99
7010	5.12	3.67	3.31	-0.41	0.38	0.08	0.89
7020	5.55	3.78	3.35	-0.38	0.43	0.08	0.99
8160	4.84	7.04	6.69	-0.36	0.43	0.10	0.89
8185	7.63	6.84	5.59	-0.35	0.44	0.09	1.55
9001	2.96	4.65	5.75	-0.30	0.40	0.08	0.83
9390	2.06	6.73	4.33	-0.40	0.42	0.11	0.83

FaceReader provided a measure of valence between -1 and 1 every 0.1 seconds while each stimulus was shown, where 0 represents neutral valence. For each individual, the largest absolute value of expressed valence for each stimulus was chosen to represent expressed valence for the individual during his or her exposure to that stimulus. If FaceReader's valence was negative, the associated expressed valence value was then made to be negative. Each expressed valence mean indicates the mean expressed valence for each stimulus across all subjects. A positive expressed valence value represents a positively valenced expression, while a negative expressed valence value represents a negatively valenced expression. Each expressed arousal mean similarly indicates the mean (across all subjects) maximum value (for each subject) of facial arousal expressed (as a value between 0 and 1 calculated by FaceReader) from the time the stimulus loaded on the screen until the time the blank screen appeared. Each expressed fear mean indicates the mean (across all subjects) maximum value (for each subject) of fear expressed (as a value between 0 and 1 calculated by FaceReader) from the time the stimulus loaded on the screen until

the time the blank screen appeared. Each physiological arousal mean indicates the mean (across all subjects) of the maximum GSR value (for each subject) from the time the stimulus loaded on the screen through the time the blank screen appeared.

TABLE 6.9. Emotional Response Means for Text-Based Stimuli

	Feeling State (Ratings)			Emotional Expression (FaceReader)			Physiological State (GSR)
Text ID	**Perceived Valence**	**Perceived Arousal**	**Perceived Fear**	**Expressed Valence**	**Expressed Arousal**	**Expressed Fear**	**Physiological Arousal**
1	5.24	5.04	3.90	-0.44	0.44	0.10	0.94
2	1.98	6.57	5.98	-0.45	0.44	0.08	0.87
3	4.92	4.92	4.57	-0.48	0.42	0.10	1.20
4	3.47	5.63	6.22	-0.44	0.46	0.10	1.08
5	3.67	6.10	5.78	-0.45	0.47	0.11	0.90
6	5.35	5.55	5.43	-0.45	0.45	0.10	1.40
7	6.18	4.73	4.61	-0.48	0.41	0.10	0.99
8	3.47	5.98	5.59	-0.45	0.46	0.09	0.97
9	1.51	7.35	7.51	-0.43	0.38	0.12	1.13
545	3.63	6.33	6.61	-0.41	0.43	0.08	0.82
600	5.78	5.59	3.78	-0.46	0.45	0.13	0.89
615	2.88	6.37	6.18	-0.46	0.43	0.12	1.20
767	2.49	6.57	6.18	-0.44	0.42	0.13	1.24
965	3.08	6.29	5.86	-0.41	0.46	0.09	1.01
1006	2.73	6.37	6.10	-0.45	0.43	0.14	0.94
1036	5.55	4.45	4.14	-0.48	0.42	0.09	0.90
1109	8.29	6.02	2.73	-0.39	0.40	0.09	0.96
1117	6.61	4.65	3.27	-0.41	0.40	0.12	1.46
1230	5.16	5.00	4.73	-0.38	0.46	0.16	0.90
1484	6.84	4.73	3.55	-0.45	0.48	0.11	0.85

6.6.3. Construct Validity of Valence, Arousal, and Fear Measures

A measurement's construct validity refers to the scientific utility of the measure in terms of the extent to which the measure adequately assesses its intended construct (Nunnally and Bernstein 1994). Convergent validity is an aspect of construct validity that represents the extent to which two theoretically *related* constructs are empirically related (Campbell 1959). By comparing our results with those of prior IAPS-based (Barke 2012; Lang et al. 2008; Libkuman et al. 2005; Mikels et al. 2005) and Affective Text-based (Strapparava and Mihalcea 2007) studies, we can determine the convergent validity of our valence, arousal, and fear constructs. This is done by correlating the pilot sample's perceived valence, arousal, and emotional category of fear with those of the IAPS population (Barke 2012; Lang et al. 2008); high

correlations indicate that our measurements are in accord with the IAPS population and thereby provide support for the convergent validity of our perceived valence, arousal, and fear measurements. Furthermore, *t*-tests and associated power analyses can provide evidence that the pilot sample's perceived average levels of valence and arousal do not significantly differ from the corresponding IAPS data (Lang et al. 2008), thereby further supporting the convergent validity of our measures. Similar correlational and t-test analyses can be performed comparing the Affective Text data with our pilot sample's perceptions to determine the convergent validity of our measurements.

We also employ a multimethod approach to evaluate the convergent validity of our valence, arousal, and fear constructs by using correlations to determine the degree to which subjects' expressed valence, expressed and physiological arousal, and expressed fear are in accord with their perceived valence, arousal, and fear. Theoretically, this approach compares subjects' external expressions and physiological states with their associated self-reported perceptions.

6.6.3.1. Construct Validity of Perceived Valence and Arousal

IAPS Stimuli. The pilot sample's perceived valence and arousal values associated with the IAPS image-based stimuli (see Table 6.8) were correlated with the established IAPS valence and arousal values (Lang et al. 2008) (see Table 6.2) to determine the sample's convergent validity. Pilot sample perceived valence values were significantly positively correlated with the established IAPS valence values, Pearson's $r(16) = 0.97$, $p < 0.001$. Likewise, perceived arousal values of the IAPS stimuli for the pilot sample were significantly positively correlated with the established IAPS arousal values, Pearson's $r(16) = 0.85$, $p < 0.001$.

Two *t*-tests were additionally conducted to verify that the average perceived valence and arousal levels from this pilot study did not significantly differ from the corresponding levels in Lang et al. (2008). Table 6.10 shows the mean difference in perceived valence and arousal for each IAPS stimulus. Those for perceived valence did not significantly differ from 0, $t(15) = 1.29$, $p = 0.22$. A power analysis using a medium effect size (Cohen 1988), an alpha of 0.05, and a sample size of 16, resulted in the power of this

test equal to 0.46. However, the mean differences for perceived arousal were significantly different from 0, t (15) = -4.90, $p < 0.001$.

TABLE 6.10. Differences in Perceived Valence and Arousal between IAPS and Pilot Study Subjects

	Valence			Arousal		
Image ID	**IAPS mean *(sd)***	**Pilot [a] mean *(sd)***	**Difference**	**IAPS mean *(sd)***	**Pilot [a] mean *(sd)***	**Difference**
1111	3.25 (1.64)	2.65 (1.68)	0.60	5.20 (2.25)	7.12 (1.67)	-1.92
2345.1	2.26 (1.46)	1.71 (1.49)	0.55	5.50 (2.34)	7.39 (1.50)	-1.89
2751	2.67 (1.87)	1.71 (1.32)	0.96	5.18 (2.39)	7.67 (1.58)	-2.49
2770	4.37 (1.69)	3.86 (1.71)	0.51	5.11 (2.05)	6.06 (1.80)	-0.95
2900.1	2.56 (1.41)	2.14 (1.08)	0.42	4.61 (2.07)	6.57 (1.76)	-1.96
2900.2	6.62 (1.97)	7.24 (1.53)	-0.62	4.52 (1.92)	4.49 (2.39)	0.03
6250.1	2.63 (1.74)	2.33 (1.68)	0.30	6.92 (1.92)	7.31 (2.17)	-0.39
6250.2	6.32 (1.70)	6.22 (2.37)	0.10	5.13 (2.06)	5.43 (2.24)	-0.30
6370	2.70 (1.52)	2.41 (1.71)	0.29	6.44 (2.19)	7.47 (1.81)	-1.03
7009	4.93 (1.00)	5.94 (1.62)	-1.01	3.01 (1.97)	3.71 (2.15)	-0.70
7010	4.94 (1.07)	5.12 (1.29)	-0.18	1.76 (1.48)	3.67 (1.86)	-1.91
7020	4.97 (1.04)	5.55 (1.55)	-0.58	2.17 (1.71)	3.78 (1.70)	-1.61
8160	5.07 (1.97)	4.84 (2.26)	0.23	6.97 (1.62)	7.04 (1.57)	-0.07
8185	7.57 (1.52)	7.63 (1.57)	-0.06	7.27 (2.08)	6.84 (2.15)	0.43
9001	3.10 (2.02)	2.96 (1.62)	0.14	3.67 (2.30)	4.65 (2.32)	-0.98
9390	3.67 (1.58)	2.06 (1.46)	1.61	4.14 (2.52)	6.73 (1.83)	-2.59

[a] $N = 51$

The lack of a significant difference in perceived valence in the first *t*-test and the significant correlation described above supports convergent validity of the perceived valence measure for the IAPS images. However, the low statistical power indicates that the *t*-test had a reduced chance to detect a true significant difference between the perceived valence means of the pilot sample and those of the established IAPS data (Lang et al 2008). At the same time, the significant difference in perceived arousal in the second *t*-test does not provide evidence of convergent validity. This difference in perceived arousal between the IAPS data (Lang et al 2008) and the pilot sample may be explained by the difference in scales used to measure arousal. The IAPS measurements were obtained using the Bradley and Lang's (1994) Self-Assessment Manikin, which includes graphical labels to mark five points on the scale. The perceived arousal scale used in the pilot study did not include these labels, to maintain consistency with the perceived fear scale (for which graphical labels did not yet exist). Thus, in the pilot study, subjects rated their perceived arousal using only text-based labels (calm versus excited or agitated), so it is

possible that subjects' interpretations of these text-based labels did not correspond to the Self-Assessment Manikin's graphical labels. To mitigate this issue, Studies 1 and 2 will use Bradley and Lang's (1994) Self-Assessment Manikin (including the graphical labels).

Nevertheless, the correlation between the pilot sample's and IAPS manual's (Lang et al 2008) perceived arousal means provides evidence of convergent validity, which indicates that the perceived arousal measurement for the IAPS images in the pilot study was similar to that measurement in prior research. Consequently, the high positive correlation between the perceived arousal means of the pilot sample and of the IAPS data set (Lang et al 2008) suggests that the perceived arousal measure has reasonable construct validity for the IAPS images.

Affective Text Stimuli. Similar analyses were used to compare the pilot sample's perceived valence values associated with the Affective Text stimuli (see Table 6.9) to the established Affective Text valence values (see Table 6.4). Perceived valence values of the Affective Text stimuli for the pilot sample were significantly positively correlated with the established Affective Text valence values, Pearson's $r(11) = 0.94$, $p < 0.001$. A *t*-test was additionally conducted to verify that the average perceived valence levels in the pilot study and the corresponding measures in Strapparava and Mihalcea (2007) did not significantly differ from each other. Table 6.11 shows the mean difference in perceived valence for each Affective Text stimulus. The mean differences between perceived valences of the Affective Text data set and the pilot sample did not significantly differ from 0, $t\ (10) = 0.38$, $p = 0.71$. A power analysis using a medium effect size (Cohen 1988), alpha = 0.05, and a sample size of 11, resulted in a power of 0.32. This low statistical power indicates that the *t*-test has a reduced chance to detect a true significant difference between the perceived valence means of the pilot sample and those of the established Affective Text data (Strapparava and Mihalcea 2007). Nevertheless, the correlation between the pilot sample's and Strapparava and Mihalcea's (2007) perceived valence means and the *t*-test for perceived valence differences both provide evidence of convergent validity, and thereby support our measures of subjects' responses to the Affective Text stimuli.

TABLE 6.11. Differences in Perceived Valence between Affective Text and Pilot Study Subjects

Text ID	Affective Text Valence mean [a]	Pilot Valence mean (sd)[b]	Difference
545	3.80	3.63 (2.35)	0.17
600	7.08	5.78 (1.92)	1.30
615	2.28	2.88 (1.57)	-0.60
767	1.56	2.49 (1.49)	-0.93
965	4.04	3.08 (1.55)	0.96
1006	1.44	2.73 (1.44)	-1.29
1036	5.64	5.55 (1.55)	0.09
1109	8.24	8.29 (1.43)	-0.05
1117	7.88	6.61 (1.55)	1.27
1230	5.84	5.16 (0.88)	0.68
1484	6.36	6.84 (1.87)	-0.48

[a] Standard deviation values not available
[b] $N = 51$

6.6.3.2. Construct Validity of Perceived Fear

IAPS Stimuli. Barke (2012) provides emotion categories (e.g., fear) for all IAPS images used in this study (see Table 6.2). A dummy variable (isFear) was created for the IAPS images in this study based on whether the dominant emotion category reported in Barke (2012) was fear. Images with the dominant emotional category of fear were assigned the isFear value of 1, while all others (i.e., anger, sadness, joy, surprise, and disgust) were assigned the isFear value of 0. A Spearman rank-order correlation analysis was used to compare the pilot sample's mean perceived fear values (see Table 6.8) to these isFear values. Perceived fear values of the image stimuli for the pilot sample were significantly positively correlated with the isFear values, $r_s(16) = 0.93$, $p < 0.001$. This suggests that the perceived fear measure is sufficiently similar to perceived fear categorizations of IAPS images in prior research (Barke 2012) and provides evidence of convergent validity, thus supporting construct validity of the perceived fear measure for the IAPS stimuli used in the pilot study.

Affective Text Stimuli. Strapparava and Mihalcea (2007) provide emotion categories (e.g., fear) for all Affective Text stimuli used in this study (see Table 6.4). A dummy variable (isFear) was created for the Affective Text stimuli in this study based on whether the dominant emotion category reported in Strapparava and Mihalcea (2007) was fear. Sentences with the dominant emotion category of fear were assigned the isFear value of 1, while all others (i.e., anger, sadness, joy, surprise, and disgust) were

assigned the isFear value of 0. A Spearman rank-order correlation analysis was used to compare the pilot sample's mean perceived fear values associated with the text-based stimuli (see Table 6.9) to these isFear values. Perceived fear values of the text stimuli for the pilot sample were significantly positively correlated with the isFear emotion category values, r_s (11) = 0.95, $p < 0.001$. This correlation suggests that the perceived fear measure is sufficiently similar to perceived fear categorizations of Affective Text stimuli in prior research (Strapparava and Mihalcea 2007), and it provides evidence of convergent validity, thus supporting construct validity for perceived fear associated with the Affective Text stimuli used in the pilot study.

6.6.3.3. Construct Validity of Expressed Valence, Arousal, and Fear

Neither the IAPS data set nor the Affective Text data set includes values for expressed valence, arousal, and fear. Correlation analyses were used to compare the pilot sample's image-based mean perceived valence, arousal, and fear values to its mean expressed (i.e., FaceReader) valence, arousal, and fear values (see Table 6.8) to validate the emotion constructs. Perceived valence values of the image stimuli were not significantly correlated with the expressed valence values, Pearson's $r(14) = -0.2$, $p = 0.47$. Perceived arousal values of the image stimuli were not significantly correlated with the expressed arousal values, Pearson's $r(14) = -0.11$, $p = 0.69$. Perceived fear values of the image stimuli were not significantly correlated with the expressed fear values, Pearson's $r(14) = 0.23$, $p = 0.39$. In short, these results do not support convergent validity of the perceived and expressed dimensions of feeling state (valence, arousal, and fear) for the IAPS images. Because perceived valence, arousal, and fear have satisfactory construct validity, the lack of significant correlations between the perceived and expressed dimensions of feeling state suggests that the expressed valence, arousal, and fear measures for the IAPS images do not have sufficient construct validity.

Another series of correlation analyses compared the pilot sample's text-based mean perceived valence, arousal, and fear values to its mean expressed (i.e., FaceReader) valence, arousal, and fear values (see Table 6.9). Perceived valence values of the text stimuli were not significantly correlated with the expressed valence values, Pearson's $r(9) = -0.29$, $p = 0.39$. Perceived arousal values of the text stimuli

were not significantly correlated with the expressed arousal values, Pearson's $r(9) = -0.49$, $p = 0.13$. Perceived fear values associated with the text stimuli were not significantly correlated with the expressed fear values, Pearson's $r(9) = -0.06$, $p = 0.86$. These results do not provide evidence to support convergent validity of the perceived and expressed dimensions of feeling state (valence, arousal, and fear) for the Affective Text stimuli. Because perceived valence, arousal, and fear have satisfactory construct validity, the lack of convergence between the perceived and expressed measures for the Affective Text stimuli implies that expressed valence, arousal, and fear lack construct validity.

6.6.3.4. Construct Validity of Physiological (GSR) Arousal

A set of correlation analyses were used to compare physiological (i.e., GSR) arousal values to perceived arousal values (see Tables 6.8a and 6.8b) to help validate the arousal construct. Perceived arousal values of the IAPS stimuli were not significantly correlated with the physiological arousal values, Pearson's $r(14) = -0.18$, $p = 0.51$. Perceived arousal values of the Affective Text stimuli were not significantly correlated with the physiological arousal values, Pearson's $r(9) = 0.32$, $p = 0.33$. These results suggest that the perceived arousal values for image-based and text-based stimuli are not consistent with physiological manifestations of arousal (GSR). Therefore, the pilot study's results do not provide evidence to support the validity of the physiological arousal construct.

Correlation analyses were also used to compare physiological (i.e., GSR) arousal values to expressed (FaceReader) arousal values (see Tables 6.8 and 6.9) to evaluate arousal's construct validity using the image-based and text-based stimuli. For the IAPS stimuli, expressed arousal values were not significantly correlated with the associated physiological values, Pearson's $r(14) = -0.18$, $p = 0.51$. Expressed arousal values of the Affective text stimuli were not significantly correlated with the physiological arousal values, Pearson's $r(9) = 0.32$, $p = 0.33$. These results suggest that the expressed arousal values for image-based and text-based stimuli are not consistent with physiological manifestations of arousal (GSR), thereby providing no evidence of convergence between physiological arousal and expressed arousal, and thus not supporting the validity of the physiological arousal construct.

6.6.3.5. Issues with Valence, Arousal, and Fear Measurement and Construct Validation

The pilot study's results provide evidence to support measurement construct validity of the perceived valence, arousal, and fear construct dimensions of feeling state for both the IAPS stimuli and the Affective Text stimuli. At the same time, the results lack evidence to support the validity of the expressed valence, arousal and fear and the physiological arousal construct dimensions. It is possible that the perceived, expressed, and physiological dimensions of feeling state in internal emotional experience do not reflect a single underlying construct. This possibility is consistent with Elfenbein's (2007) explanation of display regulation, which involves "changing visible emotional expression without altering the underlying experience" (p. 337). Display regulation may have played a role in subjects suppressing their expressed emotional reactions, thereby creating disconnect between their emotional expression and their perceived feeling state. Subjects were notified that they would be recorded during the rating task in the informed consent form they signed upon registration for the study, and subjects also presumably were reminded of the recording during the webcam's configuration in the lab. Because subjects were aware that their expressions were being recorded, they may have been predisposed to focus on (and control) their expressions more than they naturally would, thus suppressing the emotional expressions that would be consistent with their self-reported valence, arousal, and fear.

Alternatively, instead of rating their own perceived valence, arousal, and fear for each stimulus, subjects may have rated the valence, arousal, and fear that they saw in each stimulus. Prior research has highlighted the potential relationship between subjects' emotion induced by stimuli and the emotion subjects recognize in stimuli (Kayser 2016). For example, the perception of facial expressions may elicit congruent expressions, resulting in (subconscious) mimicry (Dimberg and Thunberg 1998). Likewise, it is possible that emotional cues in a stimulus may cause a subject to report feeling a congruent emotion (i.e., demand characteristics), even if physiological manifestations or expressions of that emotion are not present in the subject. Such perceived mimicry could explain the lack of a correlation between perceived and expressed feeling state dimensions in the pilot study.

Tourangeau and Ellsworth (1979) summarize evidence for the various views on whether self-report, facial, and physiological measures of emotion should be positively correlated, and conclude that none of the evidence is decisive. Their study found that adopting a non-emotional expression does not prevent an emotional response (perceived) and found no correlation between facial expression and reported emotion. Furthermore, the physiological effects were not always consistent with facial expressions and reported emotions, but covering up an emotion facially (i.e., display regulation) was linked to increased physiological responding. The authors conclude that a "variety of cues – facial, physiological, situational – may enter into the subjective experience of an emotion… (but) the situational cues receive the most weight" (Tourangeau and Ellsworth 1979, p. 1530). Therefore, it is reasonable to argue that the situational cues evident in the pilot study's stimuli evoked emotional responses consistent with subjects' self-reported perceived valence, arousal, and fear.

The lack of a significant relationship among perceived, expressed, and physiological emotion is also consistent with a prior NeuroIS study investigating amygdala activation during exposure to security threat statements (Warkentin et al. 2016). Although that study found no fMRI evidence of text-based information security threats activating any limbic regions in the brain, regions involved in visual attention were activated, suggesting that threat-based stimuli increase attention more than neutral stimuli.

6.6.3.6. IAPS and Affective Text Measurement and Construct Validation Summary

The results of the pilot study provide evidence to support the construct validity of the valence, arousal, and fear construct dimensions of feeling state for the IAPS and Affective Text stimuli. However, there is a lack of evidence to support the construct validity of the expressed valence, arousal, and fear and the physiological arousal dimensions of feeling state for the IAPS and Affective Text stimuli. As discussed above, this lack of construct validity could exist due to display regulation or demand characteristics, and it is consistent with a recent NeuroIS study related to information security (Warkentin et al. 2016). Prior research suggests that perceptions can adequately measure subjective emotional experience (Tourangeau and Ellsworth 1979) and thus are sufficient for measuring the valence, arousal, and fear dimensions of feeling state. Although visceral (expressed and physiological) emotion is an

important characteristic of fear (Dimoka et al. 2011), given the lack of support for the validity of the expressed and physiological dimensions of feeling state, this dissertation will focus on perceived valence, arousal, and fear. Expressed valence, arousal, and fear, along with physiological arousal, will be explored further in a future study.

6.6.4. Identity Theft Treatment Stimuli Validation

With this evidence supporting the construct validity of our image-based and text-based perceptions of valence, arousal, and fear, it is reasonable to use these measurements to evaluate the construct validity of our identity theft perceptual stimuli created for this study. Our identity theft stimuli were designed to represent varying degrees of emotional interest, as well as varying degrees of verbalization in terms of threat severity and vulnerability.

Image-Based (Not IAPS) Treatment Stimuli. The identity theft (not IAPS) image-based stimuli created for this study (images 1001, 1002, 1003, and 1004) were designed to represent low (images 1001 and 1002) and high (images 1003 and 1004) emotional interest by adding visual elements related to the threat of identity theft. Image 1001 contains an illustration of a laptop to represent very low emotional interest. Image 1002 contains an illustration of the same laptop but adds a wallet next to the laptop to represent a slight increase in emotional interest. Image 1003 contains an illustration of a hand reaching through the same laptop (with no wallet) to represent high emotional interest. Finally, image 1004 contains an illustration of a hand reaching through the laptop toward the wallet, which also represents high emotional interest. Because increasing emotional interest in a fear appeal directly conveys danger, we expect emotional interest to increase fear. Fear and arousal should therefore increase and valence should decrease, based on the degree of emotional interest in the treatment images (e.g., in terms of fear: 1001 < 1002 < 1003 < 1004).

T-tests were conducted to investigate differences within the pilot sample between responses to the identity theft (not IAPS) image-based stimuli. As shown in Table 6.12, valence, arousal, and fear for image 1002 (computer and wallet) was not significantly different from that of image 1001 (computer). Likewise, fear and valence of image 1003 (hand and computer) were not significantly different from that of image 1004 (hand, computer, and wallet). In contrast, fear, valence, and arousal of images that

included the hand (1003 and 1004) were significantly different from those without the hand (1001 and 1002). That is, the fear and arousal for images with more emotional interest (1003 and 1004) were significantly greater than the corresponding measures for images with low emotional interest (1001 and 1002), while the valence for images with high emotional interest was significantly less (i.e., more negative) than the valence for images with low emotional interest. These results provide evidence that images 1001 and 1002 have similar (low) degrees of emotional interest and that images 1003 and 1004 likewise have similar (high) degrees of emotional interest. This is in accord with the theoretical rationales behind the creation of our identity theft images, and thereby provides evidence of divergent construct validity.

TABLE 6.12. Feeling State Mean Differences for Image-Based Identity Theft Stimuli

(a)

Stimulus	***n***	**Valence mean (sd)**	**Difference**	***t* (*p*)**
1001	51	5.59 (1.51)		
1002	51	5.55 (1.60)	1002-1001: -0. 04	-0.16 (0.87)
1003	51	3.04 (1.72)	1003-1002: -2.51 1003-1001: -2.55	-6.69 (0.00) -6.85 (0.00)
1004	51	2.80 (1.61)	1004-1003: -0.24 1004-1002: -2.75 1004-1001: -2.78	-1.43 (0.16) -7.66 (0.00) -8.16 (0.00)

(b)

Stimulus	***n***	**Arousal mean (sd)**	**Difference**	***t* (*p*)**
1001	51	4.02 (2.17)		
1002	51	4.10 (2.09)	1002-1001: 0.08	0.24 (0.81)
1003	51	6.61 (1.55)	1003-1002: 2.51 1003-1001: 2.59	6.93 (0.00) 6.65 (0.00)
1004	51	7.08 (1.38)	1004-1003: 0.47 1004-1002: 2.98 1004-1001: 3.06	2.37 (0.02) 8.95 (0.00) 8.49 (0.00)

TABLE 6.12 (continued). Feeling State Mean Differences for Image-Based Identity Theft Stimuli

(c)

Stimulus	*n*	Fear mean (sd)	Difference	*t* (*p*)
1001	51	3.43 (2.17)		
1002	51	3.71 (2.43)	1002-1001: 0.28	0.60 (0.55)
1003	51	6.45 (2.00)	1003-1002: 2.74 1003-1001: 3.02	6.23 (0.00) 7.31 (0.00)
1004	51	6.65 (2.07)	1004-1003: 0.20 1004-1002: 2.94 1004-1001: 3.22	0.49 (0.63) 6.59 (0.00) 7.67 (0.00)

Text-Based (Not IAPS) Treatment Stimuli. As previously defined, threat severity refers to the significance or magnitude of a threat conveyed in a fear appeal, while threat vulnerability refers to the extent to which a fear appeal conveys one's likelihood of experiencing a threat. By increasing threat severity and threat vulnerability, a fear appeal can elicit a greater emotional response based on the functional evolutionary perspective on fear (Öhman 1994).

The identity theft (not Affective Text) threat severity stimuli created for this study (sentences 1 and 2) were designed to convey different degrees of threat severity by increasing the financial consequences of the threat's occurrence. Sentence 1 states "victims pay nothing to resolve identity theft linked to weak passwords" to represent low threat severity. Sentence 2 states that "victims pay high legal fees to resolve identity theft linked to weak passwords" to represent high threat severity. Likewise, the identity theft (not Affective Text) threat vulnerability stimuli created for this study (sentences 3 and 4) were designed to convey different levels of threat vulnerability by increasing the likelihood of the threat's occurrence. Sentence 3 states "few identity theft occurrences can be linked to weak passwords" to represent low threat vulnerability. Sentence 4 states that "most identity theft occurrences can be linked to weak passwords" to represent high threat vulnerability. Because higher levels of threat severity and threat vulnerability directly convey dimensions of danger, we expect threat severity and threat vulnerability to increase arousal and fear and to decrease valence, based on the degree of threat severity and threat vulnerability in the treatment sentences (e.g., in terms of fear: 1 < 2 and 3 < 4).

T-tests were conducted to determine whether the mean valence, arousal, and fear values significantly differed between the high and low threat severity stimuli and between the high and low threat vulnerability stimuli. As shown in Table 6.13, arousal and fear for the high threat severity stimulus (stimulus 2) were significantly greater than that of the low threat severity stimulus (1), while valence for the high threat severity stimulus was significantly less than that of the low threat severity stimulus. Likewise, arousal and fear for the high threat vulnerability stimulus (4) were significantly greater than those of the low threat vulnerability stimulus (3), while valence for the high threat vulnerability stimulus was significantly less than that of the low threat vulnerability stimulus. These results provide evidence that the fear evoked by the text-based identity theft stimuli with high threat severity and vulnerability was significantly greater than that evoked by the neutral text-based identity theft stimuli (with low threat severity and vulnerability). This is consistent with the theoretical rationales behind the creation of our text-based identity theft stimuli, and thereby provides evidence of divergent construct validity.

TABLE 6.13. Feeling State Mean Differences for Text-Based Identity Theft Stimuli

(a)

Stimulus	***n***	**Valence** $\bar{x}$ **(sd)** [a]	**Difference**	***t* (*p*)**
1	51	5.24 (2.82)	2-1: -3.25	-7.38 (0.00)
2	51	1.98 (1.29)		
3	50	4.96 (2.37)	4-3: -1.52	-3.98 (0.00)
4	50	3.44 (1.77)		

(b)

Stimulus	***n***	**Arousal** $\bar{x}$ **(sd)** [a]	**Difference**	***t* (*p*)**
1	51	5.04 (2.28)	2-1: 1.53	4.40 (0.00)
2	51	6.57 (1.71)		
3	50	4.92 (1.89)	4-3: 0.76	2.36 (0.02)
4	50	5.68 (1.96)		

(c)

Stimulus	***n***	**Fear** $\bar{x}$ **(sd)** [a]	**Difference**	***t* (*p*)**
1	51	3.90 (1.80)	2-1: 2.08	7.02 (0.00)
2	51	5.98 (1.71)		
3	50	4.60 (2.25)	4-3: 1.64	4.29 (0.00)
4	50	6.24 (2.17)		

Identity Theft Treatment Stimuli Conclusions. The results of the analyses described above provide sufficient evidence to support the construct validity and therefore the use of our identity theft images and sentences as stimuli that represent different degrees of emotional interest, threat severity, and threat vulnerability in Study 1. First, the arousal and fear of the high emotional interest images were significantly greater than those of the low emotional interest images, while the valence of the high emotional interest images was significantly less than that of the low emotional interest images. Likewise, the arousal and fear of the high threat severity sentence were significantly greater than those of the low threat severity sentence, while the valence of the high threat severity sentence was significantly less than that of the low threat severity sentence. Finally, the arousal and fear of the high threat vulnerability sentence were significantly greater than those of the low threat vulnerability sentence, just as the valence of the high threat vulnerability sentence was significantly less than that of the low threat vulnerability sentence. Overall, the results of the pilot study suggest that the identity theft stimuli created for this study (1, 2, 3, 4, 1001, 1002, 1003, and 1004) are acceptable to use in Study 1.

6.7. Discussion and Conclusion

The pilot study focused on validating the valence, arousal, and fear measurements that were intended to represent the three construct dimensions of feeling state. Based on the pilot study's results, we can conclude that these measures have reasonable construct validity and are thus acceptable to use in Study 1. However, the results do not provide evidence to support the construct validity of expressed valence, arousal, and fear, nor evidence to support the construct validity of physiological arousal measures. Therefore, expressed valence, arousal, and fear, along with physiological arousal, will be explored further in future research, but not be employed in this dissertation's studies.

The pilot study also focused on developing the images and sentences associated with identity theft to establish the stimuli for Study 1. A set of images was designed to represent high and low emotional interest, while a set of sentences was created to represent high and low threat severity and threat vulnerability. The pilot study provided evidence of construct validity for the identity theft stimuli designed to represent high versus low emotional interest, threat severity, and threat vulnerability, as well

as evidence of construct validity for the high (images 1003 and 1004) and low (images 1001 and 1002) identity theft emotional interest stimuli. Fear is a reaction to a particular threat (Witte 1992). Based on the valence, arousal, and fear subjects reported in response to our identity theft images and sentences in the pilot study, we can conclude that the stimuli designed to represent high emotional interest and threat verbalization conveyed more of a threat than the stimuli designed to represent low emotional interest and threat verbalization. All of the identity theft stimuli are thus acceptable to use with the IAPS and Affective Text stimuli from the pilot study as part of the rating task in Study 1.

The pilot study also quantified threat severity and threat vulnerability by determining the dollar amount for threat severity and the percentage amount for threat vulnerability associated with identity theft. The value three standard deviations above the mean of the response to the question "what is the minimum financial cost of identity theft that would make you think identity theft is a **severe** threat" (from the pilot study survey) will represent high threat severity in Study 1. Therefore, sentence 2 will be changed to "Victims pay an average of $9,575 in legal fees to resolve identity theft linked to weak passwords" in Study 1. Sentence 1 ("Victims are not responsible for costs resulting from identity theft linked to weak passwords") will continue to be used to represent low threat severity. Likewise, the value two standard deviations above the mean of the response to the question "what is the minimum likelihood of identity theft linked to weak passwords that would make you feel **vulnerable** to identity theft" (from the pilot study survey) will represent high threat vulnerability in Study 1. Therefore, sentence 4 will be changed to "99% of identity theft occurrences can be linked to weak passwords". The value two standard deviations below the mean of the response to this question will represent low threat vulnerability, so sentence 3 will be changed to "Less than 9% of identity theft occurrences can be linked to weak passwords". Note that we could not use three standard deviations per our original plan for threat vulnerability due to the upper vulnerability likelihood limit of 1.00.

The pilot study additionally established the labels (emoticons) for relative amounts of fear in the fear rating scale. The five emoticons in the correct order with the smallest overlap in standard deviations were selected from subjects' ranking of emoticons in the pilot study. Therefore, the labels for the fear

rating scale were determined to be the expressionless face, slightly frowning face, worried face, fearful face, and face screaming in fear (Unicode 2016), representing the range from unafraid to afraid. The neutral face and anguished face (Unicode 2016) will not be used in the fear rating scale in Study 1.

The pilot study finally was intended to verify that the study protocols proceed as intended and additionally provided an opportunity to identify potential issues with the survey (which captured subjects' perceptions) prior to the full data collection effort. Based on the pilot study feedback, subjects were able to follow the instructions and answer the questions without any confusion, so the study protocols were determined to be acceptable for the subsequent studies.

Chapter 7

STUDY 1: HOW FEAR APPEAL COMPONENTS INDIVIDUALLY INFLUENCE FEAR

Study 1 focuses on a fear appeal's threat severity, threat vulnerability, and emotional interest separately to better identify the different roles that they can play in terms of eliciting fear. Focusing on a fear appeal's threat severity and threat vulnerability separately will allow us to better identify the extent to which each threat-based text component of a fear appeal can affect fear. Likewise, the focus on emotional interest alone is important because images have the potential to elicit strong emotions, yet they remain overlooked as a component of fear appeal models. This study provides initial evaluations of, and support for, hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}c}$.

7.1. Operationalization of Feeling State and External Emotional Expression

Just as it was in the pilot study, feeling state was operationalized using three semantic differential scales measuring fear, valence, and arousal, with the fear scale representing the discrete emotions approach and the valence and arousal scales representing the dimensional approach (see Chapter 6). The *fear* item was based on emoticons showing increasing expressions of fear (unafraid to afraid), as determined by the pilot study. The *valence* item consisted of a happy-to-unhappy scale based on Bradley and Lang's (1994) Self-Assessment Manikin. The *arousal* item likewise consisted of a calm to agitated or excited semantic differential scale based on Bradley and Lang's (1994) Self-Assessment Manikin.

External emotional expression was operationalized based on FaceReader analyses of subjects' facial expressions, as described in Chapter 6. A video recording of each subject was analyzed using Noldus FaceReader, which calculated measurements of expressed valence, arousal, and fear based on changes in a subject's facial expression using Ekman's (1984) Facial Action Coding System.

FaceReader calculated *expressed valence* based on the intensity of expressed positive emotion minus the intensity of expressed negative emotion. FaceReader calculated *expressed arousal* based on the activation values of the 20 action units (Ekman and Friesen 1978), listed in Table 6.1. FaceReader also calculated *expressed fear* based on the activation values of seven action units (Ekman and Friesen 1978), as described in Chapter 6.

7.2. Stimuli for the Manipulation of Threat-Related Fear Appeal Components

Twenty sentences and twenty images were used as stimuli in this study, just as in the pilot study (see Chapter 6 for more details). The text-based stimuli included 11 headlines selected from the Affective Text dataset (sentences starting at 545) (Strapparava and Mihalcea 2007), four sentences describing threat severity or threat vulnerability associated with the information security threat of identity theft (sentences 1-4), and five sentences associated with the threat of terrorism (sentences 5-9), as summarized in Table 7.1.

TABLE 7.1. Text-Based Stimuli for Study 1

Text ID	Sentence
1	Victims are not responsible for identity theft costs linked to weak passwords
2	Victims pay an average of $9,575 in legal fees to resolve identity theft linked to weak passwords
3	Less than 9% of identity theft occurrences are linked to weak passwords
4	99% of identity theft occurrences are linked to weak passwords
5	Anti-terror protesters detained after weekend violence in Houston
6	Terror suspects detained after weekend violence in Houston
7	Terror suspects detained after weekend violence in North Africa
8	Anti-terror protesters detained after weekend violence in North Africa
9	Houston feared as staging ground for terror
545	Two detained in body parts mailing
600	Man rides stationary bike for 85 hours
615	Anger at release of two held over beheading plot
767	Bigger, more aggressive rats infesting UK
965	Venezuela, Iran fight U.S. dominance
1006	North Africa feared as staging ground for terror
1036	VP starts visit to Japan, Australia
1109	Retinal implants helping blind people see again
1117	Scientists tout cocoa’s health benefits
1230	Vietnamese bank plans IPO listing
1484	Marijuana helps ease HIV nerve pain, study says

The Affective Text sentences were chosen to represent the conventional categories of emotion (Ekman 1992): fear, surprise, anger, joy, sadness, and disgust, in addition to neutral emotion. The sentences describing threats related to terrorism were included to divert subjects' focus from the treatment stimuli's emphasis on passwords and identity theft. All of the text-based stimuli were displayed in a black Times New Roman font and centered on a white background.

Threat severity was manipulated in terms of the financial cost associated with identity theft that occurs because of weak passwords. The sentences with text IDs of 1 and 2 were designed to represent low and high degrees of threat severity. The pilot study determined that high threat severity for identity theft had a potential loss of $9,575, which was 3 standard deviations above the mean of the response to "what is the minimum financial cost of identity theft that would make you think identity theft is a severe threat". A zero value was used to represent low threat severity ("victims are not responsible for costs…"). Therefore, sentence 1, "Victims are not responsible for identity theft costs linked to weak passwords," described the lack of a financial consequence to identity theft to represent low threat severity. Sentence 2, "Victims pay an average of $9,575 in legal fees to resolve identity theft linked to weak passwords," described the high cost of identity theft to represent high threat severity.

Threat vulnerability was manipulated in terms of the percentage of identity theft linked to weak passwords. Sentences with text IDs 3 and 4 were designed to represent low and high threat vulnerability. The pilot study determined the percentage used in the high and low threat vulnerability sentences. The value 2 standard deviations above the mean of the response to "what is the minimum likelihood of identity theft linked to weak passwords that would make you feel vulnerable to identity theft" was 99%, so this percentage was used to represent high threat vulnerability; the value two standard deviations below the mean of the response to that question was 9%, so this percentage was used to represent low threat vulnerability (it was not possible to use three standard deviations per the original plan due to the upper vulnerability likelihood limit of 1.00). Sentence 3, "Less than 9% of identity theft occurrences are linked to weak passwords," described the low likelihood of identity theft linked to weak passwords to represent low threat vulnerability. Sentence 4, "99% of identity theft occurrences are linked to weak passwords,"

described the high likelihood of identity theft linked to weak passwords to represent high threat vulnerability.

The image-based stimuli included 16 images selected from the International Affective Picture System (IAPS: Lang et al. 2008), and four images associated with the information security threat of identity theft. The IAPS images were chosen to represent the conventional categories of emotion (Ekman 1992), as well as neutral images that evoke little or no emotion. Emotional interest was operationalized by manipulating elements of an image that illustrated the danger associated with identity theft, as validated in the pilot study. Four images were used to represent low (images 1001 and 1002) and high (images 1003 and 1004) emotional interest.

7.2. Method

Threat severity, threat vulnerability, and emotional interest were manipulated in a lab experiment. 71 subjects (56% female) were recruited from an undergraduate Management Information Systems course that is required for all undergraduate business students. Subjects were volunteers who received extra credit and entry into a raffle as incentives for participation. The experiment involved showing subjects a set of sentences and images related to the threat of identity theft. Subjects indicated how each stimulus made them feel in terms of valence, arousal, and fear using the scales validated in the pilot study. Subjects completed the experimental task in groups of up to 10.

The experiment separately manipulated threat severity (low/high), threat vulnerability (low/high), and emotional interest (low/high), resulting in the treatments shown in Table 7.2. Each subject was exposed to all treatments (randomly ordered).

TABLE 7.2. Study 1 Manipulations

(a)

Stimulus	Description	Threat Severity
1	Victims are not responsible for identity theft costs linked to weak passwords	Low
2	Victims pay an average of $9,575 in legal fees to resolve identity theft linked to weak passwords	High

TABLE 7.2 (continued). Study 1 Manipulations

(b)

Stimulus	Description	Threat Vulnerability
3	Less than 9% of identity theft occurrences are linked to weak passwords	Low
4	99% of identity theft occurrences are linked to weak passwords	High

(c)

Stimulus	Description	Emotional Interest
1001	Computer	Low
1002	Wallet and computer	Low
1003	Hand and computer	High
1004	Hand, wallet, and computer	High

The detailed procedure (including screenshots) is provided in Appendix C (the following is a summary of the procedure). Each subject was directed to an open seat facing a laptop in the lab (Melcher 290G). Laptops were set up so that subject could not see each other's screens. Each laptop displayed an explanation of the task. Each laptop's webcam was calibrated so that each subject's facial expressions could be recorded. Subjects began the experimental task by clicking "next" on the bottom of the screen. Half of the subjects were shown a series of images first, and the rest of the subjects were shown a series of sentences first (just as in the rating task procedure described in Chapter 6). The treatment images and sentences related to identity theft were randomly interspersed with the Affective Text and IAPS stimuli from the pilot study. Prior to each stimulus, a blank screen appeared for five seconds, acting as a buffer between stimuli. Above each stimulus, subjects were prompted to indicate how each stimulus made them feel in terms of valence (happy to unhappy), arousal (calm to agitated or excited), and fear (unafraid to afraid).

7.3. Analysis and Results

7.3.1. Text Labels vs. Emoticon Labels

The valence, arousal, and fear scales in Study 1 were like those used in the pilot study. However, the scales used in Study 1 also included emoticons as labels. This was done to maintain consistency with the Self-Assessment Manikin (Bradley and Lang 1994) valence and arousal scales, which include emoticon labels. Based on the results of the pilot, emoticon labels were selected for the fear scale to make

that scale consistent with the valence and arousal scales used in the study. Because the valence, arousal, and fear items in the Study 1 included emoticons, unlike the pilot study, a set of correlation analyses was used to compare the pilot sample's mean valence, arousal, and fear values to the associated means in Study 1, which included the emoticon labels. As shown in Table 7.3, valence, arousal, and fear values from the pilot sample of 41 stimuli were positively correlated with their associated values from the Study 1 sample of the same stimuli. These results suggest that the scales with emoticons (used in Study 1) were sufficiently similar to the validated scales without emoticons that were used in the pilot study.

TABLE 7.3. Correlations between Pilot and Study 1 Stimulus Ratings

Purpose	**Data**	***r*(*df*)**
valence scale validation	Pilot (no emoticons) vs. Study 1 (emoticons) valence	0.98 (39)***
arousal scale validation	Pilot (no emoticons) vs. Study 1 (emoticons) arousal	0.88 (39)***
fear scale validation	Pilot (no emoticons) vs. Study 1 (emoticons) fear	0.97 (39)***

*** $p < 0.001$

Because of the significant difference that was found for the average arousal values between IAPS stimuli in the pilot study and the corresponding values in Lang et al. (2008), a one-sample *t*-test was conducted to determine whether using emoticon labels for the arousal scale in Study 1 eliminated this difference. However, the mean difference in arousal was still significantly different from 0, $t(15) = -2.08$, $p = 0.046$. Although the differences in arousal between Study 1 and the corresponding values in Lang et al. (2008) were slightly less than in the pilot study, including emoticon-based labels for the arousal scale did not eliminate the significant difference. Because Study 1 focuses on the arousal evoked by the treatment stimuli, as opposed to the IAPS stimuli, the significant difference in arousal for the IAPS images between Study 1 subjects and the corresponding values in Lang et al. (2008) should not influence the analyses for Study 1. Furthermore, because the Study 1 subjects tended to exhibit lower arousal than the IAPS population (Lang et al. 2008), if the Study 1 subjects indicate a high level of arousal for certain stimuli, we can conclude that the general population's arousal for the same stimuli may be even greater.

7.3.2. Hypotheses 1_a, 2_a, and 3_a – The Influence of Threat Severity on Feeling State

As previously defined, feeling state represents an individual's subjective experience of emotion, and includes dimensions of valence, arousal, and emotional category (such as fear). Hypothesis 1_a predicted that threat severity in a fear appeal will decrease valence. Hypothesis 2_a similarly predicted that threat severity in a fear appeal will increase arousal, while hypothesis 3_a predicted that threat severity will increase fear. Because threat severity, threat vulnerability, and emotional interest were manipulated in separate treatment stimuli, three separate models were needed to evaluate each variable's influence on subjects' feeling states. Therefore, the partial least squares (PLS) method of structural equation modeling was first used to construct a measurement model based on threat severity data obtained from a sample of 71 subjects (56% female). Smart PLS version 3.2.6 (Ringle et al. 2015) was used to analyze the relationships between threat severity and valence, arousal, and fear.

The first phase of the threat severity analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. For reflective items to reliably measure their intended constructs, each item's loading should exceed 0.7 (Chin 1998). As shown in Table 7.4, the loadings of valence, arousal, and fear all met these criteria. Because threat severity only has a single item (a dichotomous dummy variable), its loading on threat severity was 1.

TABLE 7.4. Item Loadings on Feeling State

	Feeling state
valence	-0.88
arousal	0.88
fear	0.83

Average variance extracted (AVE) can be interpreted as an additional measure of reliability for constructs. AVE estimates the amount of variance in a construct that is due to its items as opposed to the amount due to measurement error and should be greater than 0.50 (Chin 2010). That is, at least 50 percent of the variance in the construct's component score should be attributed to the construct's items as opposed to measurement error (Fornell and Larcker 1981). As shown in Table 7.5, feeling state exceeded this minimum. Composite reliability is a measure of internal consistency calculated based on factor

loading, factor variance and unique/error variance. This measure differs from Cronbach's alpha because it avoids the assumption that all construct measures have equal weights, making it a closer approximation of the reliability estimate (Chin and Gopal 1995). Composite reliability measures the extent to which reflective items share in their measurement of a common construct, and it should be considered acceptable if it is greater than 0.7 (Nunnally and Bernstein 1994). As shown in Table 7.5, feeling state exceeded this minimum. Each item should strongly relate to the construct it attempts to reflect and should not have a stronger connection with another construct (Chin 2010). When each item loads higher on its own construct than on other constructs, we can claim discriminant validity at the item level. As shown in Table 7.5, the average variance extracted for feeling state is greater than the squared correlation of feeling state with threat severity, which supports discriminant validity. Examining item loadings also can provide evidence of convergent validity, which indicates the extent to which a construct's items converge in their representation of that construct (Chin 2010). Relatively high loadings for a construct's designated items that have a narrow range (such as between 0.7 and 0.9) provide greater confidence that those items can estimate the underlying construct. The loadings above 0.80 for arousal, fear, and valence (shown in Table 7.4), support convergent validity for feeling state.

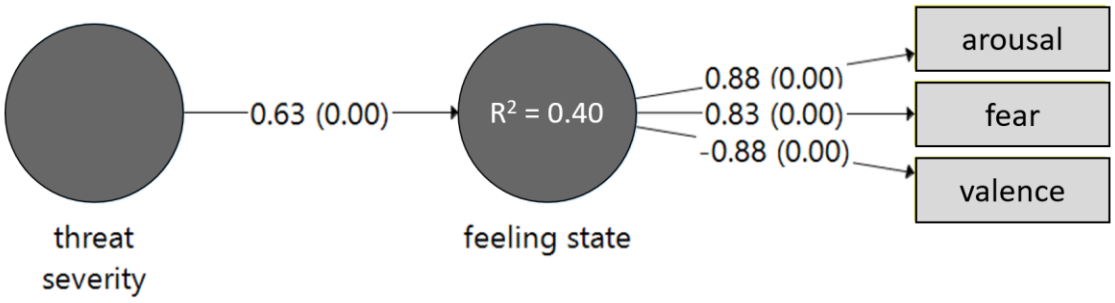
TABLE 7.5. Composite Reliability, Average Variance Extracted, and Squared Correlations

Composite Reliability	**Average Variance Extracted**		Feeling state	Threat severity
0.90	0.75	Feeling state	1	
1.00	1.00	Threat severity	0.40	1

Because PLS makes no distributional assumption, traditional parametric techniques for significance testing and evaluation are not appropriate (Chin 1998). Therefore, evaluation of PLS models involves nonparametric, prediction-oriented measures (e.g. R^2) and resampling procedures (e.g. bootstrapping). R^2 values indicate the predictive power of a structural model by representing the amount of a construct's variance that is explained by the model, so an initial evaluation of the threat severity structural model involved using PLS to examine the R^2 values for each dependent construct in the structural model (Chin 2010). Therefore, a bootstrap based on 3,000 resamples was used to evaluate the

threat severity structural model. The structural model's path coefficients and *p* values based on the bootstrap analysis are shown in Figure 7.1, along with the R^2 value for feeling state.

FIGURE 7.1. Threat Severity Structural Model
(*p* values in parentheses)



The results of the threat severity structural model evaluation provide evidence to support hypotheses 1_a, 2_a, and 3_a. The arousal, fear, and valence loadings are all significant, $p < 0.001$. The effect size f^2 indicates the extent to which a particular latent variable has a substantive impact on a dependent latent variable given the change in R^2 values provided on the dependent latent variable when the predictor variable is included or omitted in the structural equation, such that f^2 values of 0.02, 0.15, and 0.35 indicate whether a predictor variable has a small, medium, or large effect, respectively, at the structural level (Chin 2010). The threat severity structural model indicates a large effect ($f^2 = 0.66$) of threat severity on feeling state ($R^2 = 0.40$). The large effect of threat severity on feeling state, together with the significant loadings of valence, arousal, and fear on feeling state, indicate that threat severity decreases valence ($H1_a$) and increases arousal ($H2_a$) and fear ($H3_a$).

7.3.3. Hypotheses 1_b, 2_b, and 3_b – The Influence of Threat Vulnerability on Feeling State

$H1_b$ predicted that threat vulnerability in a fear appeal will decrease valence of an individual's feeling state. $H2_b$ similarly predicted that threat vulnerability in a fear appeal will increase an individual's arousal, while $H3_b$ predicted that threat vulnerability will increase an individual's fear. The partial least squares (PLS) method of structural equation modeling was used to construct a measurement model based on threat vulnerability data obtained from a sample of 71 subjects (56% female).

The first phase of the threat vulnerability analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. As shown in Table 7.6, the loadings of valence, arousal, and fear all met these criteria. Because threat vulnerability only has a single item (a dichotomous dummy variable with a value of 0 for the low threat vulnerability identity theft stimulus and 1 for the high threat vulnerability stimulus), its loading on threat vulnerability was 1.

TABLE 7.6. Item Loadings on Feeling State

	Feeling state
valence	-0.90
arousal	0.88
fear	0.84

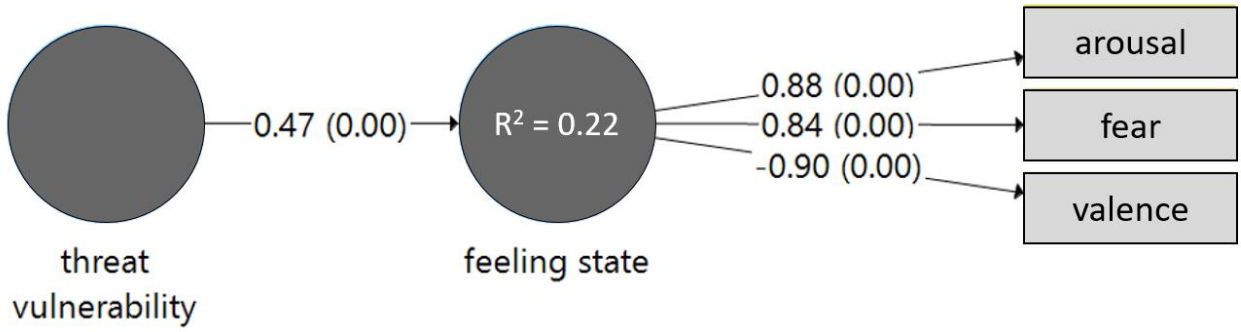
All variables also met or exceeded the minimum cutoffs suggested for composite reliability and average variance extracted, as shown in Table 7.7. Feeling state's average variance extracted is also greater than its squared correlation with any other latent construct. Therefore, the results support feeling state's reliability and convergent and discriminant validities.

TABLE 7.7. Composite Reliability, Average Variance Extracted, and Squared Correlations

Composite Reliability	**Average Variance Extracted**		Feeling state	Threat vulnerability
0.91	0.77	Feeling state	1	
1.00	1.00	Threat vulnerability	0.22	1

An initial evaluation of the threat vulnerability structural model involved using PLS to examine the path coefficient and R^2 values in the structural model. A bootstrap based on 3,000 resamples was then used to calculate *p* values for the path coefficient and item loadings in the threat vulnerability structural model. The structural model's path coefficients and *p* values based on the bootstrap analysis are shown in Figure 7.2, along with the R^2 value for feeling state.

FIGURE 7.2. Threat Vulnerability Structural Model
(*p* values in parentheses)



The results of the threat vulnerability structural model evaluation provide evidence to support $H1_b$, $H2_b$, and $H3_b$. The arousal, fear, and valence loadings are all significant, $p < 0.001$. Additionally, the threat vulnerability structural model indicates a medium effect ($f^2 = 0.28$) of threat severity on feeling state ($R^2 = 0.22$). The medium effect of threat vulnerability on feeling state, together with the significant loadings of valence, arousal, and fear on feeling state, indicate that threat vulnerability decreases valence ($H1_b$) and increases arousal ($H2_b$) and fear ($H3_b$).

7.3.3. Hypotheses 1_c, 2_c, and 3_c – The Influence of Emotional Interest on Feeling State

$H1_c$ predicted that the emotional interest dimension of pictorial vividness in a fear appeal will decrease valence. $H2_c$ similarly predicted that emotional interest in a fear appeal will increase arousal, while $H3_c$ predicted that emotional interest will increase fear. The partial least squares (PLS) method of structural equation modeling was used to construct a measurement model based on emotional interest data obtained from a sample of 71 subjects (56% female).

The first phase of the emotional interest analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. As shown in Table 7.8, the loadings of valence, arousal, and fear all met these criteria. Because emotional interest only has a single item (a dichotomous dummy variable with a value of 0 for the low emotional interest identity theft stimuli and 1 for the high emotional interest stimuli), its loading on emotional interest was 1.

TABLE 7.8. Item Loadings on Feeling State

	Feeling state
valence	-0.88
arousal	0.92
fear	0.92

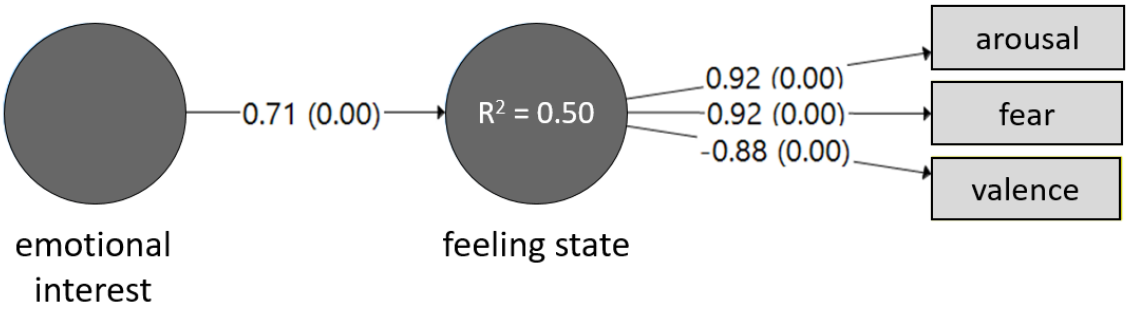
All variables also met or exceeded the minimum cutoffs suggested for composite reliability and average variance extracted, as shown in Table 7.9. Feeling state's average variance extracted is also greater than its squared correlation with any other latent construct. Therefore, the results support feeling state's reliability and convergent and discriminant validities.

TABLE 7.9. Composite Reliability, Average Variance Extracted, and Squared Correlations

Composite Reliability	**Average Variance Extracted**		Feeling state	Emotional interest
0.93	0.82	Feeling state	1	
1.00	1.00	Emotional interest	0.50	1

An initial evaluation of the emotional interest structural model involved using PLS to examine the path coefficient and R^2 values in the structural model. A bootstrap based on 3,000 resamples was then used to calculate *p* values for the path coefficient and item loadings in the emotional interest structural model. The structural model's path coefficients and *p* values based on the bootstrap analysis are shown in Figure 7.3, along with the R^2 value for feeling state.

FIGURE 7.3. Emotional Interest Structural Model
(*p* values in parentheses)



The results of the emotional interest structural model evaluation provide evidence to support $H1_c$, $H2_c$, and $H3_c$. The arousal, fear, and valence loadings are all significant, $p < 0.001$. Additionally, the emotional interest structural model indicates a large effect ($f^2 = 1.02$) of emotional interest on feeling state

(R^2 = 0.50). The large effect of emotional interest on feeling state, together with the significant loadings of valence, arousal, and fear on feeling state, indicate that emotional interest decreases valence ($H1_c$), and increases arousal ($H2_c$) and fear ($H3_c$).

7.4. Conclusion

Study 1 investigated the extent to which threat severity, threat vulnerability, and emotional interest associated with an information security threat separately evoke fear. Therefore, this study measured subjects' valence, arousal, and fear in response to stimuli related to identity theft. As summarized in Table 7.10, the results of Study 1 provided evidence to support all the hypotheses tested.

TABLE 7.10. Tests of Emotion Process Model Hypotheses

Hypothesis	Prediction	Result
1a	Threat severity decreases feeling state valence	Supported
1b	Threat vulnerability decreases feeling state valence	Supported
1c	Emotional interest decreases feeling state valence	Supported
2a	Threat severity increases feeling state arousal	Supported
2b	Threat vulnerability increases feeling state arousal	Supported
2c	Emotional interest increases feeling state arousal	Supported
3a	Threat severity increases feeling state fear	Supported
3b	Threat vulnerability increases feeling state fear	Supported
3c	Emotional interest increases feeling state fear	Supported

Based on the results of Study 1, we can conclude that threat severity, threat vulnerability, and emotional interest all separately influence the valence, arousal, and fear dimensions of feeling state. The threat severity, threat vulnerability, and emotional interest structural models suggest that emotional interest had the greatest individual effect on feeling state, followed by threat severity and then threat vulnerability, based on the f^2 values summarized in Table 7.11 below. This result implies that emotional interest is an important component of fear appeals that can convey threat as much as (if not more than) the conventional text-based threat severity and threat vulnerability components.

TABLE 7.11. Effects (f^2) of Fear Appeal Components on Feeling State (R^2)

	f^2	R^2
Threat Severity	0.66	0.40
Threat Vulnerability	0.28	0.22
Emotional Interest	1.02	0.50

Additionally, Study 1 found that the effect of threat severity, threat vulnerability, and emotional interest on feeling state was balanced among the valence, arousal, and fear dimensions of feeling state. This result suggests that the threat-based components of a fear appeal do not necessarily influence any particular dimension of feeling state more than the others, which implies that increasing any of the threat-related components of a fear appeal can result in an increase in all of the dimensions of feeling state.

The next study (Study 2) will build upon these results and further explore the emotional impact of a fear appeal by investigating how different combinations of threat severity, threat vulnerability, and emotional interest influence feeling state.

Chapter 8

STUDY 2: How Fear Appeal Components Combine to Elicit Fear

Study 1 investigated a fear appeal's threat severity, threat vulnerability, and emotional interest as separate components, and provided initial support for hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}c}$. Study 2 examines these hypotheses when threat severity and threat vulnerability are combined (forming threat verbalization) and when threat verbalization is combined with emotional interest. This allows us to identify the extent to which these fear appeal components can work together to elicit fear.

8.1. The Influence of Combined Threat Severity and Threat Vulnerability on Feeling State

The first part of Study 2 consisted of a lab experiment that manipulated threat severity and threat vulnerability to test whether the relationships in hypotheses $1_{a\text{-}b}$, $2_{a\text{-}b}$, and $3_{a\text{-}b}$ (between threat severity and vulnerability and feeling state valence, arousal, and fear) persist when threat severity and vulnerability appear together.

Just as it was in Study 1, feeling state was operationalized using three semantic differential scales measuring fear, valence, and arousal. The *fear* item was based on emoticons showing increasing expressions of fear (unafraid to afraid), as determined by the pilot study. The *valence* item consisted of a happy-to-unhappy scale based on Bradley and Lang's (1994) Self-Assessment Manikin. The *arousal* item likewise consisted of a calm-to-agitated or excited semantic differential scale based on Bradley and Lang's (1994) Self-Assessment Manikin.

8.1.1. Stimuli for the Manipulation of Threat Verbalization

The threat severity and threat vulnerability sentences from Study 1 were used to develop four threat verbalization stimuli, as shown in Table 8.1 (stimulus IDs 10-13). Each threat verbalization stimulus included a low or high severity sentence paired with a low or high vulnerability sentence.

We expect increasing threat verbalization to decrease valence and to increase arousal and fear. Therefore, the stimulus with low threat severity and vulnerability (sentence 10) should be characterized by low arousal and fear and neutral (neither positive nor negative) valence, while the stimulus with high threat severity and vulnerability (sentence 11) should be characterized by low valence and high arousal and fear. The sentences with mixed levels of severity and vulnerability (sentences 12 and 13) should be characterized by valence, arousal, and fear levels between those of sentences 10 and 11.

TABLE 8.1. Text-Based Stimuli for Study 2

Stimulus ID	Sentence(s)	Threat Severity	Threat Vulnerability
10	Victims are not responsible for any costs resulting from identity theft. Less than 9% of identity theft occurrences can be linked to weak passwords.	Low	Low
11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.	High	High
12	Victims pay an average of $9,575 in legal fees to resolve identity theft. Less than 9% of identity theft occurrences can be linked to weak passwords.	High	Low
13	Victims are not responsible for any costs resulting from identity theft. 99% of identity theft occurrences are linked to weak passwords.	Low	High
14*	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.	Low	Low
15*	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.	High	High
16*	Terror suspects draw attention after weekend violence. North Africa feared to be staging ground for terror.	High	Low
17*	Protesters draw attention after weekend violence. Houston feared to be staging ground for terror.	Low	High
545**	Two detained in body parts mailing.		
600**	Man rides stationary bike for 85 hours.		
615**	Anger at release of two held over beheading plot		
767**	Bigger, more aggressive rats infesting U.K.		
965**	Venezuela, Iran fight U.S. dominance		
1036**	VP starts visit to Japan, Australia		
1109**	Retinal implant helping blind people see again		
1117**	Scientists tout cocoa's health benefits		
1230**	Vietnamese bank plans IPO listing		
1484**	Marijuana helps ease HIV nerve pain, study says		

* Same format as focal stimuli (10-12) to divert subjects' focus from passwords and identity theft.
** Additional stimuli to divert subjects' focus from passwords and identity theft.

In addition to the threat verbalization stimuli, the set of text-based stimuli also included four sentence pairs associated with the threat of terrorism (stimulus IDs 14-17) to divert subjects' focus from the threat verbalization stimuli's emphasis on passwords and identity theft, as shown in Table 8.1. The text-based stimuli additionally included 10 headlines selected from the Affective Text (Strapparava and Mihalcea 2007) dataset (stimulus IDs starting at 545), which represented the conventional categories of emotion: fear, surprise, anger, joy, sadness, and disgust (Ekman 1992) and neutral emotion to divert subjects' focus on passwords and identity theft. All of the text-based stimuli were displayed in a black Times New Roman font and centered on a white background.

8.1.2. Experimental Procedure

Fifty-eight subjects (40% female) were recruited from an undergraduate Management Information Systems course that is required for all undergraduate business students. Subjects were volunteers who received extra credit and entry into a raffle as incentives for participation. The detailed procedure (including screenshots) is provided in Appendix D. The following is a summary of the procedure.

Each subject was directed to an open seat facing a laptop in the lab (Melcher 290G). Laptops were set up so that subject could not see each other's screens and each laptop displayed an explanation of the task. Subjects began the experimental task by clicking "next" on the bottom of the screen. Subjects were shown a series of stimuli consisting of those presented in Table 8.1. The treatment stimuli related to identity theft (IDs 10 to 13) and the other stimuli (IDs 14 to 1484) were randomly interspersed and the order randomly presented for each subject. Prior to each stimulus, a blank screen appeared for five seconds, acting as a buffer between stimuli. Above each stimulus, subjects were prompted to indicate how each stimulus made them feel in terms of valence (happy/unhappy), arousal (calm/agitated or excited), and fear (unafraid/afraid).

8.1.3. Analysis and Results – $H1_{a\text{-}b}$, $H2_{a\text{-}b}$, and $H3_{a\text{-}b}$

As previously defined, feeling state represents an individual's subjective experience of emotion, and includes dimensions of valence, arousal, and emotional category (such as fear). Hypotheses $1_{a\text{-}b}$

predicted that threat severity and threat vulnerability (respectively) in a fear appeal will decrease valence. Hypotheses $2_{a\text{-}b}$ similarly predicted that threat severity and threat vulnerability (respectively) in a fear appeal will increase arousal, while hypotheses $3_{a\text{-}b}$ predicted that threat severity and threat vulnerability (respectively) will increase fear. Study 1 provided evidence that threat severity and vulnerability can individually influence valence, arousal, and fear. We examined in this study whether these hypothesized relationships persist when threat severity and threat vulnerability appear together in a fear appeal.

We expected that increasing a fear appeal's threat verbalization will decrease valence, increase arousal, and increase fear, such that fear appeals with high threat severity and vulnerability (stimulus 11) should have higher arousal and fear and lower valence than fear appeals with low threat severity and vulnerability (stimulus 10). Furthermore, based on the large effect of threat severity (**f^2** = 0.66) on feeling state (**R^2** = 0.40) and the medium effect of threat vulnerability (**f^2** = 0.28) on feeling state (**f^2** = 0.22) found in Study 1, we expected that fear appeals with high threat severity and low threat vulnerability (stimulus 12) should have higher arousal and fear and lower valence than fear appeals with low threat severity and high threat vulnerability (stimulus 13). Therefore, we expected an ordering of 11 > 12 > 13 > 10 for arousal and fear and an ordering of 10 > 13 > 12 > 11 for valence. PLS was used to construct a verbalization stimulus measurement model based on data obtained from a sample of 58 individuals (40% female). Smart PLS version 3.2.6 (Ringle et al. 2015) was used to analyze the relationships between the constructs and their associated items.

The fear appeal treatment stimuli were operationalized as three dummy variables (is_stim11, is_stim12, and is_stim13) using indicator coding, with stimulus 10 as the reference group. Responses associated with stimuli 11, 12, and 13 were coded as 1 for the dummy variable associated with each (is_stim11, is_stim12, and is_stim13, respectively) and as 0 for the other dummy variables. For example, responses associated with stimulus 11 were coded as 1 for is_stim11 and as 0 for is_stim12 and is_stim13.

The first phase of analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. For reflective items to reliably measure their intended constructs,

each item's loading should exceed 0.70 (Chin 1998). As shown in Table 8.2 below, every reflective item's loading on its intended construct met these criteria. The dummy items used for the threat verbalization manipulations were formative and thus not addressed by these reliability and validity evaluations.

TABLE 8.2. Item Loadings on Feeling State

	Feeling state
valence	-0.83
arousal	0.75
fear	0.83

All variables also met or exceeded the minimum cutoffs suggested for composite reliability and average variance extracted (Chin 2010), as shown in Table 8.3 below. Feeling state's average variance extracted was also greater than its squared correlation with any other latent construct. Therefore, the results supported feeling state's reliability and convergent and discriminant validities.

TABLE 8.3. Composite Reliability, Average Variance Extracted, and Squared Correlations

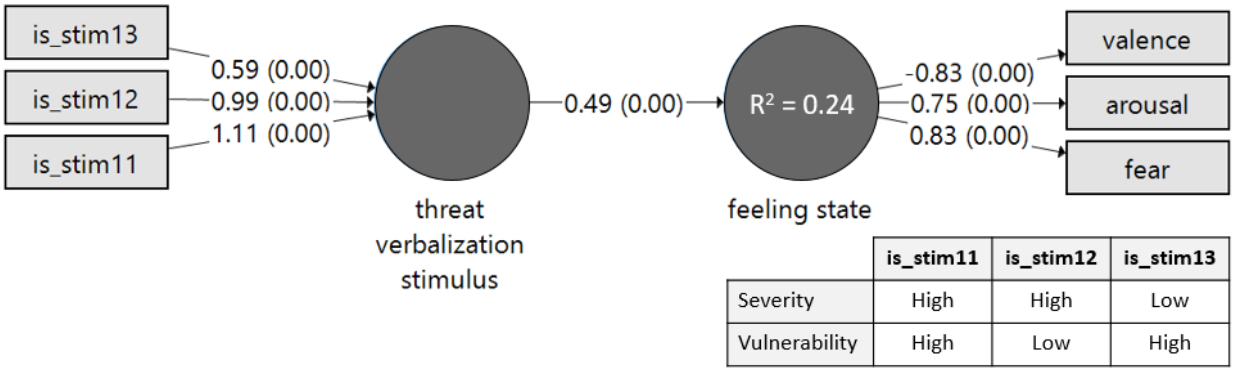
Composite Reliability	**Average Variance Extracted**		Feeling state	Threat verbalization
0.85	0.65	Feeling state	1	
1.00	1.00	Threat verbalization	0.24	1

An initial evaluation of the verbalization stimulus structural model involved using PLS to examine the path coefficient and R^2 values in the structural model. A bootstrap based on 3,000 resamples was then used to calculate *p* values for the path coefficients and item loadings in the verbalization stimulus structural model. The structural model's path coefficients, loadings, and *p* values based on the bootstrap analysis are shown in Figure 8.1, along with the R^2 value for feeling state.

The stimulus with high threat severity and high threat vulnerability (stimulus 11) had a weight greater than the other stimuli, followed by the stimulus with high threat severity and low threat vulnerability (stimulus 12) and the stimulus with low threat severity and high threat vulnerability (stimulus 13); this ordering is in accord with our expectations described above. The arousal, fear, and valence loadings were all significant, $p < 0.001$, as were the weights of the three dummy items.

Additionally, the threat verbalization stimulus structural model indicated a medium effect ($f^2 = 0.31$) of the threat verbalization stimulus on feeling state ($R^2 = 0.24$).

FIGURE 8.1. Verbalization Stimulus Structural Model
(*p* values in parentheses)



	is_stim11	is_stim12	is_stim13
Severity	High	High	Low
Vulnerability	High	Low	High

Each dummy item represents a comparison between stimulus 11 (high severity and high vulnerability), 12 (high severity and low vulnerability), or 13 (low severity and high vulnerability) and stimulus 10 (low severity and low vulnerability). When threat vulnerability and threat severity both increase (the comparison between stimulus 10 and stimulus 11, represented by is_stim11), this results in significant differences in feeling state: reducing valence, increasing arousal, and increasing fear. Holding threat vulnerability constantly low and increasing threat severity (comparing stimulus 10 and stimulus 12, represented by is_stim12) results in the same significant differences, as does holding threat severity constantly low and increasing threat vulnerability (comparing stimulus 10 and stimulus 13, represented by is_stim13). These results suggest that, in accord with the Study 1 findings, both threat vulnerability and threat severity can decrease valence, increase arousal, and increase fear, even when those fear appeal components are combined. The weights of formative items represent the relative contribution of each item to its corresponding latent variable (Garson 2016). Thus, the verbalization stimulus structural model indicates that threat severity (item weight of 0.99 for the stimulus with high severity and low vulnerability) had a greater influence than threat vulnerability (item weight of 0.59 for the stimulus with low severity and high vulnerability) on the threat verbalization stimulus latent variable.

8.2. The Influence of Combined Threat Verbalization and Emotional Interest on Feeling State

The second part of Study 2 consisted of a lab experiment that manipulated emotional interest and threat verbalization to test whether the relationships in hypotheses 1_c, 2_c, and 3_c (between emotional interest and valence, arousal, and fear, respectively) persist when threat verbalization and emotional interest appear together.

Just as it was in the previous study, feeling state was operationalized using three semantic differential scales measuring fear, valence, and arousal. The *fear* item was based on emoticons showing increasing expressions of fear (unafraid to afraid), as determined by the pilot study. The *valence* item consisted of a happy-to-unhappy scale based on Bradley and Lang's (1994) Self-Assessment Manikin. The *arousal* item likewise consisted of a calm-to-agitated or excited semantic differential scale based on Bradley and Lang's (1994) Self-Assessment Manikin.

8.2.1. Composite Stimuli for the Manipulation of Threat Verbalization and Emotional Interest

The text-based stimuli from the first part of Study 2 were combined with the image-based stimuli from Study 1 to develop a set of composite stimuli, as shown in Table 8.4. The threat verbalization sentences (10 and 11) were combined with emotional interest images (1001 and 1004) to develop four composite treatment stimuli related to the threat of identity theft (A1 through B2), as summarized in Table 8.4. Stimulus A1 was developed by combining the low threat verbalization sentences ("Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords") with the low emotional interest image of a computer (instead of the white background used for text-based stimuli in the previous experiments). Stimulus A2 consisted of the high threat verbalization sentences ("Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords") and the low emotional interest image. Stimulus B1 consisted of the low threat verbalization sentences and the high emotional interest image of a hand reaching through a computer, while Stimulus B2 contained the high threat verbalization sentences and the high emotional interest image.

Each composite treatment stimulus (A1 through B2) thus included low or high threat verbalization and low or high emotional interest. We expect increasing threat verbalization and increasing emotional interest to decrease valence and to increase arousal and fear. Therefore, the stimulus with low threat verbalization and emotional interest (stimulus A1) should be characterized by low arousal and fear and neutral (neither positive nor negative) valence, while the stimulus with high threat verbalization and emotional interest (stimulus B2) should be characterized by low valence and high arousal and fear. The stimuli with mixed (low and high) components (stimuli A2 and B1) should be characterized by levels of valence, arousal, and fear between those of stimulus A1 and stimulus B2.

TABLE 8.4. Composite Stimuli for Study 2

Stimulus ID	Image ID	Description	Text ID	Sentence
A1	1001	Computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
A2	1001	Computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
B1	1004	Hand, wallet, and computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
B2	1004	Hand, wallet, and computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
E	6370	Attack	14	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.
F	6370	Attack	15	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.
G	7009	Coffee mug	14	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.
H	7009	Coffee mug	15	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.
I	2345.1	Black eye	6	Terror suspects detained after weekend violence in Houston
J	2751	Drunk driver	615	Anger at release of two held over beheading plot
K	2770	Mask	1036	VP starts visit to Japan, Australia
L	2900.1	Crying	1117	Scientists tout cocoa's health benefits
M	2900.2	Smiling	1109	Retinal implants helping blind people see again
N	6250.1	Aimed gun	965	Venezuela, Iran fight U.S. dominance
O	6250.2	Ice cream	1230	Vietnamese bank plans IPO listing
P	7010	Basket	545	Two detained in body parts mailing
Q	7020	Fan	600	Man rides stationary bike for 85 hours
R	8185	Sky divers	1484	Marijuana helps ease HIV nerve pain, study says
S	9001	Cemetery	1006	North Africa feared as staging ground for terror
T	9390	Dirty dishes	767	Bigger, more aggressive rats infesting UK

Affective Text sentences were combined with IAPS images to develop 12 additional composite stimuli (I through T), as summarized in Table 8.4. The IAPS and Affective Text stimuli were chosen to represent the conventional categories of emotion (Ekman 1992), as well as neutral stimuli that evoke little or no emotion. Finally, four additional composite stimuli were created to divert subjects' focus from the treatment stimuli's emphasis on passwords and identity theft, using sentences associated with the threat of terrorism (14 and 15) and IAPS images with low and high emotional interest (6370 and 7009), as summarized in Table 8.4.

8.2.3. Experimental Procedure

Forty-seven subjects (55% female) were recruited from an undergraduate Management Information Systems course that is required for all undergraduate business students. Subjects were volunteers who received extra credit and entry into a raffle as incentives for participation. The detailed procedure (including screenshots) is provided in Appendix E. The following is a summary of the procedure.

Each subject was directed to an open seat facing a laptop in the lab (Melcher 290G). Laptops were set up so that subject could not see each other's screens and each laptop displayed an explanation of the task. Subjects began the experimental task by clicking "next" on the bottom of the screen. Subjects were shown a series of stimuli (shown in Table 8.4). The treatment stimuli related to identity theft (IDs A1 through B2) were randomly interspersed with the other stimuli (IDs E through T) and the order randomly presented for each subject. Prior to each stimulus, a blank screen appeared for five seconds, acting as a buffer between stimuli. Above each stimulus, subjects were prompted to indicate how each stimulus made them feel in terms of valence (happy/unhappy), arousal (calm/agitated or excited), and fear (unafraid/afraid).

8.2.4. Analysis and Results – $H1_{a\text{-}c}$, $H2_{a\text{-}c}$, and $H3_{a\text{-}c}$

Hypotheses $1_{a\text{-}c}$ predicted that threat severity, threat vulnerability, and emotional interest (respectively) in a fear appeal will decrease valence. Hypothesis $2_{a\text{-}c}$ similarly predicted that threat severity, threat vulnerability, and emotional interest (respectively) in a fear appeal will increase arousal,

while hypothesis $3_{a\text{-}c}$ predicted that threat severity, threat vulnerability, and emotional interest (respectively) will increase fear. Study 1 provided evidence that each fear appeal component can individually influence valence, arousal, and fear, while the first part of Study 2 provided evidence that threat severity and vulnerability can maintain their influence feeling state when they appear together (i.e., threat verbalization). We employed the partial least squares (PLS) method of structural equation modeling to determine whether the relationships between emotional interest and feeling state also persist when threat severity, threat vulnerability, and emotional interest appear together in a fear appeal.

We expected that increasing a fear appeal's emotional interest and threat verbalization will decrease valence, increase arousal, and increase fear, such that fear appeals with high emotional interest and threat verbalization (stimulus B2) should have higher arousal and fear and lower valence than fear appeals with low emotional interest and threat verbalization (stimulus A1). Furthermore, based on the large effect of emotional interest **(**f^2 = 1.02) on feeling state and the lesser effects of threat severity **(**f^2 = 0.66) and vulnerability **(**f^2 = 0.28) on feeling state in Study 1, along with the lesser effect of threat verbalization (f^2 = 0.31) on feeling state in the first part of this study, we expect that fear appeals with high emotional interest and low threat verbalization (stimulus B1) should have higher arousal and fear and lower valence than fear appeals with low emotional interest and high threat verbalization (stimulus A2). Therefore, we expect an ordering of B2 > B1 > A2 > A1 for arousal and fear and an ordering of A1 > A2 > B1 > B2 for valence. PLS was used to construct a verbalization stimulus measurement model based on data obtained from a sample of 47 individuals (55% female). Smart PLS version 3.2.6 (Ringle et al. 2015) was used to analyze the relationships between the constructs and their associated items.

The composite stimulus model used subjects' valence, arousal, and fear data associated with each treatment stimulus (i.e., subjects' feeling states for stimuli A1 through B2). The treatment stimuli were operationalized as three dummy variables (is_A2, is_B1, and is_B2) using indicator coding, with stimulus A1 as the reference group. Responses associated with stimuli A2, B1, and B2 were coded as 1 for the dummy variable associated with each (is_A2, is_B1, and is_B2, respectively) and as 0 for the other

dummy variables. For example, responses associated with stimulus A2 were coded as 1 for is_A2 and as 0 for is_B1 and is_B2.

The first phase of analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. For reflective items to reliably measure their intended constructs, each item's loading should exceed 0.70 (Chin 1998). As shown in Table 8.5 below, every reflective item's loading on its intended construct met these criteria. The dummy items used for the composite stimulus manipulations were formative and thus not addressed by these reliability and validity evaluations.

TABLE 8.5. Item Loadings on Feeling State

	Feeling state
valence	-0.86
arousal	0.87
fear	0.91

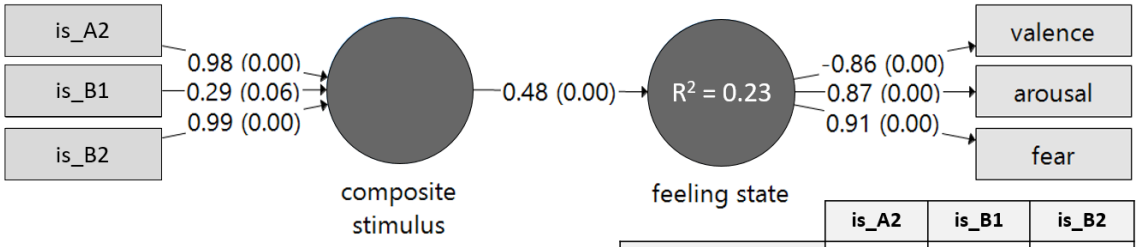
All variables also met or exceeded the minimum cutoffs suggested for composite reliability and average variance extracted (Chin 2010), as shown in Table 8.6 below. Feeling state's average variance extracted was also greater than its squared correlation with any other latent construct. Therefore, the results supported feeling state's reliability and convergent and discriminant validities.

TABLE 8.6. Composite Reliability, Average Variance Extracted, and Squared Correlations

Composite Reliability	**Average Variance Extracted**		Feeling state	Composite stimulus
0.91	0.77	Feeling state	1	
1.00	1.00	Composite stimulus	0.23	1

An initial evaluation of the composite stimulus structural model involved using PLS to examine the path coefficient and R^2 values in the structural model. A bootstrap based on 3,000 resamples was then used to calculate *p* values for the path coefficients and item loadings in the composite stimulus structural model. The structural model's path coefficients, loadings, and *p* values based on the bootstrap analysis are shown in Figure 8.2, along with the R^2 value for feeling state.

FIGURE 8.2. Composite Stimulus Structural Model
(*p* values in parentheses)



	is_A2	is_B1	is_B2
Emotional interest	Low	High	High
Threat verbalization	High	Low	High

The composite stimulus structural model indicated a medium effect ($f^2 = 0.29$) of composite stimulus on feeling state ($R^2 = 0.23$). The stimulus with high emotional interest and high threat verbalization (B2) had a weight greater than that of the other stimuli, followed by the stimulus with low emotional interest and high threat verbalization (A2) and the stimulus with high emotional interest and low threat verbalization (B1). The arousal, fear, and valence loadings were all significant, $p < 0.001$, as were the weights of two dummy items. The weight of the dummy item for the stimulus with high emotional interest and low threat verbalization (B1) was not statistical significant, $p = 0.06$, which suggests that subjects' responses to stimuli with high emotional interest and low threat verbalization did not significantly differ from their responses to stimuli with low emotional interest and threat verbalization. Thus, the structural model suggests that threat verbalization significantly influenced feeling state independent of emotional interest, but emotional interest significantly influenced feeling state only when threat verbalization was high.

To better understand the lack of significance of is_B1, paired sample *t*-tests were conducted regarding changes in subjects' valence, arousal, and fear responses between the stimulus with low emotional interest and low threat verbalization (stimulus A1) and the stimulus with high emotional interest and low threat verbalization (B1). When multiple hypotheses are tested at a time, the likelihood of making a Type I error (i.e., incorrectly rejecting a null hypothesis) increases. The Bonferroni (1936) correction tests each individual hypothesis at a significance level of α/n, where α is the overall alpha level and n is the number of hypotheses, such that the alpha value for the entire set of n hypothesis tests is equal

to α (Shaffer 1995). However, critics of such adjustments argue that they are unnecessary at best, and applicable only when the universal null hypothesis is of interest, when the same test is repeated in many subsamples, or when searching for significant associations without pre-established hypotheses (Perneger 1998). Since we are interested in examining details regarding our pre-established hypotheses, this correction is not used below.

As shown in Table 8.7(a), the valence for high emotional interest and low threat verbalization was significantly less than low emotional interest and low threat verbalization (p = 0.025). Likewise, the arousal for high emotional interest and low threat verbalization was significantly greater than low emotional interest and low threat verbalization (p = 0.023), as shown in Table 8.7(b). However, the fear for high emotional interest and low threat verbalization was not significantly different from low emotional interest and low threat verbalization (p = 0.13), as shown in Table 8.7(c). Thus, holding threat verbalization constantly low and increasing emotional interest (i.e., comparing stimulus A1 to stimulus B2) results in significantly increased arousal and significantly decreased valence, but no significant difference in fear.

TABLE 8.7. Feeling State Mean Differences for Composite Stimuli

(a)

Stimulus	Emotional Interest	Verbalization	*n*	Valence $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	47	5.26 (2.38)		
B1	High	Low	47	4.49 (2.45)	B1-A1: -0.77	-2.32 (0.025)

(b)

Stimulus	Emotional Interest	Verbalization	*n*	Arousal $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	47	3.60 (1.91)		
B1	High	Low	47	4.32 (1.83)	B1-A1: 0.72	2.36 (0.023)

(c)

Stimulus	Emotional Interest	Verbalization	*n*	Fear $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	47	3.21 (2.22)		
B1	High	Low	47	3.72 (2.37)	B1-A1: 0.51	1.55 (0.129)

The results of Study 2 thus provide evidence to support hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}b}$. Emotional interest notably had the greatest effect (**f^2** = 1.02) on feeling state of the fear appeal components investigated in Study 1, even though it did not independently influence fear in the current study. When emotional interest was combined with low threat verbalization, its influence on fear disappeared, although it did significantly decrease valence and increase arousal. The fear dimension of feeling state was included to distinguish subjects' fear response from anger, which also is characterized by low valence and high arousal (Plutchik 1980).

It is thus possible that high emotional interest and low threat verbalization caused subjects to feel anger, rather than fear. Within this study's stimuli, threat vulnerability was operationalized in terms of the likelihood of experiencing identity theft due to weak passwords, while threat severity was operationalized in terms of the financial cost associated with experiencing identity theft due to weak passwords. Thus, the stimulus with low threat verbalization conveyed a low likelihood of experiencing identity theft due to weak passwords, along with zero financial cost associated with experiencing identity theft due to weak passwords. The low threat verbalization thus constituted a potential personal violation (identity theft) without financial ramifications. When an individual evaluates something in his or her environment to be dangerous, the individual's feeling state will tend to be characterized by fear (Plutchik 1980). In contrast, when an individual evaluates something in his or her environment to be unpleasant and aversive but not dangerous, the individual's feeling state will tend to be characterized by anger (Plutchik 1980). Thus, when faced with an image portraying identity theft combined with text indicating no harmful consequences, subjects may have felt the potential for personal violation, which would be unpleasant and aversive but not dangerous, and thereby felt anger rather than fear. The emotional interest component of the image emphasized the averseness of the event by illustrating the hand reaching for a wallet, but the fear appeal's text would emphasize the lack of a financial cost (and thus the lack of danger) for that violation.

8.3. Conclusion

The first part of Study 2 focused on investigating the degree to which information security-related threat verbalization evokes fear when threat severity and vulnerability appear together in a fear appeal. The results of this investigation supported hypotheses $1_{a\text{-}b}$, $2_{a\text{-}b}$, and $3_{a\text{-}b}$, as shown in Table 8.8, indicating that the influences of threat severity and threat vulnerability on feeling state persist even when those two text-based fear appeal components are combined. The second part of Study 2 addressed the degree to which information security-related emotional interest evokes fear when threat verbalization and emotional interest appear together in a fear appeal. The results of this part also supported hypotheses $1_{a\text{-}b}$, $2_{a\text{-}b}$, and $3_{a\text{-}b}$, indicating that the influences of threat verbalization (in terms of threat severity and threat vulnerability) on feeling state persist even when those fear appeal components are combined with emotional interest. The results of this study additionally supported hypotheses 1_c and 2_c, as shown in Table 8.8, indicating that the influence of emotional interest on valence and arousal persist when emotional interest is combined with threat verbalization. However, Study 2 partially supported hypothesis 3_c, as shown in Table 8.8, suggesting that emotional interest influences feeling state fear only when threat verbalization is high. Study 3 will build upon these results by focusing on the influences of fear appeals and feeling state on an individual's information security beliefs, attitudes, intentions, and behavior.

TABLE 8.8. Tests of Emotion Process Model Hypotheses

Hypothesis	Prediction	Result
1a	Threat severity decreases feeling state valence	Supported
1b	Threat vulnerability decreases feeling state valence	Supported
1c	Emotional interest decreases feeling state valence	Supported
2a	Threat severity increases feeling state arousal	Supported
2b	Threat vulnerability increases feeling state arousal	Supported
2c	Emotional interest increases feeling state arousal	Supported
3a	Threat severity increases feeling state fear	Supported
3b	Threat vulnerability increases feeling state fear	Supported
3c	Emotional interest increases feeling state fear	Partially supported*

*When threat severity and threat vulnerability are high

Chapter 9

STUDY 3

How Fear Appeals Influence Information Security Behavior

Study 1 investigated a fear appeal's threat severity, threat vulnerability, and emotional interest separately, and provided initial support for hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}c}$. Study 2 examined combinations of those components, providing full support for hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}b}$ and partial support for hypothesis 3_c. Study 3 focused on individuals' information security behavior, providing evaluations of hypotheses $5_{a\text{-}d}$, $6_{a\text{-}f}$, $7_{a\text{-}d}$, and 8, as well as reevaluations of hypotheses $1_{a\text{-}c}$, $2_{a\text{-}c}$, and $3_{a\text{-}c}$ in a field setting.

9.1. Treatments for the Manipulation of Threat Verbalization and Threat Representation

Combinations of images and sentences related to the threat of identity theft that were used as treatments in Study 2 are also employed in this study, as shown in Table 9.1.

TABLE 9.1. Fear Appeal Treatments

Stimulus ID	Image ID	Description	Text ID	Sentence
A1	1001	Computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
A2	1001	Computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
B1	1004	Computer, hand, and wallet	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
B2	1004	Computer, hand, and wallet	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.

Each fear appeal treatment stimulus thus included low or high threat verbalization and low or high threat representation. We expect increasing threat verbalization and increasing threat representation to increase behavioral beliefs of threat severity and threat vulnerability. Therefore, the stimulus with low threat verbalization and low threat representation (stimulus A1) should be characterized by low threat

severity and vulnerability beliefs, while the stimulus with high threat verbalization and high threat representation (stimulus D2) should be characterized by high threat severity and vulnerability beliefs. The stimuli with mixed (low and high) components (stimuli A2 and D1) should be characterized by threat severity and vulnerability beliefs between those of stimulus A1 and stimulus D2.

9.2. Operationalization of Behavior Process Model (BPM) Constructs

Survey items were developed to measure most of the BPM constructs, as shown in Table 9.2.

TABLE 9.2. Survey Items for Study 3

Scale	Statement	Adapted from
Severity belief	Identity theft can be a severe consequence of my weak passwords	Fishbein & Ajzen 2010; Witte et al. 1996
	Using weak passwords can lead to serious negative consequences such as identity theft	Fishbein & Ajzen 2010; Witte et al. 1996
	Bad things like identity theft can happen if I use weak passwords	Fishbein & Ajzen 2010; Ronis 1992
Vulnerability belief	It is possible that someone could steal my identity by obtaining my passwords	Witte et al. 1996
	Using weak passwords makes it easier for an identity thief to access my personal information	Fishbein & Ajzen 2010; Ronis 1992
	Using weak passwords increases my likelihood of experiencing identity theft	Fishbein & Ajzen 2010; Ronis 1992
Attitude	Strong passwords are [bad-good]	Fishbein & Ajzen 2010
	Strong passwords are [unimportant-important]	Fishbein & Ajzen 2010
	Strong passwords are [unnecessary-necessary]	Fishbein & Ajzen 2010
Subjective norm	Most people who are important to me think that I should use strong passwords	Fishbein & Ajzen 2010
	Most people I respect would use strong passwords if they were in my situation	Fishbein & Ajzen 2010
	Most people whose opinions I value would approve of my using strong passwords	Fishbein & Ajzen 2010
Perceived behavioral control	Strong passwords are easy to use	Fishbein & Ajzen 2010
	Using strong passwords is entirely within my control	Fishbein & Ajzen 2010
	I am able to use strong passwords without much effort	Fishbein & Ajzen 2010
Behavioral intention	I intend to use strong passwords on a regular basis	Fishbein & Ajzen 2010
	I plan to use strong passwords for my online accounts	Fishbein & Ajzen 2010
	I will use strong passwords in the future	Fishbein & Ajzen 2010
Perceived password strength	I use strong passwords on a regular basis	Fishbein & Ajzen 2010
	I don't use weak passwords on a regular basis	Fishbein & Ajzen 2010
	My passwords are generally strong enough for me to avoid identity theft	Fishbein & Ajzen 2010

Information security behavior was operationalized in terms of the strength of subjects' passwords. Based on the assumption that a password's strength corresponds to uncertainty, prior research has

measured password strength based on Shannon's (1951) model of entropy for encoding language into bits. A frequently cited measure created by the National Institute of Standards and Technology (NIST) approximates a password's strength primarily based upon its length and the constraints imposed upon its creation (Burr et al. 2004). At the same time, this estimation of password strength does not check for common patterns (such as dictionary words, spatial strings such as "asdf", or character repetitions or sequences such as "1234"). Zxcvbn is an open source password strength estimator that calculates a password's entropy based on the sum of its constituent patterns, along with an approximated time to crack and strength score (Wheeler 2012). In order to calculate entropy, zxcvbn matches against several dictionaries (English words, names and surnames, and Burnett's 10,000 common passwords), spatial keyboard patterns (QWERTY, Dvorak, and keypad patterns), repeats (e.g., aaa), sequences (e.g., 123, gfedcba), years from 1900 to 2019, and dates (e.g., 3-13-1997, 13.3.1997, and 1331997) (Wheeler 2012).

We used both NIST entropy and zxcvbn entropy to calculate observed information security behavior in terms of password strength. In particular, change in NIST (or zxcvbn) password strength was the difference between the NIST (or zxcvbn) entropies of subjects' post-treatment (from the Study 3 survey) and pre-treatment (from the registration form) passwords. We also measured subjects' perceived information security behavior using their responses to three items related to their perceptions of password strength, as shown in Table 9.2. Change in perceived password strength was calculated as the difference between subjects' responses to these items after and before exposure to the treatment. In order to reduce subjects' focus on their baseline and post-treatment passwords, the perceived password strength items addressed subjects' perceptions about their general password behavior, as opposed to perceptions about their baseline and post-treatment password behavior.

9.3. Experimental Procedure

Threat verbalization and threat representation were manipulated in a field experiment that collected data related to subjects' password beliefs, attitudes, and behaviors. 220 subjects (55% female) were recruited from an undergraduate Management Information Systems course that is required for all undergraduate business students. Subjects were volunteers who received extra credit and entry into a

raffle as incentives for participation. The detailed procedure (including screenshots) is provided in Appendix F. The following is a summary of the procedure.

Three months after subjects were initially recruited to participate in the study (see Chapter 5), all subjects who completed the registration procedure were sent an email that invited them to complete a brief survey (67% of subjects who ended up completing the survey also participated in the pilot study or the Study 1 or 2 lab experiments). Of the 315 emails that were sent, 10 were not able to be delivered. One week after the initial email, 206 surveys were started and 189 were completed. At that time, the subjects who had not completed the survey were sent an email that reminded them about the survey, which led to an additional 31 completed surveys. The total response rate for the survey was thus 70%.

Subjects used their own computers to complete the survey. When subjects followed the survey link from the emailed message, they were randomly shown one of the fear appeal treatments (see Table 9.1) and prompted to continue. Subjects were then shown a series of items related to threat severity and vulnerability beliefs, as well as attitudes, perceived behavioral control, subjective norm, intentions, and behaviors related to password strength (see Table 9.2). Subjects were also prompted to rate their feeling state (in terms of valence, arousal, and fear) associated with the fear appeal treatment shown. After submitting their survey responses, subjects were prompted to enter the email address and password associated with their account for the study (created upon registration) to receive credit for their participation. When each subject clicked "next", those who entered passwords were shown a message stating that their account information was not recognized, and all subjects (including those who indicated that they forgot their passwords) were prompted to create a new account for the study. After entering their information, subjects were shown a message stating that their account was successfully updated and that their participation was logged.

9.4. Analysis and Results – The Influence of Fear Appeals on Behavior

Hypotheses $5_{a\text{-}b}$ predicted that threat verbalization in a fear appeal will increase threat severity and threat vulnerability beliefs, respectively. Hypothesis $5_{c\text{-}d}$ similarly predicted that threat representation in a fear appeal will increase threat severity and threat vulnerability beliefs, respectively. Hypotheses $6_{a\text{-}b}$

predicted that decreased valence in feeling state will increase threat severity and threat vulnerability beliefs, respectively, while hypotheses $6_{c\text{-}d}$ and $6_{e\text{-}f}$ predicted that increased arousal and fear (respectively) in feeling state will increase threat severity and threat vulnerability beliefs.

Hypotheses $7_{a\text{-}b}$ predicted that threat severity and threat vulnerability beliefs (respectively) will decrease attitude toward the problematic behavior and increase information security behavioral intention, while hypotheses $7_{c\text{-}d}$ predicted that perceived behavioral control and subjective norm (respectively) will increase information security behavioral intention. Finally, hypothesis 8 predicted that information security behavioral intention will increase information security behavior.

We employed the partial least squares (PLS) method of structural equation modeling to test the BPM's hypothesized relationships regarding a fear appeal's influence on information security behavior. PLS was used to construct a behavior process structural model based on data obtained from a sample of 184 individuals, 55% female (36 subjects were shown a fear appeal with a different image, so their data were not used for this analysis). Smart PLS version 3.2.6 (Ringle et al. 2015) was used to analyze the relationships between the constructs and their associated items.

The behavior process structural model used survey data (see Table 9.2), observed password strength, and four treatments (see Table 9.1). The treatments were operationalized as three dummy variables (is_A2, is_B1, and is_B2) using indicator coding, with treatment A1 as the reference group. Responses associated with treatments A2, B1, and B2 were coded as 1 for the dummy variable associated with each (is_A2, is_B1, and is_B2, respectively) and as 0 for the other dummy variables. For example, responses associated with treatment A2 were coded as 1 for is_A2 and as 0 for is_B1 and is_B2.

The first phase of analysis consisted of evaluating the measures' adequacy based on the item loadings on their respective constructs. For reflective items to reliably measure their intended constructs, each item's loading should exceed 0.70 (Chin 1998). As shown in Table 9.3, most reflective item loadings met these criteria. The dummy items used for the treatments were formative and thus not addressed by these reliability and validity evaluations.

TABLE 9.3. Item Loadings on Feeling State

	Feeling State	Severity Belief	Vulnerability Belief	Attitude	Subjective Norm	Perceived Behavioral Control	Behavioral Intention	Password Strength	Perceived Password Strength
Feeling state valence	**-0.76**	-0.20	-0.16	-0.04	-0.06	-0.19	-0.12	0.01	-0.16
Feeling state arousal	**0.78**	0.27	0.15	0.09	0.17	0.16	0.23	0.02	0.24
Feeling state fear	**0.88**	0.33	0.23	0.12	0.16	0.19	0.18	0.00	0.15
Severity Belief 1	0.29	**0.88**	0.64	0.39	0.51	0.31	0.39	0.15	0.33
Severity Belief 2	0.17	**0.77**	0.51	0.34	0.43	0.28	0.44	0.03	0.31
Severity Belief 3	0.35	**0.87**	0.60	0.38	0.54	0.33	0.46	0.08	0.37
Vulnerability Belief 1	-0.01	0.19	**0.13**	-0.03	0.20	0.05	0.05	0.05	0.05
Vulnerability Belief 2	0.19	0.55	**0.84**	0.30	0.46	0.12	0.34	0.14	0.23
Vulnerability Belief 3	0.19	0.66	**0.88**	0.34	0.45	0.30	0.41	0.12	0.28
Attitude 1	0.05	0.34	0.31	**0.81**	0.29	0.10	0.26	0.01	0.15
Attitude 2	0.10	0.36	0.31	**0.89**	0.29	0.15	0.29	0.11	0.21
Attitude 3	0.11	0.42	0.35	**0.87**	0.33	0.28	0.40	0.16	0.27
Subjective Norm 1	0.17	0.53	0.44	0.27	**0.86**	0.32	0.55	0.13	0.44
Subjective Norm 2	0.20	0.48	0.41	0.30	**0.82**	0.35	0.57	0.12	0.54
Subjective Norm 3	0.02	0.47	0.47	0.31	**0.82**	0.31	0.51	0.18	0.41
Perceived Behav. Ctrl 1	0.21	0.26	0.20	0.19	0.33	**0.89**	0.55	0.12	0.59
Perceived Behav. Ctrl 2	0.15	0.43	0.30	0.13	0.31	**0.52**	0.32	0.10	0.27
Perceived Behav. Ctrl 3	0.16	0.25	0.15	0.18	0.30	**0.88**	0.56	0.06	0.63
Behavioral Intention 1	0.15	0.41	0.35	0.29	0.58	0.62	**0.89**	0.25	0.72
Behavioral Intention 2	0.19	0.50	0.46	0.38	0.63	0.45	**0.89**	0.13	0.62
Behavioral Intention 3	0.24	0.47	0.39	0.36	0.56	0.61	**0.93**	0.14	0.68
NIST PW Strength	0.02	0.07	0.10	0.07	0.13	0.15	0.18	**0.88**	0.23
zxcvbn PW Strength	-0.01	0.12	0.16	0.13	0.17	0.03	0.14	**0.81**	0.17
Perceived PW Strength 1	0.27	0.36	0.26	0.25	0.53	0.54	0.66	0.14	**0.86**
Perceived PW Strength 2	0.19	0.36	0.30	0.19	0.49	0.66	0.69	0.29	**0.90**
Perceived PW Strength 3	0.11	0.31	0.22	0.22	0.43	0.51	0.58	0.19	**0.83**

Two items, vulnerability belief 1 and perceived behavioral control 2, did not have loadings that exceeded 0.70 on their respective constructs. Vulnerability belief 1 had several cross-loadings greater than its loading on vulnerability belief (0.13). Additionally, this item differed from the other two vulnerability belief items, because it was not based on “using weak passwords”. That is, vulnerability belief 1 depends on an individual’s perception of his or her current passwords’ strengths, while vulnerability belief items 2 and 3 are worded such that the individual’s response is based on the hypothetical situation in which he or she is using weak passwords. On the other hand, perceived behavioral control 2 did not have any cross-loadings greater than its loading on perceived behavioral

control (0.52). While perceived behavioral control items 1 and 3 focus on the effort and ease of use associated with using strong passwords, perceived behavioral control 2 addressed the individual's control over using strong passwords. Although the current study did not place any constraints upon passwords, it may be that subjects previously experienced restrictions on other passwords' length or characters (e.g., some websites restrict passwords to alphanumeric characters), which presumably could have influenced their responses to perceived behavioral control 2.

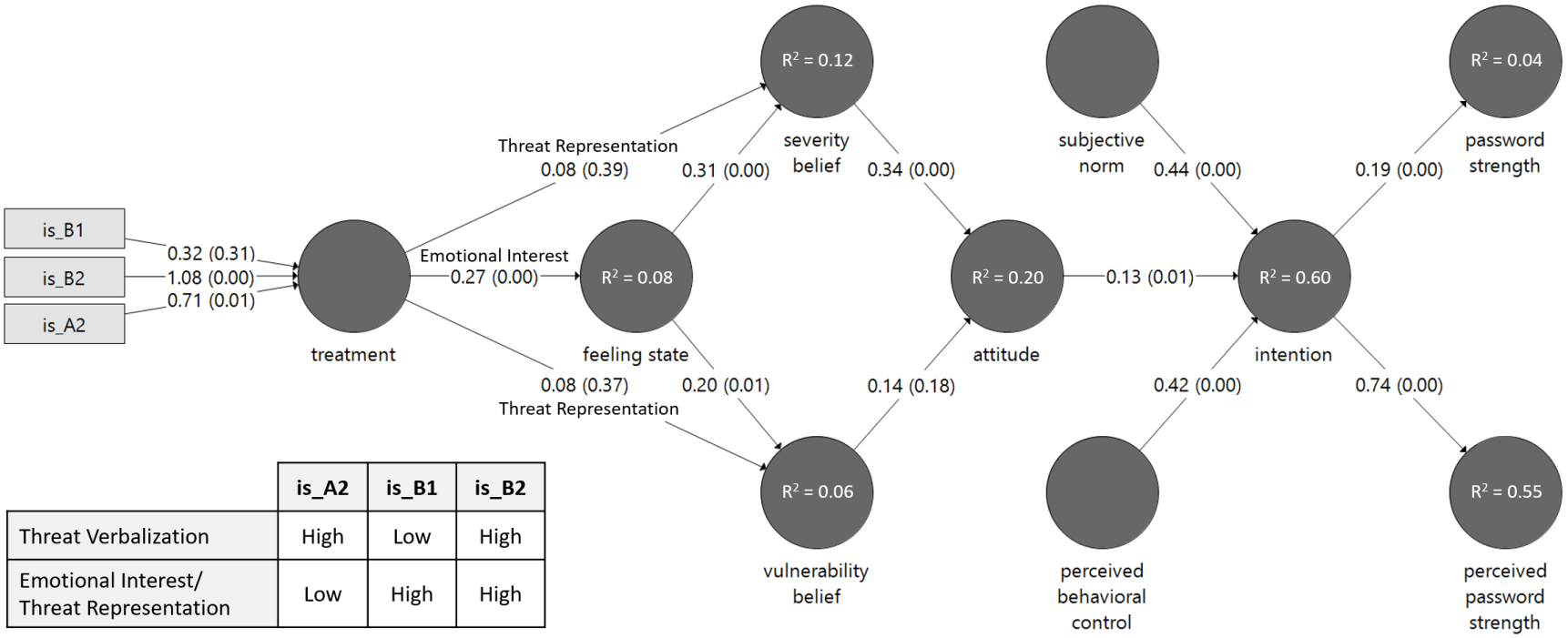
All variables also met or exceeded the minimum cutoffs suggested for composite reliability and average variance extracted (Chin 2010), as shown in Table 9.4. Each latent construct's average variance extracted was also greater than its squared correlation with any other latent construct. Therefore, the results supported each latent construct's reliability and convergent and discriminant validities.

An initial evaluation of the composite stimulus structural model involved using PLS to examine the path coefficient and R^2 values in the structural model. A bootstrap based on 3,000 resamples was then used to calculate *p* values for the path coefficients and item loadings in the composite stimulus structural model. The structural model's path coefficients, loadings, and *p* values based on the bootstrap analysis are shown in Figure 9.1, along with R^2 values below each latent variable.

TABLE 9.4. Composite Reliability, Average Variance Extracted, and Squared Correlations

Composite Reliability	Average Variance Extracted		Fear Appeal	Feeling State	Severity Belief	Vulnerability Belief	Attitude	Subjective Norm	Perceived Behavioral Control	Behavioral Intention	Password Strength	Perceived Password Strength
1.00	1.00	**Fear Appeal**	1									
0.85	0.65	**Feeling State**	0.08	1								
0.88	0.70	**Severity Belief**	0.03	0.11	1							
0.69	0.50	**Vulnerability Belief**	0.02	0.05	0.49	1						
0.90	0.74	**Attitude**	0.00	0.01	0.19	0.14	1					
0.87	0.69	**Subjective Norm**	0.00	0.03	0.35	0.27	0.13	1				
0.82	0.62	**Perceived Behavioral Control**	0.02	0.05	0.13	0.06	0.05	0.15	1			
0.93	0.81	**Behavioral Intention**	0.02	0.05	0.26	0.19	0.14	0.43	0.39	1		
0.84	0.7	**Password Strength**	0.00	0.00	0.01	0.02	0.01	0.03	0.01	0.04	1	
0.90	0.75	**Perceived Password Strength**	0.00	0.05	0.16	0.09	0.06	0.32	0.44	0.55	0.06	1

FIGURE 9.1. Behavior Process Structural Model
(*p* values in parentheses)



	is_A2	is_B1	is_B2
Threat Verbalization	High	Low	High
Emotional Interest/ Threat Representation	Low	High	High

TABLE 9.5. Item Loadings and *p* Values

	Feeling State	Severity Belief	Vulnerability Belief	Attitude	Subjective Norm	Perceived Behavioral Control	Behavioral Intention	Password Strength	Perceived Password Strength
Feeling state valence	-0.76 (0.00)								
Feeling state arousal	0.78 (0.00)								
Feeling state fear	0.88 (0.00)								
Severity Belief 1		0.88 (0.00)							
Severity Belief 2		0.77 (0.00)							
Severity Belief 3		0.87 (0.00)							
Vulnerability Belief 1			0.13 (0.46)						
Vulnerability Belief 2			0.84 (0.00)						
Vulnerability Belief 3			0.88 (0.00)						
Attitude 1				0.81 (0.00)					
Attitude 2				0.89 (0.00)					
Attitude 3				0.87 (0.00)					
Subjective Norm 1					0.86 (0.00)				
Subjective Norm 2					0.82 (0.00)				
Subjective Norm 3					0.82 (0.00)				
Perceived Behav. Ctrl 1						0.89 (0.00)			
Perceived Behav. Ctrl 2						0.52 (0.00)			
Perceived Behav. Ctrl 3						0.88 (0.00)			
Behavioral Intention 1							0.89 (0.00)		
Behavioral Intention 2							0.89 (0.00)		
Behavioral Intention 3							0.92 (0.00)		
NIST PW Strength								0.88 (0.00)	
zxcvbn PW Strength								0.81 (0.00)	
Perceived PW Strength 1									0.86 (0.00)
Perceived PW Strength 2									0.90 (0.00)
Perceived PW Strength 3									0.83 (0.00)

All constructs illustrated in Figure 9.1 have reflective items except for treatment. As shown in Table 9.5, the loadings for most reflective items were statistically significant, $p < 0.001$, with the exception of the loading of vulnerability belief 1, with $p = 0.46$. Dropping this item and rerunning the model did not significantly change any of the model results. Treatment included three formative dummy items (is_A2, is_B1, and is_B2). The dummy item indicating high threat verbalization and high emotional interest (is_B2) and the dummy item indicating high threat verbalization and low emotional interest (is_A2) were significantly larger than the reference treatment of low threat verbalization and low emotional interest ($p <= 0.01$). The dummy item indicating low threat verbalization and high emotional interest (is_B1) was not significantly different from the reference treatment ($p = 0.31$).

The significance of is_A2 suggests that, when keeping emotional interest low, increasing threat verbalization from low to high significantly decreased valence and increased arousal and fear. Similarly, the significance of is_B2 suggests that increasing both emotional interest and threat verbalization from low to high also significantly decreased valence and increased arousal and fear. Taken together, the effects of is_A2 and is_B2 suggest that threat verbalization significantly influences feeling state independent of emotional interest, but that emotional interest only influences feeling state when threat verbalization is high. This is consistent with the composite stimulus structural model from Study 2, in which the weight of the stimulus with high emotional interest and high threat verbalization (is_B2) was significant while the weight of the stimulus with high emotional interest and low threat verbalization (is_B1) was not.

In order to determine whether the high emotional interest and low verbalization treatment (is_B1) influenced feeling state in the same way that it did in Study 2, independent sample *t*-tests were conducted with regard to changes in subjects' valence, arousal, and fear responses between the treatment with low emotional interest and low threat verbalization (A1) and the treatment with high emotional interest and low threat verbalization (B1).

As illustrated in Table 9.6(a), the valence for high emotional interest and low threat verbalization was not significantly different from low emotional interest and low threat verbalization ($p = 0.43$).

Likewise, the arousal for high emotional interest and low threat verbalization was not significantly different from low emotional interest and low threat verbalization, as shown in Table 9.6(b), ($p = 0.26$). Finally, the fear for high emotional interest and low threat verbalization was not significantly different from low emotional interest and low threat verbalization, as shown in Table 9.6(c), ($p = 0.14$). Thus, holding threat verbalization constantly low and increasing emotional interest (i.e., comparing stimulus A1 to stimulus B2) does not result in significantly increased arousal, significantly decreased valence, or significantly increased fear. A power analysis using a small effect size (Cohen 1988), an alpha of 0.05, and a sample size of 53, resulted in the power of these tests equal to 0.18. This very low statistical power indicates that the *t*-test had a reduced chance to detect a true significant difference between the perceived valence, arousal, and fear means, so the lack of significances should be viewed with caution.

TABLE 9.6. Feeling State Mean Differences for Composite Stimuli

(a)

Stimulus	Emotional Interest	Verbalization	*n*	Valence $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	53	4.28 (2.29)		
B1	High	Low	57	3.95 (2.11)	B1-A1: -0.33	0.80 (0.43)

(b)

Stimulus	Emotional Interest	Verbalization	*n*	Arousal $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	53	4.70 (1.98)		
B1	High	Low	57	5.14 (2.13)	B1-A1: 0.44	-1.13 (0.26)

(c)

Stimulus	Emotional Interest	Verbalization	*n*	Fear $\bar{x}$ (sd)	Difference	*t* (*p*)
A1	Low	Low	53	4.40 (2.37)		
B1	High	Low	57	5.11 (2.58)	B1-A1: 0.71	-1.50 (0.14)

Although treatment did not have significant direct effects on severity ($p = 0.39$) or vulnerability ($p = 0.37$) beliefs, it did significantly affect feeling state ($p < 0.001$). Thus, threat verbalization and threat representation did not directly influence behavioral beliefs, even though (consistent with Study 2) threat verbalization and emotional interest did significantly decrease valence and increase arousal and fear. At the same time, feeling state significantly affected severity ($p < 0.001$) and vulnerability ($p < 0.01$) beliefs.

Severity belief also significantly affected attitude ($p < 0.001$), and attitude significantly affected behavioral intention ($p = 0.05$). However, the significant effects of both subjective norm ($p < 0.001$) and perceived behavioral control ($p < 0.001$) on behavioral intention were greater ($f^2 = 0.38$ and $f^2 = 0.37$, respectively) than that of attitude ($f^2 = 0.04$). Finally, although behavioral intention significantly affected both password strength ($p < 0.01$) and perceived password strength ($p < 0.001$), the effect of behavioral intention on perceived password strength ($f^2 = 1.24$) was much greater than the effect of behavioral intention on password strength ($f^2 = 0.04$).

9.5. Discussion and Conclusion

Study 3 focused on investigating the extent to which a fear appeal's threat representation and threat verbalization influence information security beliefs, attitudes, intentions and behaviors. Therefore, this study measured subjects' responses to a fear appeal related to the threat of identity theft. As summarized in Table 9.7, the results of Study 3 provided evidence to support 10 of the 15 hypotheses tested.

Based on the results of Study 3, we can conclude that threat verbalization significantly influences the valence, arousal, and fear dimensions of feeling state, and that feeling state significantly influences severity and vulnerability beliefs. Because the direct paths from threat verbalization to threat severity belief and threat vulnerability belief were not significant, the structural model provides evidence for feeling state's full mediation of the relationship between a fear appeal's threat verbalization and an individual's behavioral beliefs (Kenny 2018). The structural model suggests that feeling state has a larger influence on severity belief than on vulnerability belief, and that severity belief is the major influence on attitude. This result is similar to the findings of a meta-analysis that investigated 105 studies that manipulated severity and vulnerability and measured attitudes, intentions, and/or behaviors (De Hoog et al. 2007); the meta-analysis found that that fear appeals' threat severity had a positive effect on attitudes, while threat vulnerability did not. Because attitudes are based on salient behavioral beliefs (Ajzen 1991), we can conclude that vulnerability belief was less salient than severity belief, even though feeling state significantly influenced both of these behavioral beliefs.

TABLE 9.7. Tests of Behavior Process Model Hypotheses

Hypothesis	Prediction	Result
1a	Threat severity decreases feeling state valence	Supported
1b	Threat vulnerability decreases feeling state valence	Supported
1c	Emotional interest decreases feeling state valence	Partially supported*
2a	Threat severity increases feeling state arousal	Supported
2b	Threat vulnerability increases feeling state arousal	Supported
2c	Emotional interest increases feeling state arousal	Partially supported*
3a	Threat severity increases feeling state fear	Supported
3b	Threat vulnerability increases feeling state fear	Supported
3c	Emotional interest increases feeling state fear	Partially supported*
5a	Threat verbalization increases severity belief	Not Supported
5b	Threat verbalization increases vulnerability belief	Not Supported
5c	Threat representation increases severity belief	Not Supported
5d	Threat representation increases vulnerability belief	Not Supported
6a	Feeling state valence decreases severity belief	Supported
6b	Feeling state valence decreases vulnerability belief	Supported
6c	Feeling state arousal increases severity belief	Supported
6d	Feeling state arousal increases vulnerability belief	Supported
6e	Feeling state fear increases severity belief	Supported
6f	Feeling state fear increases vulnerability belief	Supported
7a	Severity belief increases intention via attitude	Supported
7b	Vulnerability belief increases intention via attitude	Not Supported
7c	Perceived behavioral control increases intention	Supported
7d	Subjective norm increases intention	Supported
8	Behavioral intention increases security behavior	Supported

* Supported when threat verbalization is high

Although the major fear appeal theories do not include subjective norm, we found that it had a larger effect than attitude on behavioral intention. Even though the fear appeal treatments in Study 3 were not intended to influence normative beliefs (and thus subjective norm), our results suggest that these beliefs were still predominant compared to behavioral beliefs regarding password behavior. This effect of subjective norm is in accord with some prior research investigating employee compliance with information security policies (Hu et al. 2012). Hu et al. suggest that "individual attitudes towards information security may not matter as much as the subjective norm" in an organizational context (Hu et al. 2012, p. 638). It is possible that the confidential nature of passwords influenced subjects' normative beliefs (and thus subjective norms) related to their referents' approval and use of strong passwords. Most

individuals are not likely to share password information, so it is possible that subjects overestimated their important and respected referents' approval and use of strong passwords. This would be consistent with subjects' overestimation of their own perceived password strength compared to their actual password behavior in this study. Nevertheless, these results, along with the larger influence of subjective norm (versus attitude) on behavioral intention, suggest that perceived social pressure to improve information security behavior is particularly important when social pressure includes organizational referents.

Perceived behavioral control also had a larger effect on behavioral intention than did attitude. Most major fear appeal theories include aspects of perceived behavioral control in terms of perceived self-efficacy (Rogers 1983; Witte 1992). Additionally, prior meta-analyses of fear appeals research (Floyd et al. 2000; Milne et al. 2000) found that conveyed self-efficacy in fear appeals has the strongest impact on an individual's protection motivation, which arouses, sustains, and directs activity (Rogers 1975). These results, along with the large influence of perceived behavioral control on behavioral intention in Study 3, suggest that the ability of a fear appeal to convey self-efficacy may significantly increase perceived behavioral control and thereby increase the individual's intention to perform that behavior.

Our results also indicated that fear appeal images only influence feeling state (and thereby severity belief) when threat verbalization is high. On the other hand, fear appeal images' emotional interest) had the largest effect on feeling state in Study 1, when the images were shown without any text. A fear appeal's pictorial vividness (based on its emotional interest) can evoke a fear-based response (i.e., decreasing valence and increasing arousal and fear) when the image stands alone by allowing individuals to form their own interpretations of the image. In contrast, a fear appeal image that is accompanied by threat verbalization limits individuals' interpretations of the image to the text-based explanation of the threat. When emotional interest and threat verbalization are both high, the fear appeal image reinforces the fear appeal's severity and vulnerability statements. When a fear appeal's threat verbalization is low, high emotional interest may not increase fear, but the fear appeal may still evoke an emotional response, such as anger (as may have occurred when individuals exhibited low valence and high arousal without fear in Study 2).

Although fear appeal research has historically neglected fear (Dillard 1994), our results suggest that it is changes in feeling state brought about by fear appeals that can lead to an individual's acceptance of a fear appeal (that leads to the individual adopting a severity behavioral belief consistent with the fear appeal's message). This behavioral belief then positively influences the individual's attitude toward performing the fear appeal's recommended behavior, which contributes to the individual's intention to actually perform that behavior. However, subjects' information security intention influenced perceived password strength much more than their actual password strength. This result suggests that individuals believed that they were using stronger passwords than those they actually used. The fear appeal treatments did not address criteria for strong passwords (such as increasing entropy and decreasing patterns), so it is reasonable to conclude that subjects were not sufficiently informed regarding how to increase password strength. The next chapter will build upon these results and discuss all three studies' limitations and implications, as well as directions for future research.

Chapter 10

CONCLUSION

Organizations currently face a substantial and expensive information security problem, in that individual users can create vulnerabilities in an organization's information security by carelessness, negligence, and/or willful noncompliance with security policies and procedures. Organizations consequently need to motivate employees' information security behavior, which includes their conscious involvement in protecting information and information systems assets (Straub and Welke 1998). Previous studies have indicated that fear appeals can motivate individuals to change attitudes and behaviors in a variety of areas, including information security (Boss et al. 2015; Herath and Rao 2009; Jenkins et al. 2014; Johnston and Warkentin 2010). However, recent reviews of fear appeals research in this domain have highlighted gaps in the literature, including a lack of attention to the role of fear (Anderson et al. 2016; Boss et al. 2015; Crossler et al. 2013).

Therefore, to reinstitute and clarify the role of fear in information security fear appeals, this dissertation focused on developing and testing the emotion process model (EPM) and behavior process model (BPM) for fear appeal threats. The EPM explains how individuals experience fear in response to threats in information security fear appeals, based on Elfenbein's (2007) integrated intrapersonal process framework for emotion in organizations, LeDoux's (2000) model of fear-processing circuitry, and Witte's (1992) extended parallel process model. The BPM extends the EPM by incorporating Ajzen's (1991) theory of planned behavior to explain how a fear appeal can influence individuals' information security behaviors.

A pilot study was conducted to validate the measurements and develop the stimuli used in the subsequent experiments. The pilot study's results did not provide evidence to support the construct validity of expressed valence, arousal, and fear (hypotheses $4_{a\text{-}c}$), so those measures were not employed in subsequent studies. Two lab (Studies 1 and 2) and one field (Study 3) experimental studies were conducted to test the relationships predicted by the EPM and BPM. The results of all three studies provided evidence to support most of the hypotheses tested, as shown in Table 10.1.

TABLE 10.1. Results of All Hypothesis Tests*

	Prediction	Pilot	Study 1	Study 2	Study 3
1a	Threat severity decreases feeling state valence	-	S	S	S
1b	Threat vulnerability decreases feeling state valence	-	S	S	S
1c	Emotional interest decreases feeling state valence	-	S	S	PS**
2a	Threat severity increases feeling state arousal	-	S	S	S
2b	Threat vulnerability increases feeling state arousal	-	S	S	S
2c	Emotional interest increases feeling state arousal	-	S	S	PS**
3a	Threat severity increases feeling state fear	-	S	S	S
3b	Threat vulnerability increases feeling state fear	-	S	S	S
3c	Emotional interest increases feeling state fear	-	S	PS**	PS**
4a	Feeling state valence is positively correlated with expressed valence	NS	-	-	-
4b	Feeling state arousal is positively correlated with expressed arousal	NS	-	-	-
4c	Feeling state fear will be positively correlated with expressed fear	NS	-	-	-
5a	Threat verbalization directly increases severity belief	-	-	-	NS
5b	Threat verbalization directly increases vulnerability belief	-	-	-	NS
5c	Threat representation directly increases severity belief	-	-	-	NS
5d	Threat representation directly increases vulnerability belief	-	-	-	NS
6a	Feeling state valence decreases severity belief	-	-	-	S
6b	Feeling state valence decreases vulnerability belief	-	-	-	S
6c	Feeling state arousal increases severity belief	-	-	-	S
6d	Feeling state arousal increases vulnerability belief	-	-	-	S
6e	Feeling state fear increases severity belief	-	-	-	S
6f	Feeling state fear increases vulnerability belief	-	-	-	S
7a	Severity belief increases intention via attitude	-	-	-	S
7b	Vulnerability belief increases intention via attitude	-	-	-	NS
7c	Perceived behavioral control increases intention	-	-	-	S
7d	Subjective norm increases intention	-	-	-	S
8	Behavioral intention increases security behavior	-	-	-	S

***** S = supported; NS = not supported; PS = partially supported; - = not tested

** When threat vulnerability and severity are high

Studies 1 and 2 focused only on the hypotheses that involved fear appeal components and feeling state dimensions ($H1_a$-$H3_c$). In Study 1, each fear appeal component (threat severity, threat vulnerability, and emotional interest) was manipulated in a different stimulus. That is, none of the stimuli contained multiple fear appeal components. In contrast, Study 2 manipulated different levels of threat severity and threat vulnerability within each text-based stimulus (resulting in four different stimuli). Study 2 also manipulated two levels of threat verbalization (consisting of low severity and vulnerability versus high severity and vulnerability) along with two levels of emotional interest (low versus high) together, resulting in four different stimuli. Study 3 similarly manipulated threat verbalization and emotional interest (the two images used to manipulate emotional interest were also interpreted as manipulating threat representation), resulting in four different stimuli. Finally, each subject in Studies 1 and 2 was shown all of each study's stimuli, while each subject in Study 3 was shown only one fear appeal stimulus. The subjects in Studies 1 and 2 reported their feeling state valence, arousal, and fear for each stimulus as part of a rating task, while the Study 3 subjects were shown a fear appeal stimulus when they attempted to log into their accounts created for the study. That is, the Study 3 treatment (exposure to a fear appeal stimulus) was designed to appear as if the stimulus was part of a regular login procedure, as opposed to the overt stimuli used in Studies 1 and 2. Due to their differing contexts, the results of each study provide unique insights.

10.1. Implications

The results of Study 1 provided evidence that fully supported all of the hypotheses tested (1_a-3_c). Thus, we conclude that threat severity, threat vulnerability, and emotional interest can separately influence the valence, arousal, and fear dimensions of feeling state. Emotional interest had the largest individual effect on feeling state, followed by threat severity and then threat vulnerability. This result suggests that images are important and have the potential to convey at least as much threat as conventional text-based components of a fear appeal. Furthermore, because the effect of each separate fear appeal component was balanced among the feeling state dimensions (e.g., threat severity influenced valence, arousal, and fear to similar degrees, based on their loadings of -0.88, 0.88, and 0.83, respectively,

in the threat severity structural model in Figure 7.1), increasing any of the threat-related components of a fear appeal tended to influence all of the feeling state dimensions equally.

The results of Study 2 also provided evidence to evaluate the hypotheses (1_a-3_c). These results fully supported hypotheses $1_{a\text{-}b}$, $2_{a\text{-}b}$, and $3_{a\text{-}b}$, which indicates that the influences of threat severity and threat vulnerability on feeling state persist even when those components appear together. Study 2 also provided evidence that supported hypotheses 1_c and 2_c, and partially supported 3_c, with emotional interest increasing fear only when threat verbalization (the combination of threat severity and threat vulnerability) is high. This interaction of emotional interest's influence on fear with increasing threat verbalization suggests that subjects can interpret fear appeal images in different ways, depending on a fear appeal's text.

In this case, threat verbalization provided a context for subjects' interpretation of the fear appeal image by mentioning identity theft, but the fear appeal's low severity (zero financial ramifications) signified no danger while the low threat vulnerability (less than 9% likelihood) still allowed for the threat to occur. As a result, valence significantly decreased, and arousal significantly increased though fear did not increase. It is possible that subjects felt anger, which, like fear, is characterized by low valence and high arousal. Based on Plutchik's (1980) psychoevolutionary theory of emotion, anger and fear both include "cognitive evaluations, subjective changes, autonomic and neural arousal, impulses to action, and behavior designed to have an effect upon the stimulus that initiated the complex sequence" (p. 217). When an individual evaluates something in his or her environment to be dangerous, the individual's feeling state will tend to be characterized by fear (Plutchik 1980). In contrast, when an individual evaluates something in his or her environment to be unpleasant and aversive but not dangerous, the individual's feeling state will tend to be characterized by anger (Plutchik 1980). Thus, when faced with an image portraying identity theft combined with text indicating no harmful consequences, subjects may have felt the potential for personal violation, which would be unpleasant and aversive but not dangerous, and thereby felt anger rather than fear.

Study 3 provided evidence to evaluate 24 hypotheses. Sixteen of the hypotheses were supported, three were partially supported, and five were not supported. Consistent with the results of Studies 1 and 2, threat verbalization significantly decreased valence and increased arousal and fear, independent of emotional interest. On the other hand, emotional interest only influenced feeling state when threat verbalization was high. Study 3 found that fear appeals' threat representation did not significantly influence severity and vulnerability behavioral beliefs. Rather, fear appeals influenced these beliefs via the influence on feeling state. This fully mediated influence highlights the importance of an individual's internal emotional experience on his or her response to a fear appeal. Study 3 also indicated that feeling state had a larger influence on severity belief than on vulnerability belief, and that severity belief was the predominant influence on attitude.

Study 3 also provided evidence that subjective norm and perceived behavioral control have larger effects than attitude on behavioral intention. This suggests that a fear appeal's ability to influence control and normative beliefs (and thus perceived behavioral control and subjective norm, respectively) may be more effective ways to affect behavioral intention than trying to influence behavioral beliefs regarding a particular information security behavior. Finally, subjects' information security intention influenced perceived password strength much more than their actual password strength. This suggests that individuals believed they were using stronger passwords than what they actually used. This suggests that subjects were not sufficiently informed about how to increase password strength, and that fear appeals should provide guidance about a recommended response in addition to persuading individuals to adopt that response.

10.2. Limitations

Each study was subject to several limitations that may have influenced the internal or external validity of the results.

10.2.1. Internal Validity Limitations

Studies 1 and 2 were lab experiments, which allowed for precise control of both extraneous and independent variables and thus increased internal validity. On the other hand, the field experiment in

Study 3 had less control over extraneous variables, because it took place in subjects' normally occurring social settings. For example, it is possible that subjects experienced events that influenced their password strength perceptions and behavior (such as learning about a data breach in the news) at some point between the initial measurements (upon study registration) and the post-treatment measurements (in the Study 3 survey). Subjects' history over the duration of Study 3, along with experimental mortality and repeated testing effects, thus represent threats to internal validity (Shadish et al. 2002). For example, more than 300 subjects initially registered for the study (and created baseline passwords), while only 220 subjects participated in Study 3. It is possible that the 220 subjects who fully participated in the study were more diligent or motivated than the subjects who did not complete Study 3, and thus were more likely to improve their password behavior. Likewise, subjects who participated in the pilot study, Study 1, or Study 2 in addition to Study 3 were repeatedly asked about passwords; this could have primed them to improve their post-treatment perceived and actual password strength regardless of the fear appeal treatment. However, an independent samples *t*-test for mean password strength differences found no significant difference between the 124 subjects who participated in the pilot, Study 1, or Study 2 in addition to Study 3 and the 60 subjects who only participated in Study 3: $t(123) = -0.43$, $p = 0.667$. Similarly, an independent samples *t*-test for mean perceived password strength differences found no significant difference between the subjects who participated in the pilot, Study 1, or Study 2 in addition to Study 3 and the subjects who only participated in Study 3: $t(123) = -0.95$, $p = 0.345$. A power analysis using a medium effect size (Cohen 1988), an alpha of 0.05, and a sample size of 60, resulted in the power of these tests equal to 0.78. This statistical power indicates that the *t*-test results provide reasonable support for the lack of differences among groups in terms of perceived and actual password strength.

Additionally, the multiple-group design and random assignment of fear appeal treatments to subjects should have mitigated any experimental mortality, repeated testing or history effects (Shadish et al. 2002). For example, because the fear appeal treatments were randomly assigned to subjects, repeated testing effects should have manifested equally in all treatment groups. Likewise, history and mortality effects were controlled because they would have been balanced across all groups.

10.2.2. External Validity Limitations

Studies 1 and 2 were lab experiments in which subjects performed a rating task in a controlled setting. Lab experiments have low ecological validity, because the lab setting may not reflect subjects' natural responses (Shadish et al. 2002). In particular, subjects' emotional responses to stimuli may have been exacerbated by the lab setting. In a natural environment, fear appeals must capture individuals' attention to evoke emotional responses, whereas subjects in the lab experiments were already focused on the stimuli (based on the nature of the rating task) and were prompted to report their emotional responses, thus making subjects attentive to the stimuli and their emotional responses. Other factors may limit the studies' external validities. The subjects for all three studies were volunteers recruited from an undergraduate Management Information Systems course required for all business majors. It is thus possible that these subjects were more interested and/or knowledgeable in information systems and information security than people who have never studied information systems, which could have influenced subjects' feeling state responses and their beliefs, intentions, and behaviors related to password strength. However, this would make our results more conservative than they otherwise would have been for the general population, given, for example, the increased likelihood for our sample to have stronger baseline passwords (resulting in less change in password strength).

Additionally, the three studies' subjects may be considered a narrow data base from which to draw conclusions about individual behavior, based on the tendency for undergraduate students to have stronger cognitive skills and uncrystallized (i.e., likely to change) attitudes compared to the general population (Sear 1986). However, student subjects can still "provide useful and informative data about basic psychological processes" (Kardes 1996, p. 287). Furthermore, Locke (1986) provides direct evidence to support the appropriateness of students as research subjects. Results of studies with student subjects in a lab setting closely corresponded to results of studies without student subjects conducted in a field setting (Locke 1986). Thus, the undergraduate sample should not negatively influence the studies' external validity.

Another factor that may limit the external validity of Studies 1 through 3 involves the fear appeal

components that were included in the treatment stimuli. The fear appeal components employed in the three studies intentionally excluded response efficacy and self-efficacy. The threat-based components in this investigation were more likely to elicit a fear response, while efficacy-based components would more likely limit that fear response (Witte 1992). As a result, the fear appeal stimuli in all three studies may have been more threat-oriented than the stimuli in other fear appeal research (Boss et al. 2015; Johnston and Warkentin 2010; Johnston et al. 2015; Warkentin et al. 2016). The exclusion of response efficacy and self-efficacy was nevertheless important, because it allowed for a better understanding of the way information security fear appeals evoke fear and thereby can influence behavior.

Finally, the fear appeals in all three studies focused on password strength as a representation of information security behavior. Passwords are associated with several security and usability issues (Morris and Thompson 1979; Bonneau et al. 2012), yet they provide a conceptually simple, readily observable metric for information security behavior. However, prior research has identified at least 67 protection-based information security behaviors, and studying a single protective behavior does not necessarily reflect individuals' willingness and/or abilities to perform multiple protective behaviors (Posey et al. 2013). Thus, our studies' focus on a single information security threat (and behavior) limits the results' external validity. For example, subjects' responses to fear appeals related to password strength may be greater than responses to fear appeals focused on information security behaviors that are not as closely associated with protecting individuals' personal information, such as storing sensitive corporate information only on protected media. Additionally, Study 3 focused on subjects' immediate behavior after their exposure to a fear appeal, so the longitudinal effects of the fear appeal are unclear. For example, it is possible that information security fear appeals that focus on general and long-term behaviors (e.g., information security policy compliance in general) may be less effective.

10.3. Conclusion and Future Research

Most research on information security fear appeals has focused on examining relationships among components of the fear appeal's message, perceptions of the message, and behavioral intentions (Johnston and Warkentin 2010). Reviews of this literature have highlighted the omission of fear appeal

manipulations and fear measurement, as well as a failure to measure actual protective behaviors (Anderson et al. 2016; Boss et al. 2015; Crossler et al. 2013). This dissertation extends prior research by investigating relationships among fear appeal components, emotional responses to and beliefs associated with those components, information security behavioral intentions, and perceived and actual information security behavior.

We identified pictorial vividness (in terms of emotional interest) as a neglected rhetorical component of fear appeals and provided evidence that this component can influence an individual's feeling state in different ways, depending on the fear appeal's composition. The results of Study 1 indicated that emotional interest can convey threat as much as (if not more than) the conventional text-based threat severity and threat vulnerability components. The results of Study 2 suggested that emotional interest does not increase fear when combined with low threat verbalization, although it may influence other emotions (such as anger).

We also identified feeling state as an important factor of individuals' behavioral beliefs about threat severity and vulnerability. Whereas fear has been neglected in fear appeals research (Dillard 1994), the results of Study 3 suggest that feeling state fully mediates the relationship between a fear appeal's threat verbalization and an individual's behavioral beliefs. The results of Study 3 also indicate that subjective norm and perceived behavioral control can have a greater influence on information security behavioral intention than attitude, which suggests that information security fear appeals may be more effective if they target normative or control beliefs, as opposed to behavioral beliefs such as threat severity and threat vulnerability.

Finally, the results of Study 3 indicate that information security intention influence individuals' perceptions of their information security behavior more than their actual information security behavior. This suggests that in order to be effective, an organization's information security efforts must assure that individuals are knowledgeable about the specific actions required of suggested security behavior.

The results of this investigation have highlighted several avenues for future research. First, our inability to find significant relationships among feeling state, physiological state, and external emotional

expression indicates that further investigation is needed to clarify individuals' emotional responses to fear appeal threats. We intend to examine whether these relationships are non-linear and time-sensitive by employing neural network analyses of subjects' facial expression and skin conductance data. Further research on the effect of self-efficacy and normative statements in fear appeals is also warranted, given the large influences of perceived behavioral control and subjective norm on information security behavioral intention in Study 3. In particular, exploring the influence of a fear appeal on an individual's control beliefs and normative beliefs (and therefore on the individual's perceived behavioral control and subjective norm) would clarify whether fear appeals may more effectively use non-attitudinal ways of influencing behavioral intention and thereby behavioral change. Additionally, the results of Study 2 suggest that the interaction of emotional interest and threat verbalization may evoke emotions other than fear. Although research in other disciplines has explored the motivating potential of emotional appeals other than fear (e.g., Nabi 2002), the scope of similar research in the information security literature remains limited to fear alone. Nevertheless, persuasive messages that elicit emotions such as humor, sadness, anger, happiness, disgust, and surprise have the potential to address different factors that may motivate individuals to improve their information security behavior.

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Appendix A

GLOSSARY

Arousal: The dimension of feeling state that describes its magnitude, which, for example, differentiates anger from the more intense rage

Attention: The first step of the emotional registration process in which an individual's sensory organs are oriented to take in a particular stimulus (Elfenbein 2007)

Attitude: The positive or negative evaluation of the consequences of performing a particular behavior (Ajzen 1991)

Behavior: The manifest, observable response in a given situation with respect to a given target (Ajzen 1991)

Behavioral belief: The subjective probability that a behavior will produce a particular outcome (Ajzen 1991)

Control belief: The perceived presence of factors that may facilitate or impede performance of a particular behavior (Ajzen 1991)

Coping potential: The evaluation of the degree to which an individual can control and adjust to consequences associated with a stimulus (Scherer 2013)

Cortico-amygdala path: See *delayed emotional registration*

Delayed emotional registration: Stage of the emotional registration process in which sensory information associated with a stimulus travels to the thalamus and then to the neocortex (which is involved in executive control for higher mental functions), which routes the information to the hippocampus and the amygdala (Goleman 1995), represented by the *cortico-amygdala path*

Emotional experience: The psychological and physiological sense of being affected emotionally by an event (Elfenbein 2007)

Emotional expression: Process in which internal emotional experience manifests as expressive cues that are perceptible to others and can include visible emotional displays and/or audible emotional sounds (such as a gasp, laugh, or scream)

Emotional registration: Intervening stage in between exposure to a stimulus and internal emotional experience (Elfenbein 2007); see *immediate emotional registration* and *delayed emotional registration*

Fear: A negatively valenced emotion accompanied by a high level of arousal that is elicited by a threat that is perceived to be significant and personally relevant (Witte 1992)

Fear appeal: A persuasive message designed to scare people by describing the terrible things that will happen if they do not do what the message recommends (Witte 1992)

Feeling rules: The chronic goals of the registration process that include a sense of how one should feel (Elfenbein 2007); norms for how one should feel, influencing an individual's expectations regarding the emotional category (e.g., fear), intensity, and duration

Feeling state: An individual's subjective experience of emotion, which includes dimensions of *valence* and *arousal*

Immediate emotional registration: Stage of the emotional registration process in which sensory information associated with a stimulus travels to the thalamus and then across a single synapse to the amygdala (Goleman 1995), represented by the *thalamo-amygdala path*

Implications: The evaluation of the degree to which a stimulus has positive or negative consequences (Scherer 2013)

Initial appraisal: The initial instance of *internal emotional experience* influencing and anchoring *delayed emotional registration*

Intention: An indication of a person's readiness to perform a given behavior, based on *attitude, subjective norm,* and *perceived behavioral control* (Ajzen 1991)

Internal emotional experience: See *emotional experience*

Intrinsic unpleasantness: The aspect of relevance that evaluates the degree to which a stimulus is in itself unpleasant (Scherer 2013)

Message attitude: an individual's positive or negative evaluation of self-performance of a particular behavior

Normative beliefs: an individual's beliefs regarding the judgments of significant others concerning a particular behavior

Novelty: The aspect of relevance that evaluates the degree to which a stimulus is sudden, unfamiliar, and unpredictable (Scherer 2013)

Perceived behavioral control: An individual's perceived ease or difficulty of performing a particular behavior (Ajzen 1991)

Perceived response efficacy: An individual's beliefs about the effectiveness of a recommended response (Witte 1992)

Perceived self-efficacy: An individual's beliefs about his or her ability to perform the recommended response (Rogers 1983)

Perceived threat severity: An individual's beliefs about the seriousness of a particular threat (Witte 1992)

Perceived threat vulnerability: An individual's beliefs about his or her chances of experiencing a particular threat (Witte 1992)

Physiological state: The physical changes that accompany emotional experience, such as changes in heartbeat, breathing, and muscle tension

Reappraisal: After *initial appraisal,* the subsequent instances of internal emotional experience influencing and adjusting *delayed emotional registration*

Relevance: The evaluation of whether a stimulus deserves further processing because of its bearing on our well-being, as determined by the results of the novelty, intrinsic unpleasantness, and task pertinence checks (Scherer 2013)

Response efficacy: The fear appeal component that describes the effectiveness of a recommended response in deterring a threat (Rogers 1975)

Schema: The step of the emotional registration process that involves an act of sense-making (Elfenbein 2007) in a series of rudimentary checks associated with the stimulus (Scherer 1995)

Self-efficacy: The fear appeal component that conveys one's ability to perform a recommended response (Rogers 1983)

Subjective norm: The perceived social pressure to engage or not to engage in a particular behavior, based on normative beliefs and/or the perceived behavioral expectations of important referent individuals (Ajzen 1991)

Task pertinence: The aspect of relevance that evaluates the degree to which a stimulus is important for an individual's current task goals (Scherer 2013)

Thalamo-amygdala path: See *immediate emotional registration*

Threat: An external stimulus variable (e.g., an environmental or message cue) that exists in the environment (Witte 1992)

Threat severity: The significance or magnitude of a threat conveyed in a fear appeal

Threat vulnerability: the component of a fear appeal related to one's likelihood of experiencing a threat

Valence: The dimension of *feeling state* that differentiates positive from negative feeling states (Scherer 2005)

Appendix B

SUBJECT RECRUITMENT AND REGISTRATION

All subjects were recruited from a management information systems course that is required for all undergraduate business students, so the sample drawn from this course includes undergraduate students from all business majors. To recruit subjects, the following information was read to students in three sections of the course (about 1,000 total students):

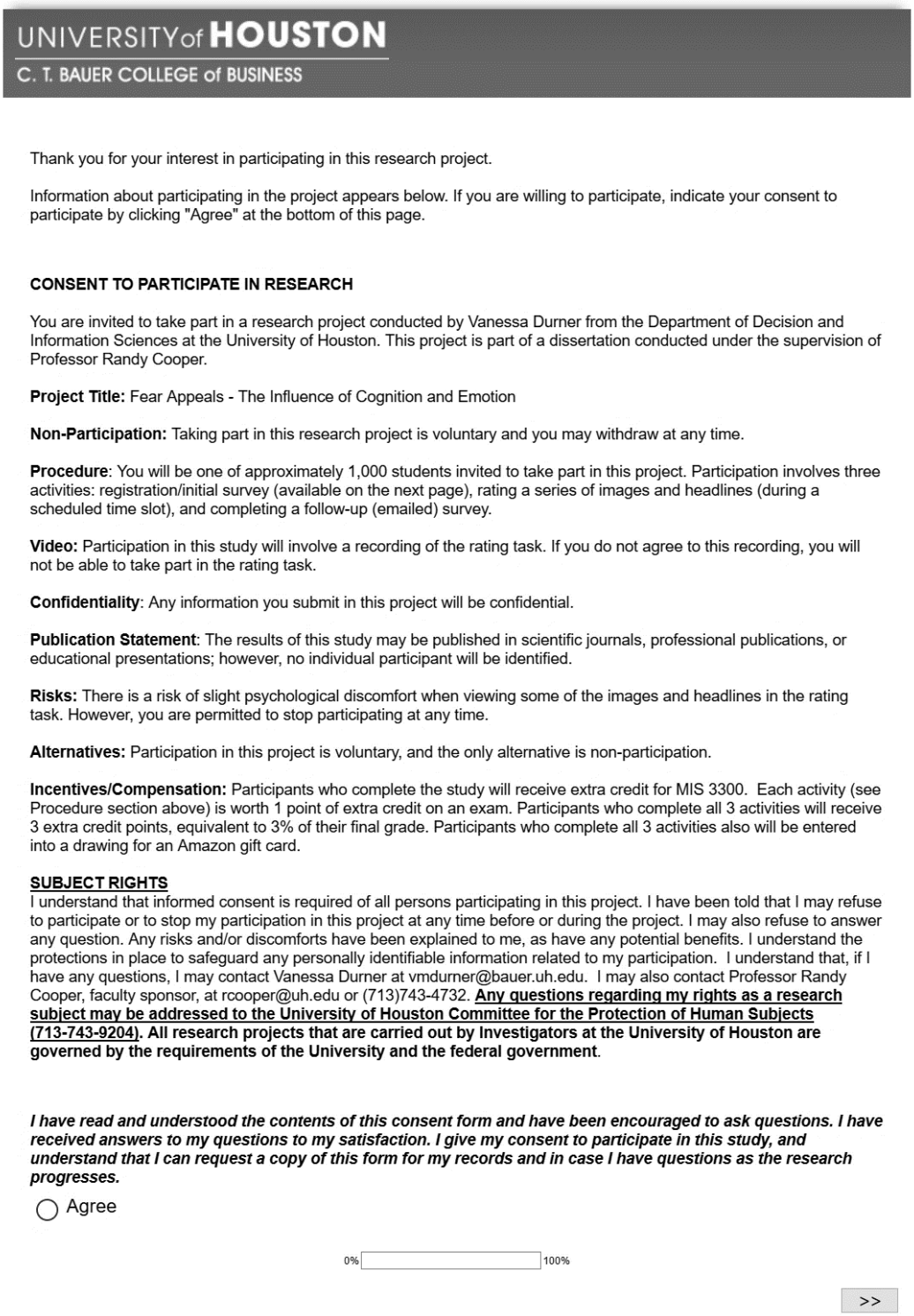
> I invite you to participate in a study I'm conducting as part of my dissertation. This project has been reviewed and approved by the University of Houston Committees for the Protection of Human Subjects. Your participation is completely voluntary and will entail signing up for a 30-minute session on campus, where you will complete an image- and headline-rating task and a survey. Participants who complete the task and survey will receive up to 3 points of extra credit for this course. Additionally, participants will have the opportunity to enter a drawing for an Amazon gift card. If you are interested in participating, please sign up at the study website at http://tinyurl.com/MIS-Study.

Additionally, a recruitment flyer was provided to students via Blackboard, as shown below in Figure B.1.

FIGURE B.1. Recruitment Flyer

When students followed the link, they were shown the following consent form and were prompted to indicate their willingness to participate in the research project, as shown in Figure B.2.

FIGURE B.2. Informed Consent Form



UNIVERSITY of HOUSTON
C. T. BAUER COLLEGE of BUSINESS

Thank you for your interest in participating in this research project.

Information about participating in the project appears below. If you are willing to participate, indicate your consent to participate by clicking "Agree" at the bottom of this page.

CONSENT TO PARTICIPATE IN RESEARCH

You are invited to take part in a research project conducted by Vanessa Durner from the Department of Decision and Information Sciences at the University of Houston. This project is part of a dissertation conducted under the supervision of Professor Randy Cooper.

Project Title: Fear Appeals - The Influence of Cognition and Emotion

Non-Participation: Taking part in this research project is voluntary and you may withdraw at any time.

Procedure: You will be one of approximately 1,000 students invited to take part in this project. Participation involves three activities: registration/initial survey (available on the next page), rating a series of images and headlines (during a scheduled time slot), and completing a follow-up (emailed) survey.

Video: Participation in this study will involve a recording of the rating task. If you do not agree to this recording, you will not be able to take part in the rating task.

Confidentiality: Any information you submit in this project will be confidential.

Publication Statement: The results of this study may be published in scientific journals, professional publications, or educational presentations; however, no individual participant will be identified.

Risks: There is a risk of slight psychological discomfort when viewing some of the images and headlines in the rating task. However, you are permitted to stop participating at any time.

Alternatives: Participation in this project is voluntary, and the only alternative is non-participation.

Incentives/Compensation: Participants who complete the study will receive extra credit for MIS 3300. Each activity (see Procedure section above) is worth 1 point of extra credit on an exam. Participants who complete all 3 activities will receive 3 extra credit points, equivalent to 3% of their final grade. Participants who complete all 3 activities also will be entered into a drawing for an Amazon gift card.

SUBJECT RIGHTS
I understand that informed consent is required of all persons participating in this project. I have been told that I may refuse to participate or to stop my participation in this project at any time before or during the project. I may also refuse to answer any question. Any risks and/or discomforts have been explained to me, as have any potential benefits. I understand the protections in place to safeguard any personally identifiable information related to my participation. I understand that, if I have any questions, I may contact Vanessa Durner at vmdurner@bauer.uh.edu. I may also contact Professor Randy Cooper, faculty sponsor, at rcooper@uh.edu or (713)743-4732. **Any questions regarding my rights as a research subject may be addressed to the University of Houston Committee for the Protection of Human Subjects (713-743-9204). All research projects that are carried out by Investigators at the University of Houston are governed by the requirements of the University and the federal government**.

I have read and understood the contents of this consent form and have been encouraged to ask questions. I have received answers to my questions to my satisfaction. I give my consent to participate in this study, and understand that I can request a copy of this form for my records and in case I have questions as the research progresses.

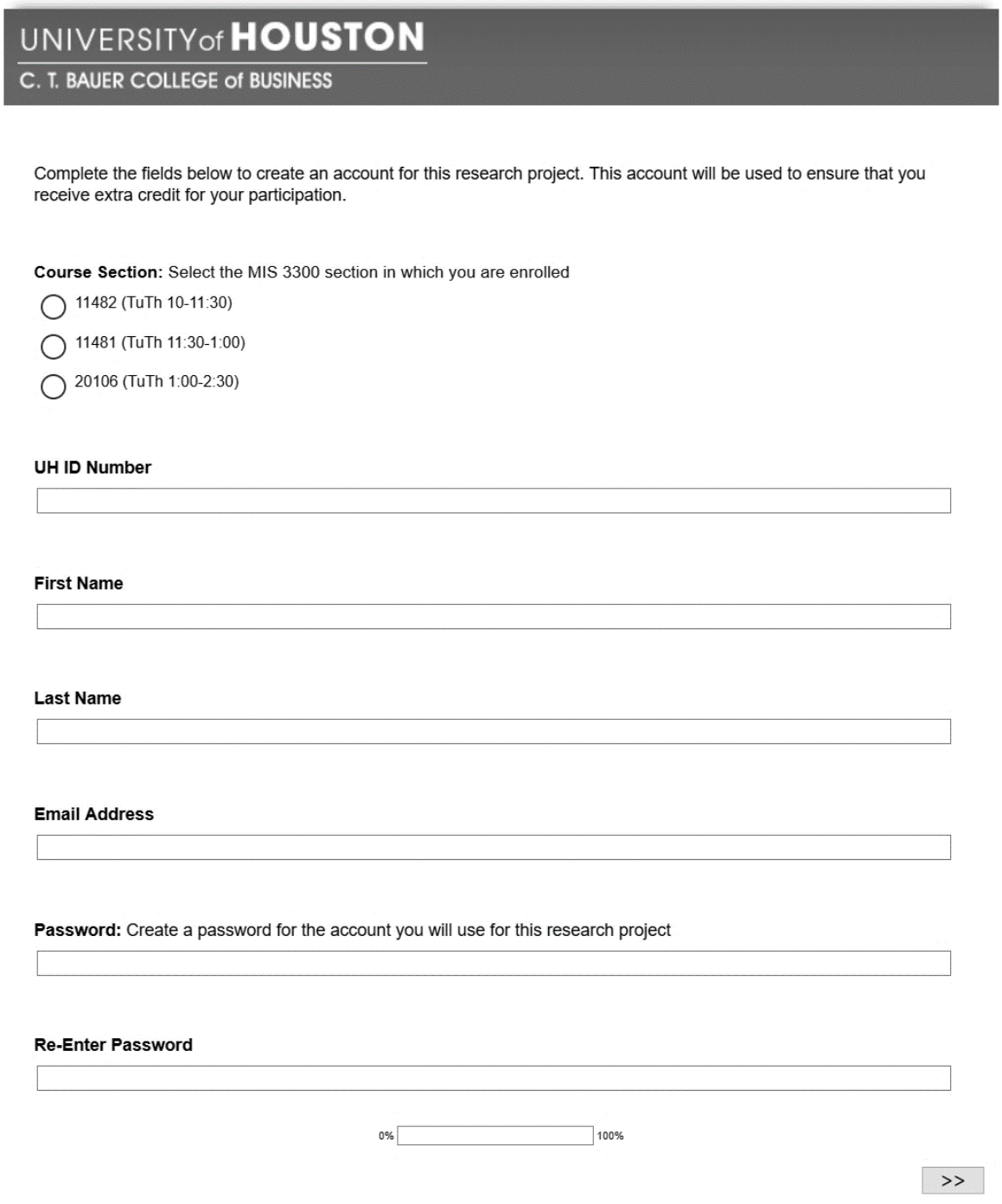
◯ Agree

0% 100%

>>

After clicking “Agree” at the bottom of the consent form shown in the previous section, each subject was prompted to create an account for the research project, as shown in Figure B.3.

FIGURE B.3. Account Creation Form



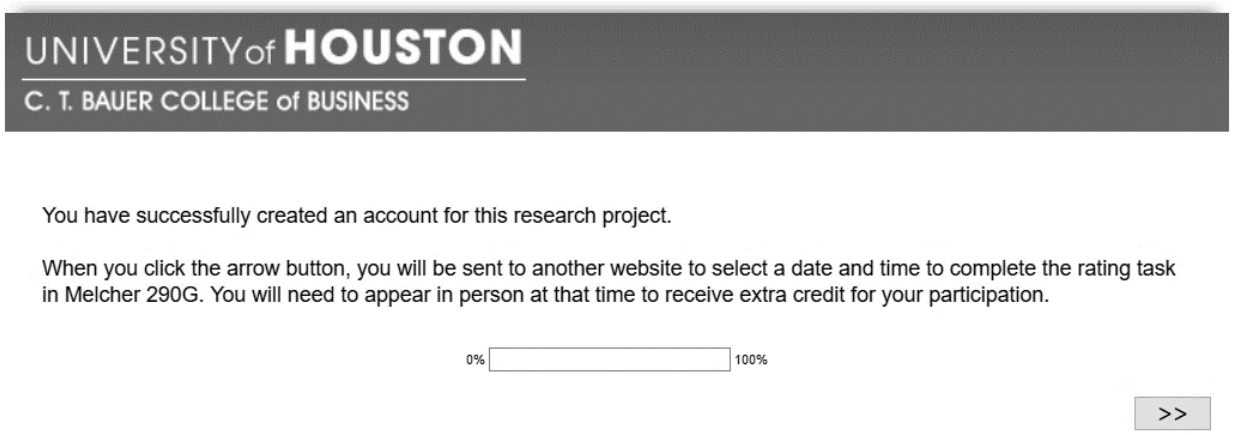
After subjects completed the registration form shown in the previous section, they were prompted to answer a series of randomly ordered items related to computer efficacy, computer anxiety, lay rationalism, and perceived password strength, as shown in Table B.1 below. The computer efficacy, computer anxiety, and lay rationalism items were included in order to control for their potential effect on subjects' responses to an information security fear appeal. The perceived password strength items were included as a measure of subjects' perceived information security behavior.

TABLE B.1. Registration Survey Items

Statement/Question	Scale	Source
I feel confident troubleshooting computer problems	Computer self-efficacy	Barbeite & Weiss 2004
I feel confident understanding computer-related terms	Computer self-efficacy	Barbeite & Weiss 2004
I feel confident explaining why software will or will not run on a given computer	Computer self-efficacy	Barbeite & Weiss 2004
I feel confident writing simple programs for the computer	Computer self-efficacy	Barbeite & Weiss 2004
Working with a computer would make me very nervous	Computer anxiety	Barbeite & Weiss 2004
I get a nervous feeling when thinking about using a computer	Computer anxiety	Barbeite & Weiss 2004
Computers make me very uncomfortable	Computer anxiety	Barbeite & Weiss 2004
Computers make me feel uneasy	Computer anxiety	Barbeite & Weiss 2004
When making decisions, I like to analyze financial costs and benefits and resist the influence of my feelings	Lay rationalism	Hsee et al 2015
When choosing between two options, one of which makes me feel better and the other better serves the goal I want to achieve, I choose the one that makes me feel better	Lay rationalism	Hsee et al 2015
When making decisions, I think about what I want to achieve rather than how I feel	Lay rationalism	Hsee et al 2015
When choosing between two options, one of which is financially superior and the other "feels" better to me, I choose the one that is financially better	Lay rationalism	Hsee et al 2015
When choosing between products, I rely on my gut feelings rather than on product specifications (numbers and objective descriptions)	Lay rationalism	Hsee et al 2015
When making decisions, I focus on objective facts rather than subjective feelings	Lay rationalism	Hsee et al 2015
Overall, how strong are your passwords? [strong/weak]	Perceived password strength	n/a
How often do you use weak passwords? [always/never]	Perceived password strength	n/a
How do you think your passwords compare to other people's passwords? [stronger/weaker]	Perceived password strength	n/a
How likely is it that you will experience identity theft due to your passwords? [likely/unlikely]	Perceived password strength	n/a

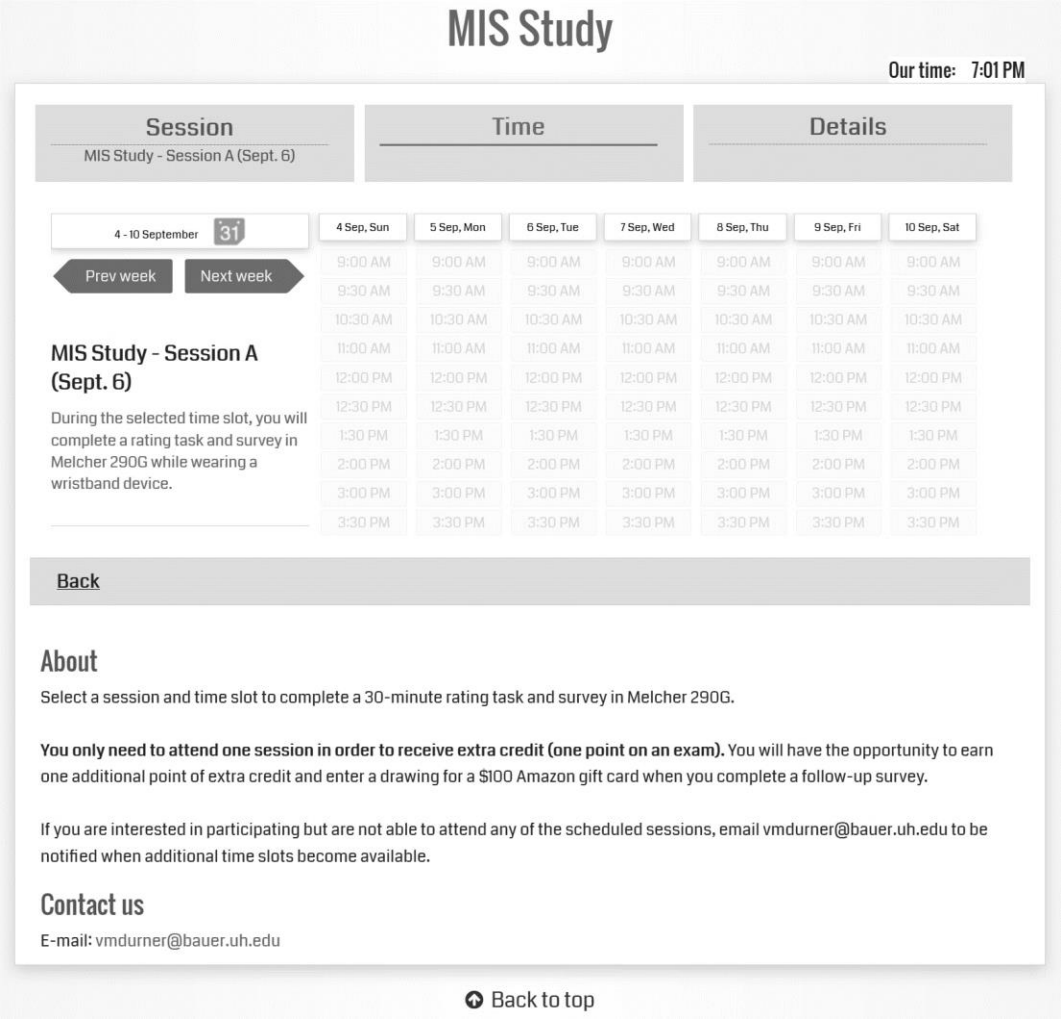
After completing the survey described in the section above, subjects were directed to another website to schedule a time to complete an in-person task, as shown in Figure B.4.

FIGURE B.4. Account Creation Confirmation



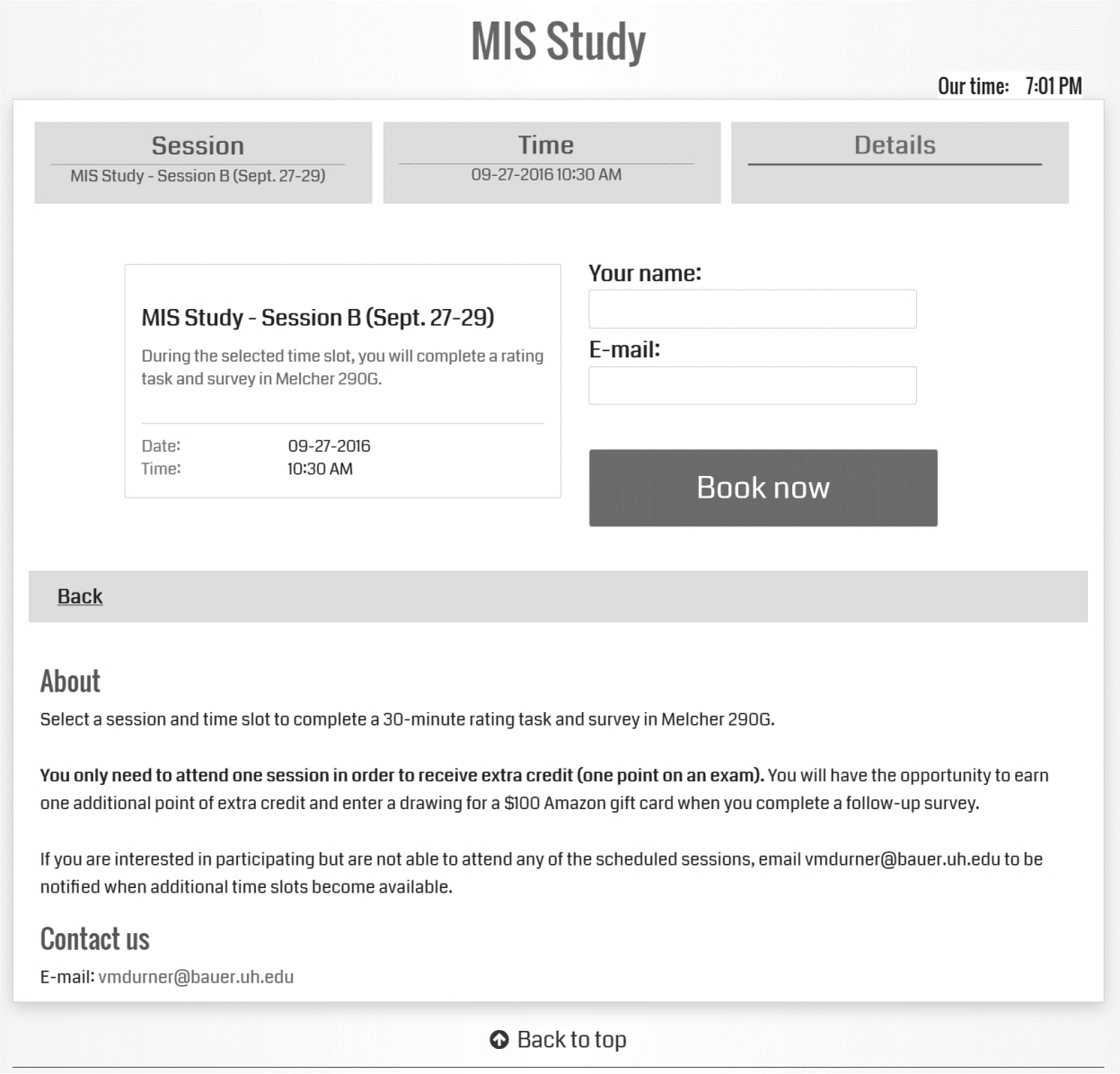
Subjects were prompted to select a date and time for the rating task by clicking on an available time slot, as shown in Figure B.5. Up to 10 subjects were allowed to register for each time slot, with 5 time slots available per day. When the maximum number of subjects was reached for a particular time slot, the time slot was longer shown as an option.

FIGURE B.5. Rating Task Appointment Selection



After subjects clicked on an available time slot, they were prompted to enter their names and email addresses to reserve that selected time, as shown in Figure B.6. When subjects clicked “book now”, they received an email that confirms their reserved time slot. Subjects additionally received another email 24 hours prior to their scheduled time as a reminder of their reserved time slot.

FIGURE B.6. Rating Task Appointment Form



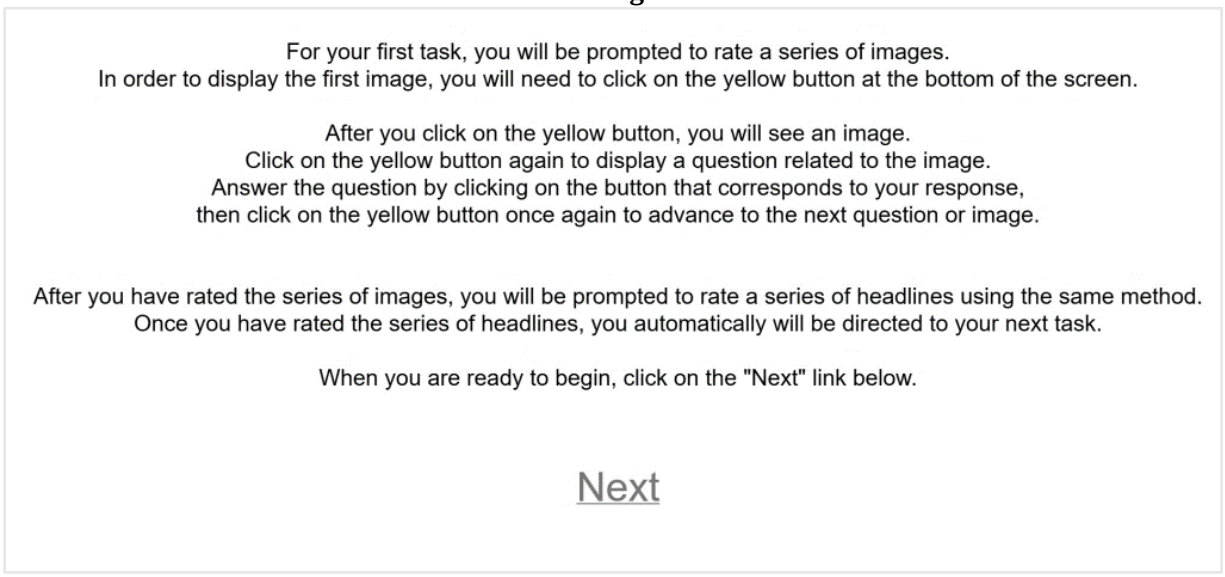
Appendix C

PILOT STUDY PROCEDURE

Laptops were set up so that subjects could not see each other's screens. When each subject arrived, he or she was randomly assigned a unique participant ID and directed to an open laptop. The participant ID was used in order to link subjects' survey responses to their mouse movements, GSR, and facial expressions. When each subject was seated, a GSR wristband was strapped on the subject's non-dominant hand and the webcam was positioned to record the subject's face. Subjects were instructed to raise their hand if they had any questions or technical issues while completing the task. Once the webcam and GSR were configured, each subject's participant ID was entered, and the webcam recording started.

Each laptop displayed an explanation of the image and headline rating task, as shown in Figure C.1. Each subject clicked on the "next" link to begin the task.

FIGURE C.1. Rating Task Instructions



Upon clicking "next", half of the subjects were shown a series of images (the other half of the subjects were shown a series of sentences first). The series of images included five potential fear appeal images, representing different combinations of elements related to information security (computer alone, computer/wallet, computer/hand, computer/hand/wallet, and computer/face/wallet). The other images are a subset of the images in the international affective picture system (IAPS) dataset. In keeping with the

usage agreement for the IAPS dataset, none of the images can be included here. However, the images presented to subjects were similar to the ones presented in Figure C.2.

FIGURE C.2. Images Similar to International Affective Picture System Stimuli

Moderate arousal
Positive valence
Low fear

Low arousal
Neutral valence
Low fear

High arousal
Negative valence
High fear

The IAPS images were chosen to represent fear, surprise, anger, joy, sadness, disgust, and neutral images (as determined by Barke 2012), as shown in Table C.1 below.

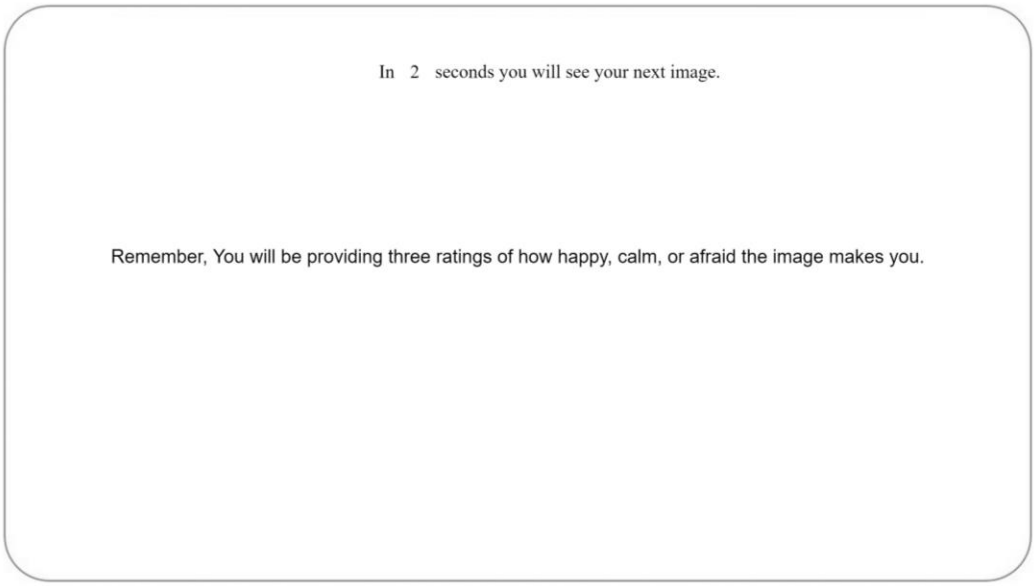
Table C.1. Image-Based Stimuli for the Pilot Study

	IAPS			Libkuman	Mikels	Barke
Image Number	**Image Description**	**$\mu_{valence}$ (Range: 1-9; 5 is neutral)**	**$\mu_{arousal}$ (Range: 1-9)**	**μ_{fear} (Range: 1-9)**	**Emotion**	
1001	Computer	5*	1*	1*	Neutral*	Neutral*
1002	Computer/wallet	4*	2*	2*	Neutral*	Neutral*
1003	Computer/hand	3*	5*	5*	Fear*	Fear*
1004	Computer/hand/wallet	2*	6*	6*	Fear*	Fear*
1005	Computer/face/wallet	2*	6*	6*	Fear*	Fear*
1111	Snakes	3.25	5.20	-	Disgust	Disgust
2345.0	Skydivers	7.41	5.42	-	Amusement	-
2345.1	Black eye	2.26	5.50	-	-	Anger
2751	Drunk driving	2.67	5.18	-	-	Anger
2770	Mask	4.37	5.11	-	-	Surprise
2900.1	Crying	2.56	4.61	-	Sadness	Sadness
2900.2	Smiling	6.62	4.52	-	Amusement	Joy
6250.1	Aimed gun	2.63	6.92	7.08	Fear	Fear
6250.2	Ice cream	6.32	5.13	-	Amusement	Joy
6370	Attack	2.70	6.44	6.65	Fear	Fear
7009	Mug	5.27	1.27	-	-	Neutral
7010	Basket	4.94	1.76	-	-	Neutral
7020	Fan	5.05	1.51	-	-	Neutral
8160	Rock climbers	5.07	6.97	-	Awe	Surprise
9001	Cemetery	3.10	3.67	-	-	Sadness
9390	Dishes	3.67	4.14	-	Disgust	Disgust

* Estimated value

Above each image, subjects were prompted to answer three items related to how the stimulus makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid). The images were displayed in a random order for each individual, blocked by the computer threat images, in order to avoid any ordering effects and to ensure that no two computer threat images appear next to each other. Furthermore, a screen with no image appeared for 5 seconds prior to each image, acting as a buffer between images. As soon as subjects entered a rating, the "next" button appeared at the bottom of the screen. When subjects clicked on the "next" button, they advanced to the next image or rating prompt. Figure C.3 shows a sequence of the rating task for one of the images.

FIGURE C.3. Image Rating Sequence



Please look at the image below. Click the "next" button to provide a rating of how the image makes you feel.

NEXT

How does this image make you feel?

Very Happy	Slightly Happy	Neither Happy nor Unhappy	Slightly Unhappy	Very Unhappy
		*		

NEXT

Next, half of the subjects were shown a series of 20 headlines (the other half of the subjects were shown the series of images described above). The headlines included four sentences related to high and low threat severity and threat vulnerability associated with identity theft due to weak passwords (rows 1-4 in Table C.2). Most of the other headlines (rows 10-20 in Table C3) are a subset of the sentences in the

Affective Text dataset. The Affective Text headlines were chosen to represent fear, surprise, anger, joy, sadness, disgust, and neutral sentences. The remaining headlines (rows 5-10 in Table C3) are modifications of sentences in the Affective Text dataset in order to include threat severity and vulnerability issues that are unrelated to identity theft.

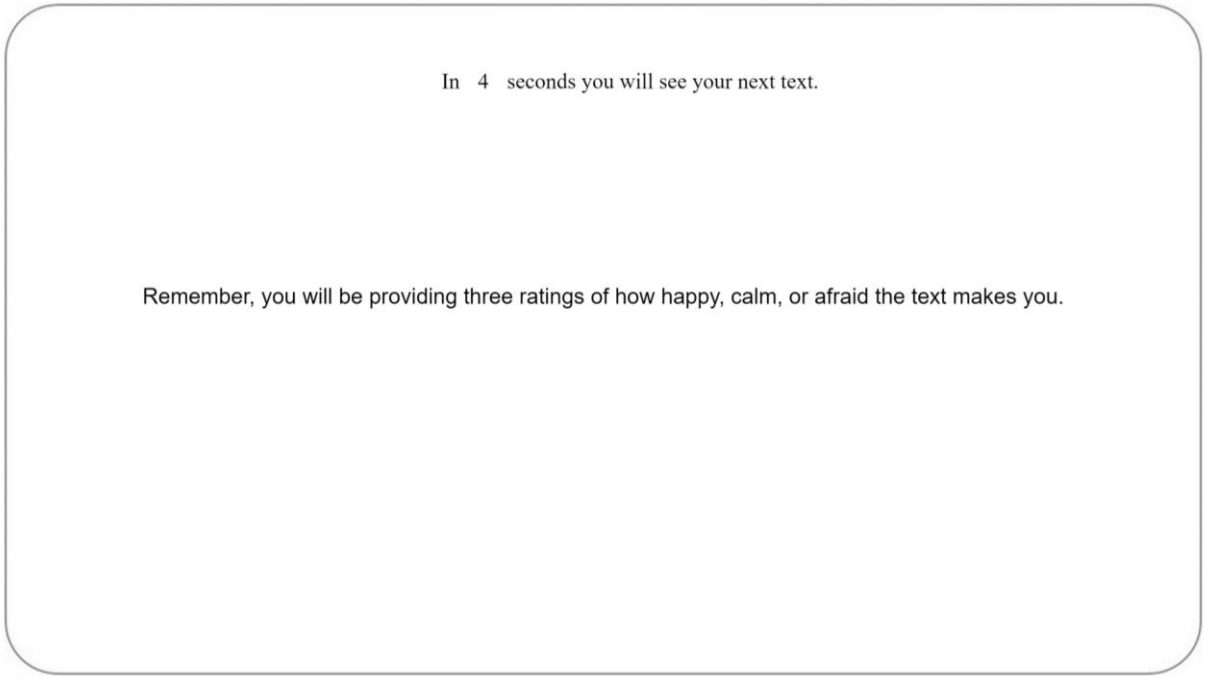
Table C.2. Text-Based Stimuli for the Pilot Study

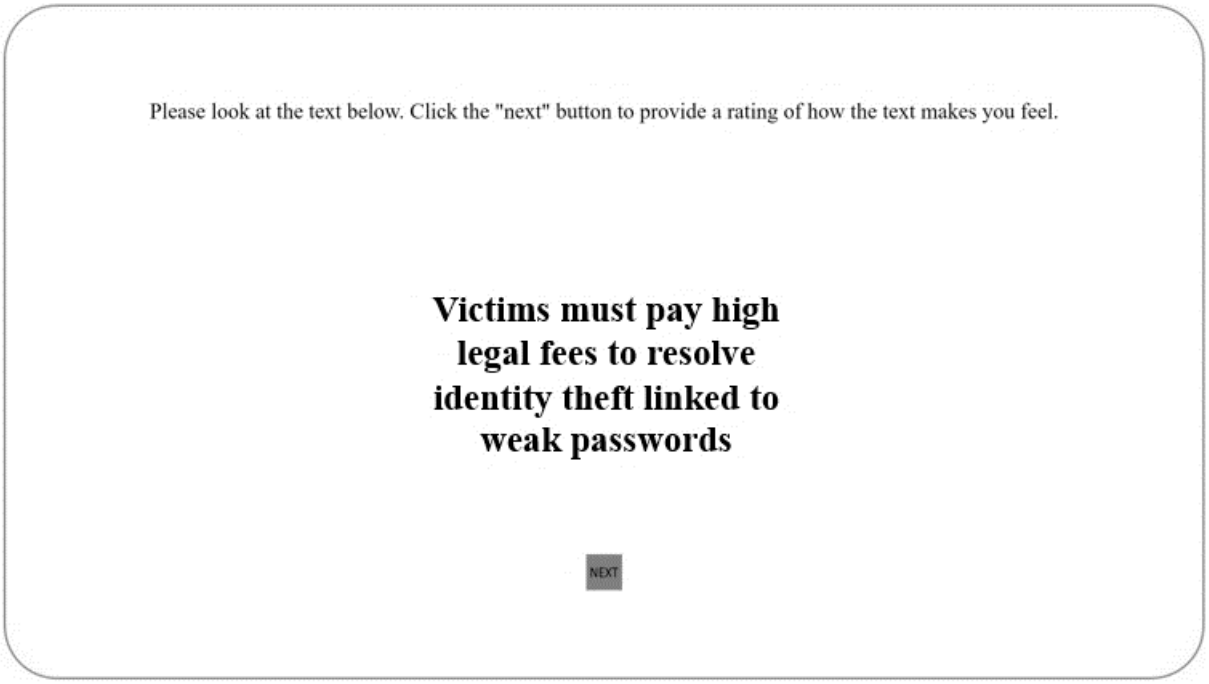
Row	Text ID	Sentence	$\mu_{valence}$ (-8 to 8; 0 is neutral)	Emotion	Threat Severity	Threat Vulnerability
1	T001	Victims are not responsible for costs resulting from identity theft linked to weak passwords	2*	Neutral*	Low	-
2	T002	Victims are responsible for paying high legal fees to resolve identity theft linked to weak passwords	-2*	Fear*	High	-
3	T003	Few identity theft occurrences can be linked to weak passwords	1*	Neutral*	-	Low
4	T004	Most identity theft occurrences can be linked to weak passwords	-4*	Fear*	-	High
5	T005	Anti-terror protesters detained after weekend violence in Houston	-4*	Neutral*	Low*	High*
6	T006	Terror suspects detained after weekend violence in Houston	-7*	Fear*	High*	High*
7	T007	Terror suspects detained after weekend violence in North Africa	-5*	Fear*	High*	Low*
8	T008	Anti-terror protesters detained after weekend violence in North Africa	-3*	Neutral*	Low*	Low*
9	T009	Houston feared as staging ground for terror	-6*	Fear*	High*	High*
10	1006	North Africa feared as staging ground for terror	-7.12	Fear	High*	Low*
11	965	Venezuela, Iran fight U.S. dominance	-1.92	Anger	-	-
12	615	Anger at release of two held over beheading plot	-5.44	Anger	-	-
13	545	Two detained in body parts mailing	-2.4	Disgust	-	-
14	767	Bigger, more aggressive rats infesting UK	-6.88	Disgust	-	-
15	600	Man rides stationary bike for 85 hours	4.16	Surprise	-	-
16	1484	Marijuana helps ease HIV nerve pain, study says	2.72	Surprise	-	-
17	1109	Retinal implant helping blind people see again	6.48	Joy	-	-
18	1117	Scientists tout cocoa's health benefits	5.76	Joy	-	-
19	1036	VP starts visit to Japan, Australia	1.28	Neutral	-	-
20	1230	Vietnamese bank plans IPO listing	1.68	Neutral	-	-

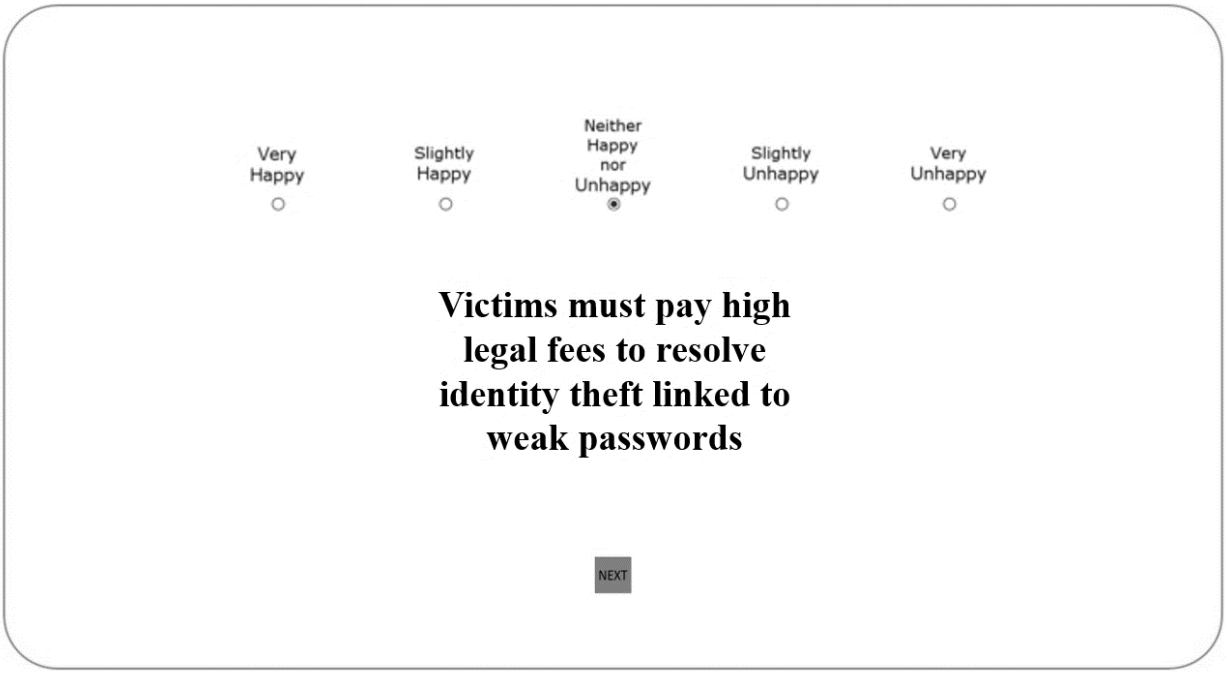
*Estimated value; $\mu_{valence}$ and emotion values are based on Affective Text valence and emotion category values.

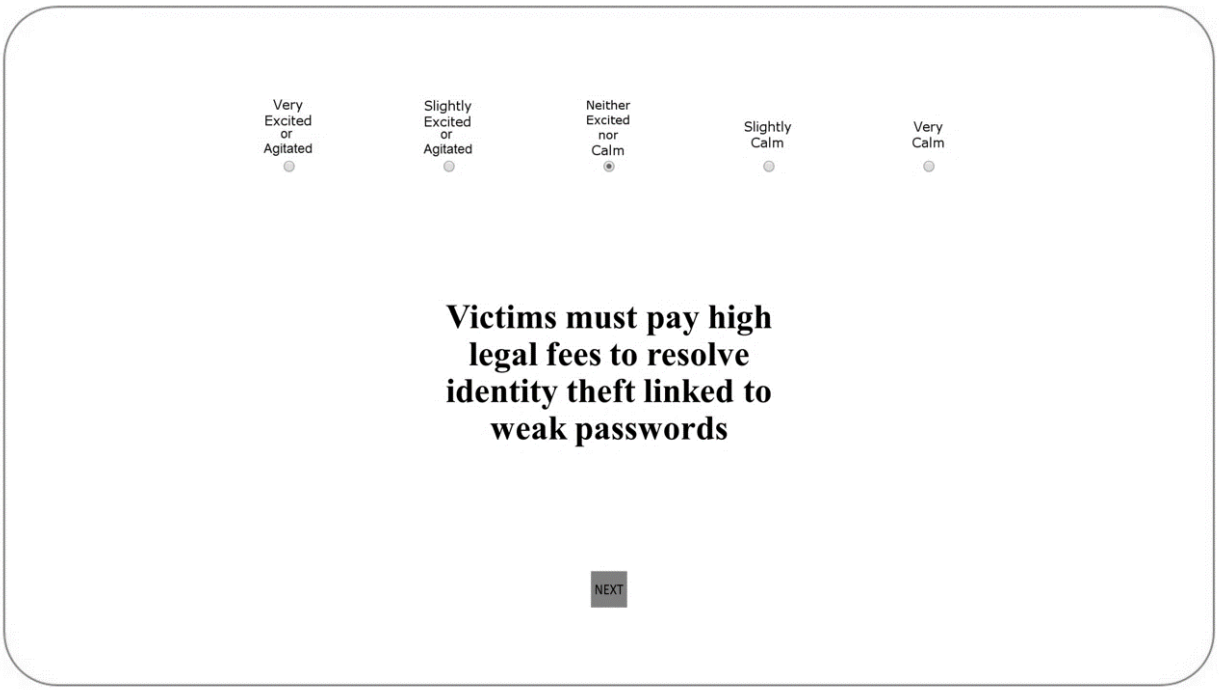
Like the previous image-rating task, subjects were prompted to indicate how each sentence made them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid). The sentences were displayed in a random order for each individual, in order to avoid any ordering effects. Furthermore, a screen with no text appeared for 5 seconds prior to each sentence, acting as a buffer between the text-based stimuli. As soon as subjects entered a rating, the "next" button appeared at the bottom of the screen. When subjects clicked on the "next" button, they advanced to the next sentence or rating prompt. Figure C.4 shows a sequence of the rating task for one of the sentences.

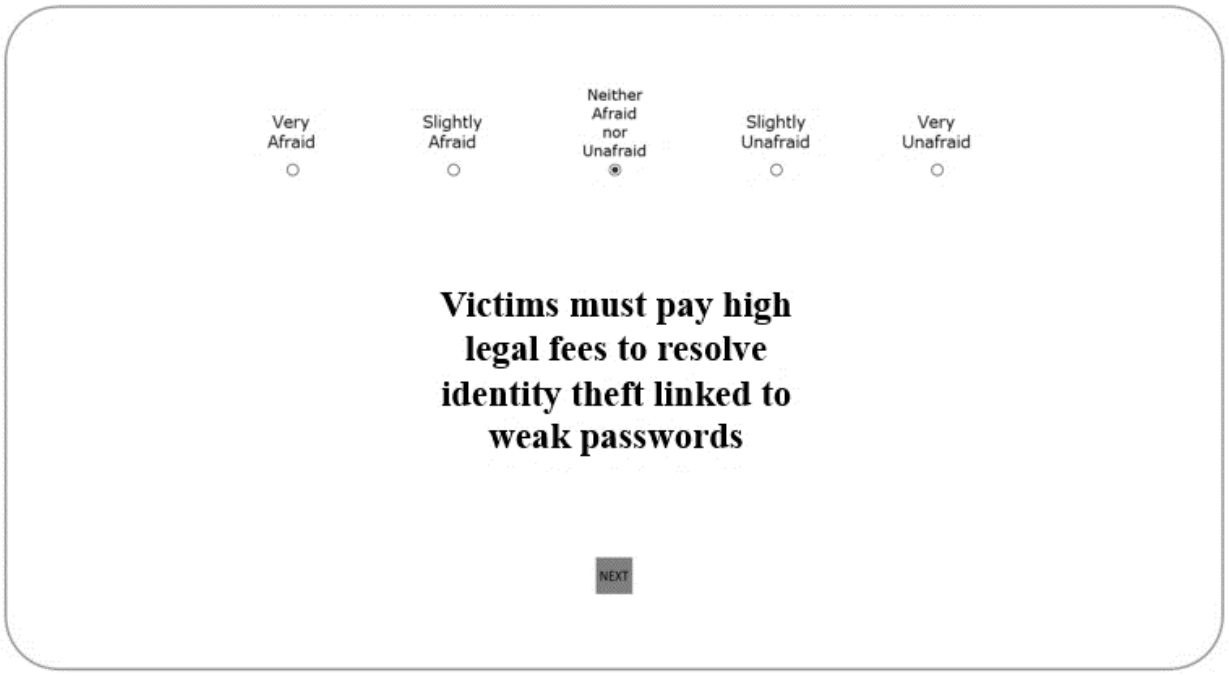
FIGURE C.4. Text Rating Sequence




Please look at the text below. Click the "next" button to provide a rating of how the text makes you feel.
Victims must pay high legal fees to resolve identity theft linked to weak passwords
NEXT

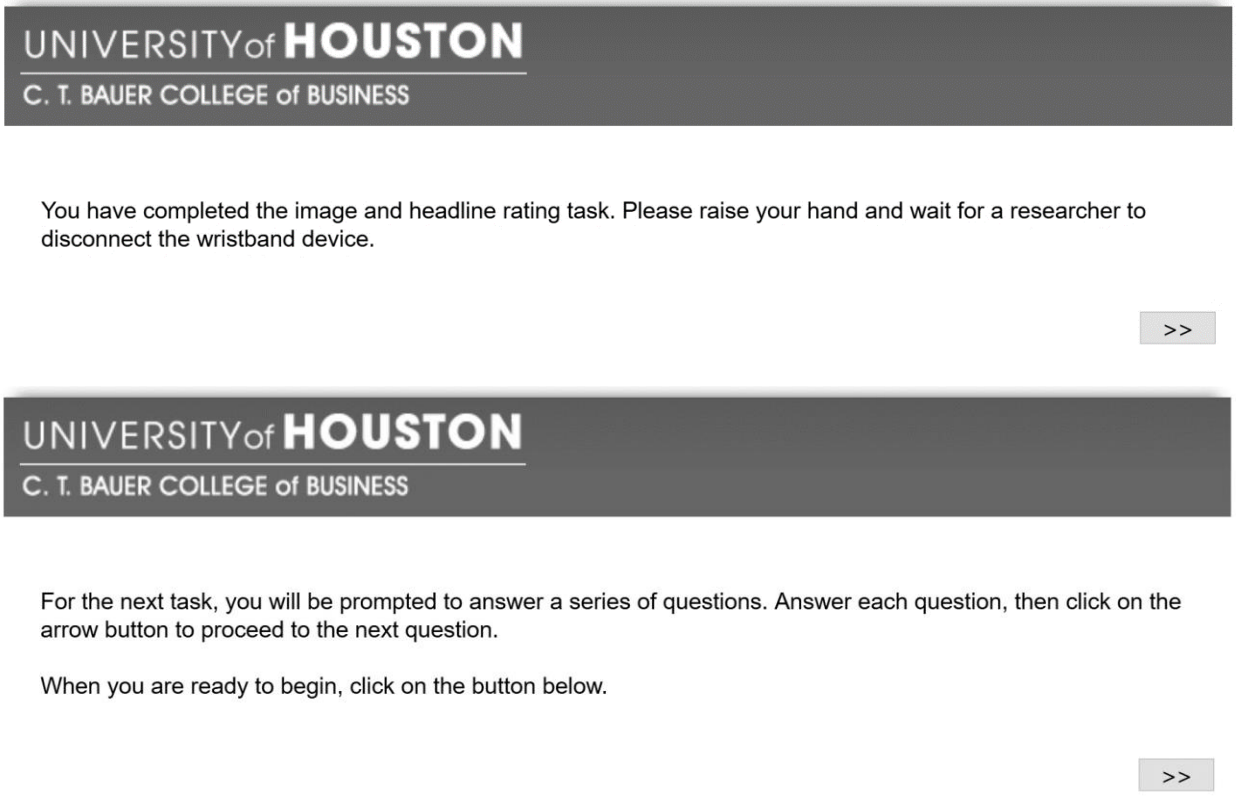

Very Happy
Slightly Happy
Neither Happy nor Unhappy
Slightly Unhappy
Very Unhappy
Victims must pay high legal fees to resolve identity theft linked to weak passwords
NEXT



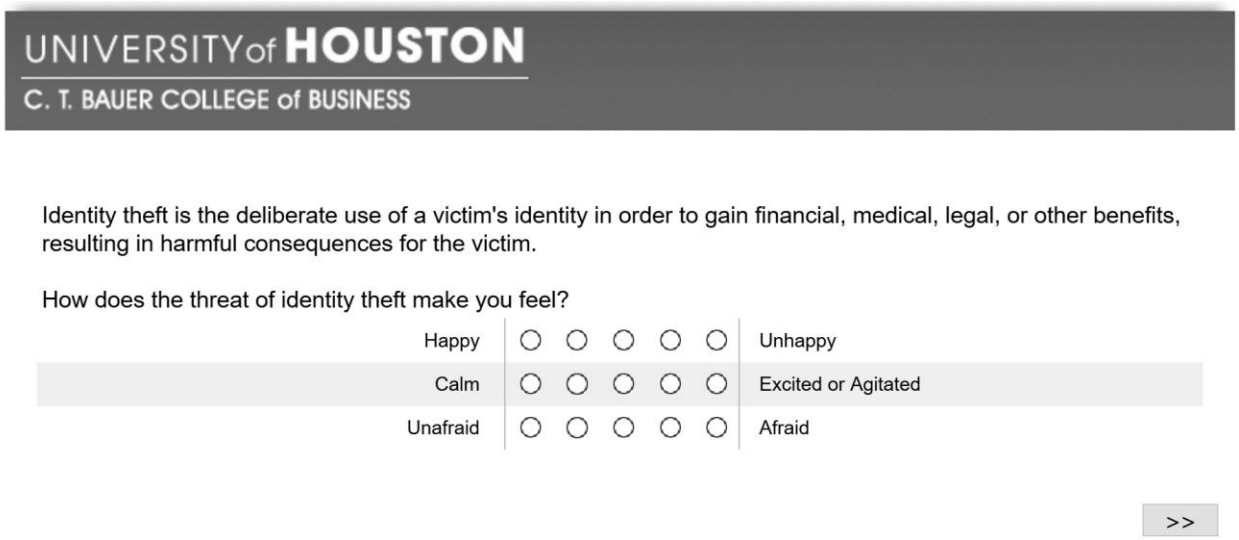


After the sentence-rating task, subjects were redirected to another website, which instructed subjects to raise their hand and wait for a researcher to disconnect the GSR device and stop the recording. Next, subjects were shown instructions for a set of questions related to identity theft, as shown in Figure C.5.

FIGURE C.5. Survey Instructions



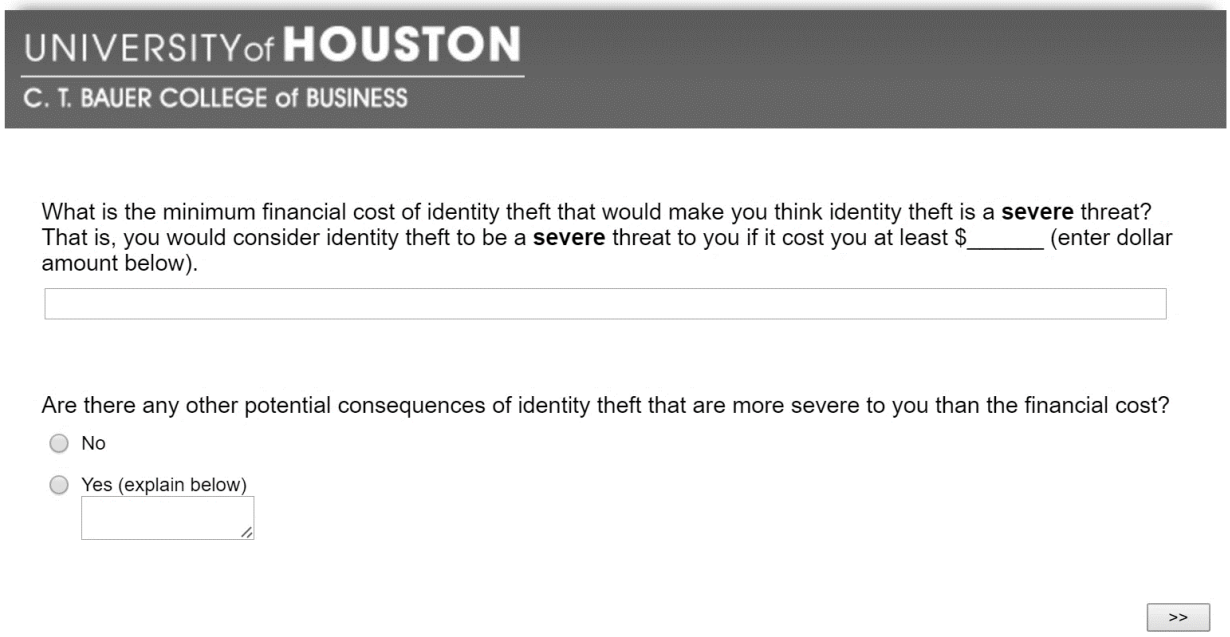
The first question prompted subjects to indicate how the threat of identity theft made them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (afraid/unafraid).



Next, subjects were involved in answering a set of questions about identity theft as it relates to stolen passwords, as shown below. To determine the minimum financial cost of identity theft that would

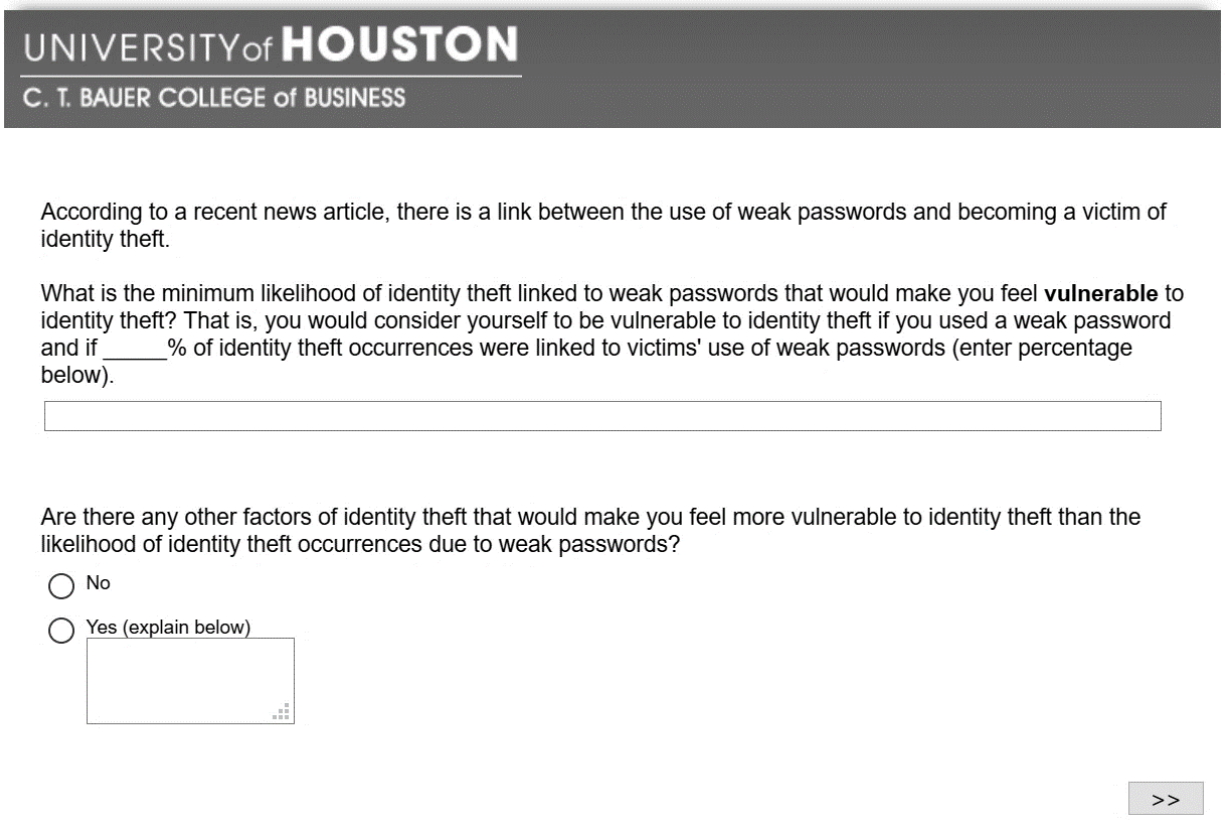
make subjects think identity theft is a severe threat (threat severity) and to identify any alternative sources of threat severity related to identity theft, subjects were prompted to respond to the two questions shown in Figure C.6. A value 3 standard deviations above the mean of the response to this question was used to represent high threat severity in the fear appeal treatment for Studies 1 and 2. Headline T001 in Table C3 ("Victims are not responsible for costs resulting from identity theft linked to weak passwords") was used to represent low threat severity in studies 1 and 2.

FIGURE C.6. Survey Items to Quantify Threat Severity Stimuli



Likewise, to determine the minimum likelihood of identity theft linked to weak passwords that would make subjects feel vulnerable to identity theft (threat vulnerability) and to identify any alternative sources of threat vulnerability related to identity theft, subjects were prompted to respond to the two items shown in Figure C.7. A value 3 standard deviations above the mean of the response to this question was used to represent high threat vulnerability in the fear appeal treatment for Study 2, while, a value 3 standard deviations below the mean of the response to this question was used to represent low threat vulnerability in studies 1 and 2.

FIGURE C.7. Survey Items to Quantify Threat Vulnerability Stimuli



After the questions related to identity theft, subjects were prompted to answer how much they agree or disagree with a set of statements related to the information security threat and response, as shown below in Table C3. These items were based on the fear appeal components in protection motivation theory and the parallel response model, and measured subjects' threat severity belief, threat vulnerability belief, response efficacy belief, password self-efficacy, and perceived response cost.

Table C.3. Pilot Study Survey Items

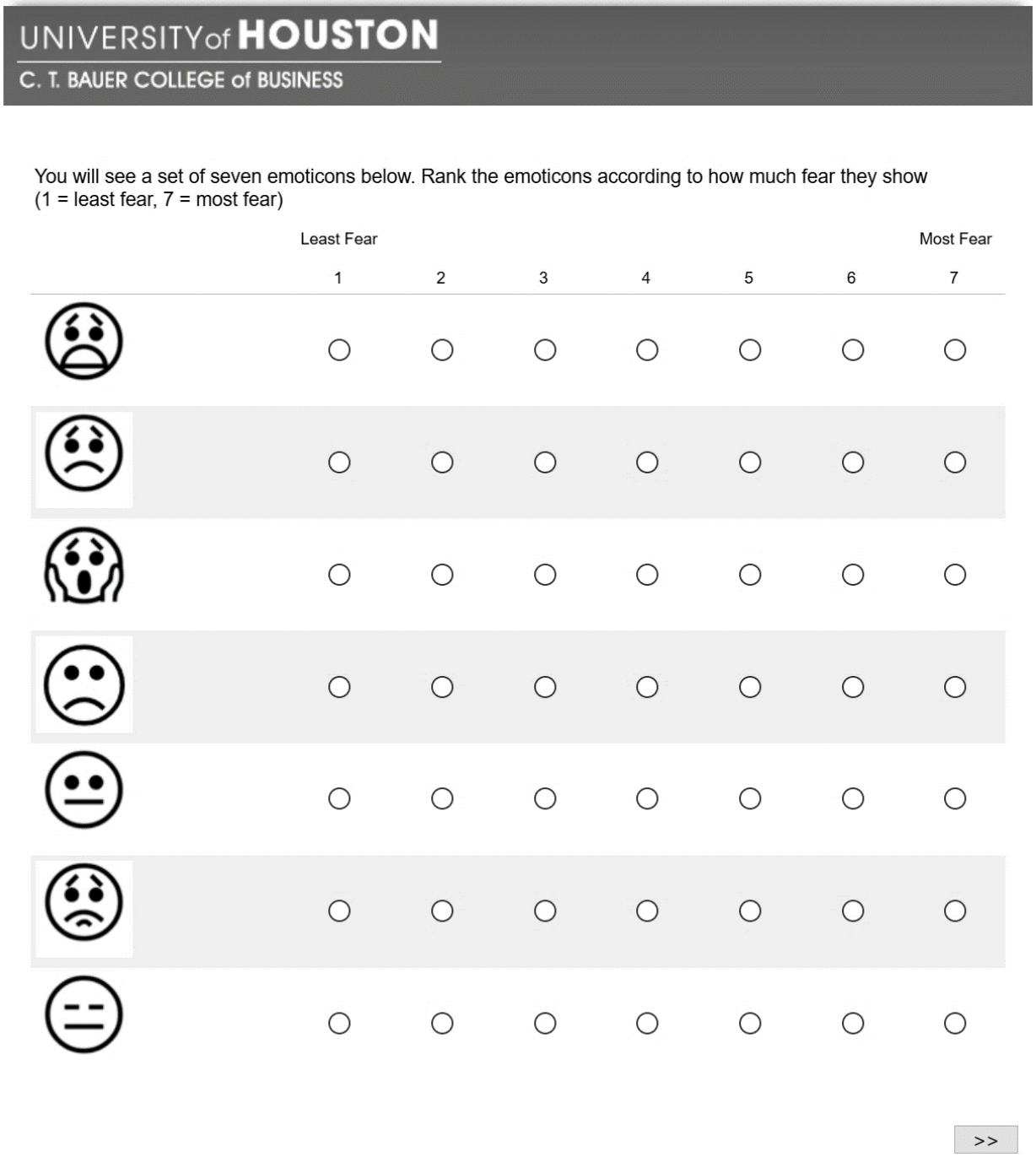
Item	Statement	Scale	Source
1	The consequences would be severe if someone stole my identity by guessing my passwords	Threat severity	Witte et al. 1996
2	The consequences would be serious if an identity thief cracked my passwords	Threat severity	Witte et al. 1996
3	If an identity thief obtained my passwords, I would suffer a lot of pain	Threat severity	Milne et al. 2002
4	It is likely that an identity thief could guess my passwords	Threat vulnerability	Johnston & Warkentin 2010
5	It is possible that someone could steal my identity by obtaining my passwords	Threat vulnerability	Johnston & Warkentin 2010
6	I am at risk for an identity thief cracking my passwords	Threat vulnerability	Johnston & Warkentin 2010

Table C.3 (continued). Pilot Study Survey Items

7	Using strong passwords is effective for preventing identity theft	Response efficacy	Johnston & Warkentin 2010
8	If I use strong passwords, I lessen my chances of identity theft	Response efficacy	Milne et al. 2002
9	Using strong passwords is a good way to reduce the risk of identity theft	Response efficacy	Milne et al. 2002
10	Strong passwords are easy to use	Password Self-efficacy	Johnston & Warkentin 2010
11	Strong passwords are convenient to use	Password Self-efficacy	Johnston & Warkentin 2010
12	I am able to use strong passwords without much effort	Password Self-efficacy	Johnston & Warkentin 2010
13	If I use strong passwords, they will be difficult for me to remember	Response cost	Milne et al. 2002
14	I feel discouraged from using strong passwords because it would cause me too many problems	Response cost	Milne et al. 2002
15	The costs of using strong passwords outweigh the benefits	Response cost	Milne et al. 2002

Next, subjects were prompted to rate seven emoticons according to the extent to which they display fear, as shown in Figure C.8. The emoticons were displayed in a random order for each individual to control for potential ordering effects. This ranking established the images for the relative amounts of fear in the perceived fear rating scale, based on the five emoticons in the correct order with the smallest overlap in standard deviations. The fear rating scale was used to measure the fear perceived in studies 1 and 2. The emoticon images were added to the fear rating scale in order to maintain consistency with the images that serve as labels for the valence and arousal scales in the self-assessment manikin (Bradley & Lang 1994) that were used in studies 1 and 2.

FIGURE C.8. Survey Items to Determine Fear Rating Scale Labels

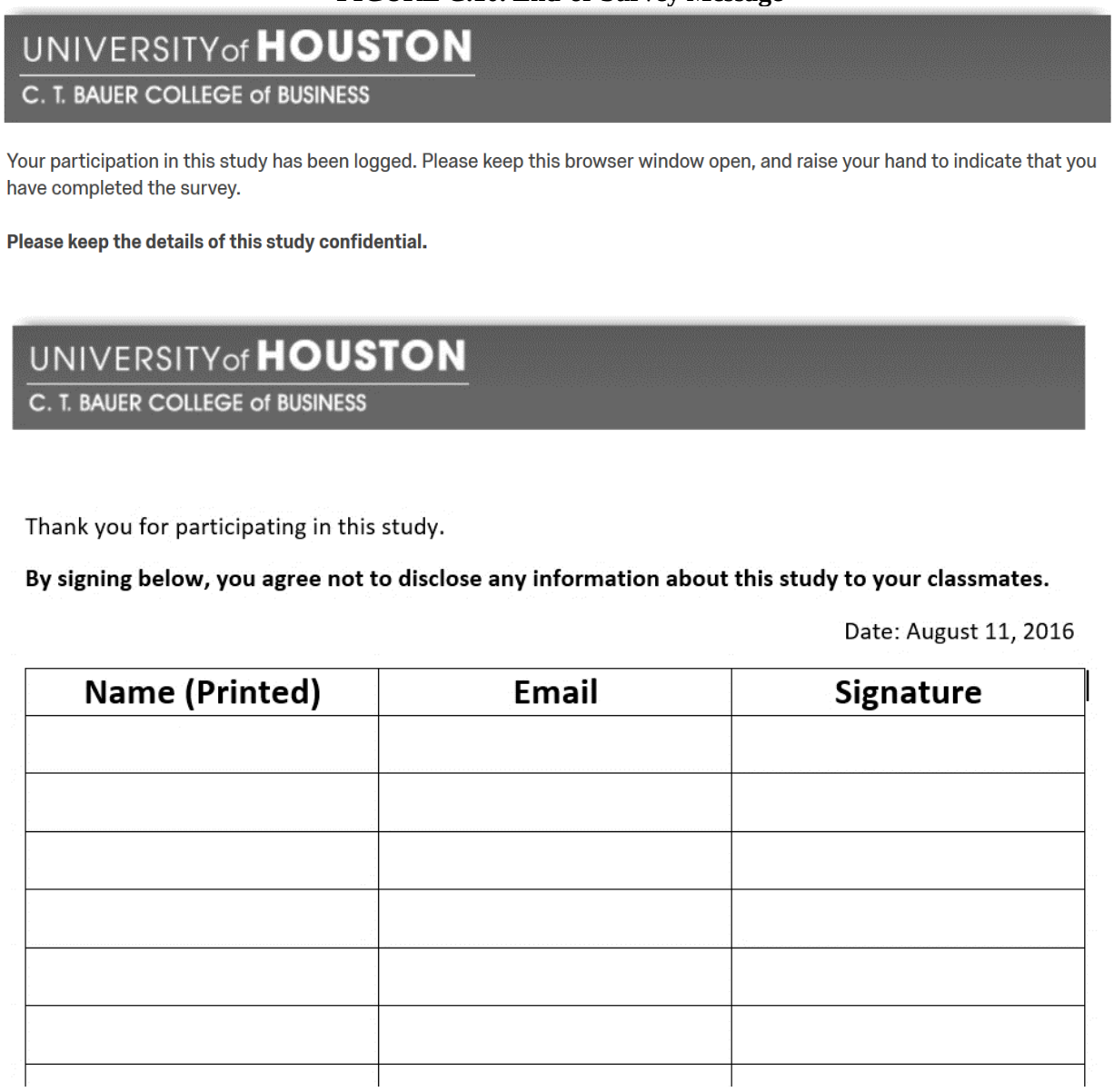


Finally, subjects were prompted to answer questions related to demographic information, as shown in Figure C.9.

FIGURE C.9. Survey Items to Determine Demographic Information

After subjects responded to the questions above, they were shown a message that thanked them for their participation, as shown in Figure C.10. Subjects were instructed to raise their hands once they completed the survey and then were reminded to not discuss the study with others. Before leaving, subjects were asked to sign out to receive their extra credit.

FIGURE C.10. End-of-Survey Message



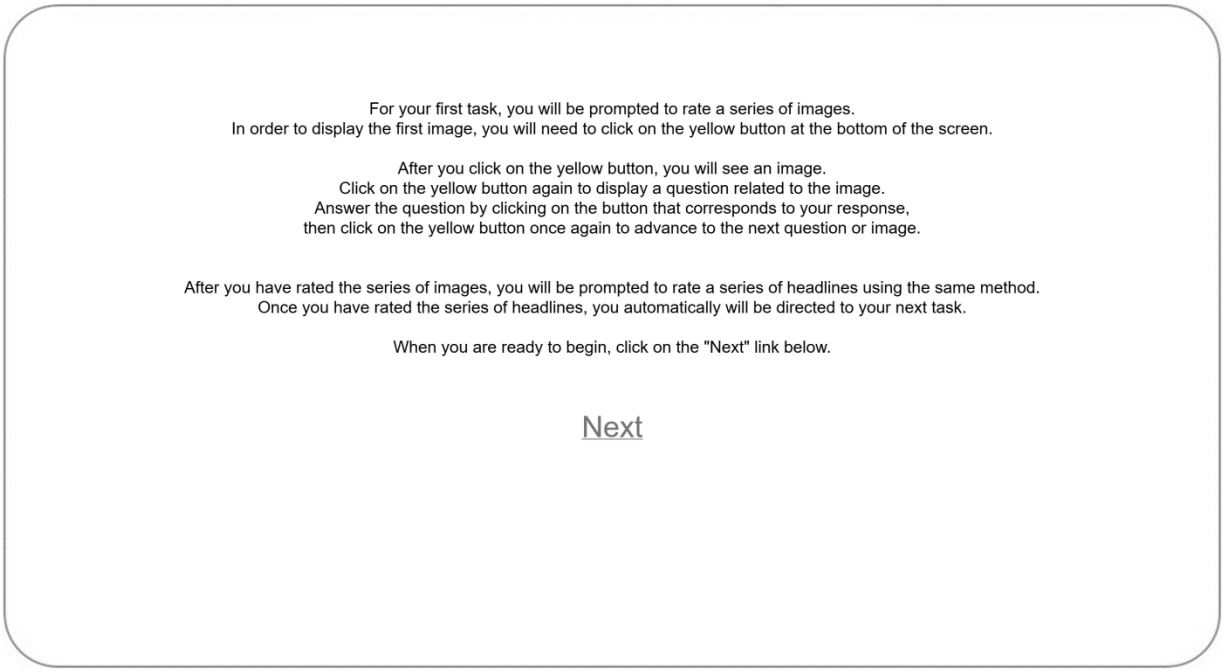
Appendix D

STUDY 1 PROCEDURE

When students arrived for their scheduled time slot, they were directed to an open seat in the classroom (Melcher 290G). Laptops were set up so that subjects could not see each other's screens. Each subject was randomly assigned a unique participant ID. This ID was also passed as a variable to the survey that each subject completed after the rating task, in order to link subjects' survey responses to their ratings.

Subjects were instructed to raise their hand if they had any questions or technical issues while completing the rating task. Each laptop displayed an explanation of the task, as shown in Figure D.1. Each subject needed to click on "next" to begin the task.

FIGURE D.1. Rating Task Instructions



Next, half of the subjects were shown a series of 21 images (the other half of the subjects were shown a series of 20 headlines first). The series of images included five potential fear appeal images, representing different combinations of elements related to information security (computer alone, computer/wallet, computer/hand, computer/wallet/hand, computer/wallet/face). The other images were a

subset of the images in the international affective picture system (IAPS) dataset. The IAPS images were chosen to represent fear, surprise, anger, joy, sadness, disgust, and neutral images (as determined by Barke 2012), as shown in Table D.1 below.

TABLE D.1. Image-Based Stimuli for Study 1

Image Number	Image Description	$\mu_{valence\ (SD)*}$ (Range: 1-9; 5 is neutral)	$\mu_{arousal\ (SD)*}$ (Range: 1-9)	μ_{fear*} (Range: 1-9)	Emotion	
					Mikels	Barke
1001	Computer	5.63 (1.52)	3.98 (2.17)	3.35 (2.18)	Neutral	Neutral
1002	Computer/wallet	5.55 (1.60)	4.10 (2.09)	3.71 (2.43)	Neutral	Neutral
1003	Computer/hand	3.04 (1.72)	6.61 (1.55)	6.45 (2.00)	Fear	Fear
1004	Computer/hand/wallet	2.80 (1.61)	7.08 (1.38)	6.65 (2.07)	Fear	Fear
1005	Computer/face/wallet	3.00 (1.55)	6.69 (1.52)	6.41 (2.01)	Fear	Fear
1111	Snakes	2.65 (1.68)	7.12 (1.67)	6.84 (2.07)	Disgust	Disgust
2345.1	Black eye	1.71 (1.49)	7.39 (1.50)	6.45 (2.08)	-	Anger
2751	Drunk driving	1.71 (1.32)	7.67 (1.58)	7.24 (1.99)	-	Anger
2770	Mask	3.86 (1.71)	6.06 (1.80)	6.14 (1.97)	-	Surprise
2900.1	Crying	2.14 (1.08)	6.57 (1.76)	5.59 (1.93)	Sadness	Sadness
2900.2	Smiling	7.24 (1.53)	4.49 (2.39)	2.84 (2.19)	Amusement	Joy
6250.1	Aimed gun	2.33 (1.68)	7.31 (2.17)	7.16 (2.36)	Fear	Fear
6250.2	Ice cream	6.22 (2.37)	5.43 (2.24)	3.67 (2.39)	Amusement	Joy
6370	Attack	2.41 (1.71)	7.47 (1.81)	7.35 (1.86)	Fear	Fear
7009	Mug	5.94 (1.62)	3.71 (2.15)	2.65 (1.95)	-	Neutral
7010	Basket	5.12 (1.29)	3.67 (1.86)	3.31 (2.17)	-	Neutral
7020	Fan	5.55 (1.55)	3.78 (1.70)	3.35 (1.99)	-	Neutral
8160	Rock climbers	4.84 (2.26)	7.04 (1.57)	6.89 (1.93)	Awe	Surprise
9001	Cemetery	2.96 (1.62)	4.65 (2.32)	5.75 (2.08)	-	Sadness
9390	Dishes	2.06 (1.46)	6.73 (1.83)	4.33 (2.18)	Disgust	Disgust

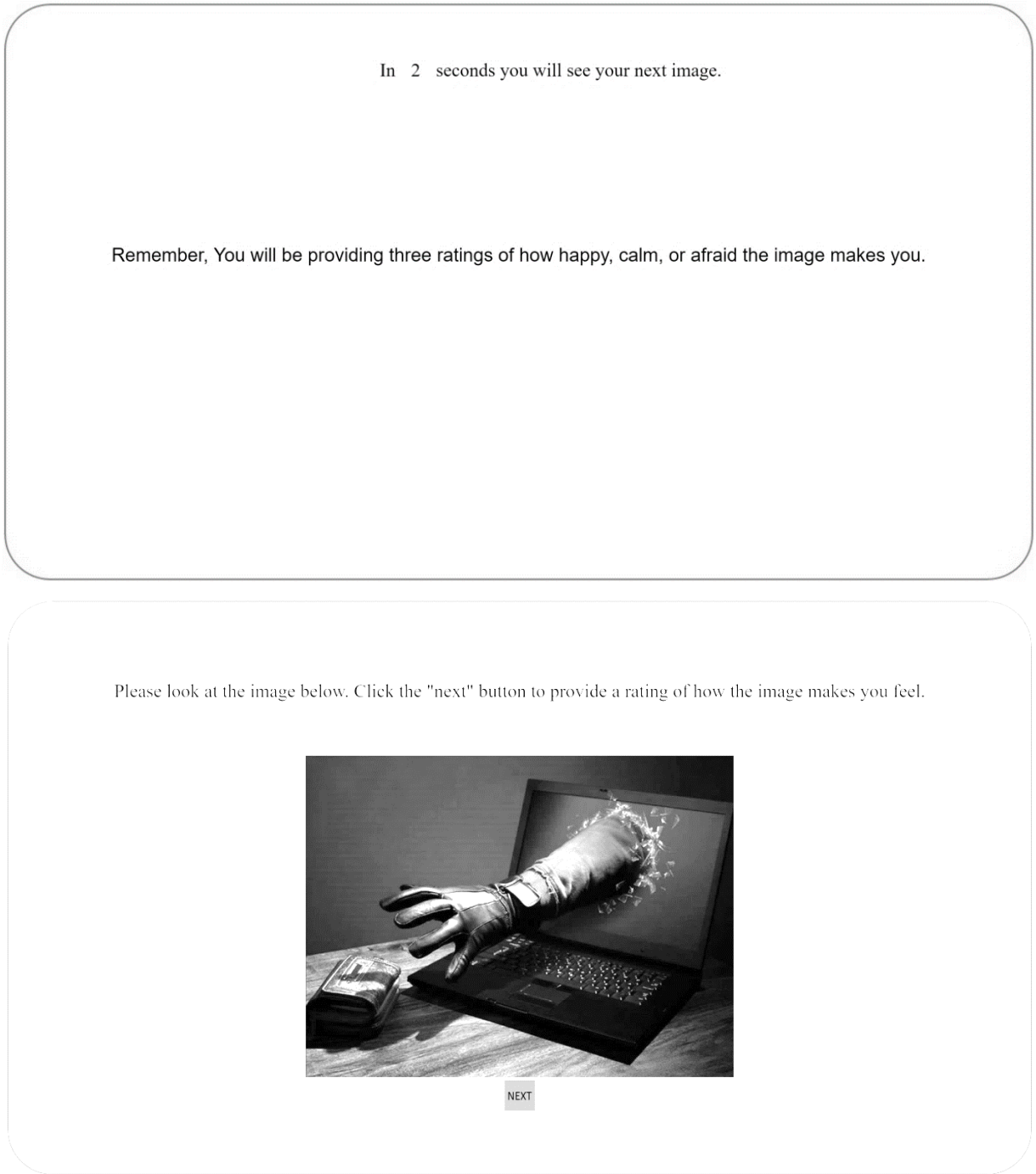
* N = 51 (from pilot study)

Above each image, subjects were prompted to answer three items related to how the stimulus makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid). These items were different than those used in the pilot study in that answers to these items are in terms of icons from Bradley and Lang's (1994) Self-Assessment Manikin (SAM) for valence and arousal and the emoticons ranked in the pilot study for fear.

When subjects clicked "next" to proceed, they were shown the series of 21 images shown in Table D.1. The images were displayed in a random order for each subject, blocked by the computer threat images, to avoid any potential ordering effects and to ensure that no two computer threat images appeared next to each other.

Prior to each image, a screen with no image appeared for five seconds, acting as a buffer between images. As soon as subjects entered a rating for an image, the “next” button appeared at the bottom of the screen. When subjects clicked on the “next” button, they advanced to the next image or rating prompt, as shown in Figure D.2.

FIGURE D.2. Study 1 Image Rating Sequence



=

How does this image make you feel?

Happy  Unhappy

How does this image make you feel?

Agitated  Calm

Next, half of the subjects were shown a series of 20 sentences (the other half of the subjects were shown the series of images described above). The headlines included four sentences related to high and low threat severity and vulnerability associated with identity theft due to weak passwords (rows 1-4 in Table D.2); these were modified from those used in the pilot study as described above. The sentences regarding identity theft vulnerability and severity used the likelihood values and the dollar values identified by pilot study responses. Most of the other sentences (rows 10-20 in Table D.2) were a subset of the sentences in the Affective Text dataset, which consists of 1000 headlines with their emotional category (including anger, disgust, fear, joy, sadness, and surprise) and valence (Strapparava & Mihalcea 2007). The Affective Text sentences were chosen to represent fear, surprise, anger, joy, sadness, disgust, and neutral sentences. The remaining sentences (rows 5-9 in Table D.2) were sentences in the Affective Text dataset that were modified to address threat severity and vulnerability issues unrelated to identity theft.

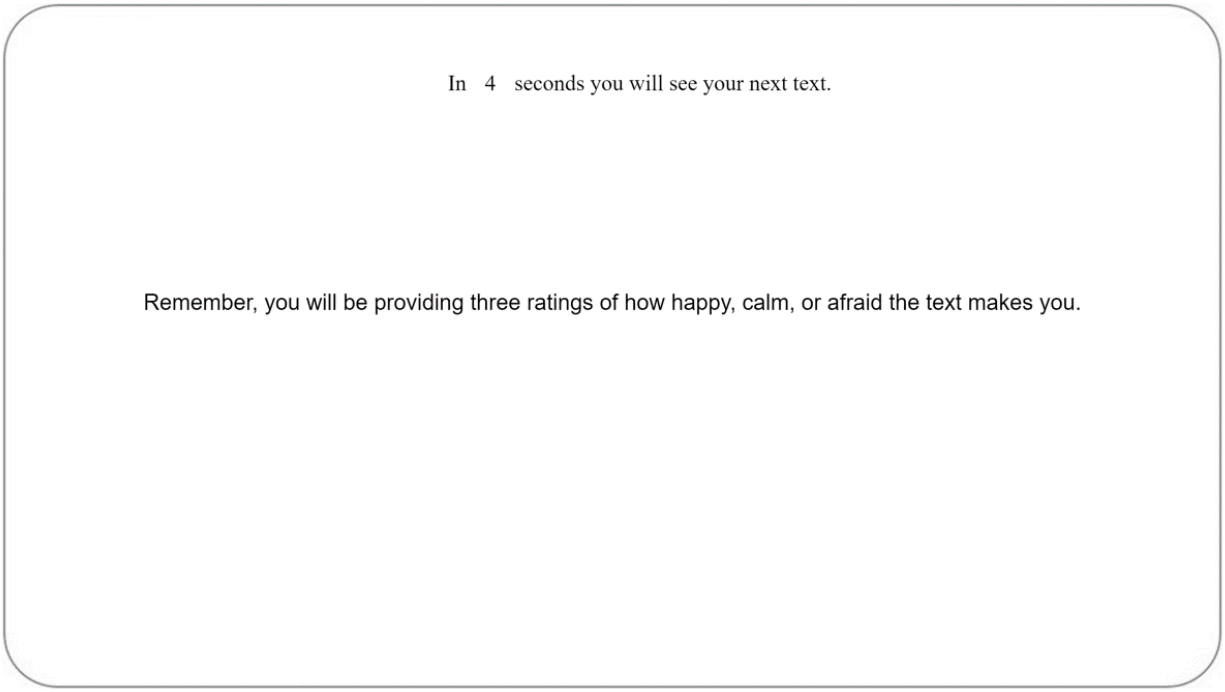
TABLE D.2. Text-Based Stimuli for Study 1

Row	ID	Sentence	$\mu_{valence}$ (SD)* (1 to 9; 5 is neutral)	$\mu_{arousal}$ (SD)* (1 to 9; 5 is neutral)	μ_{fear} (SD)* (1 to 9; 5 is neutral)	Emotion Category	Threat Severity	Threat Vulnerability
1	T001	Victims are not responsible for costs resulting from identity theft linked to weak passwords	5.24 (2.82)	5.04 (2.28)	3.90 (1.80)		Low	-
2	T002	Victims are responsible for paying an average of $9,575 in legal fees to resolve identity theft linked to weak passwords	1.98** (1.29)	6.57** (1.71)	5.98** (1.71)		High	-
3	T003	Less than 9% of identity theft occurrences can be linked to weak passwords	4.92** (2.37)	4.92** (1.87)	4.57** (2.24)		-	Low
4	T004	99% of identity theft occurrences can be linked to weak passwords	3.47** (1.77)	5.63** (1.98)	6.22** (2.16)		-	High
5	T005	Anti-terror protesters detained after weekend violence in Houston	3.67 (2.10)	6.10 (1.57)	5.78 (1.50)		Low	High
6	T006	Terror suspects detained after weekend violence in Houston	5.38 (2.80)	5.50 (1.89)	5.42 (2.07)		High	High
7	T007	Terror suspects detained after weekend violence in North Africa	6.18 (2.37)	4.80 (2.01)	4.61 (1.83)		High	Low
8	T008	Anti-terror protesters detained after weekend violence in North Africa	3.35 (1.86)	5.98 (1.57)	5.63 (1.41)		Low	Low
9	T009	Houston feared as staging ground for terror	1.55 (1.06)	7.35 (1.90)	7.51 (1.99)	Fear	High	High
10	1006	North Africa feared as staging ground for terror	2.73 (1.44)	6.37 (1.81)	6.06 (2.09)	Fear	High	Low
11	965	Venezuela, Iran fight U.S. dominance	3.12 (1.57)	6.22 (1.60)	5.82 (1.88)	Anger	-	-
12	615	Anger at release of two held over beheading plot	2.88 (1.57)	6.33 (1.58)	6.22 (1.70)	Anger	-	-
13	545	Two detained in body parts mailing	3.51 (2.22)	6.29 (1.95)	6.73 (1.88)	Disgust	-	-
14	767	Bigger, more aggressive rats infesting UK	2.46 (1.43)	6.62 (1.82)	6.19 (1.99)	Disgust	-	-
15	600	Man rides stationary bike for 85 hours	5.82 (1.88)	5.59 (1.97)	3.71 (2.29)	Surprise	-	-
16	1484	Marijuana helps ease HIV nerve pain, study says	6.92 (1.87)	4.80 (2.38)	3.47 (2.39)	Surprise	-	-
17	1109	Retinal implant helping blind people see again	8.37 (1.36)	6.10 (3.08)	2.73 (2.04)	Joy	-	-
18	1117	Scientists tout cocoa's health benefits	6.53 (1.53)	4.57 (2.13)	3.35 (1.91)	Joy	-	-
19	1036	VP starts visit to Japan, Australia	5.59 (1.51)	4.41 (1.51)	4.06 (1.76)	Neutral	-	-
20	1230	Vietnamese bank plans IPO listing	5.16 (0.88)	5.00 (1.06)	4.73 (1.55)	Neutral	-	-

*N = 51 (from pilot study); Emotion values are based on Affective Text emotion category values.
** These results are based on sentences in the pilot study that did not include dollars and likelihoods.

For each sentence, subjects were prompted to indicate how each makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid). The emoticons used in the fear rating scale were based on the results of the pilot study. A screen with no headline appeared for 5 seconds prior to each headline, acting as a buffer between headlines. As soon as subjects entered a rating, the "next" button appeared at the bottom of the screen. When subjects clicked on the "next" button, they advanced to the next headline or rating prompt. Below is a sequence of the rating task for one of the headlines.

FIGURE D.3. Study 1 Text Rating Sequence



Please look at the text below. Click the "next" button to provide a rating of how the text makes you feel.

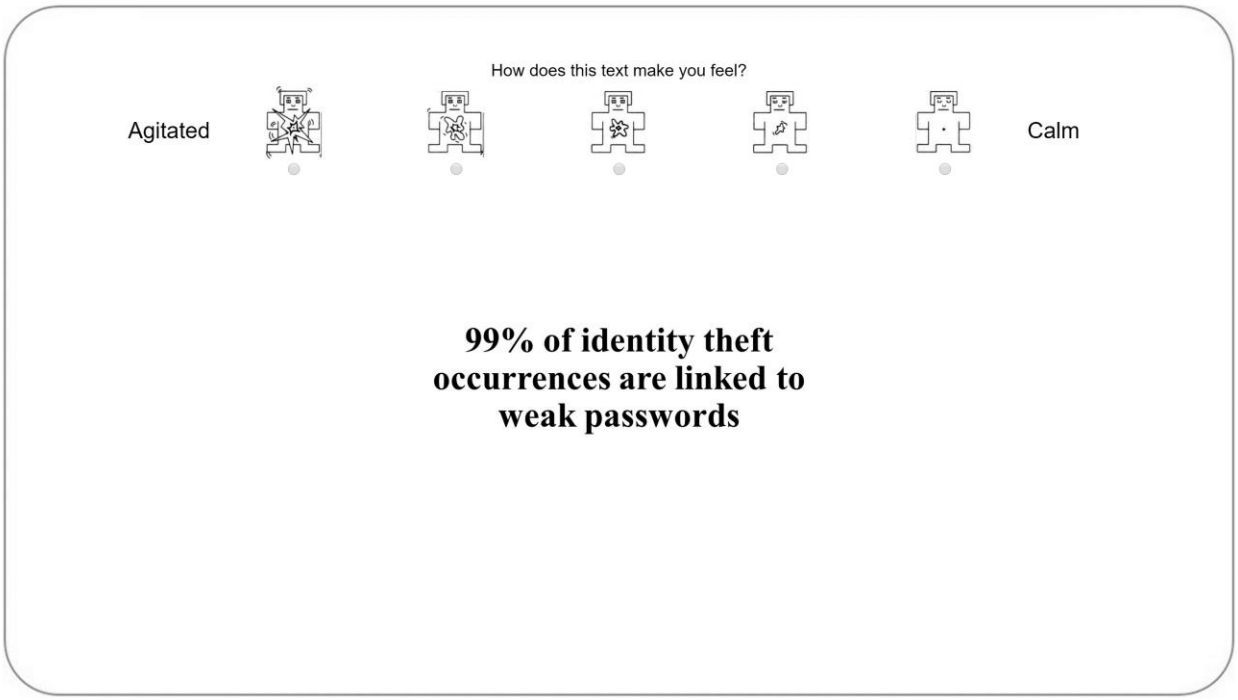
99% of identity theft occurrences are linked to weak passwords

NEXT

How does this text make you feel?

Happy  Unhappy

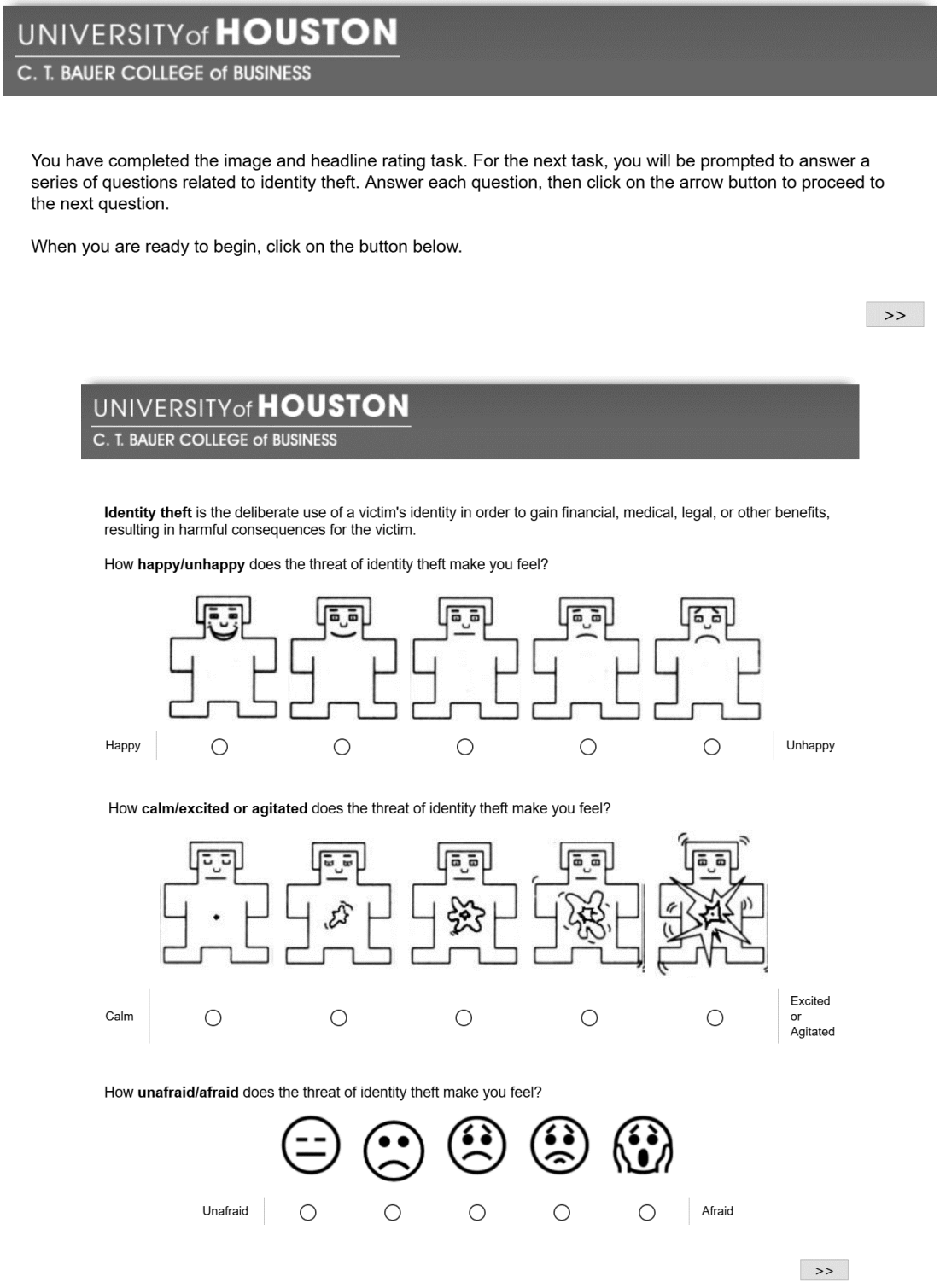
99% of identity theft occurrences are linked to weak passwords



After the sentence-rating task, subjects were shown instructions for a set of questions related to identity theft, as shown in Figure D.4. These items prompted subjects to indicate how the threat of identity theft makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated),

and fear (afraid/unafraid). This allowed us to isolate the effect of the threat in general to better understand what part of the fear appeal elicits the most fear.

FIGURE D.4. Survey Items to Determine Feeling State in Response to the Threat of Identity Theft



Finally, subjects were prompted to answer questions related to demographic information. After subjects submitted their responses, they were shown a message that thanked them for their participation, as shown in Figure D.5. Subjects were instructed to raise their hands once they completed the survey. Before leaving, subjects were asked to sign a non-disclosure statement to receive their extra credit.

FIGURE D.5. End-of-Survey Message

Your responses have been submitted. Raise your hand to indicate that you have completed the survey.

Please keep the details of this study confidential.

Thank you for participating in this study.

Thank you for participating in this study.

By signing below, you agree not to disclose any information about this study to your classmates.

Date: August 11, 2016

Name (Printed)	Email	Signature

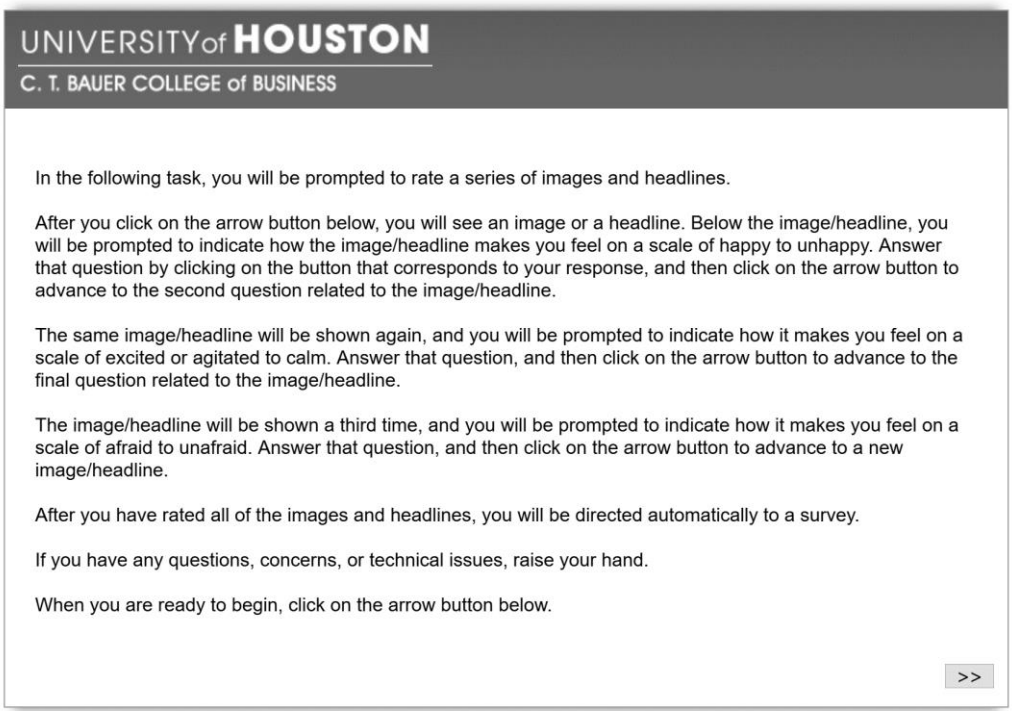
Appendix E

STUDY 2 PROCEDURE

Study 2 collected data from two different lab experiments. The first experiment only involved text-based stimuli, while the second involved composite (image and text) stimuli. Subjects were not allowed to participate in both Study 2 experiments. The experimental setting and initial procedure were the same for both procedures.

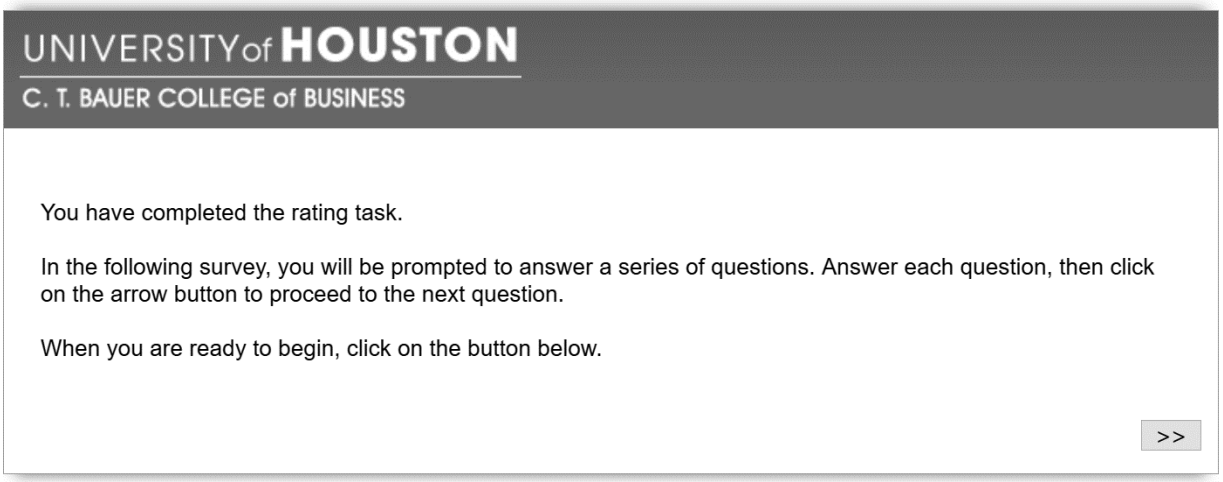
When students arrived for their scheduled time slot, they were directed to an open seat in the classroom (Melcher 290G). Laptops were set up so that subjects could not see each other's screens, and each laptop displayed an explanation of the task, as shown in Figure E.1. Each subject was assigned a unique participant ID, and subjects were instructed to raise their hand if they had any questions or technical issues.

FIGURE E.1. Study 2 Rating Task Instructions



After clicking the arrow button, subjects were shown a series of stimuli and prompted to rate each one in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid), using the same scales as Study 1. A screen with no headline appeared for 5 seconds prior to each stimulus, acting as a buffer between stimuli. As soon as subjects entered a rating, the arrow button appeared at the bottom of the screen. When subjects clicked on the arrow button, they advanced to the next stimulus or rating prompt. After the rating task, subjects were shown instructions for a survey, as shown in Figure E.2.

FIGURE E.2. Study 2 Survey Instructions



The next set of questions prompted subjects to indicate how the threat of identity theft makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (afraid/unafraid), using the same items as Study 1 (see Figure D.4). This allowed us to isolate the effect of the threat in general to better understand what part of the fear appeal elicits the most fear. Finally, subjects were prompted to answer questions related to demographic information (see Figure C.9). After subjects submitted their responses, they were shown a message that thanked them for their participation (see Figure D.5). Subjects were instructed to raise their hands once they completed the survey. Before leaving, subjects were asked to sign a non-disclosure form to receive their extra credit.

E.1. Text-Based Stimulus Rating Task

After clicking the arrow button, subjects were shown a series of 18 randomly ordered stimuli. The stimuli included four sets of sentences related to high and low threat severity and vulnerability associated with identity theft due to weak passwords (IDs 10-13 in Table E.1); the threat severity and vulnerability sentences were the same as those used in Study 1. The sentences regarding identity theft vulnerability and severity used the likelihood values and the dollar values identified by pilot study responses. The headlines with IDs 14-17 in Table E.1 were taken from the Affective Text dataset and were modified to address threat severity and vulnerability issues unrelated to, but having a format similar to, the identity theft sentences. The other headlines (IDs 545-1484 in Table E.1) were a subset of the sentences from the Affective Text dataset, with emotional categories chosen to represent fear, surprise, anger, joy, sadness, disgust, and neutral (Strapparava & Mihalcea 2007). All sentences other than those associated with identity theft were included in order to divert subjects' focus from passwords and identity theft.

TABLE E.1. Text-Based Stimuli for Study 2

Stimulus ID	Sentence(s)	Threat Severity	Threat Vulnerability
10	Victims are not responsible for any costs resulting from identity theft. Less than 9% of identity theft occurrences can be linked to weak passwords.	Low	Low
11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.	High	High
12	Victims pay an average of $9,575 in legal fees to resolve identity theft. Less than 9% of identity theft occurrences can be linked to weak passwords.	High	Low
13	Victims are not responsible for any costs resulting from identity theft. 99% of identity theft occurrences are linked to weak passwords.	Low	High
14*	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.	Low	Low
15*	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.	High	High
16*	Terror suspects draw attention after weekend violence. North Africa feared to be staging ground for terror.	High	Low
17*	Protesters draw attention after weekend violence. Houston feared to be staging ground for terror.	Low	High
545**	Two detained in body parts mailing.		
600**	Man rides stationary bike for 85 hours.		
615**	Anger at release of two held over beheading plot		

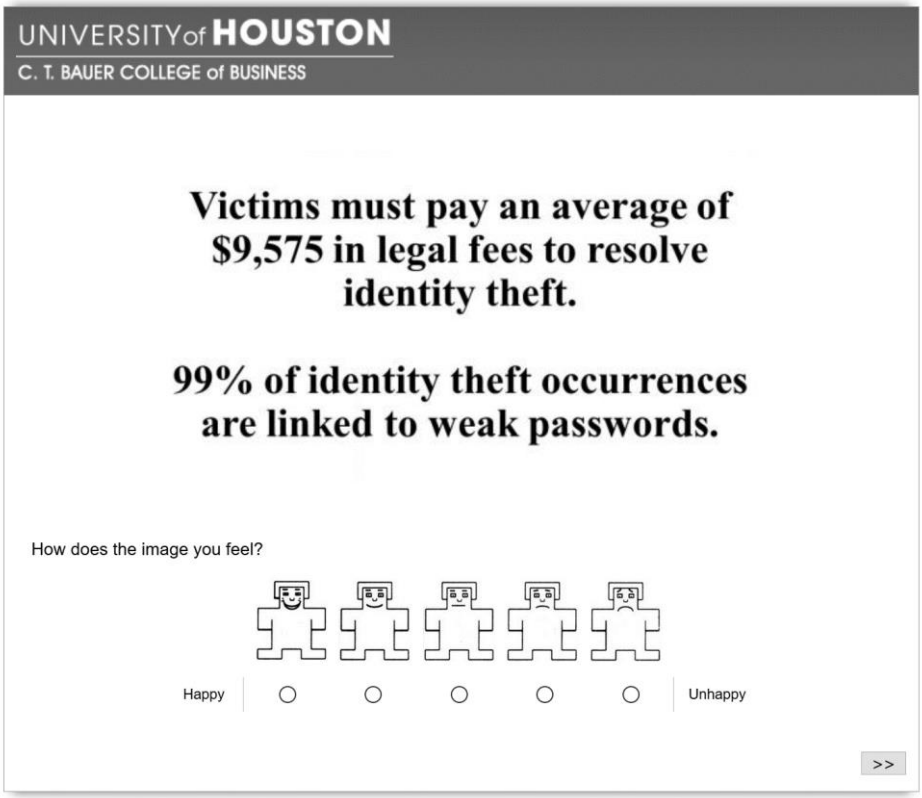
TABLE E.1 (continued). Text-Based Stimuli for Study 2

767**	Bigger, more aggressive rats infesting U.K.		
965**	Venezuela, Iran fight U.S. dominance		
1036**	VP starts visit to Japan, Australia		
1109**	Retinal implant helping blind people see again		
1117**	Scientists tout cocoa's health benefits		
1230**	Vietnamese bank plans IPO listing		
1484**	Marijuana helps ease HIV nerve pain, study says		

* Same format as focal stimuli (10-12) to divert subjects' focus from passwords and identity theft.
** Additional stimuli to divert subjects' focus from passwords and identity theft.

For each stimulus, subjects were prompted to indicate how each makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid), using the same scales as Study 1. A screen with no headline appeared for 5 seconds prior to each stimulus, acting as a buffer between stimuli. As soon as subjects entered a rating, the arrow button appeared at the bottom of the screen. When subjects clicked on the arrow button, they advanced to the next stimulus or rating prompt. Figure E.3 shows a sequence of the rating task for one of the stimuli.

FIGURE E.3. Verbalization Stimulus Rating Sequence



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Victims must pay an average of $9,575 in legal fees to resolve identity theft.

99% of identity theft occurrences are linked to weak passwords.

How does the image you feel?

Excited or Agitated ○ ○ ○ ○ ○ Calm

>>

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Victims must pay an average of $9,575 in legal fees to resolve identity theft.

99% of identity theft occurrences are linked to weak passwords.

How does the image you feel?

Afraid ○ ○ ○ ○ ○ Unafraid

>>

E.2. Composite Stimulus Rating Task

After clicking the arrow button, subjects were shown a series of 20 randomly ordered stimuli. The text-based stimuli from the first part of Study 2 were combined with the image-based stimuli from Study 1 to develop a set of composite stimuli, as shown in Table E.2.

TABLE E.2. Composite Stimuli for Study 2

Stimulus ID	Image ID	Description	Text ID	Sentence
A1	1001	Computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
A2	1001	Computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
B1	1004	Hand, wallet, and computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
B2	1004	Hand, wallet, and computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
E	6370	Attack	14	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.
F	6370	Attack	15	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.
G	7009	Coffee mug	14	Protesters draw attention after weekend violence. North Africa feared to be staging ground for terror.
H	7009	Coffee mug	15	Terror suspects draw attention after weekend violence. Houston feared to be staging ground for terror.
I	2345.1	Black eye	6	Terror suspects detained after weekend violence in Houston
J	2751	Drunk driver	615	Anger at release of two held over beheading plot
K	2770	Mask	1036	VP starts visit to Japan, Australia
L	2900.1	Crying	1117	Scientists tout cocoa's health benefits
M	2900.2	Smiling	1109	Retinal implants helping blind people see again
N	6250.1	Aimed gun	965	Venezuela, Iran fight U.S. dominance
O	6250.2	Ice cream	1230	Vietnamese bank plans IPO listing
P	7010	Basket	545	Two detained in body parts mailing
Q	7020	Fan	600	Man rides stationary bike for 85 hours
R	8185	Sky divers	1484	Marijuana helps ease HIV nerve pain, study says
S	9001	Cemetery	1006	North Africa feared as staging ground for terror
T	9390	Dirty dishes	767	Bigger, more aggressive rats infesting UK

The low and high threat verbalization sentences (10 and 11) were combined with low and high emotional interest images (1001 and 1004) from Study 1 to develop four composite treatment stimuli related to the threat of identity theft (A1 through B2), as summarized in Table E.2. Stimulus A1 was developed by combining the low threat verbalization sentences ("Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft

occurrences can be linked to weak passwords") with the low emotional interest image of a computer (instead of the white background used for text-based stimuli in the previous experiments). Stimulus A2 consisted of the high threat verbalization sentences ("Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords") and the low emotional interest image. Stimulus B1 consisted of the low threat verbalization sentences and the high emotional interest image of a hand reaching through a computer, while Stimulus B2 contained the high threat verbalization sentences and the high emotional interest image.

Each composite treatment stimulus (A1 through B2) thus included low or high threat verbalization and low or high emotional interest. Affective Text sentences were combined with IAPS images to develop 12 additional composite stimuli (I through T), as summarized in Table E.2. The IAPS and Affective Text stimuli were chosen to represent the conventional categories of emotion (Ekman 1992), as well as neutral stimuli that evoke little or no emotion. Finally, four additional composite stimuli were created in order to divert subjects' focus from the treatment stimuli's emphasis on passwords and identity theft, using sentences associated with the threat of terrorism (14 and 15) and IAPS images with low and high emotional interest (6370 and 7009), as summarized in Table E.2.

For each stimulus, subjects were prompted to indicate how each makes them feel in terms of valence (happy/unhappy), arousal (calm/excited or agitated), and fear (unafraid/afraid), using the same scales as Study 1. A blank screen appeared for 5 seconds prior to each stimulus, acting as a buffer between stimuli. As soon as subjects entered a rating, the arrow button appeared at the bottom of the screen. When subjects clicked on the arrow button, they advanced to the next stimulus or rating prompt. Below is a sequence of the rating task for one of the stimuli.

FIGURE E.4. Composite Stimulus Rating Sequence

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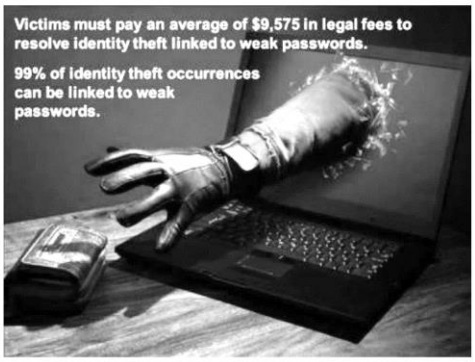

How does this make you feel?

Happy ○ ○ ○ ○ ○ Unhappy

>>

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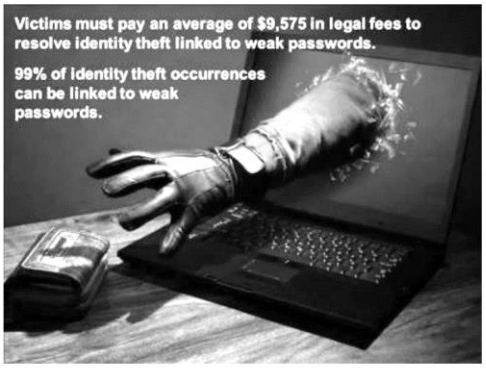
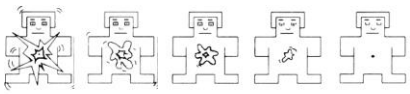


How does this make you feel?



Excited or Agitated ○ ○ ○ ○ ○ Calm

>>

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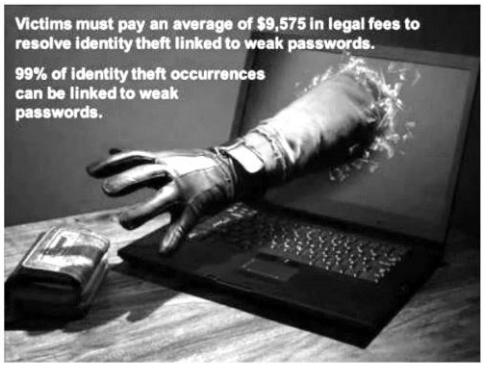


How does this make you feel?

Afraid ○ ○ ○ ○ ○ Unafraid

>>

Appendix F

STUDY 3 PROCEDURE

Three months after subjects were initially recruited to participate in the study, all subjects who completed the registration procedure were sent an email that invited them to complete a brief survey. The initial email message is shown below.

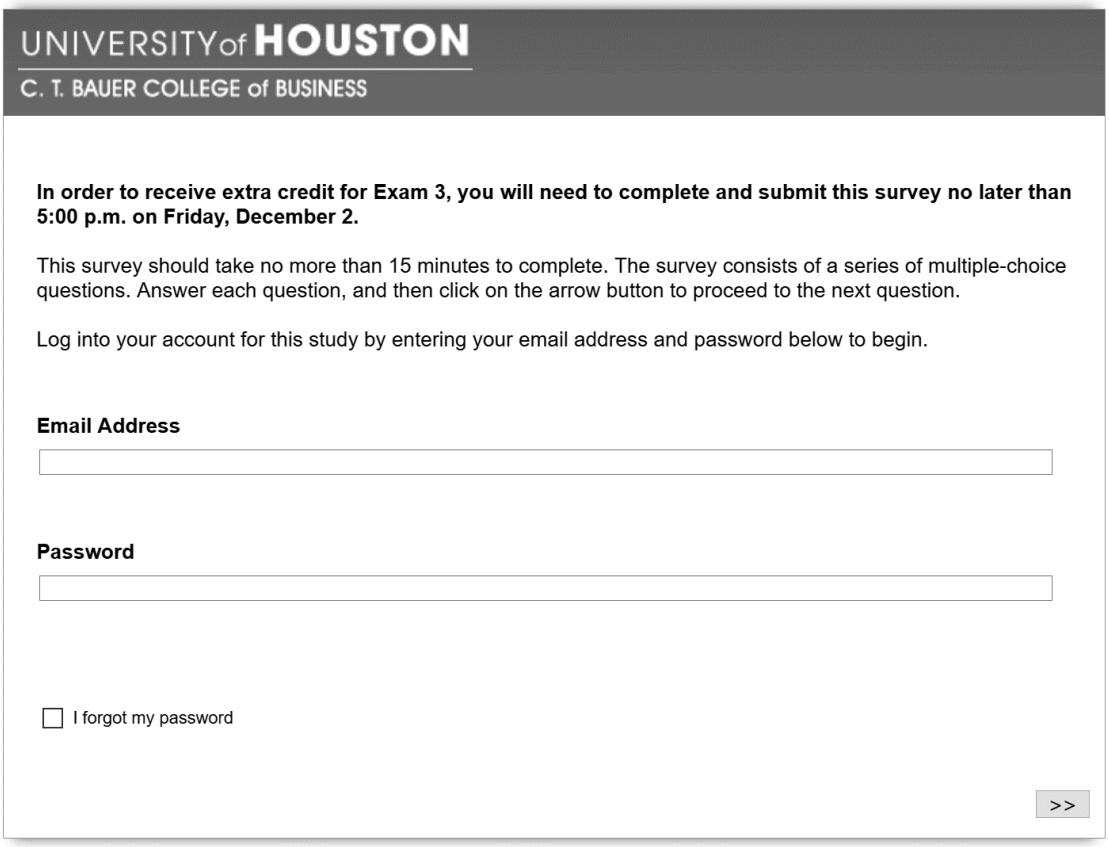
> You are invited to complete a survey as part of the MIS Study research project.
>
> You will receive one point of extra credit on Exam 3 in MIS 3300 if you complete the survey before 5 p.m. on December 2.
>
> The survey should take less than 15 minutes to complete.
>
> If you have any questions, concerns, or technical issues related to the survey, please contact vmdurner@bauer.uh.edu.
>
> **Follow this link to the Survey:** ${l://SurveyLink?d=Take the survey}
>
> Or copy and paste the URL below into your internet browser:
> ${l://SurveyURL}

One week after the initial email, subjects who had not completed the survey were sent an email that reminded them about the survey. The reminder email message is shown below.

> Our records indicate that you have not yet completed the follow-up survey for the MIS Study. December 2 is the **final day** to complete this survey for extra credit.
>
> You will receive 1 point of extra credit on Exam 3 in MIS 3300 if you complete the survey **before 5:00 p.m. on December 2**.
>
> The survey should take less than 15 minutes to complete.
>
> If you have any questions, concerns, or technical issues related to the study, please contact vmdurner@bauer.uh.edu.
>
> **Follow this link to the Survey:** ${l://SurveyLink?d=Take the survey}
>
> Or copy and paste the URL below into your internet browser:
> ${l://SurveyURL}

When subjects followed the link from the emailed message, they were shown instructions for the survey and prompted to enter their email address and password to begin, as shown in Figure F.1.

FIGURE F.1. Password Prompt



When subjects clicked on the arrow button, they were randomly shown a single fear appeal treatment (see Table F.1) and prompted to continue. Each fear appeal treatment stimulus included low or high threat verbalization and low or high threat representation, and combinations of images and sentences related to the threat of identity theft in Study 2 were employed as treatments in this study. Each subject only saw one of the fear appeal treatments.

TABLE F.1. Fear Appeal Treatments for Study 3

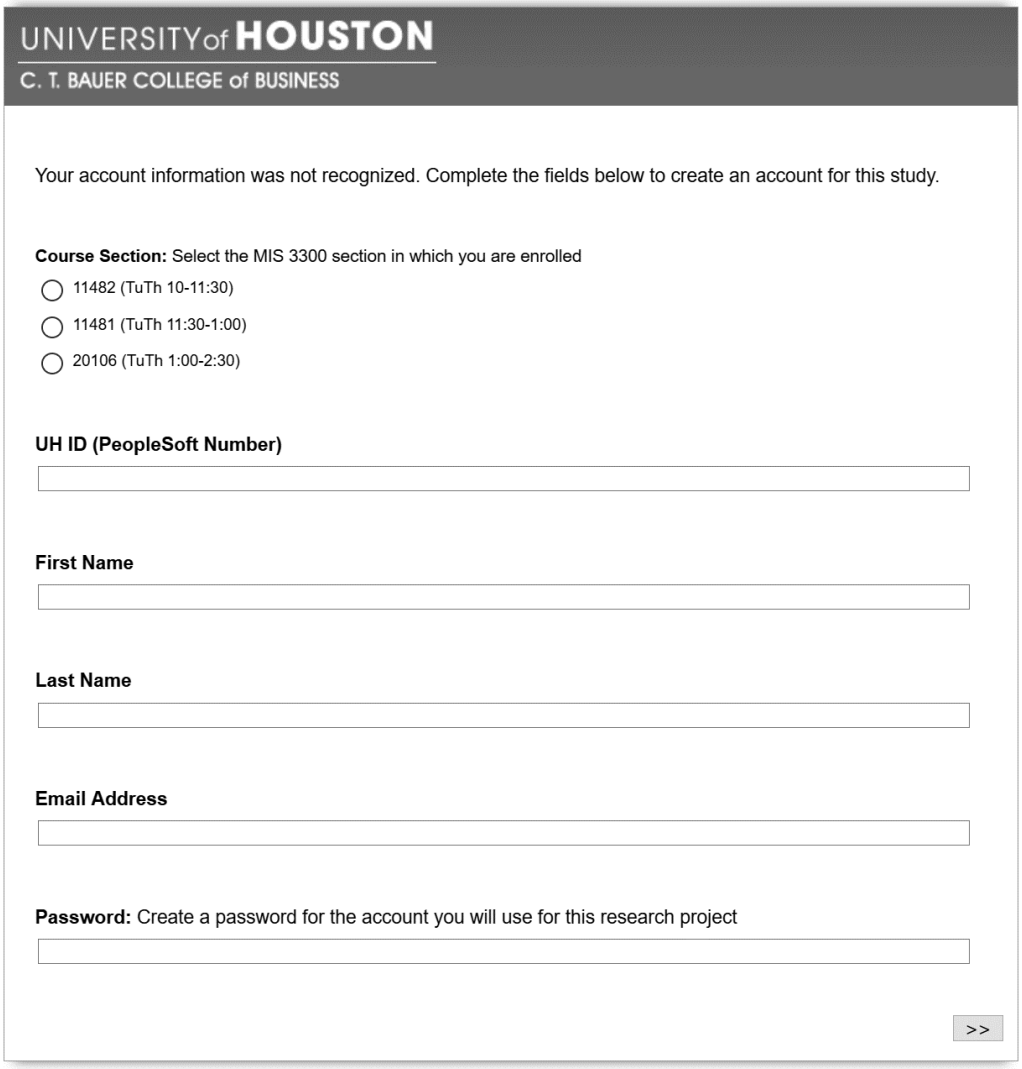
Stimulus ID	Image ID	Description	Text ID	Sentence
A1	1001	Computer	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
A2	1001	Computer	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.
B1	1004	Computer, hand, and wallet	10	Victims are not responsible for costs resulting from identity theft occurrences linked to weak passwords. Less than 9% of identity theft occurrences can be linked to weak passwords.
B2	1004	Computer, hand, and wallet	11	Victims pay an average of $9,575 in legal fees to resolve identity theft. 99% of identity theft occurrences are linked to weak passwords.

For example, subjects seeing treatment A2 would be shown the following.

FIGURE F.2. Fear Appeal Treatment Example

After clicking on the arrow button, subjects were shown a message that that prompted them to enter a new password, as shown in Figure F.3.

FIGURE F.3. Password Update Prompt



After entering a new password, subjects were shown a message stating that their account was successfully updated, as shown in Figure F.4.

FIGURE F.4. Password Update Confirmation Message

After clicking on the arrow button, subjects were then shown a series of items related to threat severity and vulnerability beliefs, as well as attitudes, perceived behavioral control, subjective norm, intentions, and behaviors related to password strength (see Table F.2).

TABLE F.2. Survey Items for Study 3

Scale	Statement	Adapted from
Severity belief	Identity theft can be a severe consequence of my weak passwords	Fishbein & Ajzen 2010; Witte et al. 1996
	Using weak passwords can lead to serious negative consequences such as identity theft	Fishbein & Ajzen 2010; Witte et al. 1996
	Bad things like identity theft can happen if I use weak passwords	Fishbein & Ajzen 2010; Ronis 1992
Vulnerability belief	It is possible that someone could steal my identity by obtaining my passwords	Witte et al. 1996
	Using weak passwords makes it easier for an identity thief to access my personal information	Fishbein & Ajzen 2010; Ronis 1992
	Using weak passwords increases my likelihood of experiencing identity theft	Fishbein & Ajzen 2010; Ronis 1992
Attitude	Strong passwords are [bad-good]	Fishbein & Ajzen 2010
	Strong passwords are [unimportant-important]	Fishbein & Ajzen 2010
	Strong passwords are [unnecessary-necessary]	Fishbein & Ajzen 2010
Subjective norm	Most people who are important to me think that I should use strong passwords	Fishbein & Ajzen 2010
	Most people I respect would use strong passwords if they were in my situation	Fishbein & Ajzen 2010
	Most people whose opinions I value would approve of my using strong passwords	Fishbein & Ajzen 2010
Perceived behavioral control	Strong passwords are easy to use	Fishbein & Ajzen 2010
	Using strong passwords is entirely within my control	Fishbein & Ajzen 2010
	I am able to use strong passwords without much effort	Fishbein & Ajzen 2010
Behavioral intention	I intend to use strong passwords on a regular basis	Fishbein & Ajzen 2010
	I plan to use strong passwords for my online accounts	Fishbein & Ajzen 2010
	I will use strong passwords in the future	Fishbein & Ajzen 2010
Perceived password strength	I use strong passwords on a regular basis	Fishbein & Ajzen 2010
	I don’t use weak passwords on a regular basis	Fishbein & Ajzen 2010
	My passwords are generally strong enough for me to avoid identity theft	Fishbein & Ajzen 2010

Each subject was also prompted to rate his or her feeling state (in terms of valence, arousal, and fear) associated with the fear appeal treatment that they had seen prior to taking the survey. For example, Figure F.5 shows the rating prompt for subjects who were shown the A2 fear appeal treatment.

FIGURE F.5. Fear Appeal Treatment Rating Prompt

After submitting their survey responses, subjects were shown a message thanking them for their participation, as shown in Figure F.6.

FIGURE F.6. End-of-Survey Message