Journal of the Association for Information Systems (2019) **20**(12), 1774-1793
doi: 10.17705/1jais.00585

RESEARCH ARTICLE

ISSN 1536-9323

The Role of Evaluability Bias and the Fairness Effect in the Escalation of Commitment to Troubled Software Product Development Projects

Jong Seok Lee[1], Mark Keil[2], Sang Cheol Park[3]
[1]The University of Tennessee, Knoxville, USA, jlee236@utk.edu
[2]Georgia State University, USA, mkeil@gsu.edu
[3]Daegu University, South Korea, scpark77@daegu.ac.kr

Abstract

New software product development entails considerable risks. One significant risk is that decision makers can become overly committed to troubled software product development projects (i.e., *escalation of commitment*). While prior research has identified factors that promote escalation in information technology projects, there has been little attempt to leverage the context of software product development, which can include evaluating attributes of a software product under development and weighing a personal financial reward tied to a successful product launch. In this study, we conducted two experiments to investigate how *evaluability bias* concerning software attributes and the *fairness effect* that arises from the relative amount of a personal financial reward influence the escalation of commitment to troubled software product development projects. Our findings suggest that the escalation of commitment to troubled software product development projects is influenced by both *evaluability bias*, which affects the perceived attractiveness of a software product under development, and the *fairness effect*, which influences the perceived attractiveness of a personal financial reward tied to a successful product launch. This study contributes to both the information systems literature and the escalation literature by providing novel theoretical explanations as to why escalation occurs in the context of new software product development.

Keywords: Escalation of Commitment, Software Product Development, Evaluability Bias, Fairness Effect.

Zhenhui Jiang was the accepting senior editor. This research article was submitted on March 3, 2018, and underwent three revisions.

1 Introduction

New software product development is a critically important business process because it can lead to products that can help companies gain a competitive advantage by setting a new industry trend or creating a new niche market. Despite its potential returns, new software product development is not without risk. One significant risk is that decision makers can become overly committed to troubled product development projects (Biyalogorsky, Boulding, & Staelin, 2006; Boulding, Morgan, & Staelin, 1997)—a phenomenon known as *escalation of commitment* (Brockner, 1992; Staw, 1976, 1981). Prior research on new product development has shown that decision makers often fail to terminate or adequately redirect a new product development project despite negative signs and instead choose to invest additional resources into the troubled project (Biyalogorsky et al., 2006; Boulding et al., 1997; Keil, Depledge, & Rai, 2007; Schmidt & Calantone, 2002). For example, when a competitor has already introduced a new product that is reportedly superior to a product under development, it may make sense to redirect or terminate the project rather than to invest additional resources to complete and launch the product (Arkes & Blumer, 1985). Failing to redirect troubled projects can lead to a significant waste of organizational resources and may adversely affect the company in other ways.

Due to its significant implications in new product development settings, escalation of commitment has attracted interest among both marketing and information systems (IS) researchers (Biyalogorsky et al., 2006; Keil et al., 2007; Schmidt & Calantone, 2002). However, our understanding of what drives escalation in *new software product development* is quite limited. Moreover, while prior IS research has identified several factors that promote escalation in IT projects (e.g., sunk cost and personal responsibility), it has failed to leverage the context of software product development, which can include evaluating attributes of a software product under development. When software product development projects go awry, evaluation of the software product's attributes is one input that decision makers can use to judge the ultimate viability of such a product and whether it makes sense to continue the project as planned. Therefore, in this study we focus on a decision bias that we call *evaluability bias*, which is associated with evaluating a software product' attributes, and investigate how it influences escalation of commitment in the context of software product development. Evaluability refers to the relative ease with which an attribute can be evaluated in relation to other attributes (Bazerman & Moore, 2013). When a decision maker is presented with a software product having two attributes and one of these is easier to evaluate than the other, this can result in evaluability bias, meaning that the easy-to-evaluate attribute dominates the evaluation of the software product (i.e., the more difficult-to-evaluate attribute is neglected). Thus, the decision maker will perceive the software product to be attractive when the easy-to-evaluate attribute carries a superior value.

The context of software product development also frequently involves personal financial rewards that are tied to a successful product launch. For example, at the outset of a project, the project manager might receive the promise of a financial reward for successfully launching a new product. Prior research on judgment and decision-making has found that people tend to favor a reward payoff structure that is perceived as being fair (Bazerman, White, & Loewenstein, 1995), a phenomenon that we call *the fairness effect*. Therefore, in this study we also aim to investigate the impact of the fairness effect on escalation of commitment in the context of software product development.

Software product development represents a novel context in which to study escalation and by leveraging two features that are germane to this context, we are able to contribute to both the IS literature and the escalation of commitment literature, as escalation scholars have not previously investigated the impact of evaluability bias or the fairness effect. Furthermore, we chose to investigate these two factors in a single study, as they both have the potential to influence perceived attractiveness of project-related outcomes in new software product development, which can influence escalation decisions. Specifically, we propose that evaluability bias will affect the perceived attractiveness of a software product under development, and that the fairness effect will affect the perceived attractiveness of a personal financial reward tied to a successful product launch, both of which will promote the escalation of commitment to troubled software product development projects. In the sections that follow we report the results of two laboratory experiments that were conducted, one with IT undergraduate students and the other with IT professionals in order to test these ideas. We begin, however, with a review of relevant literature on escalation of commitment, evaluability bias, and the fairness effect.

2 Escalation of Commitment and New Software Product Development

Escalation of commitment was first investigated in an experiment by Staw (1976) who found that individuals allocate additional resources to a previously chosen but failing course of action due to personal responsibility for having initiated the course of action. Motivated by frequent media reports of runaway systems projects that seemed to take on lives of their own, IS researchers began focusing attention on the problem of IT project escalation beginning in the mid-1990s (Keil, 1995; Newman & Sabherwal, 1996). Over time, this topic has become one of enduring interest to both IS researchers (Heng, Tan, & Wei, 2003; Lee, Keil, & Kasi , 2012; Mähring, Keil, Mathiassen, & Pries-Heje, 2008; Pan et al., 2004; G. Pan, S. Pan., & Flynn, 2006; Truex, Holmström, & Keil, 2006) and practitioners (Fichman, Keil, & Tiwana, 2005; Keil & Mähring, 2010). In addition, several researchers have explored the escalation phenomenon in the context of new product development (Biyalogorsky et al., 2006; Boulding et al. 1997; Keil et al., 2007; Schmidt & Calantone, 2002). Notable factors that have been found to influence escalation decisions in new product development include sunk cost (Arkes & Blumer, 1985), project completion level (Keil, Truex, & Mixon, 1995), and personal responsibility for initiating a project (Schmidt & Calantone, 2002). Furthermore, drawing on risk-taking theory, Keil, Tan et al. (2000) showed that the decision maker's risk perception has a significant influence on the decision to continue working on a software product development project despite negative feedback.

Our focus on anticipatory outcomes (i.e., product launch and associated financial reward) differentiates our study from much of the prior work on escalation, which has addressed temporal factors that focus on the "past" or "present." Much of the research on escalation of commitment has had a retrospective focus on factors that psychologically linked the decision maker to the troubled project—e.g., personal responsibility for having initiating the project (Staw, 1976), or prior investments that went into a project (Arkes & Blumer, 1985; Garland, 1990). Escalation researchers have also found several psychological or social factors that can be thought of as "present" oriented, and these factors inextricably link the decision maker to the troubled project and promote project escalation (e.g., the decision maker is the project champion, experiences job insecurity, is emotionally attached to the project, or is subject to norms for consistency, etc.) (Brockner, 1992; Keil, 1995; Newman & Sabherwal, 1996; Sabherwal, Sein, & Marakasc, 2003; Staw, 1981).

There has been comparatively little work on "future"-oriented factors that may drive escalation behavior. Conlon & Garland (1993) found that individuals become more willing to continue working on a troubled project when the project is near completion, and Moon (2001) confirmed this so-called "completion effect." The role of prospective thinking in escalation decisions was further highlighted in a study by Wong and Kwong (2007), who found that individuals anticipate future outcomes in escalation situations and are more willing to continue pursuing a failing course of action when the possibility of future regret about withdrawal is high (i.e., anticipated regret).

In the context of software product development, two anticipatory outcomes that are important to decision makers are: (1) a software product that is under development, and (2) a personal financial reward tied to a successful launch of a software product. However, prior research offers no explanations for what may influence the perceived attractiveness of these two anticipatory outcomes in the minds of decision makers who find themselves in escalation situations involving new software product development. Against this backdrop, this study has the potential to contribute not only to the established stream of research on IT project escalation, but also to the broader stream of literature on escalation of commitment by providing novel theoretical explanations as to future-oriented considerations that may influence escalation decisions.

3 Evaluability Bias and the Fairness Effect

We focus on evaluability bias (often referred to in the literature as the evaluability hypothesis (Hsee, 1996)) and the fairness effect (Bazerman et al., 1995) because we believe they can offer new theoretical insights into the escalation of commitment to new software product development. While normative decision theories assume that people tend to be rational decision makers and have consistent preferences, research has shown that individuals' preference or value assessment can change depending on evaluation conditions (Bazerman, Loewenstein, & White, 1992; Hsee, 1996; Hsee, Loewenstein, Blount, & Bazerman, 1999). One factor that can affect an individual's preference is the evaluability of an object's attributes. In addition, in making financial or purchasing decisions it is known that an individual's preference can be heavily influenced by the relative amount of a financial reward promised to him or her in comparison to the amount promised to others (i.e., perceptions of fairness). In what follows, we offer a concise review of evaluability bias and the fairness effect.

First, while some attributes are inherently easier to evaluate than others (e.g., the cover of a book is easier to evaluate than its contents), it is commonly known that the evaluability of an attribute improves when it is presented with some form of comparative information, such as using a scale. For instance, in an experiment that involved a hiring decision, Hsee (1996) found that when individuals were asked to evaluate a job candidate for a computer programmer position, their preference was largely determined by an attribute of the candidate that was presented using a scale (e.g., 4.9 GPA on a 5-point scale) as opposed to an attribute of the candidate that was not presented on a scale (e.g., experience writing 10 programs). Based on a series of laboratory experiments, Hsee (1996) proposed that people's preferences for an object are more heavily influenced by attributes that are easy to evaluate. Applying this concept to the context of software product development, people evaluating a software product under development may base their decision more on a software attribute that is easy to evaluate than on a software attribute that is difficult to evaluate. For example, the user interface on a software product may be easier to evaluate than the quality of the data structure that underlies the product. Thus, in evaluating a software product, individuals may base their decision disproportionally on the user interface (an attribute that is easy to evaluate), essentially underweighting the data structure (an attribute that is more difficult to evaluate). Furthermore, we suggest that evaluability bias is likely to play an especially important role in the software product development context due to the invisibility of software (Abdel-Hamid & Madnick, 1991; Brooks, 1987), which makes it inherently difficult to evaluate certain attributes of a software product under development.

Second, the fairness effect relates to a broad body of work on fairness in decision-making. It is well documented that people sometimes make choices that are inconsistent with their economic self-interest. One reason for this has to do with social-comparison processes (Tenbrunsel & Diekmann, 2002) that produce decisions that are in conflict with underlying preferences. For instance, in workplace settings comparative reward information can lead people to focus more on the relative amount promised to them in comparison to the amount promised to others, as opposed to the absolute amount they stand to gain. Bazerman et al. (1994) found that individuals who evaluated a job offer that paid equally compared to other job candidates (e.g., $75K for self, $75K for others) liked the offer, whereas individuals who evaluated a job offer that paid more in absolute amount but paid less compared to other job candidates (e.g., $85K for self, $95K for others) did not like the offer. In addition, Bazerman et al. (1992) found that in evaluating an outcome consisting of a payoff for oneself and a payoff for another person, individuals tend to care more about relative payoffs than absolute payoffs. Specifically, Bazerman et al. (1992) found that people who were asked to evaluate the payoff of $500 for oneself and $500 for another person (i.e., an equal payoff) reacted more positively to their payoff, than did people who were asked to evaluate the payoff of $600 for oneself and $800 for another person (i.e., an unequal but greater payoff). This decision tendency has been demonstrated in different decision settings, including hiring decisions (Bazerman, Schroth, Shah, , Diekmann, & Tenbrunsel, 1994) and job offer acceptance decisions (Tenbrunsel & Diekmann, 2002).

4 Development of Hypotheses

In this section, we theorize how evaluability bias concerning software attributes and the fairness effect that arises from the relative amount of a personal financial reward, affect escalation decisions in the context of software product development.

4.1 Evaluability Bias and Escalation of Commitment

In order to evaluate a software product under development, decision makers commonly assess the quality of software attributes. Such information may be presented using a scale, or with no scale. Using a scale allows decision makers to easily evaluate how good a software product is on that attribute (e.g., a score of 5 on a 5-point scale for "reliability" can be easily interpreted as excellent). In contrast, when an attribute is presented in absolute terms and with no scale (e.g., 350 "software functions"), it is more difficult to judge the quality of the product based on that attribute. Drawing on the notion of evaluability bias, we suggest that the overall evaluation of a product will be determined largely by the evaluation of a software attribute that is easy to evaluate (e.g., one that is presented on a scale) rather than by the evaluation of a software attribute that is difficult to evaluate (e.g., one that is presented without a scale). Based on this line of reasoning, we expect that evaluability bias concerning software attributes will have a significant effect on the perceived attractiveness of a software product. Specifically, the decision maker will perceive the software product to be attractive when the easy-to-evaluate attribute carries a superior value. The arguments presented above suggest the following hypothesis:

H1a: When an easy-to-evaluate attribute carries a superior value, evaluability bias will have a positive influence on the perceived attractiveness of a software product (even if the difficult-to-evaluate attribute carries an inferior value).

In addition, we expect that the perceived attractiveness of a software product induced by evaluability bias will positively affect escalation of commitment. Lee, Keil, & Wong (2015) found that expectancy beliefs concerning goal attainment have a positive effect on the escalation of commitment. Further, prior escalation studies suggest that some hope of success or a positive belief is required for escalation of commitment to occur (Heath, 1995). In other words, individuals escalate their commitments to a previously chosen course of action based on a positive assessment of future outcomes that may result from the continued commitment. In the context of software product development, this would presumably include situations in which a positive appraisal of the product (based on its attributes) leads decision makers to conclude that a product launch will be successful. While there may be other factors that influence decision makers' assessment of the viability of a new software product, because of the invisible nature of software (Abdel-Hamid & Madnick, 1991; Brooks, 1987) and the uncertainty associated with developing new products (Urban, Weinberg, & Hauser, 1996), decision makers must rely heavily on their own subjective evaluation of software attributes. We expect that if an appraisal of software attributes causes a decision maker to perceive the software product under development as attractive, this will have a positive influence on his or her decision to continue working on a troubled software product development project. Based on the arguments presented above, we hypothesize:

H1b: The perceived attractiveness of a software product will have a positive influence on the escalation of commitment to new software product development.

4.2 The Fairness Effect and Escalation of Commitment

A common practice in the context of software product development is to offer a personal financial reward that is tied in some way to the success of the product launch. The perception of such a financial reward may be influenced by the fairness effect. Prior research on fairness and decision-making demonstrates that people are biased in a self-serving manner in that they pay great attention to the amount of the payoff that they receive in comparison to the amount of the payoff that others receive (Bazerman et al. 1995). This concern over fairness means that people become more focused on comparative payoffs and making sure that they attain an equal share of the pie, and become less focused on the absolute amount of payoffs that they receive (i.e., maximizing their payoffs). Thus, when financial rewards are promised to project members, the fairness effect can influence project managers' perceived attractiveness of the financial reward promised to them. The fairness effect suggests that decision makers will find a promised financial reward that is equal to that of a co-worker to be more attractive than a promised financial reward that is less than that offered to a co-worker. The arguments presented above suggest the following hypothesis:

H2a: When the amount of one's financial reward is equal to that of others, the fairness effect will have a positive influence on the perceived attractiveness of a financial reward.

Prior research on IT project escalation has found that the decision to continue working on troubled IT projects is driven by the anticipation that continued investment may lead to a large payoff (Keil, 1995). This indicates that decision makers consider a potential financial reward associated with successful completion of the project in escalation situations and that this can lead them to continue working on a troubled IT project. Furthermore, in escalation situations, decision makers generate a subjective expected utility associated with a decision to continue by comparing potential rewards and the costs of continuing the failing course of action (Brockner, 1992). This suggests that decision makers may be more likely to continue pursuing a failing course of action when there is a personal financial reward associated with completing the course of action and when they perceive the reward to be attractive. Further, Sleesman, Conlon, McNamara, & Miles (2015) suggested that reward systems are likely to have a significant influence on whether or not people decide to continue with a failing course of action. Drawing on the above arguments and prior research on escalation, we theorize that if decision makers perceive a financial reward to be attractive, this will have a positive effect on their decision to continue pursuing troubled software product development projects. Thus, we hypothesize:

H2b: The perceived attractiveness of a financial reward will have a positive influence on the escalation of commitment to new software product development.

Before proceeding to the method section, we present our overall research model showing the hypothesized relationships. We included age, gender, and IT-related work experience as controls, as these variables have been found to have significant effects on business decision-making (Taylor, 1975; Venkatesh, Morris, & Ackerman, 2000).

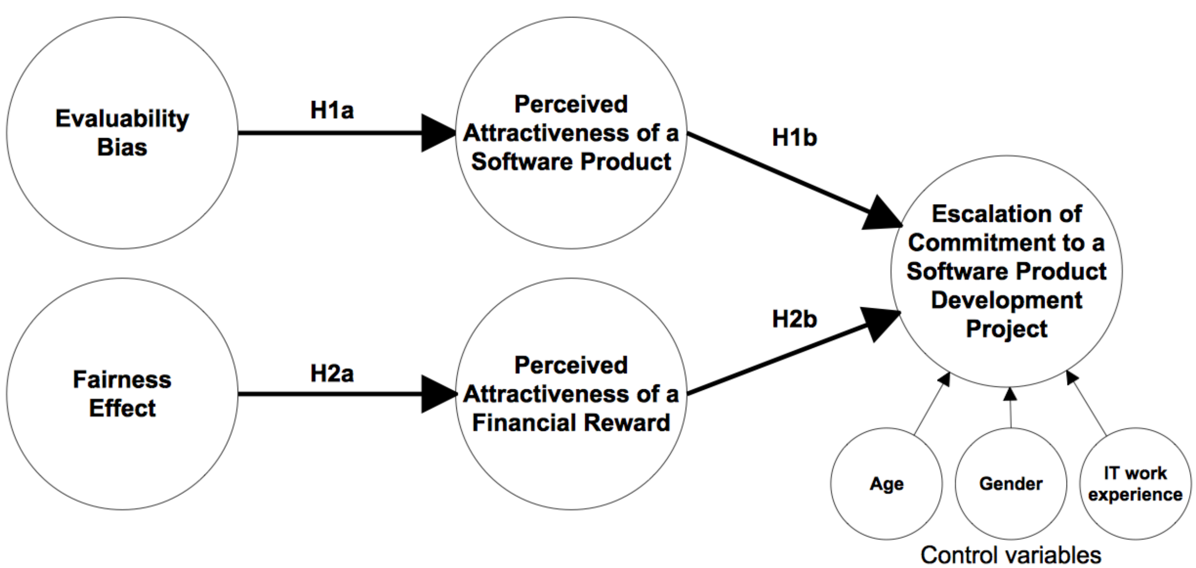

Figure 1. Research Model

5 Method

Our study involved two experiments: one using student subjects (Experiment 1) and one using IT professionals (Experiment 2). We chose the experimental method in order to examine the causal effects of evaluability bias and the fairness effect on escalation decisions in new software product development. Experiments are useful for demonstrating that causal effects exist (Kozlowski, 2009). They also help rule out the possibility of reverse causality, since the experimenter manipulates independent variable(s) (Colquitt, 2008). Thus, well-designed experiments allow researchers to achieve higher internal validity than is possible with other research methods. For this reason, experiments have been widely used by scholars who study evaluability bias and the fairness effect (e.g., Bazerman et al., 1992; Hsee 1996; and González-Vallejoa & Moran, 2001), as well as those who study escalation (e.g., Staw, 1976; Keil, Tan et al., 2000; Moon, 2001; and Wong & Kwong, 2007). In the following section, we discuss the experimental design, manipulations, and measures used in our experiments.

5.1 Experimental Design and Decision Task

Both experiments involved a 2x2 factorial design in which we manipulated the ratings of two software attributes and the amount of financial reward relative to a project co-manager. For the experimental decision task, we created a new software product development scenario based on Arkes and Blumer's (1985) classic "radar blank" plane scenario. We chose this as our model because it involves a new product development context and has been widely adapted and used in escalation studies (e.g., Conlon & Garland, 1993; Moon, 2001; and Wong, 2005). Appendix A shows the actual scenario we used. In the scenario, participants were told that they had been working with a colleague as a co-manager on a project that was expected to deliver a lucrative business intelligence (BI) product for external sale. Participants were also told that the project had fallen behind schedule due to beta testing, and that, in the meantime, another firm had begun marketing a BI software package that was reportedly superior. This constituted the negative feedback about the project. Further, within the scenario participants were provided with the ratings of two software attributes and information about personal financial rewards, and then asked to make a decision about whether or not to continue working on the project.

5.2 Manipulations

First, to test the effect associated with evaluability bias, we chose two software attributes that are often used in evaluating a software product: functionality (operationalized as the number of modules) and reliability (operationalized as a reliability rating on a 5-point scale).[1] We chose functionality and reliability because these two attributes have been shown to be the two most important criteria for evaluating software products (Keil & Tiwana, 2005). Since the theory behind evaluability bias suggests that people will focus on attributes that are easy to evaluate, it was necessary to have one attribute that could be operationalized in an easy-to-evaluate fashion and one that could be operationalized in a difficult-to-evaluate fashion. By expressing reliability in the form of a rating on a 5-point scale, we made this attribute easy to evaluate and by representing functionality in terms of the number of modules, we made this attribute difficult to evaluate.

Using these two software attributes, we created two experimental conditions (see Table 1). In one condition, the reliability was highly rated (5.0/5.0) and the number of modules was relatively small (50). In the other, the reliability was mediocre (3.0/5.0) and the number of modules was relatively large (350).[2] We reasoned that decision makers' evaluation of the software product under development would be more strongly influenced by the software attribute that was easy to evaluate (i.e., reliability) than the software attribute that was difficult to evaluate (i.e., number of modules). Based on this, we predicted that decision makers in the superior reliability / inferior number of modules condition would perceive the software product under development to be more attractive than decision makers in the inferior reliability / superior number of modules condition.

[1] While decision makers can access other attributes that are important in evaluating a software product under development, we limited our focus to two attributes in order to keep the experiment manageable and because our aim was to focus on the theoretical mechanism through which evaluability bias can influence escalation of commitment to troubled software product development projects, not the specific attributes per se.

[2] This manipulation was modeled after the manipulation used in an experiment by Hsee (1996). In that experiment, subjects were asked to play the role of a company owner and evaluate a job candidate for a computer programmer position based on two attributes: undergraduate grade point average (GPA) and experience with a special computer language named KY. GPA was given on a 5-point scale and easier to evaluate than the KY language experience, which was presented as the number of KY programs that the candidate had written in the past two years. Using these attributes, two experimental conditions were created. In one, the GPA was high (4.9/5.0) and the number of programs was low (10). In the other, the GPA was low (3.0/5.0) and the number of programs was high (70).

Table 1. Experimental Conditions: Evaluability Bias

	Reliability (easy-to-evaluate attribute)	Number of modules (difficult-to-evaluate attribute)
Superior reliability / inferior number of modules condition	5.0/5.0	50
Inferior reliability / superior number of modules condition	3.0/5.0	350

Table 2. Experimental Conditions: Fairness Effect

	Oneself	Co-manager
Equal-amount condition	$10,000	$10,000
Unequal-amount condition	$15,000	$20,000

Second, to test the fairness effect associated with a financial reward, we introduced a financial bonus tied to the software product's successful launch, which would be divided between the two project co-managers (see Table 2). In one experimental condition, participants were told that both they and their co-manager would each receive a $10,000 bonus (equal-amount condition). In the other condition, participants were told that they would receive a $15,000 bonus and their co-manager would receive a $20,000 bonus (unequal-amount condition).[3] We reasoned that decision makers would be highly influenced by the relative amount of the financial reward promised to them in comparison to their co-manager. Thus, we anticipated that decision makers in the equal-amount condition would perceive the reward to be more attractive than decision makers in the unequal-amount condition. We expected this effect to occur despite the fact that the unequal- amount condition offered a larger bonus. Finally, to control for other factors that might influence the perception of fairness, the project co-manager was described as having graduated with the same degree from the same school as the decision maker, and as having the same number of years at the company.

5.3 Measures

We measured escalation of commitment by assessing willingness to continue—the most widely used approach in previous escalation studies (e.g., Garland, 1990; Moon, 2001; and Keil, Tan et al. 2000). Because project managers do not typically possess the decision rights to continue or abandon an endeavor but often make recommendations to senior management, we created two measurement items to align with the typical situation in most organizations. For both perceived attractiveness of a software product and perceived attractiveness of a financial reward, we adapted four measurement items from Sarker and Valacich (2010). The experiment also included a series of manipulation checks and some questions relating to age, gender, and work experience. All items were measured on a 7-point scale and are shown in Appendix B.

6 Experiment 1

6.1 Participants and Procedure

For Experiment 1, we recruited 144 undergraduate students enrolled in IS courses at a large urban university in the southeastern United States. We obtained permission from instructors to conduct the experiment during class time in their regular classrooms. At the experiment's outset, we explained the purpose of this study in lay terms without revealing the precise research objectives in order to avoid creating demand effects. Specifically, we told participants that this was a scenario-based experiment involving decision-making in the context of new software product development, and that they would be asked to play the role of a project co-manager working for a technology and consulting firm. We then handed out paper-based experimental materials, which included a scenario and a questionnaire. The average age of the participants was 25.3 years old, and the average IT-related work experience was 1.4 years. The average age was slightly older than typical college students because the university tends to have many nontraditional students who enter the school with some work experience. Of the participants, 104 were male and 40 were female.

[3] This manipulation approach is consistent with prior research on the fairness effect (e.g., Bazerman et al., 1992), which manipulated the relative amount of a payoff (unequal vs. equal).

6.2 Results

6.2.1 Manipulation Checks

To check the validity of the manipulation involving software attribute evaluability, we asked participants to answer two questions on a 7-point scale: one question pertained to the evaluability of the reliability rating (easy-to-evaluate attribute), while the other pertained to the evaluability of the number of modules (difficult-to-evaluate attribute). We conducted a repeated-measures analysis of variance (ANOVA) to compare the perceived evaluability of reliability rating versus the perceived evaluability of the number of modules. The results indicated that participants perceived the reliability rating to be easier to evaluate (M = 4.46, SD = 1.82) than the number of modules (M = 3.03, SD = 1.70), and that this difference was statistically significant ($F(1,143) = 74.37$, $p < 0.01$).

To check the validity of the manipulation involving a financial reward, we asked participants to answer two questions (also on a 7-point scale) related to the financial bonus and whether it was perceived as fair and evenhanded. We conducted a one-way ANOVA to determine if a statistically significant difference existed in how participants perceived the financial bonus between the equal amount group and the unequal amount group. The results indicated that the mean difference between the equal-amount condition (M = 5.26, SD = 1.27) and the unequal-amount condition (M = 3.34, SD = 1.63) was significant and in the expected direction ($F(1,142) = 61.31$, $p < 0.01$).

Appendix C provides the details of how we checked and confirmed that the basic assumptions for repeated-measures ANOVA (i.e., normality and sphericity) and for the one-way ANOVA (i.e., normality, independence, and homogeneity of variance) held.

6.2.2 Descriptive Statistics, Correlations, and Reliability

As Table 3 shows, we examined the means, standard deviations, and correlations among study variables. Escalation of commitment had significant correlations with evaluability bias (0.22), fairness effect (0.21), perceived attractiveness of a software product (0.53), and perceived attractiveness of a financial reward (0.34). Further, all three measured variables exhibited adequate reliability.

6.2.3 Hypothesis Testing

First, we conducted a factorial ANOVA to examine the influences of evaluability bias and the fairness effect on escalation of commitment across different experimental groups. The ANOVA results indicated that the participants in the superior reliability / inferior number of modules condition had a greater willingness to continue (M = 5.25, SD = 1.30) than the participants in the inferior reliability / superior number of modules condition (M = 4.62, SD = 1.55), and this difference was statistically significant ($F(1,140) = 7.67$, $p < 0.01$, $\eta^2_p = 0.05$). Further, the same analysis also showed that the participants in the equal-amount condition had a greater willingness to continue (M = 5.25, SD = 1.37) than the participants in the unequal-amount condition (M = 4.65, SD = 1.48), and this difference was statistically significant ($F(1,140) = 6.75$, $p < 0.05$, $\eta^2_p = .05$). These results were consistent with what we expected based on evaluability bias and the fairness effect. No significant interaction effect was found between the two independent variables. For the ANOVA, we checked and confirmed three basic assumptions (normality, independence, and homogeneity of variance) as explained in Appendix C.

Table 3. Descriptive Statistics, Correlations, and Reliability

		1	2	3	4	5	*M*	*SD*	α
1	Evaluability bias^{+}	–					.49	.50	–
2	Fairness effect^{+}	.01	–				.51	.50	–
3	Perceived attractiveness of a software product	.26**	.05	–			4.62	1.16	.88
4	Perceived attractiveness of a financial reward	.08	.17*	.27**	–		5.34	1.35	.86
5	Escalation of commitment	22**	.21*	.53**	.34**	–	4.94	1.46	.73

Notes: N = 144; * $p < 0.05$; ** $p < 0.01$

$^{+}$ Manipulated variables: we coded "inferior reliability / superior functionality" and "an unequal amount reward" as 0, and coded "superior reliability / inferior functionality" and "an equal amount reward" as 1

Next, we proceeded to test two pairs of hypotheses (H1a/H1b and H2a/H2b). Since each pair of hypotheses involved a path model (evaluability bias→perceived attractiveness of a software product→escalation & fairness effect→perceived attractiveness of a financial reward→escalation), we adopted a process model analysis approach recommended by Hayes (2013) and used the PROCESS SPSS macro (version 3) provided at www.processmacro.org. Further, this approach uses bootstrapping, which is a statistical method based on random resampling with replacement from the dataset (Shrout & Bolger, 2002; Preacher & Hayes, 2008) that does not require an assumption of normality.

We conducted two separate bootstrapping analyses with 5,000 resamples for each pair of hypotheses, and we included age, gender, and IT-related work experience as control variables. For each analysis, we configured our model based on model 4 in Hayes (2013). The results of the first bootstrapping analysis indicated that evaluability bias had a significant positive influence on the perceived attractiveness of a software product ($\beta = 0.58$; lower-level confidence interval (LLCI) = 0.20, upper-level confidence interval (ULCI) = 0.95), and that the perceived attractiveness of a software product had a significant positive influence on escalation of commitment ($\beta = 0.62$; LLCI = 0.43, ULCI = 0.81). These results provided support for H1a and H1b. In addition, the results of the analysis indicated that the indirect effect of evaluability bias (through perceived attractiveness of a software product) on the escalation of commitment was significant (*ab path effect* = 0.36, LLCI = 0.12, ULCI = 0.62) and that the direct effect of evaluability bias on escalation of commitment was not significant (*c path effect* = 0.26; LLCI = -0.17, ULCI = 0.69), suggesting full mediation.

The results of the second bootstrapping analysis indicated that the fairness effect had a significant positive influence on the perceived attractiveness of a financial reward ($\beta = 0.49$; LLCI = 0.04, ULCI = 0.94), and that the perceived attractiveness of a financial reward had a significant positive influence on escalation of commitment ($\beta = 0.36$; LLCI = 0.19, ULCI = 0.53). These results provided support for H2a and H2b. In addition, the results of the analysis indicated that the indirect effect of the fairness effect (through the perceived attractiveness of a financial reward) on the escalation of commitment was significant (*ab path effect* = 0.18, LLCI = 0.01, ULCI = 0.41) and that the direct effect of the fairness effect on the escalation of commitment was not significant (*c path effect* = 0.40; LLCI = -0.07, ULCI = 0.86), suggesting full mediation.

6.2.4 Discussion

The findings of Experiment 1 provide initial empirical evidence on how evaluability bias concerning software attributes and the fairness effect associated with a personal financial reward can influence the escalation of commitment to software product development. First, we found that participants' escalation decisions are swayed by software attributes that are easier to evaluate. Specifically, participants in the superior reliability / inferior number of modules condition were more willing to continue working on troubled software product development projects than were participants in the inferior reliability / superior number of modules condition. Further, the perceived attractiveness of a software product was found to fully mediate this effect. Second, we found that participants' escalation decisions were influenced by the relative amount of a reward compared to a peer. Specifically, participants showed greater willingness to continue working on troubled projects when their reward was equal to that of a peer than when their reward was smaller than that of a peer (even though the absolute amount of the participant's award was greater in the latter case). Further, we found that perceived attractiveness of a financial reward fully mediated this effect.

After obtaining encouraging results in Experiment 1, we replicated the experiment with South Korean IT professionals. We conducted this additional experiment with IT professionals because, while prior research found that business students can be adequate subjects for business decision-making research (Remus, 1986), there is always the possibility that students may not respond to the stimulus materials in the same way that IT professionals might respond. The primary purpose of the second experiment was to increase generalizability by showing that the results obtained with the student subjects not only held up with experienced professionals but across a different cultural setting as well. The second experiment also has replication value and adds robustness to our findings.

7 Experiment 2

7.1 Participants and Procedure

For Experiment 2, we recruited 133 IT professionals in South Korea through professional contacts; all participants had a minimum of three years' work experience in IT development projects. During recruitment, we explained the purpose of this study in lay terms, without revealing the precise research objectives in order to avoid demand effects. Specifically, we informed participants that we were conducting a scenario-based experiment involving decision-making in new software product development and that they would be asked to play the role of a project co-manager working for a technology and consulting firm. We sent those who volunteered to take part in the experiment an email with a link to the web-based experimental materials, including the scenario and questionnaire. The average age of participants was

38 years old, and the average IT-related work experience was 9.9 years. Of the participants, 111 were male, 20 were female, and 2 did not indicate their gender.

Experiment 2 involved the same 2x2 factorial design used in Experiment 1 in which we manipulated the ratings of two software attributes and the amount of financial reward relative to a project co-manager. We followed an iterative approach, translating the materials used in Experiment 1 into Korean and then back-translating them into English. We did this to ensure that the meaning of the scenario and the questions would be the same for participants in both countries. Two of the authors performed the Korean translation; then, to verify the translation's accuracy, both the original and translated experiment materials were examined by a neutral bilingual researcher who was not involved in this study or aware of its purpose. Two other independent translators back-translated the Korean version into English. Finally, the original and back-translated items were compared and another round of translation and back-translation was conducted, whereupon both translators agreed that the meaning had been preserved in the two versions.

7.2 Results

7.2.1 Manipulation Checks

We conducted a repeated-measures ANOVA and found that participants perceived the reliability rating to be easier to evaluate (M = 3.89, SD = 1.50) than the number of modules (M = 3.28, SD = 1.41) and that this difference was statistically significant ($F(1,131) = 24.92$, $p < 0.01$). We conducted a one-way ANOVA and found that the mean difference between the equal-amount condition (M = 4.83, SD = 1.18) and the unequal-amount condition (M = 3.71, SD = 1.23) was significant and in the expected direction ($F(1,130) = 28.30$, $p < 0.01$). We tested the assumptions required for the repeated-measures ANOVA and the one-way ANOVA, and found that the assumptions were met.

7.2.2 Descriptive Statistics, Correlations, and Reliability

As Table 4 shows, we examined the means, standard deviations, and correlations among study variables. Escalation of commitment had significant correlations with evaluability bias (0.21), fairness effect (0.20), perceived attractiveness of a software product (0.54), and perceived attractiveness of a financial bonus (0.51). Further, all three measured variables exhibited high reliability.

7.2.3 Hypothesis Testing

First, we conducted a factorial ANOVA and found that the participants in the superior reliability / inferior number of modules condition had a greater willingness to continue (M = 5.39, SD = 1.40) than the participants in the inferior reliability / superior number of modules condition (M = 4.71, SD = 1.80) and that this difference was statistically significant ($F(1,128) = 6.50$, $p < 0.05$, $\eta^2_p = .05$). Further, the same analysis also showed that the participants in the equal-amount condition had a greater willingness to continue (M = 5.38, SD = 1.40) than the participants in the unequal-amount condition (M = 4.71, SD = 1.80) and that this difference was statistically significant ($F(1,128) = 6.24$, $p < 0.05$, $\eta^2_p = 0.05$). These results were consistent with those obtained in Experiment 1. No significant interaction effect was found between the two independent variables. Further, we checked and confirmed the three basic assumptions for the ANOVA.

Next, we proceeded to test two pairs of hypotheses (H1a/H1b & H2a/H2b) using the same approach used in Experiment 1 (two separate bootstrapping analyses with 5,000 resamples for each pair of hypotheses). The results of the first bootstrapping analysis indicated that the evaluability bias had a significant positive influence on the perceived attractiveness of a software product ($\beta = 0.53$; LLCI = 0.04, ULCI = 1.01) and that the perceived attractiveness of a software product had a significant positive influence on the escalation of commitment ($\beta = 0.64$; LLCI = 0.47, ULCI = 0.82). These results provided support for H1a and H1b.

Table 4. Descriptive Statistics, Correlations, and Reliability

		1	2	3	4	5	*M*	*SD*	α
1	Evaluability bias⁺	–					0.52	0.5	–
2	Fairness effect⁺	0.03	–				0.52	0.5	–
3	Perceived attractiveness of a software product	0.19*	0.02	–			3.97	1.38	0.94
4	Perceived attractiveness of a financial reward	0.14	0.15	0.49**	–		4.06	1.42	0.92
5	Escalation of commitment	0.21*	0.20*	0.54**	0.51**	–	5.04	1.65	0.90

Notes: N = 133; * $p < 0.05$; ** $p < 0.01$

⁺ Manipulated variables: we coded "inferior reliability / superior functionality" and "an unequal amount reward" as 0, and coded "superior reliability / inferior functionality" and "an equal amount reward" as 1

In addition, the results of the analysis indicated that the indirect effect of the evaluability bias (through the perceived attractiveness of a software product) on the escalation of commitment was significant (*ab path effect* = 0.34, LLCI = 0.03, ULCI = 0.75) and that the direct effect of the evaluability bias on the escalation of commitment was not significant (*c path effect* = 0.37; LLCI = -0.13, ULCI = 0.87), suggesting full mediation.

The results of the second bootstrapping analysis indicated that the fairness effect had a significant positive influence on the perceived attractiveness of a financial reward (β = 0.50; LLCI = 0.01, ULCI = 1.00), and that the perceived attractiveness of a financial reward had a significant positive influence on the escalation of commitment (β = 0.59; LLCI = 0.41, ULCI = 0.77). These results provided support for H2a and H2b. In addition, the results of the analysis indicated that the indirect effect of the fairness effect (through the perceived attractiveness of a financial reward) on the escalation of commitment was significant (*ab path effect* = 0.30, LLCI = 0.01, ULCI = 0.69) and that the direct effect of the fairness effect on the escalation of commitment was not significant (*c path effect* = 0.37; LLCI = -0.14, ULCI = 0.89), suggesting full mediation.

7.2.4 Discussion

The findings of Experiment 2 provide added support for the influences of evaluability bias and the fairness effect on the escalation of commitment to new software product development. The results of Experiment 2, which involved IT professionals in a different cultural setting with significant IT work experience (an average of 9.9 years), were consistent with the findings of Experiment 1, which involved IT students. These findings are particularly valuable as they indicate that Experiment 1's results are generalizable to working IT professionals and hold up across two different cultures. As with IT students in the US, IT professionals in South Korea were more willing to continue working on troubled projects given an attribute (reliability) that was highly rated on a relative scale. They were also more willing to continue working on a troubled project if offered a reward that was equal to a peer, and less willing to continue if their reward was smaller than that of a peer. Further, we found consistent support for our theorized mediating mechanisms underlying these effects.

8 General Discussion

8.1 Theoretical Implications

This study makes two important theoretical contributions. First, it offers novel theoretical explanations based on evaluability bias (Hsee, 1996) and the fairness effect (Bazerman et al., 1995) for why escalation may occur in the context of new software product development, thus adding to the body of knowledge on IS project escalation. To date, prior research has focused on applying well-known theoretical lenses to understanding the escalation of commitment in software and product development settings, such as self-justification (Staw, 1976), loss aversion (Garland, 1990; Staw & Hoang, 1995), and goal proximity (Conlon & Garland, 1993). While these perspectives are useful for understanding escalation decisions, they do not leverage the context of software product development. This study contributes to the IS project escalation literature by leveraging the context of software product development, which can include evaluating software attributes of a software product under development and weighing a personal financial reward tied to a successful product launch. By drawing on evaluability bias and the fairness effect, we were able to leverage the context of software product development in a way that advances knowledge in this area. Further, our study highlights mediating mechanisms underlying evaluability bias and the fairness effect, thus offering a more nuanced understanding of *how* evaluability bias and the fairness effect influence the escalation of commitment to software product development.

Second, our study also contributes to the broader body of literature on the escalation of commitment in several respects. Prior to our study, neither evaluability bias nor the fairness effect had been investigated in escalation research, and probing the effects of these factors represents a contribution to the escalation literature. In addition, while prior research has emphasized retrospective thinking (e.g., fixation on sunk cost) as escalation drivers, our study adds to a small but growing stream of research that focuses on *prospective* thinking in escalation of commitment (Moon, 2001; Wong & Kwong, 2007). Further, while prior research has suggested that the escalation of commitment occurs when there exists some hope of success (Conlon & Garland, 1993), it has not been previously shown what drives people to anticipate positive outcomes in escalation situations despite negative feedback. Our study begins to address this question by offering new insights into how evaluability bias and the fairness effect can influence the perceived *attractiveness* of anticipatory outcomes (in our case, the attractiveness of the software product itself and the financial reward associated with a successful launch).

8.2 Practical Implications

This study has several important practical contributions. First, it underscores that bias can occur when decision makers evaluate multiple attributes of a software product under development. Specifically, in evaluating a software product, managers may consider several attributes of the product, but some attributes may be inherently easier to evaluate than others. When this occurs, managers' evaluation of the product may be more heavily influenced by attributes that are easy to evaluate, while attributes that are difficult to evaluate are not given the attention that they deserve. One potential consequence of such a biased evaluation is continued commitment to a troubled project. One way to overcome this evaluability bias is to obtain the necessary domain knowledge to properly assess difficult to evaluate attributes (Hsee & Zhang, 2010). For example, when dealing with software attributes that are difficult to evaluate, it may be advisable to consult an expert to aid in the assessment process. Another way to overcome evaluability bias is to improve the evaluability of all relevant attributes. This can be done by using a standard scale or baseline for comparison purposes which can improve evaluability (Hsee, 1996). In fact, comparative information is commonly used in various business-decision settings, including hiring decisions (Bazerman et al., 1992) and performance evaluation of employees (Goffin, Jelley, Powell, & Johnston, 2009; Moore & Klein, 2008). Using these approaches can help decision makers to make more informed decisions based on the evaluation of all relevant attributes of a software product as opposed to a biased evaluation that is driven by easy-to-evaluate attributes.

Second, software requirements determine the functionality (i.e., functional requirements) and performance criteria (i.e., nonfunctional requirements) of a software application. In evaluating a software application, a set of attributes that are primarily concerned with the functionality aspect of the application is tested against functional requirements (e.g., a set of modules that have been identified during the requirements determination stage). In contrast, a set of other attributes that are primarily concerned with the performance aspect of the application is tested against non-functional requirements (e.g., reliability, efficiency, portability, etc.). In this study, we chose to investigate one functionality-related attribute (number of modules) and one performance-related attribute (reliability) and theorized that number of modules is inherently more difficult to evaluate than reliability. Evaluating performance-related attributes typically involves technical testing or using mathematical metrics. Hence, performance-related attributes are relatively easy to evaluate. In contrast, evaluating functionality-related attributes often depends on subjective perceptions of decision makers or potential users—for example: How many features is good enough (i.e., number of modules)? How easy it is to use the features (i.e., usability)? and so forth. Thus, functionality-related attributes may be inherently more difficult to evaluate. The results of our study show that decision makers base their escalation decisions largely on easy-to-evaluate attributes, and this finding indicates that decision makers may fail to adequately consider how good or bad a product is in terms of difficult-to-evaluate attributes (e.g., functionality-related attributes). Therefore, one practical implication of our work is that managers should be aware of the potential of evaluability bias to influence decision-making. Further, they should take steps to develop metrics that can aid in assessing difficult-to-evaluate software attributes.

Third, it is well known that people are motivated by financial incentives. One implication of our work is that people respond more acutely to the relative amount of financial incentives assigned to them (in comparison to that of peers) than the absolute amount. While we believe financial incentives can be a useful tool to enhance the motivation of employees, it may not be advisable to publicly disclose the actual amount that will be given to each employee as doing so can trigger the fairness effect and cause undesirable behavioral consequences. For example, project managers may become overly committed to a project when they know their financial incentive is equal or greater than that of their peer, or they may become demotivated when they know their financial incentive is less than that of their peer.

8.3 Limitations and Directions for Future Research

As an initial step toward understanding the role of evaluability bias and the fairness effect in the escalation of commitment to a new software product development project, we conducted two laboratory experiments. While laboratory experiments offer strong internal validity, external validity is often sacrificed to some degree, as experimental settings cannot possibly replicate all of the nuances of actual organizational settings. Despite this shortcoming, our primary objective was to investigate evaluability bias and the fairness effect in escalation decisions, thus a controlled environment was necessary. Further, in the escalation literature, the findings of research based on experimental data have been quite consistent with the findings of research based on field data, including case study data (Keil, 1995), longitudinal data (Staw, Barsade, & Koput, 1995), secondary data (Staw & Hoang, 1995), and survey data (Keil, Mann, & Rai, 2000). Nonetheless, we acknowledge that despite the positive features of laboratory experiments, one direction for future research is to investigate how evaluability bias and the fairness effect manifest themselves in organizational settings involving new software product development.

Another direction for future research is to investigate factors that may reduce evaluability bias. For example, Hsee and Zhang (2010) suggest that prior domain knowledge or experience about a particular object, or attribute enhances evaluability. Most people, for example, can easily evaluate another person's height without comparative information as they have sufficient knowledge about human height and the measurement unit(s) commonly employed in this context. In our experiment, we controlled for individual differences (e.g., domain knowledge) in subjects through random assignment; however, domain knowledge could be an important factor moderating or reducing evaluability bias in the escalation of commitment. Thus, we suggest that further research is warranted to investigate how prior knowledge or experience could be used to reduce evaluability bias in software product development.

In addition, in investigating the effect of evaluability bias associated with software attributes on escalation decisions, our study was limited to two software attributes (reliability and functionality). Clearly, there are other software attributes that are also important in evaluating software products (e.g., cost, ease of use, maintainability, etc.). Thus, one direction for future research would be to extend the findings of this study by exploring other software attributes.

In terms of the fairness effect, we explored just two conditions; one involved equal rewards and the other involved unequal rewards causing the participant to feel disadvantaged. We did this in order to generate feelings of unfairness so that we might see how this affected escalation decisions. This begs the question of what might happen if the participants received $20,000 while their colleague received $15,000 (i.e., a situation in which the rewards are not equal but the participant is not disadvantaged). The literature on fairness has shown that people have a strong desire for fairness and in ultimatum games involving splitting of a payoff with another individual, the average demand by the proposer is to keep less than 70% of the total and share the rest (Bazerman and Moore, 2013). This would suggest that some inequality might be perceived as "fair" from the perspective of the individual who is not disadvantaged by the split. Thus, while the unequal split described above could technically be classified as "unfair" we suspect that subjects would not view it as such because they would not be on the losing end of the inequality. Whether such a split would affect decision-making in an experiment such as ours remains an empirical question that can only be addressed by conducting additional research.

Another direction for extending our work would be to examine the impact of evaluability bias and the fairness effect in group decision-making settings. Group decision-making has the potential to lead to better decision-making outcomes, but this is by no means assured and there are known pitfalls (e.g., groupthink) that can affect the quality of group decision-making. To date, neither evaluability bias nor the fairness effect have been investigated in group decision-making settings and this may represent a promising avenue for future research.

8.4 Conclusion

Despite its importance, the escalation of commitment to new software product development remains relatively unexplored. This is concerning because the escalation of commitment in new software product development settings can result in a significant waste of organizational resources, and can even result in an erosion of competitive position within the market over time. In fast-changing markets such as those for new software products, such escalation can be particularly problematic. The findings of this study suggest that evaluability bias and the fairness effect can cause managers to view a product and a financial reward in a more positive light. By altering the perceived attractiveness of both software product and financial reward, evaluability bias and the fairness effect can result in the escalation of commitment to troubled software product development projects.

Acknowledgments

This work was supported in part by a grant from the Fogelman College of Business & Economics at the University of Memphis. This research support does not imply endorsement of the research results by either the Fogelman College or the University of Memphis.

References

Abdel-Hamid, T., & Madnick, S. E. (1991). *Software project dynamics: An integrated approach*. Englewood Cliffs, NJ: Prentice Hall.

Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Process, 35*(1), 124-149.

Bazerman, M. H., Loewenstein, G. F., & White, S. B. (1992). Reversals of preference in allocation decisions: Judging an alternative versus choosing among alternatives. *Administrative Science Quarterly, 37*(2), 220–240.

Bazerman, M. H. & Moore, D. A. (2013). *Judgment in managerial decision making*. Hoboken, NJ: Wiley.

Bazerman, M. H., Schroth, H., Shah, P. P., Diekmann, K. A., & Tenbrunsel, A. E. (1994). The inconsistent role of comparison others and procedural justice in reactions to hypothetical job descriptions: Implications for job acceptance decisions. *Organizational Behavior and Human Decision Processes, 60*(3), 326-352.

Bazerman, M. H., White, S. B., & Loewenstein, G. F. (1995). Perceptions of fairness in interpersonal and individual choice situations. *Current Directions in Psychological Science*, *4*(2), 39-43.

Biyalogorsky, E., Boulding, W., & Staelin, R. (2006). Stuck in the past: Why managers persist with new product failures. *Journal of Marketing, 70*(2), 108-121.

Boulding, W., Morgan, R., & Staelin, R. (1997). Pulling the plug to stop the new product drain. *Journal of Marketing Research, 34*(1), 164–176.

Brockner, J. (1992). The escalation of commitment to a failing course of action: Toward theoretical progress. *Academy of Management Review, 17*(1), 39-61.

Brooks, F. P. J. (1987). No Silver Bullet: Essence and accidents of software engineering. *IEEE Computer*, *20*(4), 10-19.

Colquitt, J. (2008). Publishing laboratory research in AMJ: A question of when, not if. *Academy of Management Journal, 51*(4), 616-620.

Conlon, D. E., & Garland, H. (1993). The role of project completion information in resource allocation decisions. *Academy of Management Journal, 36*(2), 402-413.

Fichman, R., Keil, M., & Tiwana, A. (2005). Beyond options valuation: "Options Thinking" in IT project management. *California Management Review, 47*(2), 74-96.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Thousand Oaks, CA: SAGE.

Garland, H. (1990). Throwing good money after bad: The effect of sunk costs on the decision to escalate commitment to an ongoing project. *Journal of Applied Psychology, 75*(6), 728-731.

Goffin, R., Jelley, R. B., Powell, D. M., & Johnston, N. G. (2009). Taking advantage of social comparisons in performance appraisal: The relative percentile method. *Human Resource Management, 48*(2), 251-268.

González-Vallejoa, C., & Moran, E. (2001). The evaluability hypothesis revisited: Joint and separate evaluation preference reversal as a function of attribute importance. *Organizational Behavior and Human Decision Processes*, *86*(2), 216-233.

Hayes, A. (2013) Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. New York, NY: Guilford.

Heath, C. (1995). Escalation and deescalation of commitment in response to sunk costs: The role of budgeting in mental accounting. *Organizational Behavior and Human Decision Processes*, *62*(1), 38-54.

Heng, C. S., Tan, B. C. Y., & Wei, K. K. (2003). De-Escalation of commitment in software projects: Who matters? What matters? *Information and Management*, *41*(1), 99-110.

Hsee, C. K. (1996). The evaluability hypothesis: An explanation for preference reversals between joint and separate evaluations of alternatives. *Organizational Behavior and Human Decision Processes, 67*(3), 247-257.

Hsee, C. K., Loewenstein, G. F., Blount, S., & Bazerman, M. H. (1999). Preference reversals between joint and separate evaluations of options: A review and theoretical analysis. *Psychological Bulletin*, *12*(5), 576-590.

Hsee, C. K., & Zhang, J. (2010). General evaluability theory. *Perspectives on Psychological Science, 5*(4), 343-355.

Keil, M. (1995). Pulling the plug: Software project management and the problem of project escalation. *MIS Quarterly*, *19*(4), 421-447.

Keil, M., Depledge, G., & Rai, A. (2007). Escalation: The role of problem recognition and cognitive bias. *Decision Sciences, 38*(3), 391-421.

Keil, M., & Mähring, M. (2010). Is your project turning into a black hole. *California Management Review*, *53*(1), 6-31.

Keil, M., Mann, J., & Rai, A. (2000). Why software projects escalate: An empirical analysis and test of four theoretical models. *MIS Quarterly, 24*(4), 67-87.

Keil, M., Tan, B. C. Y., Wei, K.-K., Saarinen, T., Tuunainen, V., & Wassenaar, A. (2000). A cross-cultural study on escalation of commitment behavior in software projects. *MIS Quarterly, 24*(2), 299-325.

Keil, M., & Tiwana, A. (2005). Beyond cost: the drivers of COTS application value. *IEEE software*, *22*(3), 64-69.

Keil, M., Truex, D. P., & Mixon, R. (1995). The effects of sunk cost and project completion on information technology project escalation. *IEEE Transactions on Engineering Management*, *42*(2), 372-381.

Kozlowski, S. W. J. (2009). Editorial. *Journal of Applied Psychology, 94*(1), 1-4.

Lee, J. S., Keil, M., & Kasi, V. (2012). The effect of an initial budget and schedule goal on software project escalation. *Journal of Management Information Systems*, *29*(1), 51-77.

Lee, J. S., Keil, M., & Wong, K. F. E. (2015). The effect of goal difficulty on escalation of commitment. *Journal of Behavioral Decision Making*, *28*(2), 114-129.

Mähring, M., Keil, M., Mathiassen, L., & Pries-Heje, J. (2008). Making IT project de-escalation happen: An exploration into key roles. *Journal of the Association for Information Systems, 9*(8), 462-496.

Moon, H. (2001). Looking forward and looking back: Integrating completion and sunk-cost effects within an escalation-of-commitment progress decision. *Journal of Applied Psychology, 86*(1), 104-113.

Moore, D. A., & Klein, W. M. P. (2008). Use of absolute and comparative performance feedback in absolute and comparative judgments and decisions. *Organizational Behavior & Human Decision Processes, 107*(1), 60-74.

Newman, M., & Sabherwal, R. (1996). Determinants of commitment to information systems development: A longitudinal investigation. *MIS Quarterly, 20*(1), 23-54.

Pan, G., Pan, S. L., & Flynn, D. (2004). De-escalation of commitment to information systems projects: A process perspective. *Journal of Strategic Information Systems, 13*(3), 247-270.

Pan, G., Pan, S. L., Newman, M., & Flynn, D. (2006). Escalation and de-escalation of commitment to information technology projects: A commitment transformation analysis of an e-government project. *Information Systems Journal, 16*(1), 3-21.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879-891.

Remus, W. (1986). Graduate students as surrogates for managers in experiments on business decision making. *Journal of Business Research, 13*(1), 19-25.

Sabherwal, R., Sein, M. K., & Marakasc, G. M. (2003). Escalating commitment to information system projects: Findings from two simulated experiments. *Information and Management, 40*(8), 781-798.

Sarker, S., & Valacich, J. S. (2010). An alternative to methodological individualism: A non-reductionist approach to studying technology adoption by groups. *MIS Quarterly, 34*(4), 779-808.

Schmidt, J. B., & Calantone, R. J. (2002). Escalation of commitment during new product development. *Journal of the Academy of Marketing Science, 30*(2), 103-118.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7*(4), 422-445.

Sleesman, D. J., Conlon, D. E., McNamara, G., & Miles, J. E. (2012). Cleaning up the big muddy: A meta-analytic review of the determinants of escalation of commitment. *Academy of Management Journal*, 55(3), 541-562.

Staw, B. M. (1976). Knee-deep in the big muddy: A study of escalating commitment to a chosen course of action. *Organizational Behavior and Human Performance, 16*(1), 27-44.

Staw, B. M. (1981). The escalation of commitment to a course of action. *The Academy of Management Review, 6*(4), 577-587.

Staw, B. M., Barsade, S. G., & Koput, K. W. (1995). Escalation at the credit window: A longitudinal study of bank executives' recognition and write-off of problem loans. *Journal of Applied Psychology*, *82*(1), 130-142.

Staw, B. M., & Hoang, H. (1995). Sunk costs in the NBA: Why draft order affects playing time and survival in professional basketball. *Administrative Science Quarterly, 40*(3), 474-494.

Taylor, R. N. (1975). Age and experience as determinants of managerial information processing and decision making performance. *Academy of Management Journal, 18*(1), 74-81.

Tenbrunsel, A. E., & Diekmann, K. A. (2002). Job-decision inconsistencies involving social comparision information: The role of dominating alternatives. *Journal of Applied Psychology, 87*(6), 1149-1158.

Truex, D., Holmström, J., & Keil, M. (2006). Theorizing in information systems research: A reflexive analysis of the adaptation of theory in information systems research. *Journal of the Association for Information Systems, 7*(12), 797-821.

Urban, G. L., Weinberg, B. D., & Hauser, J. R. (1996). Premarket forecasting of really-new products. *Journal of Marketing, 60*(1), 47-60.

Venkatesh, V., Morris, M. G., & Ackerman, P. L. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Processes, 83*(1), 33-60.

Wong, K. F. E. (2005). The role of risk in making decisions under escalation situations. *Applied Psychology: An International Review, 54*(4), 584-607.

Wong, K. F. E., & Kwong, J. Y. Y. (2007). The role of anticipated regret in escalation of commitment. *Journal of Applied Psychology, 92*(2), 545-554.

Appendix A

Instructions: The task that follows is part of a study that examines individual decision-making. This is a role-playing experiment in which you are asked to read a scenario, and work on the decision task as if the scenario were real.

You are a project manager for Comsoft, a technology and consulting firm. Ten months ago, you were named as a project co-manager with your colleague James to lead a project that was expected to deliver a lucrative business intelligence (BI) system, called BI-ware for external sale. Both you and James graduated together from the same school with the same degree and have been with the company for the same number of years. Your project was scheduled to be completed one month ago but the beta testing process took longer than anticipated and as a result, the project fell behind schedule. In the meantime, another firm has just started marketing a business intelligence software package that will compete directly with yours, and which is reported to be a superior product. Further, due to the delays it will take at least another month to complete your project.

Now you are faced with the decision of whether to recommend to your boss, the chief executive officer (CEO), that your project be continued or abandoned. When you took on this project, the CEO offered a financial bonus of $35,000 [$20,000] that would be divided between you and James according to the table below. This bonus, if received, will help you pay for a new car that you have been planning to buy. However, the financial bonus will be awarded only if the BI-ware system becomes successful in the market. Two attributes that will influence whether BI-ware will become successful in the market are the number of modules and the reliability rating (i.e., how bug-free the software is).

Please consult the table below for specific information regarding both the financial bonus and the two BI-ware attributes and then answer the questions that follow.

Financial bonus information		**BI-ware attributes information**	
Project manager A (You)	$15,000 [$10,000]	Number of modules	50 [350]
Project manager B (James)	$20,000 [$10,000]	Reliability rating on a 5-point scale (with 5 being the highest reliability rating possible)	5.0/5.0 [3.0/5.0]

Appendix B

Table B1. Constructs and Measurement Items

Constructs	Measures	Sources
Escalation of commitment	1. I would recommend continuing the project to the CEO. 2. I am inclined to recommend to the CEO that this project be continued.	(Garland, 1990; Moon, 2001; Wong & Kwong, 2007)
Perceived attractiveness of a software product	1. To what extent do you have a positive orientation toward the BI-ware system? 2. To what extent do you have a good feeling about the BI-ware system? 3. To what extent do you consider the BI-ware system to be acceptable for use? 4. Indicate the extent of attractiveness of using the BI-ware system.	(Sarker & Valacich, 2010)
Perceived attractiveness of a financial reward	1. To what extent do you have a positive orientation toward the financial bonus offered? 2. To what extent do you have a good feeling about the financial bonus that was offered? 3. To what extent do you consider the financial bonus to be acceptable? 4. Indicate the extent of attractiveness of the financial bonus.	(Sarker & Valacich, 2010)
Manipulation checks for evaluability	1. How easy is it for you to evaluate how good the BI-ware system is based on the information provided regarding the reliability rating? 2. How easy is it for you to evaluate how good the BI-ware system is based on the information provided regarding the number of modules?	Created for this study
Manipulation checks for fairness	1. I believe that the financial bonus offered by the CEO to me and the co-PM is fair. 2. I believe that the CEO put together an evenhanded financial bonus plan for me and the .	Created for this study

Appendix C

Table C1. Testing Assumptions of ANOVA

Assumptions of ANOVA	For each one-way and factorial ANOVA reported in this study, we checked to see if three basic assumptions were met: (1) normality (i.e., the residuals or errors are normally distributed); (2) independence (i.e., the residuals or errors are not related to each other); and (3) homogeneity of variance (i.e., the variances of the groups are the same). In order to check the normality assumption, we assessed the distribution of Y|X (i.e., the distribution of the residuals) by examining the Q-Q plot of residuals. The Q-Q plot showed clearly the pattern of normal distribution. In order to assess the assumption of independence, we examined a scatterplot of residuals on predicted values of Y. We did not see any evidence suggesting lack of independence. Further, since all subjects were recruited independently and no collaboration was allowed, it is reasonable to assume that the observations in our data were independent from each other. Third, in order to check the assumption of homogeneity of variance, we conducted Levene's test, which tests the null hypothesis that the variances of the groups are the same. Levene's test was not significant, indicating the assumption of homogeneity of variance was met.
	For each repeated-measure ANOVA reported in this study, we checked to see if two basic assumptions were met: (1) normality (i.e., the residuals or errors are normally distributed) and (2) sphericity (i.e., the equality of the variances of the differences between treatment levels). First, in order to check the normality assumption, we assessed the distribution of Y|X (i.e., the distribution of the residuals) by examining the Q-Q plot of residuals. The Q-Q plot of residuals showed clearly the pattern of normal distribution. These results indicated that the normality assumption was met. Second, sphericity is a potential issue only if there are more than two treatment levels (Field, 2013) and our experiment involved only two levels (easy to evaluate and difficult to evaluate). Thus, sphericity was not an issue for our data.

About the Authors

Jong Seok Lee is an assistant professor in the Department of Accounting and Information Management in the Haslam College of Business at the University of Tennessee, Knoxville. Jong holds a PhD in computer information systems from Georgia State University. His research focuses on behavioral and managerial issues in managing Information Technology projects. His work has been published in scholarly journals, including *Information Systems Research, Journal of Management Information Systems, European Journal of Information Systems, and Journal of Behavioral Decision Making*, and presented at international conferences including International Conference on Information Systems and Academy of Management Meetings.

Mark Keil is a Distinguished University Professor at Georgia State University where he is the John B. Zellars Professor of Computer Information Systems in the J. Mack Robinson College of Business. Keil's research focuses on IT project management and decision-making and includes work on preventing IT project escalation, improving IT project status reporting, identifying and managing IT project risks, improving project control, managing IT implementation projects, and overcoming barriers to system use. He has published over 100 peer-reviewed journal articles in top academic and practitioner-oriented publications. Keil currently serves as a senior editor for *MIS Quarterly* and is on the editorial board of the *Journal of Management Information Systems*. He has previously served in a variety of other editorial roles for top journals in his field. He is a past division chair for the Academy of Management (Organizational Communication and Information Systems Division). He holds BSE, SM, and DBA degrees from Princeton University, MIT Sloan School, and Harvard Business School respectively.

Sang Cheol Park is an assistant professor of the Department of Business Administration at Daegu University in Korea. He received his PhD in MIS from Sungkyunkwan University in Korea. His research focuses on the areas of judgment and decision-making in technology usage and IT project management contexts. His papers have been published in *European Journal of Information Systems, Information Systems Journal, Journal of Global Information Management, Journal of Computer Information Systems, Computers in Human Behavior*, among other outlets.