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ABSTRACT

We have recently witnessed an uptake in the number of campus related incidents. School administrations are increasingly concerned about notification systems to alert students against the incidents and to provide advice on actions that they would like the students to take. However whether students appropriately react to notifications sent by these systems are still less understood. This paper develops and validates an instrument to measure the critical factors (subjective norm, threat appraisal, message efficacy, and media richness) that motivate students to comply with the directions in the notifications. The instrument has been validated through a pretest, followed by a pilot test, finally a main field test based on the data collected from a large Northeastern university. This research attempts to inform both theory and practice, and will help develop policy suggestions on what can be done to improve compliance with emergency notifications on university campus.

Keywords

Emergency notification systems, campus emergency, instrument, measurement of intention, compliance.

INTRODUCTION

Recent critical incidents on university campuses serve to demonstrate importance of campus emergency management notification systems. In order to promote campus safety, many universities have implemented mass notification systems, a variety of notification solutions (e.g., e-mail, text messages, SNS, and websites) have been used to communicate emergency notifications across campus. Through these different channels a larger proportion of community members can be reached quickly during a campus related extreme event. It has been reported that, in Virginia Tech shooting, 2 hours and 15 minutes after the first shooting, the Virginia Tech administration sent an e-mail to staff, faculty and students about the first shooting. Only 10 minutes after the e-mail was circulated, the shooter started shooting again and killed 9 and wounded 3students(Flannery). Lesson learned from this tragedy incident is that the success of campus emergency response depends on (a) using mass notification systems to communicate accurate information to the community as soon as possible and (b) the immediate compliance of these messages upon receipt. The mass notification systems are effective only where there is compliance. Due to the time sensitive nature of these events, immediate actions are necessary. Verification using other channels or people leads to loss of precious time and may negatively impact students' safety.

This study aims to first, develop a conceptual model to investigate student's intention to comply with campus emergency notifications based on the theory of reasoned act (TRA) (Ajzen, 1985), the protection motivation theory (PMT) (Rogers, 1975) and the media richness theory(Daft, Lengel, and Trevino, 1987). Building on these theories, we postulate that student's intention to comply with emergency notifications is influenced by threat appraisal, message efficacy, subjective norm, and media richness. Secondly, this paper presents an instrument to measure the critical factors that motivate students to comply with notifications.

RELATED WORK

Previous studies in emergency response management context have highlighted a number of important topics such as crisis response and communication systems design (Dilmaghani and Rao, 2007; Hale, 1997), system effectiveness evaluation (Uhr, Johansson, and Fredholm, 2008), the use of communication channels for emergency response (Sullivan, Hakkinen, and DeBlois, 2010; White, Plotnick, Kushma, and Hiltz, 2009). There are also several studies that focus on the human perspective(Shaw and Goda, 2004),resource allocation (Fiedrich, Gehbauer, and Rickers, 2000), response management and coordination (Rowan, 1994), and human computer interaction (Carver and Turoff, 2007). However, academic literature dealing with campus emergencies from an Information Systems (IS) perspective is scanty and the area remains understudied.

In campus emergency notification context, most studies focus on the acceptance and utilization of communication technologies. One study (Sherman-Morris, 2010) conducted at Mississippi State University concluded that the notification system deployed in this university was successful in disseminating the critical information during a tornado near-miss. Gulam and Murray (2009) show that it is the effective usage of text-based emergency notification system rather than the deployment of the system makes the university community safer. Even for a system with simple technology, the adoption process involves complex individual perceptions and the social context (Wu, Qu, and Preece, 2008). There are also few studies have looked at the design of campus emergency notification systems. Sharpe (2009) introduced the success of Illini Alert System, which focuses on the ease of use in system design. Leonidis, A., and G. Baryannis (2009) present a semantics based, context-aware notification system that provides personalized alerts to graduate students.

The success of emergency response largely depends on people's coordination and compliance. Down and Cutter (2009) studied hurricane evacuations in the United States, and found that residents will often ignore public warnings based on past experiences and individual perception of risk. Even if an alert message is issued and understood, people may not take proper action comply with the instructions. One of the reasons is that people can't evaluate the potential risk correctly (Mileti and O'Brien, 1992). Getting individuals to comply with notifications is a difficult task because human response to warnings is a complex social process (Tierney, 2000). Rowan (1994) argues that social factors such as building trust, establishing credibility, creating awareness greatly affect response to warnings. In the context of campus emergency management, Gow, Townsend, McGee, and Anderson, (2008) discover that effective campus emergency response requires take into account social dimensions such as human responses to warnings, institutional policy and procedures. However, none of the published literature has explored in a systemic fashion the factors that influence student's intention to comply with emergency notifications.

CONCEPTUAL MODEL DEVELOPMENT

Theoretical Background

In this paper, we propose and test a model to understand the effect of various factors on student's intention to comply with campus emergency notifications.

The motivations of people's behaviors have been studied in many different contexts. The most widely used theory is the theory of reasoned action (TRA)(Ajzen, 1985) and the theory of planned behavior (TPB) (Ajzen, 1991). The TRA proposes that behavior intention indicates the actual behavior. Intentions to perform volitional behaviors of different kinds can be predicted with high accuracy from attitudes and subjective norms. Attitudes, subjective norms are shown to be related to appropriate sets of behavior beliefs, and normative beliefs. In the IS domain the TRA has been widely adopted. The technology acceptance model (TAM) is one of the most influential extensions of TRA in the literature. TAM uses two technology acceptance measurements- perceived usefulness and perceived ease of use to replaces the measurements of attitude in the TRA. And some other researches of IS security have followed the TPB, (Bulgurcu, 2010; and Herath et al., 2009b).

Consistent with the TRA, our dependent variable is compliance intention. In the campus emergency response context, whether to comply with the notifications immediately or verify with other channels first and then comply leads to different consequences. For example, in many emergencies there might be only few minutes for students to escape the building. If a student chooses to first confirm with other channels, he/she might lose the best timing to escape and get hurt in the incident. As a result, we use a categorical variable compliance intention as our dependent variable, which includes three categories: intention to comply immediately, intention to verify first and then comply, and intention to ignore.

In our model, we first adopt the two main constructs of the TRA - attitude towards behavior, and subjective norms as the main framework of the model development. Then, we analyze the behavior beliefs underlying attitude towards behavior. In our context, behavior beliefs are linked with the beliefs of the consequences of complying with the message, where the protection Motivation Theory (PMT) (Rogers, 1975) provides a good explanation. The PMT has been used in variety of

fields, (see the following meta-analysis: Floyd, Prentice-Dunn, and Rogers, 2000; Milne, Sheeran, and Orbell, 2000) including information security area (Herath et al., 2009b; Woon, Tan, and Low, 2005). The PMT proposes coping with a threat as a process of threat appraisal and a process of coping appraisal. The threat appraisal assesses the threat and the coping appraisal is how one responds to the threat. Some of the researches in the PMT literature have considered attitude (Steffen, 1990) and behavior (Melamed, Rabinowitz, Feiner, Weisberg, and Ribak, 1996) as dependent variables. But intention has most often been used as dependent variable (Neuwirth, Dunwoody, and Griffin, 2000; Stanley and Maddux, 1986).

In order to investigate the effect of media characteristics on students' behavior intention, we adopted the theory of media richness (Daft, et al.,1987). Media richness theory suggests that richer communication means are generally more effective for communication of equivocal issues than leaner, less rich media. A media can be regarded as rich if it allows for immediate feedback, multiple cues (verbal and non-verbal), language variety, and personalization (Daft, et al., 1987; Massey and Montoya-Weiss, 2006). Greater level of richness of the communication media can reduce the level of ambiguity and uncertainty on receiver's side by providing more information and reduce confusion.

Model Development

Based on the above discussion, we propose a research model that explains student's intention to comply with emergency notifications as presented in Figure 1. In line with the existing literature, we posit that a student's compliance intention is associated with subjective norm, threat appraisal, message efficacy and media richness.

Subjective norm refers to perceived social pressure to perform or not to perform the behavior. The notion that a person's intention to perform a behavior is influenced by the expectations of important others, has been widely adopted in the literature of IT related behaviors. In campus emergency notification response context the student's intention to comply or to verify then comply with emergency notifications may be influenced by their perceptions of the expectations from their parents, teachers, classmates and other people important to them.
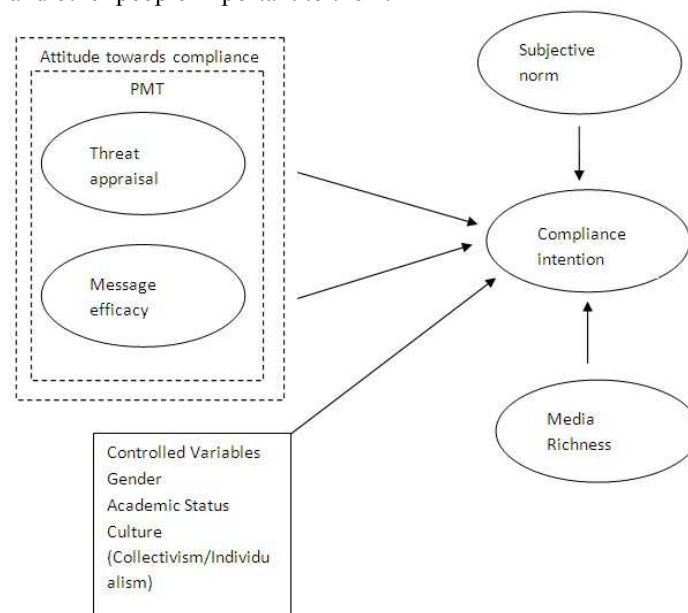
Figure 1 A Proposed Model of the Emergency Notification Compliance Intention

Attitude towards compliance is associated with the underlying behavior beliefs, which in our context are the beliefs and evaluations of the outcomes of comply with the notifications. We use the PMT to investigate the attitude. According to PMT fear appeals including the process of threat appraisal and coping appraisal. In campus emergency incidents, students will evaluate the situation which is the process of threat appraisal; and they will also evaluate whether the instructions provided in the notification can help them coping with the risk, which is the efficacy of recommended response. And here the recommended behavior is provided by the message, we name it message efficacy. Message efficacy captures student's perceptions of how the message can help them in terms of coping with the threat, by providing accurate, timely, and relevant information, and the instructions should direct them to avoid the risk.

Media richness theory suggests that greater level of richness of the communication media can provide more information and reduce confusion. Specifically, the more ambiguous and uncertain a task, the richer format of media suits it (Daft et al., 1987). Campus emergencies are usually unpredictable and the situations are complex; students are unprepared and have little experience with the situation. Media with greater level of richness can provide students clearer information, and reduce confusion, hence will affect compliance intention. Table 1 provides a brief summary of the constructs and their sources.

Construct	Source	Construct	Source
Subjective Norm	TRA (Ajzen, 1985)	Threat appraisal	PMT (Rogers, 1975)
Media richness	Media Richness Theory (Daft et al., 1987)	Message efficacy	PMT (Rogers, 1975)
Compliance intention	TRA (Ajzen, 1985)		

Table 1 Main Constructs and Related Theories

INSTRUMENT DEVELOPMENT

In order to measure the compliance intention using the constructs developed in this paper, we should first validate the instrument. There are many papers in IS literature that have proposed the processes of instrument validation in order to develop new scales with high reliability and validity (Kim, Sharman, Rao, and Upadhyaya, 2007; Moore and Benbasat, 1991; Smith, Milberg, and Burke, 1996; Straub, 1989). Instrument validation should be executed as follows: First, pre-tests the instrument; followed by a pilot test of reliability and construct validity; then, technical validation of reliability and construct validity; finally, the full scale survey.

Item Creation

In order to improve the validity and reliability of the survey questions, we adopt the questions from prior validated researches as much as possible. Otherwise, we create items to measure the constructs in our study. All constructs, were modeled using reflective indicators. After creating the items, we interviewed four experts working in the field (including: the chief of university police; vice president of university communication; the emergency planning manager of the university; and the CEO of a company who offers emergency notification solutions). The interviewees gave us suggestions on the research as well as the questionnaire, and we modified the instrument based on their feedback. By doing so we developed the first version of our instrument. Table 2 presents the latent predictor variables, the types and the sources of their measurements.

Pre-test and Pilot Testing

After the development of first version of the instrument, three rounds of pre-test were executed with 15 students participating in each round. We collected comments of the survey regarding the clarity, length, structure, etc. each time. Based on the feedbacks from the pre-tests, we modified and refined the survey questions by adding, re-phrasing and eliminating some of the questions. Following the pre-tests, we again collected the recommendations from the experts and further modified our questionnaire.

A pilot test was then executed using the second version of the instrument. The pilot survey was completed by 110 students. The preliminary analyses from the measurement model lead us to continue with the final data collection.

Main Field Testing

We conducted the main field test in a major Northeastern University. A stratified sampling technique has been used in the data collection in order to reducing the sample bias caused by underrepresentation of certain types of groups (Such as different academic years, nationalities, genders, schools etc.) in the sample. The data was collected in different schools and one class from each academic year has been randomly selected in each school. We distributed the surveys during the regular meeting times of the selected classes, and received 574 surveys, which gave us a response rate of almost 100%. Thus we avoid the non-response bias in mail or online surveys (Armstrong and Overton, 1977). Two of the surveys were eliminated due to missing of data. Finally a sample of 572 usable questionnaires was collected.

Construct	Type	Source
Subjective Norms	Reflective	Adopted from Ajzen (1991), Venkatesh et al. (2003), and Wu (2009)
Message Efficacy	Reflective	Adapted from Choudhury and Karahanna (2008) and Hsu et al. (2007)

Threat Appraisal	Reflective	Adopted from Wu (2009)
Media richness	Reflective	Developed for this study based on Daft et al. (1987)

Table 2. Sources of Measurement Items

RESULTS

In order to test the psychometric properties of the measurement scales, we have used the partial least squares method, by using SmartPLS software package (Ringle, Wende, and Will, 2005). We examined convergent validity, individual item reliability, composite reliability, and discriminate validity of the measurement model.

First, individual item loading and average variance extracted (AVE) of each construct have been examined in order to ensure that individual item's reliability and convergent validity is established. All of the item loadings were greater than 0.70 (Barchlay, Higgins and Thompson, 1995; Chin, 1998). It is recommended that factors should have Cronbach's alpha greater than 0.7 in established study and 0.6 in exploratory studies (Fornell and Larcker, 1981; Kahai and Cooper, 2003). Result shows that Cronbach's alpha values are at acceptable level, and AVE values were above the recommended value of 0.50. Therefore, we conclude that the convergent validity is satisfied.

We also established discriminate validity. We compared the square root of AVE values of each construct to the other correlations in the correlation matrix. All of the diagonal elements of the correlation matrix are greater than off-diagonal construct correlations. In addition, we also performed an exploratory factor analysis and reviewed the factor analysis results. All of the items loaded at least 0.10 less on other research constructs, following the recommendations of Gefen and Straub (2005), we conclude that discriminate validity is established.

CONCLUSION AND DISCUSSION

In this paper, we developed a conceptual model to identify the critical factors that will influence student's intention to comply with campus emergency notifications. Based on the conceptual model an instrument to measure student's intention was created and validated. The instrument allows school administrations to better prepare for campus emergencies by understanding the factors motivate students to comply with the notification messages.

The model has four components, subjective norm, message efficacy, threat appraisal and media richness. Subjective norm has been found influencing student's compliance intention indicates that it is important to raise public awareness of campus emergency management practice, and to create an environment that public understand the importance of comply with the notifications when emergencies happen on campus. Threat appraisal refers to individual's evaluation of the risk of certain situation. Message efficacy refers to the perceived effectiveness of the message in terms of helping the individual coping with the threat. In practice it is important to educate students of the potential risks of campus emergencies. Also the content of the message should convey effective solutions for avoiding the risk. Media richness will affect student's compliance intention. In the emergency response management, school administrations should use proper channel to communicate with public in order to convey clear and sufficient information.

This research has some limitations which can be addressed in future researches. In the conceptual model, we did not investigate the role of individual differences such as culture backgrounds of the students. People with different culture backgrounds may behave differently in many situations. By studying these differences, we can better understand how to use information and communication technologies more efficiently.

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