Roles of Threat and Coping Appraisal in Adoption of Green Information Technology: Ordered Protection Motivation Theory Perspective*

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While many surveys show very positive attitudes on the part of consumers towards eco-friendly products, the market share actually reflecting green IT purchases remains low in most countries. The motivations behind green IT purchase behavior are still obscure. Several studies have addressed the question of green IT diffusion from economic and normative viewpoints in an attempt to interpret IT adoption behavior. This study comes at the question from a different angle, namely negative frame, examining threat and coping behaviors using the Ordered Protection Motivation (OPM) model and threat appraisal theory. The results show that attitudes toward fairness and positive change, which are precedents of threat appraisal, play an important role in determining threat appraisal. Perceived threats in the green IT arena include habit change and ecological change. Appraisal for coping with these threats directly affects initial adoption behaviors regarding available green IT, and then indirectly encourages the purchase of new green IT products.

Keywords : IS Usage, IT Adoption, Green IT, Greening Behavior, Threat Appraisal theory, Ordered Protection Motivation Model

Ⅰ. Introduction

Green information technology, which is intended to save energy and/or control pollutants, is important in the preservation of environmental sustainability. IT contributes to eco-friendly activities such as increasing efficiency in energy consumption and optimizing resource usage [Watson *et al.*, 2010]. Consumers adopt green IT in order to improve their everyday lives or make certain tasks easier. Understanding the process of green IT adoption has become more crucial in recent years for environmental and business reasons. From an environmental viewpoint, green IT products save energy or include fewer pollutants than other IT products. From business and information systems (IS) development perspectives, producing new green IT products is only effective if consumers adopt the technology and green lifestyle associated with these products.

Since last two decades, adopting green IT behavior has been observed by IS and marketing research communities [Schoenbachler and Whittier, 1996; Bose and Luo, 2012; Arun and Lyer, 2012; Jansson *et al.*, 2010]. However, they so far oversaw that green consumers do not always purchase products based on their green identity; rather, they will more likely to purchase green IT products only when the products are compatible with already acquired green products. Curtailing behavior is one attractive method of saving energy; for example, consumers could simply reduce time to operate computers in use, rather than purchasing a new energy saving computers. Behaviors related to reducing negative environmental impact differ from behaviors related to purchasing of environmentally responsible products [Jansson *et al.*, 2010]. From an IT business perspective, the availability of free green IT hinders the purchase of other green IT. Consumers may choose to curtail their behavior rather than purchasing green IT products on the advice of web sites that instruct them on how to live an eco-friendly life.

According to message framing theory [Levin *et al.*, 1998], which distinguishes between positive and negative frames, a positive (negative) frame stresses the (un) favorable behavioral outcomes of (non) compliance with the advocated behavior [Levin *et al.*, 1998; Zhao and Pechmann, 2007]. From this viewpoint, prior IS research on IT adoption using such frameworks as the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) [Venkatesh *et al.*, 2012] has focused on the positive relationship between attitudinal factors and adoption behavior. While the TAM and UTAUT focus on positive motivations for IT adoption ("if you adopt the IT, you will experience the ease of its use and its usefulness"), we believe that negative motivations ("if you do not adopt the IT, the threat of ecological change will become a reality") also affect consumer's IT adoption behavior at least in the context of green IT. The threat of eco-change was originally derived from individual and social concerns about global warming and its negative impact on consumers' everyday lives.

Hence, this study approaches IT adoption from a new angle, namely negative frame. Our research model is rooted in Ordered Protection Motivation Theory (OPMT) and threat appraisal theory. The OPMT states that negative stimulus from environmental cues poses a threat,

which motivates people to protect themselves from the stimulus [Rogers, 1983]. The theory identifies threat appraisal as the essential element affecting protection motivation. Threat appraisal refers to "the unique and changing relationship taking place between a person with certain distinctive characteristics … and an environment whose characteristics must be predicted and interpreted" [Lazarus and Folkman, 1984, p. 24]. In the green IT consumption context, threats can arise from two sources: habit change and eco-change. Moreover, to explain what causes threat appraisal, threat appraisal theory is combined with OPMT in this study. In their empirical study, Fugate *et al.* (2012) showed that positive change orientation and change-related fairness preceded threat appraisal in the context of organizational change. Using these two theories on threat appraisal, the relationship between threat appraisal and consumers' green IT adoption behavior was examined.

This paper is organized as follows. Section 2 reviews the literature, including studies based on OPMT and threat appraisal theory, which are the foundations of the model proposed here. Section 3 introduces the research model and states the hypotheses. Sections 4 and 5 discuss the process and findings of the analysis, interpreting the findings in academic and practical terms and discussing their significance. Finally, prospective study topics are suggested.

II. Theoretical Background

2.1 Green IT Adoption Behavior

Assuming that adopting green production is different form product adoption in general, green product adoption behavior has been observed in marketing community. Focusing on green IT products, <Table 1> summarizes recent studies based on a variety of approaches and theories.

2.2 Ordered Protection Motivation Theory

Ordered Protection Motivation Theory (OPMT)

<Table 1> Summary of Research on Green IT Adoption

Authors	Theory/Approach	Results
Bose and Luo [2012]	Process management approach	Green IT adoption process is an ensemble of four phases: plan, design, implement, and measure the performance of the process.
Arun and Lyer [2012]	Resource-constrained product development approach	The innovation process meets green marketing objectives at much lower, and therefore, more affordable prices.
Molla and Abareshi [2012]	Motivation theory	Eco-efficiency and eco-effectiveness motives influence the adoption of technologies that reduce IT related emissions and IS to reduce travel and travel related emissions.
Jansson *et al.* [2010]	IT adoption theory	Values, beliefs, norms, and habit strength determine willingness to curtail and willingness for eco-innovation adoption.
Carrete [2012]	Ethnographic approach	Green behaviors is influenced by savings and frugality rather than based on environmental values.

is rooted in Protection Motivation Theory (PMT), which states that two crucial appraisals occur when an individual confronts a source of threat: threat appraisal and coping appraisal. These appraisals affect behavior through protection motivation. PMT argues that the psychological functionality in evaluating the source of threat may increase or decrease the possibility of taking a specific action [Rogers, 1983]. PMT emphasizes the cognitive processes mediating behavioral change. When a person receives threat-giving messages, he or she may be motivated to reduce the emotional unpleasantness of the situation by adopting a certain advised behavior. The level of threat arousal is directly related to the adoption of adaptive behaviors. PMT has been used as a model explaining how consumers are persuaded to use less energy [Hass et al., 1975], promote water conservation [Kantola et al., 1983], and increase earthquake preparedness [Mulilis and Lippa, 1990].
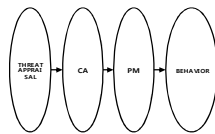
However, PMT has been criticized by scholars for not explaining the causality of threat and coping appraisal. To respond to this concern, Ordered PMT (OPMT) was developed. OPMT demonstrated that threat appraisal precedes coping appraisal [Tanner et al., 1991]. <Figure 1> illustrates that the association between threat appraisal and coping appraisal.
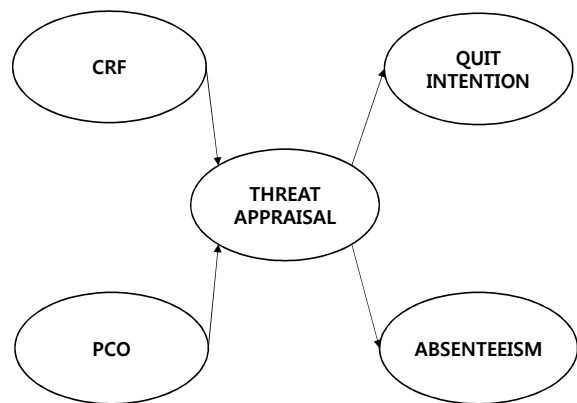
2.3 Threat Appraisal Theory

According to threat appraisal theory, certain people may perceive a change as threatening, while others do not [Fugate et al., 2012]. According to this theory, response to change can be predicted and the diversity of responses and reactions to threats can be explained [Bareil et al., 2007; Fugate et al., 2008]. Threat appraisal theory has implications for individual and organizational behavioral change research in the field of management [Colquitt et al., 2006; Fugate et al., 2012].

As shown in <Figure 2>, threat appraisal theory proposes positive change orientation (PCO) and change-related fairness (CRF) as the antecedents of threat appraisal. PCO reflects a positive perception of and attitude toward change. CRF refers to the perception of how much change can be considered fair in compar-

Notes: CA = coping appraisal, PM = protection motivation.

<Figure 1> Ordered Protection Motivation Model (reduced)

Notes: PCO = positive change orientation, CRF = change-related fairness (contextual).

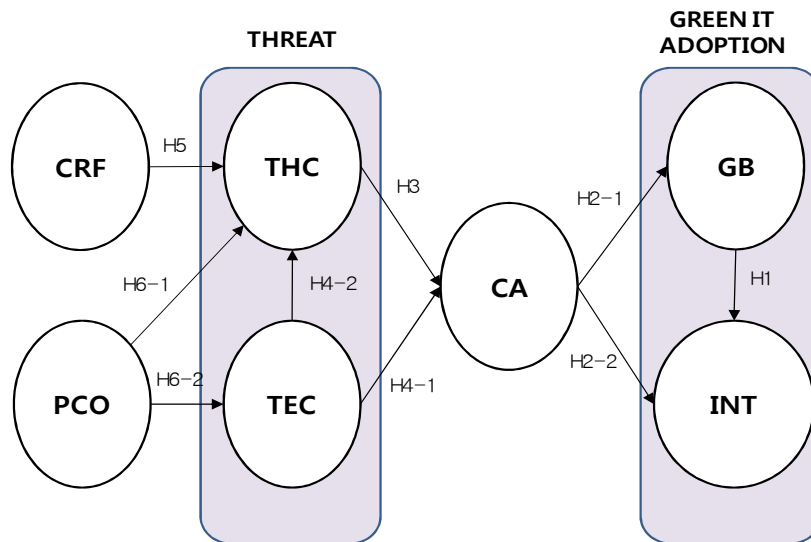<Figure 2> Model of threat Appraisal theory

ison to that of others in the same situation or another similar case. CRF is affected by the amount of effort required to change and the outcomes that the effort to change will provide. By identifying PCO and CRF, Fugate *et al.* [2012] empirically answered Lazarus and Folkman's [1984] call to determine relevant antecedents of threat appraisal.

III. Research Model and Hypotheses

An illustration of the research model depicting the antecedents of green IT adoption behavior is provided in <Figure 3>. The proposed model is rooted in OMPT and threat appraisal theory. The model is unique in that it considers the duality of threat appraisal, the coexistence of two paths to arrive at coping appraisal with regard to green behavior. OPMT alone fails to reveal why two people faced with the same

threat choose different coping behaviors. OPMT also cannot explain why a certain threat and its associated coping appraisal result in different behaviors ranging from maladaptive (e.g., consume more energy) or avoidant (e.g., curtail behavior rather than buying green IT) to adaptive (e.g., purchase green IT). Focusing on avoidant and adaptive behaviors, the proposed model allows us to compare the precedents of avoidant behavior and adaptive behavior in the context of green IT adoption.

Threat appraisal theory complements OPMT in this study. The proposed model includes diverse causes (CRF and PCO) and the results of threat appraisal (quit intention and absenteeism) [Colquitt *et al.*, 2006; Fugate *et al.*, 2012]. Thus, a certain behavior may be selected from among multiple choices to cope with a given threat. That is, the same threat may result in different responses. This study examines this diversity in the context of green IT adoption.

Notes: PCO = positive change orientation, CRF = change-related fairness, THC = threat appraisal regarding habit change, TEC = threat appraisal regarding ecological change, CA = coping appraisal, GB = green behavior toward IT, INT = intention to purchase green IT products.

<Figure 3> Research Model

3.1 Green IT Adoption

Green IT adoption consists of green behavior toward IT, purchase of green IT products, and intention to purchase green IT products. Green behavior toward IT is evident when consumers curtail their activities by conserving energy, recycling, and disposing of waste responsibly. Green behavior may happen on an everyday basis, and eventually may have a cumulative beneficial effect on the environment. Curtailment- based green behavior is rarely financially costly; however, it involves effort and often results in discomfort for the actor performing the behavior [Ritchie and McDougall, 1985; Ritchie et al., 1981]. Secondly, purchasing green IT involves replacing everyday objects with more environmentally friendly ones, despite the high cost. Intention to purchase green IT products could also be understood as adopting green innovation.

In this paper, we hypothesize that the relationships between green behavior, purchase of green IT products, and intention to purchase green IT products will be positive. If past green IT adoption behavior translates into development of green habits, then past green behavior will be positively associated with later green IT purchases [Jansson et al., 2010]. According to the Theory of Planned Behavior, consumers who intend to increase their green behavior will be more likely to purchase green IT products. Hence, we hypothesize that:

H1: Green behavior is positively associated with green IT purchase intention.

3.2 Coping Appraisal

Coping appraisal refers to the belief that the source of a threat can be handled if a certain

behavior is performed. Coping appraisal motivates a person to perform an appropriate behavior to eliminate a perceived threat. If threat perceivers believe that the recommended action -green IT consumption in this context-can avert the threat [Rogers, 1975; Bandura, 1986] and they feel confident to perform the recommended action [Bandura, 1986; Rogers, 1983], then they will be willing to perform the recommended threat-averting action. Thus, consumers with higher coping appraisal will more actively consider green IT adoption. Thus, we hypothesize that:

H2-1: Coping appraisal is positively associated with green behavior toward IT.

H2-2: Coping appraisal is positively associated with intention to purchase green IT products.

3.3 Threat Appraisal

Once a negative stimulus has been recognized, a person may perceive a threat with respect to self-esteem, goals, or values. Threat appraisal is caused by directly receiving an oral threat or learning indirectly through observation [Rogers, 1975]. Threat appraisal results in a specific response; threats can be handled either actively or by avoidance [Fugate et al., 2008]. Threat appraisal can be helpful in explaining and anticipating future behavior [Fugate et al., 2012]. In this study, which focuses on environmental threat, threat appraisal results in habit change or eco-change.

3.3.1 Threat Appraisal Regarding Habit Change(THC)

Social psychology researchers have studied

habits, how they are formed by prior behaviors, and how they anticipate future behaviors. In the IS community, habits have been regarded as strong predictors of future technology use [Kim and Malhotra, 2005]. In IS adoption theory, habits were first introduced in the UTAUT2 [Venkatesh *et al.*, 2012]. The UTAUT2 extends the UTAUT to the context of consumer IT adoption including habits, hedonic motivation, and price value. In the UTAUT2, habit is viewed as a perceptual construct that reflects the results of prior experiences [Venkatesh *et al.*, 2011]. A habit is more easily formed when behaviors are repeated in more stable contexts than in more dynamic contexts [Ouellette and Wood, 1998].

From time to time, an undesirable habit (e.g., software piracy) prohibits a person from behaving in a socially or morally acceptable manner [Limayem *et al.*, 2007]. In such a case, the behavior can be improved by changing the habit. If a contextual change is made, the habit is more likely to change [Ouellette and Wood, 1998]. For example, citizens are forced to change their habits on energy consumption when legitimate, institutional, or normative laws on energy savings or pollutant abuse are enacted. More threat appraisal resulted in more habit change in this case, but the necessity of coping with the threat was also increased in this energy consumption example.

According to the UTAUT2, habit does not necessarily affect behavioral intention. The UTAUT2 links habit to usage behavior, not behavioral intention. For insight into behavioral intention, OPMT is more informative. OPMT includes threat appraisal and coping appraisal as preceding factors of behavior intention [Rogers, 1983]. According to OMPT, habit change is a kind of threat; thus, habit change affects behavioral in-

tention when coping appraisal occurs. According to Rogers [1983], threat appraisal is positively associated with coping appraisal. For example, when more threat appraisal occurs, habit change is more likely to occur in order to cope with the threat. Hence, consumers who perceive a threat regarding habit change will feel motivated to engage in coping appraisal. Hence, we hypothesize that:

H3: Threat appraisal regarding habit change is positively associated with coping appraisal.

3.3.2 Threat Appraisal Regarding Eco-Change(TEC)

People may be concerned to varying degrees about ecological change and its impact on their lives. When it comes to green IT adoption, threat appraisal regarding eco-change results partially from the consumer's recognition of environmental (e.g., diseases from pollutants) and/ or economic (e.g., gas prices) issues. However, the severity of threat from the same issue is not the same for all consumers; it depends on their value structure and ability to cope with the threatening information. Differences in the level of threat resulting from eco-change can be explained by economic externality theory. According to this theory, threat occurs for reasons of self-benefit or altruism [Li, 2007]. Reasons of self-benefit take physical and economic wellness into account. On the other hand, reasons of altruism have to do with substantial threats about eco-change that directly or indirectly affect the individual's interests and family. Thus, we hypothesize that threat appraisal regarding eco-change will result in coping behavior.

H4-1: Threat appraisal regarding eco-change is positively associated with coping appraisal.

In addition, the more an individual performs a threat appraisal regarding eco-change, the more likely he or she will be to perform a threat appraisal regarding habit change. Ecological change requires changes in energy consumption habits. A perceived threat regarding habit change after a threat of environmental degradation will result in an appraisal of the ecological or economic cost involved in making the change. Thus we hypothesize that:

H4-2: Threat appraisal regarding eco-change is positively associated with threat appraisal regarding habit change.

3.3.3 Change-related Fairness (CRF)

Fairness is especially important to encourage behavioral change [Kernan and Hanges, 2002]. CRF provides people with a sense that a change program is trustworthy. Trust as a result of perceived fairness helps reduce the uncertainty surrounding current change and lends a measure of predictability to potential future actions [Colquitt et al., 2006].

While PCO is attitudinal, CRF is a contextual factor; the fairness depends on external factors such as policy, norms, and laws [Fugate et al., 2010]. CRF promotes individual trust in institutions such as communities, companies, and governments to manage change. The trust as a result of perceived fairness encourages positive acceptance of change [Fugate et al., 2010]. Hence, individuals who perceive more CRF will be more strongly inclined to accept new rules on energy consumption. Such individuals will not

avoid habit change; rather, they are motivated to overcome the threat regarding habit change. Such individuals may perceive the source of threat less sensitively than others. Thus, we hypothesize that:

H5: Change-related fairness is negatively associated with threat appraisal regarding habit change.

3.3.4 Positive Change Orientation (PCO)

According to threat appraisal theory, both PCO and CRF have been regarded as antecedents of threat [Fugate et al., 2010]. PCO refers to traits which enable the individual to recognize a change and respond to it in a compliant manner [Fay and Frese, 2001]. People with more PCO tend to believe that they can satisfy the necessary requirements and smoothly adapt themselves to change [Jones et al., 2005]. Hence, people with PCO will not hesitate to recognize and accept a threat appraisal from any source of change. Since our model proposes two kinds of threat appraisal, we hypothesize that:

H6-1: Positive change orientation is positively associated with threat appraisal regarding habit change.

H6-2: Positive change orientation is positively associated with threat appraisal regarding eco-change.

IV. Methods

4.1 Data Collection

Based on comprehensive reviews of the literature, a structured questionnaire was developed

including the survey items shown in Appendix A. The questionnaire was pretested and revised with 50 subjects for clarity of content, scope, and content validity. A data brokerage agency identified potential respondents. The questionnaire was then mailed to 2300 suitable respondents. Potential respondents were initially contacted through a short personalized e-mail message that outlined the nature of the survey. Since the institution was independent from the mobile shopping industry, we assumed that no sampling bias was present. To improve response rates, participation was encouraged with a small financial incentive ($5.00). In total, 400 respondents (17.4%) replied expressing an interest in participating in the study. Analysis of responses indicated that the sample was fairly equally divided between males and females (51% male). A one-way analysis of variance of differences in responses between males and females in the sample supported the conclusion that gender played no significant part in the development of the research model and its results. In terms of age, most subjects were between 20 and 50 years old, and 73% of the subjects were employees with enough income to purchase green IT products. In terms of education, 69% and 11% of the subjects had Bachelor's and Master's degrees, respectively. The data were collected by a professional data collecting company. The subjects were sponsored. The descriptive statistics relating to subjects' profiles are summarized in <Table 1>.

4.2 Measures

The constructs in the proposed model were designed to gather data from users as potential consumers of green IT. The definitions of the constructs and survey items used to measure

<Table 1> Subject Profiles

Variables	Categories	Number	%
Gender	Male	204	51.0
	Female	196	49.0
Age	< 20	80	20.0
	20s	130	32.5
	30s	128	32.0
	≥ 40s	61	15.3
	missing	1	0.2
Occupation	Employee	291	72.8
	Student	17	4.3
	Householder	56	14.0
	Misc.	36	9.0
Education	Senior high school	63	15.8
	Undergrad	18	4.5
	Bachelor's degree	274	68.5
	Master's degree or higher	42	10.5
	missing	3	0.7

the variables in the research model were primarily derived from qualitative studies. These items are listed in Appendix A. Most survey items for the constructs were drawn from previous literature and adapted for the purposes of this study. For green IT adoption, using behavior intention research in IS studies based on the TAM and UTAUT, new items were created to reflect the focus of this study on the multiple behaviors associated with green IT adoption. A seven-point Likert-type scale ranging from "strongly disagree" (1) to "strongly agree" (7)' was used to measure responses for every item.

V. Results

5.1 Validity Testing

To determine discriminant and convergent validity in the sample data set, the constructs were tested using exploratory factor analysis. To determine a fixed scale, one loading was equal to 1 in each factor. Following the recommendation of Hair *et al.* [1998], factor loadings greater than 0.50 were considered to be significant. Appendix B shows the results of the ex-

ploratory factor analysis. Regarding internal consistency (reliability), composite reliability scores for every construct (ranging from 0.805 to 0.918, as shown in <Table 2>) were well above 0.70 [Barclay *et al.*, 2004]. Average variance extracted (AVE) measures the amount of variance that a construct captures from its indicators relative to the amount due to measurement error [Chin, 1998]. The square root of the AVE score is recommended to exceed 0.70 [Hu *et al.*, 2004]. <Table 2> shows that the square root of the AVE score for every construct (ranging from 0.806 to 0.872) satisfied this requirement.

Next, confirmatory factor analysis was performed. Subsequent to validity testing, a structural equation model using maximum likelihood was estimated using the AMOS 18.0 software (SPSS, Inc., Chicago, IL, USA). <Table 3> shows the results of structural model testing from the confirmatory factor analysis. Fit measures indicated acceptable fit. The model suggested in the study was judged to be appropriate to estimate the relations among the variables, as the results were satisfactory (chi-square = 776.450, p = 0.00, degree of freedom = 295; chi-square/degree of freedom = 2.63, goodness of

<Table 2> Results of Reliability Testing

Constructs	Reliability	PCO	CRF	THC	TEC	CA	GB	INT
PCO	.940	**.837**						
CRF	.921	.267	**.837**					
THC	.899	.179	-.547	**.830**				
TEC	.942	.402	-.347	.305	**.896**			
CA	.903	.509	-.293	.277	.335	**.872**		
GB	.885	.499	-.269	.240	.597	.517	**.849**	
INT	.846	.452	-.245	.229	.446	.361	.551	**.806**

Note) The square root of average variance extracted (AVE) is shown for each construct in bold on the diagonal. PCO = positive change orientation, CRF = change-related fairness, THC = threat appraisal regarding habit change, TEC = threat appraisal regarding eco-change, CA = coping appraisal, GB = green behavior toward IT, INT = intention to purchase green IT products.

<Table 3> Structural model test

Goodness-of-fit measure	Recommended value[*]	Structural model
Chi-square/degree of freedom	≤ 3.00	2.63
Goodness-of-fit	≥ 0.90	0.88
Adjusted goodness-of-fit	≥ 0.80	0.83
Normalized fit index	≥ 0.90	0.90
Comparative fit index	≥ 0.90	0.93
Root mean square error of approximation	≤ 0.10	0.06

[*]Recommended values have been adapted from Bentler[1989] and Hair *et al.*[1998].
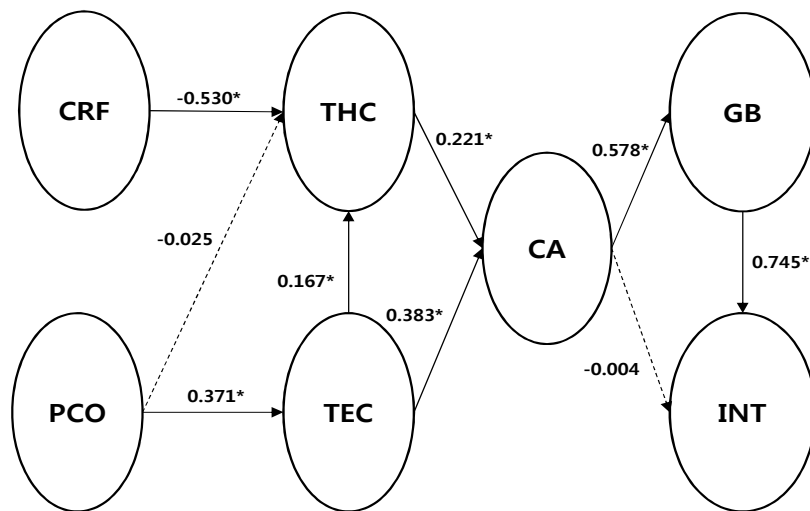
fit index = 0.88, adjusted = 0.83, normalized fit index = 0.90, comparative fit index = 0.93, root mean square of approximation = 0.06). The results indicated that the seven-factor structure was valid [Chang and Cheung, 2001].

5.2 Structural Model Path Analysis

The model was estimated as shown in <Figure 4>. Verified results of all hypotheses are summarized in <Table 4>. For H5, CRF was negatively associated with threat appraisal regarding habit change ($p < 0.001$, effect size -0.530). However, PCO had no effect on threat appraisal regarding habit change (H6-1). However, a positive association was found between PCO and threat appraisal regarding ecological change ($p < 0.001$; H6-2 supported).

Threat appraisal regarding habit change was positively related to threat appraisal regarding eco-change ($p < 0.001$; H4-2 supported). This shows that people perceived that their habits

[*]Significant at the 0.01 level.

Notes) PCO = positive change orientation, CRF = change-related fairness, THC = threat appraisal regarding habit change, TEC = threat appraisal regarding ecological change, CA = coping appraisal, GB = green behavior toward IT, INT = intention to purchase green IT products.

<Figure 4> Structural Equation Model

\<Table 4\> Results of Hypotheses Testing

Path	Estimate	SD	t－values	Support
H1: GB → INT	0.745	0.10	7.842*	Supported
H2-1: CA → GB	0.578	0.06	3.850*	Supported
H2-2: CA → INT	-0.004	0.07	-0.656	Not Supported
H3: THC → CA	0.221	0.06	3.850*	Supported
H4-1: TEC → CA	0.383	0.06	6.615*	Supported
H4-2: TEC → THC	0.167	0.05	3.060*	Supported
H5: CRF → THC	-0.530	0.06	-9.550*	Supported
H6-1: PCO → THC	-0.025	0.05	-0.481	Not Supported
H6-2: PCO → TEC	0.371	0.05	7.547*	Supported

* Significant at the 0.01 level.
Note) PCO = positive change orientation, CRF = change-related fairness, THC = threat appraisal regarding habit change, TEC = threat appraisal regarding eco-change, CA = coping appraisal, GB = green behavior toward IT, INT = intention to purchase green IT products.

could be changed due to the threat of ecological change. Hence, threat appraisal regarding eco-change led to threat appraisal regarding habit change. In the analyses of H3 and H4-1, threat appraisal regarding habit change and threat appraisal regarding eco-change were positively associated with coping appraisal (p < 0.001). These results were consistent with the message of OPMT that people engage in coping appraisal when they feel threatened.

A significant influence of coping appraisal on encouraging green behavior was observed (p < 0.001; H2-1 supported), while threat appraisal regarding eco-change and coping appraisal had no effect on intention to purchase green IT products (H2-2 not supported). This means that coping appraisal does not directly affect intention to purchase green IT. Rather, coping appraisal affects intention to purchase green IT after consumers have already manifested green behavior with regard to IT, that is, coping appraisal per se is indirectly related to green IT purchasing. In other words, in order to reduce the perceived threat of ecological change, peo-

ple will consider using existing green IT products before purchasing new green IT products.

VI. Discussion

6.1 Summary and Contributions

The results of this study demonstrated that OPMT, originally developed by Rogers [1983] to explore the link between perceived threat and coping behavior, was applicable to the context of green IT adoption as well. The effect of threat appraisal on green IT adoption was significant. As expected from Rogers [1983], threat and coping appraisal were identified as strong predictors of green behavior with regard to IT. These results are consistent with those of prior research. When the threat appraisal applies to both habit change and eco-change, the results clearly explain consumers' coping appraisal in order to resolve the threat. This information aids in interpreting customer coping behaviors. For ecological issues such as global warming or the collapse of nuclear plants, customers not only feel threatened by

negative news about ecological changes, but they also feel threatened by the possibility of change in their own lives. Previous research has stressed the importance of customer perceptions of ecological change; however, threat appraisal regarding habit change has not been addressed in previous studies.

The effect of green behavior with regard to IT on intention to purchase green IT products was also significant. According to the extended expectation-confirmation theory, if users perceive the value of green IT such as a social network service [Tang, 2010] or e-book [Shin, 2011] based on their usage experience, than they will be satisfied with green IT and more likely to continue to use it. Therefore, green behavior regarding IT was positively associated with purchase intention in this study. In addition, diffusion of innovation theory tells us when and how newly-introduced technologies are communicated, evaluated, adopted, rejected, and re-evaluated by consumers [Rogers, 1995]. The decision to adopt or reject an innovation is subject to a wide variety of factors, including perceived attributes of an innovation [Leung and Wei, 2000]. This means that confirmation of and satisfaction with a certain green IT product as an innovative technology will encourage the user to adopt the same kind of green IT product in future.

Coping appraisal itself was not positively associated with purchase intention, but only affected green behavior regarding IT. This result indicates that potential consumers of new green IT products will consider reusing available green IT products rather than directly purchasing new green IT products. For example, users performing a coping appraisal regarding en-

ergy consumption may first consider using a screen saver or activating power-saving functions in an already-owned computer rather than replacing that computer with a new type of energy-saving computer. This result may be related to the consumer's economic limit and the fact that using available green IT is more efficient than starting again with a new product.

The causal relationships between threat appraisal and its determinants (PCO and CRF) are explained by threat appraisal theory. While both these antecedents affect threat appraisal, the findings of this study indicate that PCO only affects threat regarding eco-change, not threat regarding habit change. Our study contributes to the literature on threat appraisal theory by demonstrating that the relationship between threat appraisal and its determinants is contextual. Threat appraisal regarding habit change is more egoistic and based on a rational economic concern perspective, while threat appraisal regarding eco-change is more altruistic and based on an environmental concern perspective. Hence, rational thinking, like PCO, may stimulate altruistic feelings and public concern, prompting the consumer to perform a threat appraisal regarding eco-change. Therefore, the threat must be understood in context (e.g., personal or public), rather than as a threat per se, as demonstrated by the results of this study on green IT adoption.

6.2 Implications for Theory and Practice

This paper contributes to IS research as follows. The empirical analysis outlined the path from perception of self-change to intention to adopt green IT as an innovative technology. This

path included an emotional component: threat appraisal. OPMT was newly applied to explain green IT adoption behavior. OPMT has been utilized as a fear appeal strategy for persuasion in marketing research such as social threat communication [Schoenbachler and Whittier, 1996]. However, very few empirical studies have identified the persuasive role of threat in adoption of IT or IS. This study approached green IT adoption from a different angle, using protective behavior theory to view how people adopt green IT, because green IT aims to protect the environment and sustain human life. Because OPMT emphasizes the cognitive appraisal of environmental events rather than peripheral and physiological activity, this theory is very applicable to the green IT adoption context.

Prior IS research on green consumption behavior has been written from a utilitarian perspective, illustrating the process of adoption of green IT products [Watson *et al.*, 2010]. From a utilitarian perspective, consumers adopt IT if they perceive that it will help them achieve a certain goal (e.g., energy savings) and gain more financial benefit than not adopting it. However, in the green consumption context, the effect of attitudinal factors can be confusing due to the nature of the curtailment and adoption behaviors [Jansson *et al.*, 2010]. This study showed that behavior toward green IT and green IT purchasing were motivated by causes other than conventional attitudinal factors.

The threat appraisal-oriented model proposed in this paper adds another perspective to adoption of IT compared to conventional IT adoption theories such as the TAM and UTAUT. As mentioned earlier, message framing can be used to promote a behavior by influencing the persua-

siveness of the message. For example, the message may emphasize the outcomes when (not) engaging in that particular behavior [Levin *et al.*, 1998]. Levin *et al.* [1998] distinguished between positive and negative frames. A positive frame stresses the favorable behavioral outcomes of complying with the advocated behavior. A negative frame stresses the unfavorable behavioral outcomes of noncompliance with the advocated behavior [Levin *et al.*, 1998; Zhao and Pechmann, 2007]. Although the effectiveness of the message frame may differ according to context, this study demonstrated that a negative frame can also influence consumer adoption decisions. From the message framing viewpoint, while the TAM and UTAUT focus on the positive frame ("if you adopt the IT, you will experience the ease of its use and its usefulness"), the proposed model showed that a negative frame ("if you do not adopt the IT, the threat of eco-change will become a reality") may also affect consumer IT adoption behavior in the green IT context. Researchers may consider other elements within the negative message frame in more sophisticated studies of IT adoption theory. Practitioners can utilize both positive and negative frames in a well-balanced framework to enhance green IT businesses and encourage IT adoption.

In the model proposed in this study, intention to reuse and purchase intention regarding green IT were considered. Many studies do not consider the reuse of IT or IS in the context of new IT adoption; for example, intention to adopt IT is regarded as identical to IT purchase intention, according to the theory of planned behavior. However, the results of this study demonstrated that in adopting innovative IT, consumers prefer to reuse currently available IT

before making a decision to buy new IT. Both intention to purchase green IT products and re-using available green IT products are seen as green IT adoption behavior in this study. This is an important point in illustrating the deter-minants of green IT adoption.

In this study, an empirical test was first con-ducted combining OPMT and threat appraisal theory in the model to explain consumers' green IT adoption behavior. The integrated model subdivides OPMT into threat appraisal and behavior intention. Moreover, while threat appraisal theory emphasizes the direct effect of a threat on behavior, this study examined the role of coping appraisal to improve our under-standing of how threat is associated with behavior.

The model proposed in this study is con-sistent with the research of Swim et al. [2011] on psychological dimensions of global environ-mental change. They examined the effects of en-vironmental change on human cognition, affect, and motivation to change behavior. Human cognition affects human systems, which in turn affect climate systems through human contri-butions to climate change and its consequences [Swim et al., 2011]. Psychology has made con-tributions to the understanding of how people think and feel about eco-change, which in turn influences their motivations and behavioral re-sponses to perceived and objective causes and consequences of climate change [Gifford, 2011]. This study borrowed from Gifford's theory to explain how threat regarding eco-change affects human adaptations such as green behavior.

This study also has practical implications. PCO makes consumers more amenable to change; thus, green IT marketers can use the proposed model as a mechanism to manage consumers' resistance to change more effectively. For example, product designers and promoters can learn from the vast literature and suggested practices that illustrate ways to modify individual self-efficacy [Bandura, 1977], change-related attitudes [Vakola et al., 2004], and perceived control [Neves and Caetano, 2006] to enhance consumers' PCO.

6.3 Limitations and Future Research

According to OPMT, coping responses can be defined as adaptive, avoidant or maladaptive. However, this study did not consider malad-aptive coping responses. While adaptive and avoidant responses lead to changes in behavior that reduce both fear and danger, maladaptive responses reduce the individual's fear without reducing the danger [Ray and Wilkie, 1970; Rippetoe and Rogers, 1987; Tanner et al., 1991; Schoenbachler and Whittler, 1996]. Maladaptive behaviors have been frequently found in stud-ies on physical or psychological therapy for be-haviors such as smoking. Although green IT adoption is typically an adaptive response to threat appraisal regarding habit change and eco-change, future research may identify green IT adoption as maladaptive behavior.

Social normative influence was omitted in the model because it has been widely accepted in green IT adoption research. Hence, incor-porating this construct would contribute only marginally to our knowledge on this subject. Likewise, the ethical perspective on threat ap-praisal and coping behavior was not consid-ered, even though the ethical view has often been considered in explaining adoption behav-ior and/or habit change [Matthies et al. 2006].

In this paper, since we focused on intention to adopt green IT products, actual usage behavior and user satisfaction are not explained with the proposed research model. Moreover, how a certain green IT product shown in the questionnaire save energy was not fully provided to the participants. These may influence the participants' recognition and attitude on a using certain IT product. Uncovering the relationship between intention to use and actual usage of green IT should be conducted in the future.

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<Appendix A> Constructs and Items

Construct	Item	Source
Change-related fairness (CRF)	CRF1: It is unfair that I am the only one who must change. CRF2: It is unfair that some must change while others do not have to change. CRF3: Dividing people into those who must change and those who do not have to change is unfair. CRF4: It is unfair that only some people change for the benefit of all. CRF5: I will not change if others do not.	Ashford [1988]
Positive change orientation (PCO)	PCO1: Attempting to do something new is good. PCO2: I am able to control myself when making changes in my life. PCO3: I adapt to changes in my life quite well. PCO4: I change myself without hesitation.	Fay and Frese [2001]
Threat Appraisal regarding Habit Change (THC)	THC1: It would be burdensome if my life was changed by someone else. THC2: It is threatening when someone tells me that my life habits must be changed for public benefit. THC3: Changing my habits would inconvenience me greatly. THC4: I would feel threatened if my habits were forcibly changed by others.	Lazarus and Folkman[1984] Fugate *et al.* [2010] Ho[2000]
Threat Appraisal regarding Eco-Change (TEC)	TEC1: It will be nearly impossible to restore our planet if the environment is destroyed. TEC2: If we do not behave properly, then the environment will be more likely to be damaged. TEC3: Confronting environmental damage means that mankind will be miserable. TEC4: Environmental disruption is a very serious problem.	Lazarus and Folkman[1984] Fugate *et al.* [2010] Ho[2000]
Coping Appraisal (CA)	CA1: I am convinced that I can preserve our planet. CA2: I can protect both our planet and my life. CA3: I am able to cope with environmental disruption by myself. CA4: I can use environmental protection methods.	Rogers[1983]
Green Behavior regarding IT (GB)	GB1: I will use the energy-saving utilities of my IT devices. GB3: I will use websites to inform me how to live in an eco-friendly manner.	Created
Purchase Intention toward Green IT (INT)	INT1: I will purchase an energy-saving computer to conserve our planet. INT2: I will purchase eco-friendly IT devices even though they are expensive. INT3: I will purchase a computer that is made of eco-friendly materials.	Created

<Appendix B> Results of Exploratory Factor Analysis

	Factors						
	1	2	3	4	5	6	7
CRF_2			.826				
CRF_5			.812				
CRF_3			.795				
CRF_1			.768				
CRF_4			.753				
PCO_2				.834			
PCO_3				.790			
PCO_1				.772			
PCO_4				.677			
CA_2	.874						
CA_4	.866						
CA_3	.843						
CA_1	.634						
TEC_2		.884					
TEC_3		.865					
TEC_1		.824					
TEC_4		.754					
THC_2					.824		
THC_3					.789		
THC_4					.771		
THC_1					.719		
GB_2						.777	
GB_1						.713	
INT_2							.791
INT_3							.690
INT_1							.682

Note) PCO = positive change orientation, CRF = change-related fairness, THC = threat appraisal regarding habit change, TEC = threat appraisal regarding eco-change, CA = coping appraisal, GB = green behavior toward IT, INT = intention to purchase green IT products.

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