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Gen-Yih Liao
Gung University, gyliao@acm.org

Chia-Min Wang
Gung University, m9844005@mail.cgu.edu.tw

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Exploring the Influences of Implementation Intention on Information Security Behaviors

Gen-Yih Liao

Department of Information Management, Chang Gung University, Taiwan

gyliao@acm.org

Chia-Min Wang

Department of Information Management, Chang Gung University, Taiwan

m9844005@mail.cgu.edu.tw

ABSTACT

Although information security knowledge is spreading and management tools are improving, information security incidents remain widely heard. Studies have investigated information security behaviors through motivational theories like the Theory of Planned Behavior. Since implementation intentions are considered as a behavior changing technique that may overcome goal deviations, this paper attempts to explore information security behaviors from the volitional perspective. Synthesizing the findings of twelve implementation intention studies, the proposed research model postulates that implementation intention intervention may affect information security behaviors. Besides, the moderating effects of two factors are included in the research model: difficulty of information security behaviors and strength of commitment to the goal intention. This research-in-progress paper describes the experimental methodology and provides instruments to validate the proposed model. The results are expected to establish the importance of action plans in improving information security behaviors.

KEYWORD

Information security behavior, implementation intention, experimental design, goal conflict.

INTRODUCTION

Academic studies have explored the antecedents of users' information security behaviors with an attempt to benefit the information security management. Most of the studies extend the Theory of Planned Behavior (TPB) (Anderson et al. 2010; Bulgurcu et al. 2010; Johnston et al. 2010; Siponen et al. 2010), and investigate information security behaviors with motivational variables. The findings show that security threats, self-efficacy, and perceived citizen effectiveness influence security attitude; besides, response efficacy, self-efficacy, neutralization, informal sanctions, and normative beliefs were found to influence behavior intention. In general, the studies offer implications that a solution to security behaviors would be to enhance the motivation of computer users.

These studies still have some limitations, however. First of all, most of the models are based on TPB, but motivation is only one of the determinants causing poor information security behaviors. Papies, Stroebe, & Aarts(2008) have shown that attention allocation would affect behaviors in contexts of goal conflicts. Secondly, the dependent variables in all of these studies are behavior intention, rather than behavior. According to the results shown by Sutton(1998), behavior intention may not actually trigger behavior in some scenarios. Finally, although their findings do offer suggestions to information security policies formulation, there would still be a gap between a theoretical implication and a feasible

action guideline empirically validated.

In the contexts of goal conflicts, the attention that individuals pay to the goal would influence their behaviors(Stroebe et al. 2008). This study argues that some information security events would be caused by users in goal conflicts who cannot correctly exert attention. For example, while an individual is enjoying fun with friends via Facebook, he may inadvertently leak personal information to an attacker who masquerades one of his friends or any trusted organization(Claburn 2008; Mulrean 2005; SPAMfighter 2009). Accordingly, attention allocation may be a factor to security behaviors. Furthermore, realizing how users allocate their attention in the context of goal conflicts, and assisting them to decrease their distraction, may deserve more explorations.

This study adopts a volitional perspective to realize the effects of attention allocation. Implementation intention originating from the Rubicon model of action phases is a technique to improve user's attention allocation(Gollwitzer et al. 2009). Gollwitzer(1993) indicated that, after an individual sets a goal, implementation intention can promote behavior initiation by linking a certain goal-directed behavior with an anticipated situational cues. Besides, studies have empirically validated the effects of implementation intention. These studies can be divided into several subsets, including promoting health behaviors (de Nooijer et al. 2006; Prestwich et al. 2003; Sheeran et al. 1999; Verplanken et al. 1999), improving behaviors to capture opportunities to act(Webb et al. 2004), helping manage nervous or negative feelings(Parks-Stamm et al. 2010; Sheeran et al. 2007), and increasing some specific positive but effort-consuming behaviors(Eriksson et al. 2008; Higgins et al. 2003; Nickerson et al. 2010; Pahnila et al. 2010; Sheeran et al. 2003). Notably, Pahnila & Siponen(2010) has made a first attempt to study information technology use from the implementation intention perspective. All of these studies motivate our efforts into investigating security behaviors based on implementation intentions.

It would be postulated that implementation intentions prevent computer users from ignoring the situational cues and improve in performing security behaviors. Furthermore, the effect of implementation intentions may be moderated by other variables, according to our literature review. For example, Sheeran, Webb, & Gollwitzer(2005, Study 1) have indicated that goal intentions would have an interaction with implementation intentions; also, Heckhausen & Heckhausen(2008) claims that the difficulty of goal-directed behavior and the strength of commitment to the goal intention interact with implementation intentions. These two factors are also accommodated into our research model and the experimental design. To validate the proposed research model, this paper also describes an experimental design and provides measurement instruments. The results of this study are expected to assist security practitioners in designing more feasible security policies and to provide insights into the applicability of implementation intention theories into information security behaviors.

LITERATURE REVIEW

Goal Conflict in Information Security Behaviors

Perceived goal conflict (or simply 'goal conflict') can be defined as the degree to which individuals feel that performance expectations (i.e. goals) with respect to the multiple dimensions of a task, or among multiple tasks, are incompatible(Cheng et al. 2007). For instance, Stroebe(2002) proposed the goal conflict model of eating: the eating behavior of restrained eaters is dominated by a conflict between two incompatible goals of eating enjoyment and weight

control.

Information overloading tends to appear in the daily work of knowledge workers. In Albrechtsen(2007)'s qualitative study, a subject admitted that too much information prevented them from paying attention to all the information. As various sources of information compete for attention allocation, security is usually a secondary goal (Whitten & Tygar 1999), because people use computers to facilitate the daily work rather than to manage information security. Therefore, it is easy for people to put off learning about security, or to optimistically assume that their security mechanisms are working, while they focus on their primary goals. Furthermore, if achieving security is too difficult or annoying, users may give up on it altogether (Anderson et al. 2009; Brustoloni 2006; Cranor et al. 2006; Lin et al. 2010).

Studies of Information Security Behaviors

Anderson & Agarwal(2010) claims that unlike employees in a work setting, home users are not subject to training, nor are they protected by a technical staff dedicated to keeping security software and hardware current. They used TPB and Protection Motivation Theory (PMT) to explore the information security behaviors of home users. Johnston & Warkentin(2010) used TPB, PMT, and Fear Appeals Model to explore compliance of employees with information security policies. Siponen & Vance(2010) argue that employees' failure to comply with information systems security policies is a major concern for information technology security managers, and they used TPB and Neutralization Theory to explain employee's information systems security policy violations. Bulgurcu(2010) considers that employees who comply with the information security rules and regulations of the organization are the key to strengthening information security, understanding compliance behaviors are crucial for organizations that want to leverage their human capital. They used TPB and Rational Choice Theory to analyze the compliance behavior of employees on information security policies.

These studies explore the antecedents of information security behaviors from the motivational perspective. However, since social psychologists have proposed the notion of implementation intention which could decrease users' distraction in the contexts of goal conflicts, this study will address the research problem from a different perspective.

Implementation Intention

Behavioral intention summarizes a person's motivational orientation toward an act or behavioral goal(Ajzen 1985). In the Rubicon model of action phases, goal intention is defined as a commitment to realize a wish or desire without further deliberation regarding whether to pursue it (Heckhausen et al. 2008). Gollwitzer(1993) considers the form of goal intentions as "I intend to pursue x (x specifies a desired end state, which may be defined rather abstractly)!". In summary, goal intention may achieve outcomes in an abstract level, while behavior intention is to complete more specific behaviors.

On the other hand, Gollwitzer(1993) proposes the concept of implementation intention, which is defined as the action plans that seem conducive to attaining the aspired goal state. Accordingly, implementation intention connects a certain goal-directed behavior with an anticipated situational context, as shown in Figure 1. The form of intention such as "I intend to initiate behavior x whenever the situational conditions y are met!", where x specifies a particular behavior, and y specifies situational cues, such as capturing a good opportunity(de Nooijer et al. 2006). Unlike behavioral intention or goal intention, which is merely an intention to implement a behavior without any behavioral plan, implementation

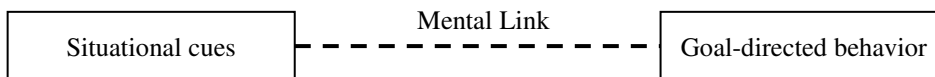intention is an intention that includes information on when, where, and how the behavior will be implemented.

Figure 1. Concept Map of Implementation Intention

The Effect of Implementation Intention

This section introduces twelve experiments of implementation intention. The results provide a basis for establishing the research model of this study. To emphasize the phenomenon of goal conflict, the goals that may conflict with each other in the experiments are summarized in Table 1.

Author(year)	The Major Goal of Intervention	The Conflicted Goal
Sheeran & Orbell(1999, Study 1)	Take Vitamin C	Forget due to involving in other goals
Verplanken & Faes(1999)	Healthy Eating	Habits to eat fatty snacks and sweets
Prestwich, et al.(2003)	Do exercise	Other personal goal
Parks-Stamm, et al.(2010)	Complete math examination	Anxiety
Webb & Sheeran(2004, Study 1)	Count the number of Fs in the text	Distraction
de Nooijer, et al.(2006)	Have fruits	Other personal goal
Sheeran & Silverman(2003)	Attend a fire training course	Other personal goal
Higgins & Conner(2003)	Against smoking	Obedience to classmates
Sheeran, et al.(2007)	Attend for psychotherapy	Anxiety
Eriksson, et al.(2008)	Interrupt habitual car use	Habit of using cars
Pahnila & Siponen(2010)	Use online newspapers	Prior behavior(reading newspapers)
Nickerson & Rogers(2010)	Get out the vote	Other personal goal

Table 1. Experiments With Goal Conflict

Sheeran & Orbell(1999, Study 1) conducted an experiment with undergraduates in America, in which the implementation intentions group was instructed to perform the repeated behavior of taking vitamin C tablets. While participants wanted to achieve the behavior, the actual effect may not be well achieved. Their findings provided insights into the processes by which implementation intentions increase the likelihood of behavioral performance. Two lines of evidence suggested that implementation intentions were effective because they improved memory for initiating the behavior. First, there was a strong correspondence between the time and place of enactment specified in participants' implementation intentions and the time and place of actual behavioral performance reported at follow-up. The second line of evidence showed that participants who formed implementation intentions were less likely to report 'forgetting' to perform the behavior than control participants.

Similar effects were found in the other studies. Verplanken & Faes(1999) undertook an experiment with college students for health eating, and they made participants form implementation intentions to achieve the goal of health eating. The results indicated that participants who had been engaged in forming implementation intentions for a healthy eating day exhibited a higher degree of healthy eating behavior, compared to the control participants, irrespective of their level of

unhealthy habits. Higgins & Conner(2003) limited the participants on teenagers with 11 to 12 years old, and applied the implementation intention to make them refuse smoking. The implementation intention group was instructed to form implementation intentions about anti-smoking for how, where, and when. The control group formed an implementation intention focusing on completing school work. Although the research results indicated that implementation intentions were not significant in reducing the numbers initiating smoking over an eight week period, there was still a trend in the predicted direction. In addition, a slightly larger percentage of children stopped smoking during the study period in the implementation condition compared to the control condition.

Prestwich, et al.(2003) conducted an experiment to make undergrads and staff exercise. The results revealed that the participants with both interventions of implementation intention and decision balanced sheet produced greater improvements than the control group in frequency and total time spent exercising per week, assuming participants need to resist the no-exercise habit. In Parks-Stamm, et al.'s(2010) investigation participants with high anxiety were found to complete more problems than those with low anxiety, when a temptation-inhibiting implementation intention was employed, and the effect of task-facilitating implementation intentions are reverse. It was made clear that the structure of one's plans (i.e., the if–then structure) is important to help participants ignore the distractions caused by anxiety. In Webb & Sheeran(2004, Study 1), the results indicated that participants who formed an implementation intention responded faster to the critical cue than did participants in another condition. These results suggested that implementation intentions provided enhanced detection of anticipated opportunities that, at the same time, frees up the cognitive capacity required to identify more complex stimuli. de Nooijer, et al.(2006) examined the effects of implementation intention on fruit consumption in motivated as well as unmotivated adults. Their results indicated that implementation intention group reported a high frequency of eating an extra serving of fruit per day implying implementation intention formation may successfully remind the participants of the goal. Another finding was that, the more committed respondents were to carrying out their implementation intention, the more likely they were to increase their fruit intake.

Sheeran & Silverman(2003) use motivational intervention based on TPB, a volitional intervention based on implementation intentions, and a combined motivational plus volitional intervention in promoting attendance at workplace health and safety training courses in the UK. Due to engagement in personal work, participants may not go to the training courses. Findings indicate that participants who formed implementation intentions (the volitional and combined interventions) were more likely to attend the courses, compared to participants in the motivational condition and controls. To increase attendance at scheduled psychotherapy, Sheeran, et al.(2007) designed an implementation intention intervention on the participants that may have negative feelings (e.g., shame) about attendance. Their findings indicated that implementation intention formation increases rates of attendance for scheduled, initial appointments for psychotherapy, and if–then planning would be especially advantageous when participants believed that psychotherapy would benefit them. Eriksson, et al.(2008) undertook an experiment that habitual car use was interrupted by means of an intervention attempting to induce a deliberate consideration to reduce personal car use. As a result of the intervention, car users with a strong car habit and a strong personal norm were found to be more likely to reduce car use as compared to those with a weak car habit and a weak personal norm. Moreover, car habit strength was not influenced by the intervention. Pahnila & Siponen(2010) explored whether the implementation intention can be applied to explore the use of online newspapers for master students. The participants were instructed to form implementation intentions to read online newspapers. Because participants have personal habits of reading newspapers, they may resist the assigned goal.

Their results showed that implementation intention intervention had a significant effect on habitual behavior, and habit has a strong impact on the use of online newspapers. Nickerson & Rogers(2010) applied the implementation intention on citizens eligible to vote who may decide not to vote due to their personal factors. The findings showed that facilitating the formation of a voting plan (i.e., implementation intentions) can increase turnout by 4.1 percent.

Moderator Variables of Implementation Intention

Difficulty of Goal-Directed Behavior

Gollwitzer & Brändstatter(1997, Study1) asked participants to express their goal intention, and used questionnaire to measure difficulty of executing intention. Since they have to undergo a series of actions to achieve the goal or may encounter obstacles, either would make them perceive high difficulty. However, implementation intention intervention was applied to make participants complete goal-directed behaviors. The results indicated that, as the goal became more difficult, the effect of implementation intention became better. Moreover, Gollwitzer et al. claimed that, although they had no evidence that implementation intentions facilitated the initiation of the intended behaviors in the anticipated situations, it seemed plausible to assume that goal completion was mediated by easing action initiation. Hence, while the goal intention is formed, people take good opportunities to achieve their goal

Strength of Commitment to the Goal Intention

Goal intention and commitment strength both measure how individuals pursuit the goal and how much confidence with completing the goal they have, so they have similar measurement scales. Orbell et al.(1997) reported that implementation intentions only enhanced compliance in performing breast self-examinations in women who strongly intended to examine their breasts, i.e., who were committed to the superordinate goal intention(Heckhausen et al. 2008). Sheeran, et al.(2005, Study 1) also found that implementation intention effects only occur when the respective superordinate goal intention is activated. Therefore, this study considers strength of commitment to the goal intention as another moderator.

METHODOLOGY

Research model and hypothesis derivation

While computer users are focusing on their primary goals, they tend to ignore information security, even optimistically assuming that their security mechanisms are working(Whitten et al. 1999). This indicates a goal conflict is occurring. Since implementation intentions could enhance the effects of situational cues on behavioral initiation, implement intention intervention may enhance information security behaviors

As aforementioned, the difficulty of the goal-directed behavior and the strength of commitment to the goal intention would interact with implementation intention. Gollwitzer & Brandstatter(1997) argue that implementation intention could decrease user's perceived difficulty about the behavior, while the more difficultly goal-directed behavior initiates, the more significant effect implementation intention is. Since Adams & Sasse(1999) argue that information security would make users feel difficult, we will apply implementation intention to promote users to achieve the goal-directed behavior of information security. On the other hand, Sheeran, et al.(2005, Study 1) claim that effect of implementation intention becomes better as the goal intention increases. Implementation intention would decrease user to ignore situational cues around, and improve on user's attention allocation to achieve the goal-directed behavior. In fact, while computer users

are busy of their job, they often omit information security messages which system provided. Therefore, we postulate that implementation intention would promote user to pay their attention to situational cues (i.e. information security messages), and achieve the goal-directed behavior of information security. Thus, this study uses the difficulty of goal-directed behavior and the strength of commitment to the goal intention as moderators, and designs our research model shown in figure 3.
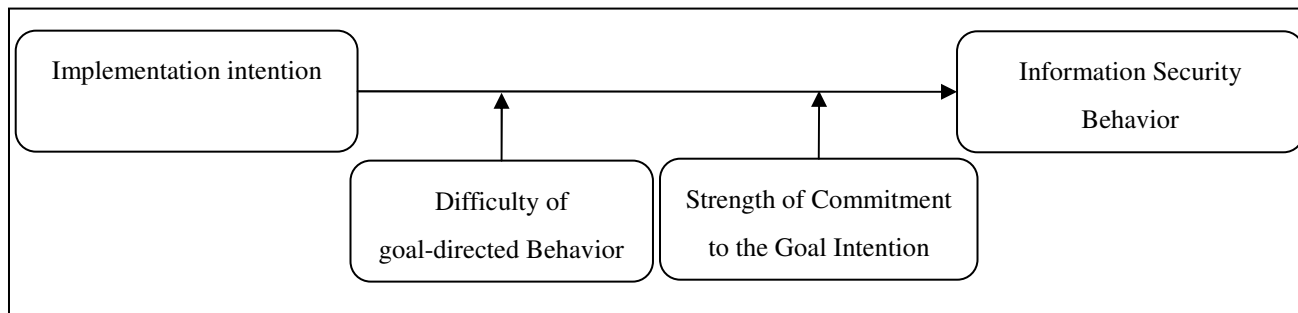

Figure 2. Research Model

Variables Definition and Measurement

Independent Variable

Our research model includes as the independent variable implementation intention. In the experiment, participants will be instructed to form an If-Then plan that helps them pay attention to situational cues.

TPB Variables

Although behavior intention may be no identical construct with goal intention (behavior intention emphasizes the behavior, but goal intention focuses an outcome or event by behavioral performance), behavior intention share similar measurement items with strength of commitment to the goal intention. Therefore, we only measure the variable of strength of commitment to the goal intention. The TPB scale consists of 18 items rated on a seven-point Likert scale.

Moderator Variables

Gollwitzer & Brandstatter(1997, Study 1) and Robinson(2001) have both measured participants' perception about goal-directed behavior/task. This study will apply their questionnaires to measure participants' perception about difficulty of information security behaviors.

Sheeran, et al.(2005, Study 1) asked participants to write how many hours they intend to spend doing goal-directed behavior. Accordingly, we will ask participants how many hours they intend to spend doing information security behaviors as the measurement of goal intention strength.

Except that the time participants intend to spend is a continuous variable (Sheeran et al. 2005), all the other variables are measured using 7-point Likert scale.

Dependent Variable

The dependent variable is measured in two ways. One is the total time participants spend dealing with information security messages. The other is a measurement based on their security behaviors. We design a goal conflicts experiment,

in which participants' security behaviors depend on their options on information security messages. Measuring the total time of security behavior be accumulated from the time participants spend on six information security messages by a timer of the system tray(Sheeran et al. 2005, Study 1). There are two types of information security messages, first is the antivirus software message and second is the intrusion detection system message (we use antivirus software messages as example below). The system tray will pop a message per 1.5 minutes respectively, and if participants read more messages, the system tray will pop another message box for them to choose. Finally, the coding principle of information security messages will ask information security experts to validity.

There are two kinds of antivirus software messages: start scan, update virus pattern, and virus detected. If the participant close the message box indicating to pop antivirus software directly, then they get zero point; otherwise, they decide to read messages, they will get distinct scores, as shown in Table 5. There are three types of scoring, includes A, B, and C, and finally we will accumulate the score of three opportunities, for instance, A + B + C = 1 + 3 + 2 = 6.

Context Message	Choice for Participants	Scoring
(A) Start Scan	No, don't start scan.	1
(A) Start Scan	Yes, start scan and close window.	2
(A) Start Scan	Yes, start scan and report back to me.	3
(B) Update Virus Pattern	No, don't update virus pattern.	1
(B) Update Virus Pattern	Yes, update virus pattern and close window.	2
(B) Update Virus Pattern	Yes, update virus pattern and report back to me.	3
(C) Virus Detected	No, don't do anything.	1
(C) Virus Detected	Yes, delete virus and close window.	2
(C) Virus Detected	Yes, delete virus and report back to me.	3

Table 2. Coding Principle of antivirus software messages

Design

A computer game will be used to involve participants in a goal conflict context. Participants are encouraged to get high scores in a computer game while maintaining information security as much as possible. We will look for 50 volunteers from our university for the pre-test and 125 volunteers for the experiment. Moreover, the participants will be randomly assigned to each of the implementation intention group and the control group in advance.

Task and Procedures

This experiment includes three phases. In the first phase, questionnaires are administered to measure the TPB variables, strength of goal intention, and difficulty of goal-directed behavior. Furthermore, the implementation intention group will be given an If-Then description in the end of questionnaires. Participants in implementation intention group will be asked to read an instruction in mind for three times to form their implementation intention.

The second phase requires participants to play a computer game. The system tray will pop information security messages (six in total) during the game, and the time participants spend dealing with the messages and their responses will be recorded. In the third phase, the participants are to fill in another questionnaire to explain whether they have detected the experiment goal.

Data Analysis

The effect of implementation intention intervention can be tested using one-way ANOVA, as there is one independent categorical variable and one continuous dependent variable. Since the time participants intend to spend is measured as a continuous variable, this study will use multiple regression analysis, as recommended in Cohen et al.(1983) for interactions with continuous variables.

FUTURE RESEARCH

This study will undertake pre-test and complete the experiment, and then analyze experiment data; finally, we will present our results in the conference.

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