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Attribution Bias and Overconfidence in Escalation of Commitment:
The Role of Desire to Rectify Past Outcomes

BY

Delilah Castillo Tine

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

Executive Doctorate in Business

In the Robinson College of Business

Of

Georgia State University

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ACCEPTANCE

This dissertation was prepared under the direction of the *Delilah Castillo Tine* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Executive Doctorate in Business in the J. Mack Robinson College of Business of Georgia State University.

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ABSTRACT

Attribution Bias and Overconfidence in Escalation of Commitment:
The Role of Desire to Rectify Past Outcomes

BY

Delilah Castillo Tine

May 11, 2013

Committee Chair: *Mark Keil*

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Escalation of commitment is the voluntary continuation of investing resources into what appears to be a failing course of action whose outcome is uncertain. Investigation into the escalation of commitment phenomenon is important to organizations because such behavior could result in grave economic loss. This research investigates two cognitive biases that we posit lead to IT escalation of commitment, namely, attribution bias and overconfidence in an escalation decision, as well as desire to rectify past outcomes (DRPO) for its potential role as a mediator. To test our research model, 160 IT managers participated in a web-based role-playing experiment. Attribution was manipulated at two levels (internal and external), creating two treatment conditions. We posited that the participants assigned to the internal attribution condition would escalate their commitment to the failing IT project to a greater extent than participants assigned to the external attribution condition; that individuals that have a high, versus low, level of overconfidence would have a greater tendency to escalate; and that DRPO would mediate the effects of attribution and overconfidence on escalation of commitment. Attribution bias was significant at the .1 level, but in the opposite direction of what was hypothesized; overconfidence showed a significant main effect on escalation. The effect of attribution bias on escalation was significantly mediated by DRPO, but the effect of overconfidence on escalation was not mediated by DRPO. Implications of these findings for both research and practice are discussed.

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CHAPTER 1: INTRODUCTION

1.1   Research Background

There are many real-life instances in which individuals can be locked into a failing course of action even in the face of opposing evidence suggesting that continuing on the same course will likely lead to failure (Staw, 1976). In the literature, such behavior is commonly referred to as escalation behavior or escalation of commitment (Staw, 1976), entrapment (Brockner, Rubin, & Lang, 1981; Brockner & Rubin, 1985; Rubin & Brockner, 1975), and throwing good money after bad (Staw, 1981). The consequence of such behavior could ultimately result in grave economic loss that can jeopardize, not only an organization's competitive standing, but also lead to its demise. Formally, Keil, Mann, and Rai (2000) propose a working definition for escalation of commitment:

> Escalation can be said to occur within an organization when there is a presence of negative project status information that fails to be processed appropriately, resulting in continuation of what appears to be a failing course of action (p. 634).

This definition reflects three defining characteristics of escalation of commitment, "where losses have been suffered, where there is an opportunity to persist or withdraw, and where the consequences of these actions are uncertain" (Staw, 1997, p. 192). In addition, central to an escalation situation is the negative feedback the decision-maker is made aware of, concerning the unlikelihood of the project's success, prior to a decision being made.

What makes the escalation of commitment phenomenon an interesting topic of study is that "such behavior appears contrary to human logic" (Staw, 1976, p. 27). For instance, one would typically expect that individuals would reverse decisions or change behaviors that produce negative outcomes; however, within the context of investment decisions, "negative consequences

may actually cause decision makers to increase the commitment of resources and undergo the risk of further negative consequences" (Staw, 1976, p. 27).

1.2   Problem Statement and Motivation for Study

Escalation of commitment has been widely examined within management, psychology, and information technology (IT) literature, and continues to be an active area of study. In software projects alone, the problem of escalation seems widespread, as confirmed by industry reports and scholars alike. For example, The Standish Group's 2003 report cited that 43 percent of software projects were over budget and 54 percent had time overruns. Earlier reports (Standish Group, 1994) cite that a 31.1 percent of software projects were canceled prior to completion. Other studies have confirmed even greater percentages of software projects coming in at a loss. For example, some IT projects have had cost overruns of up to 200 percent (Keil & Robey, 1999).

There are several theoretical perspectives regarding the reasons why escalation of commitment occurs (Keil et al., 2000), such as Self Justification Theory (Staw, 1976); Approach Avoidance Theory (Brockner, Shaw, & Rubin, 1979; Rubin & Brockner, 1975); Prospect Theory (Kahneman & Tversky, 1979; Thaler, 1980; Whyte, 1986); and Agency Theory (Harrison & Harrell, 1993). Though criticized by many scholars as an explanation for escalation, Self Justification Theory is the most dominant theoretical perspective (Brockner, 1992) and remains a strong contender as the best explanation for escalation (Brockner, 1992; Keil, 1995).

However, as with most complex phenomena, a single theoretical perspective seldom provides a complete account of why a given phenomenon occurs, and in many cases a single theoretical perspective has generated mixed results. For example, in Whyte's (1986) review of

the escalation of commitment literature, he indicates that a later study conducted by Staw and Ross (1978) failed to reproduce Staw's (1976) finding that personal responsibility for negative consequences tends to lead to escalation of commitment. Keil et al. (2000) provide similar examples of failures to replicate Staw's (1976) findings (e.g., Armstrong et al. 1993; Singer & Singer, 1985). While these studies were not necessarily pure replications of Staw (1976), their findings serve as a reminder that the escalation of commitment phenomenon is "very complex" and thus calls for "more sophisticated models to help explain escalation behavior" (Keil et. al., 2000, p. 656). Consequently, it has been suggested that a better understanding of escalation might be obtained through the application of multiple theoretical approaches (Brockner, 1992).

Within the new product development literature, we are further reminded that though several studies have enhanced our understanding of the escalation of commitment phenomenon, "the mechanism of escalation of commitment remains relatively unknown and under researched" (Schmidt & Calantone, 2002, p. 105). Having a better understanding of what factors contribute to escalation of commitment to a failing course of action is of great importance to academics and practitioners alike. For academics, having a better understanding of the escalation of commitment phenomenon can help the advancement of theory building and model development. For practitioners, a better understanding can help organizations successfully develop and implement processes to help mitigate such costly behavior and free up resources for uses that work and lead to better performance. As succinctly put by Staw and Ross (1978, p. 41),

> Questions such as whether to increase or decrease funding for corporate research
> and development in the face of negligible output, or whether to alter expenditures
> for advertising in the face of slumping sales, all address the same basic issue:
> whether to commit additional resources to a previously chosen course of action.

It is thus very important to understand what determines commitment, and to be able to identify any effects that may bias or systematically affect resource allocation decisions.

1.3   Research Perspective and Focus

Extant literature related to escalation situations cites four types of determinants of escalation behavior (Staw & Ross, 1987): (1) project determinants, such as the substantial costs that may arise for terminating a project prematurely (Northcraft & Wolf, 1984); (2) social determinants, such as not wanting to expose personal error to others (Fox & Staw, 1979); (3) organizational determinants, such as institutional inertia wherein there can be a very loose connection between organizational goals and action (March & Olson, 1976) or failures in internal communication that can make organizations slow to respond even when the need for change is recognized (Staw & Ross, 1989); and (4) psychological determinants, which represent the cognitive biases that may underlie decision-making in escalation situations. The current research focuses on the latter, *psychological determinants* of escalation of commitment.

 "Psychological factors are those that cause managers to become convinced that things do not look so bad after all…" (Keil & Mann, 1997, p. 140). Examples of psychological factors include the sunk-cost effect (Arkes & Blumer, 1985; Garland, 1990), having a prior history of success on similar projects (Keil, 1995), and a high level of personal responsibility for having initiated the course of action (Staw, 1976).

A research path receiving increasing attention is the investigation of individual cognitive biases in processing negative feedback (e.g., Depledge, 2003; Keil, Depledge, and Rai, 2007). When decision makers are presented with negative feedback about a previously chosen course of

action and must decide (Keil et al., 2007) either to continue with the previously chosen course of action or withdraw (Brockner, 1992), biased interpretations of the causes for the negative feedback may blind decision makers from recognizing the error in their previous choices and decisions. The contention is that cognitive biases prevent individuals from fully processing negative feedback, leading to escalation behavior.

Prior research (Keil, et al., 2007) has identified selective perception and illusion of control as two cognitive biases that promote escalation behavior in IT projects. However, minimal empirical efforts have been devoted to the examination of other cognitive biases that can potentially play a similar role in IT project escalation (Depledge, 2003; Keil et al., 2007). While a wide variety of cognitive biases have been identified (e.g., Sage, 1981; Hogarth, 1987) (Kirs, Pflughoeft, & Kroeck, 2001), such biases remain relatively unexplored in the escalation of commitment literature (Keil et al., 2007).

To address this theoretical gap, this study examines the effect of two types of cognitive biases on escalation of commitment: attribution bias (the internal and external factors to which a setback is attributed) and overconfidence. These biases are said to originate from the decision-maker's past experiences, intrinsic beliefs, and the task environment (Kirs et al., 2001), and have not been previously explored within the context of IT project escalation.

Discussed in greater detail in a subsequent section, attribution refers to causal information ascribed to a given setback or success. Attribution bias[1] refers to an individual's tendency to attribute their *successes* to their own efforts, abilities or other dispositions, and to attribute their *failures* to bad luck, inherent difficulty of the task, and or various environmental

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[1]Some scholars also refer to attribution bias as the self-serving bias.

[2] Overconfidence has been divided into three subareas by Moore & Healy (2008), namely, (i) overestimation (judgments of one's absolute performance or ability); (ii) miscalibration or overprecision (confidence in the

factors (Bradley, 1978; Miller & Ross, 1975). Thus, internal or endogenous attributions surface following positive feedback whereas external or exogenous attributions surface following negative feedback. However, as discussed in more detail in a subsequent section, evidence has also been found for a reversal of attribution bias, such as when, counterdefensive attributions are made (Bradley, 1978); which may result in counterdefensive bias. Formally, counterdefensive bias relates to attributing negative consequences internally (Lawson & McKinnon, 1999).

Staw and Ross (1978) provide initial evidence for the notion that individuals process information differently after a setback has been encountered and it is attributed to either internal or external factors. Thus, it is posited that the disparity in processing information may account for differences in decision-making (Staw & Ross, 1978). However, even though Staw and Ross find support for the notion that external attribution promotes escalation of commitment in resource allocation decisions (as predicted by Brehm's (1966) reactance theory), the researchers suggest that one possible focus for future research should include an examination of variables which might reinforce or heighten a self-justification effect, such as visible responsibility for negative consequences wherein adverse events are attributed directly to the individual or where the decision-maker has publicly announced or lobbied for the losing course of action; an empirical gap this research addresses. For instance, in our proposed experimental design, participants will read a scenario describing a troubled IT project. The scenario is designed to manipulate whether the cause of the setback is attributed to internal or external factors. Visible responsibility for the setback, in our case, becomes evident when participants in the internal attribution treatment condition, are explicitly informed that they attribute the causes for the setback to their own lack of skill in managing the project team and insufficient effort spent on the project. Our scenario also informs participants that the organization has publicly announced

the previous course of action; i.e., that the product will be launched in two weeks. Thus, our scenario is designed in a way that captures variables that might reinforce or heighten a self-justification effect.

Overconfidence refers to "the systematic overestimation of the accuracy of one's decisions and to the overestimation of the precision of one's knowledge" (Dittrich, Güth, & Maciejovsky, 2001, p. 2). In short, overconfidence is the tendency to be unjustifiably certain of one's ability to predict accurately (Russo & Schoemaker, 1992). As evidenced by the literature and in practice, overconfidence is a bias common among business decision-makers. For instance, it is posited that overconfident decision-makers are more prone to take bets rather than seek information that will enhance their understanding of a given object, situation, or event. By ignoring negative information, overconfident decision-makers are prone to commit to their prior course of action (Klayman, Soll, Gonzalez-Vallejo, & Barlas, 1999).

Though there are varying opinions on whether overconfidence is induced by situational factors or whether it is a stable individual trait (Griffin & Varey, 1996), the present study characterizes overconfidence as an individual trait that can be measured independently from situational factors (Russo & Schoemaker, 1992).

Attribution bias and overconfidence are thought to lead to escalation of commitment (respectively) when (a) the decision-maker attributes the project's setback to his/her own failings (e.g., lack of ability and or allocating insufficient effort in managing the project) and thus triggers a self-justification mechanism; and (b) when the decision-maker overestimates accuracy and knowledge. We argue that a decision-maker who attributes failure to internal factors will tend to ignore and or fail to fully process negative feedback, thus leading to escalation of commitment. Similarly, a decision-maker who is more overconfident will follow the same

pattern of ignoring or failing to fully process negative feedback, thus, escalating to a greater extent than a decision-maker who is less overconfident.

In addition, since it is reasonable to expect that a decision-maker who attributes failure internally will escalate his or her commitment to a failing project, and in the same manner that a decision-maker who is more overconfident is likely to escalate, in observing such behavior, a reasonable question to ask is: What might be the driving factor or reasons for this? We propose that a desire to correct previous decisions that have produced negative outcomes is a possible explanation. Consequently, a third factor to be investigated in this research is *desire to rectify past outcomes;* which may be thought of as an individual's innate motivation to rectify previous losses s/he is responsible for (Staw, 1976). Thus, this construct was examined for its potential mediating role between the relationship of attribution bias and overconfidence on escalation of commitment.

The context within which this research was developed is that of an IT product development project. This context was chosen primarily because the escalation literature suggests that IT projects seem extremely susceptible to escalation behavior given that they tend to "exhibit certain characteristics which create ambiguity" (Keil and Flatto, 1999, p. 115). Thus, a number of studies suggest that IT projects possess certain characteristics (Zmud, 1980; DeMarco, 1982; Abdel-Hamid, 1988) that may make them particularly prone to escalation (Desai & Chulkov, 2009).

1.4   Research Questions

The current research was designed to address two primary research questions, and in doing so examine the effect of attribution bias and overconfidence on escalation of commitment.

In addition, the research questions reflect an investigation into the potential mediating role of desire to rectify past outcomes on the relationships between attribution and escalation and between overconfidence and escalation. Specifically, the research questions to be investigated are:

RQ1: What effect do attribution bias and overconfidence have on escalation of commitment?

RQ2: Does desire to rectify past outcomes mediate the relationships between attribution bias and escalation and overconfidence and escalation?

We predict that individuals who attribute the causes of a project's setback to internal factors (e.g., lack of effort spent on the project), as opposed to external factors, will be more likely to escalate since these individuals will feel that their self-concept is being threatened. Consequently, instead of paying close attention to the negative feedback provided to them indicating that project is in trouble, these individuals will be more likely to be distracted by the self-justification mechanism that is typically triggered when the individual feels that his/her self concept is threatened; which typically leads to escalation of commitment. On the other hand, individuals who attribute the cause of a project's setback to external factors (e.g., bad luck) will not feel that their self-concept is being threatened and thus will be more likely to pay closer attention to the negative feedback indicating that the project is in trouble. These individuals will likely reevaluate their previous decision and be less likely to escalate than their threatened counterparts.

Similarly, we argue that overconfident individuals are less motivated to renew their commitment to a failing course of action, as these individuals have a difficult time understanding the limitations of their knowledge and thus tend to overlook information (e.g., negative feedback) that might increase their knowledge that will facilitate decision-making.

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1.5   Research Approach

A web-based role-playing experiment was used to investigate the research questions. In an effort to generalize study findings to our population of interest, 160 IT managers participated in the experiment and randomly assigned to one of two experimental treatments. Participants were asked to read a hypothetical scenario describing a troubled IT project (a variation of Keil et al., 2007) for which they are responsible. One treatment explicitly informs participants that internal factors, such as insufficient effort spent on the project and lack of skill in managing the product team, are the primary causes for the project's setback. The second treatment explicitly informs participants that external factors, such as task difficulty and bad luck, are the primary causes for the troubled project. Participants were then asked to answer a questionnaire that measures escalation of commitment, the criterion variable. In doing so, they were asked to decide to either re-evaluate the product (which represents de-escalation) or continue with the product launch as planned (which represents escalation of commitment). This measure of escalation of commitment also required participants to indicate how strong their decision is. In addition, the questionnaire was designed to measure each participant's level of overconfidence. We specifically used the confidence quiz, developed by Russo and Schoemaker (1992), to measure and capture one facet[2] of stable individual overconfidence; i.e., miscalibration, "the tendency to overestimate the precision of one's information" (Biais, Hilton, Mazurier & Pouget, 2005, p. 287). In essence, the quiz provides a measure of individual metaknowledge: "an appreciation of what we do know and what we don't know" (Russo & Schoemaker, 1992, p. 8). Questions were also included to gather basic demographic data and to measure four control

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[2] Overconfidence has been divided into three subareas by Moore & Healy (2008), namely, (i) overestimation (judgments of one's absolute performance or ability); (ii) miscalibration or overprecision (confidence in the precision of one's estimates), which is the focus of this research; and (iii) better-than-average effect or overplacement (appraisal of one's relative skills and virtues) (Merkle & Weber, 2011, p. 263).

variables (i.e., temporariness of setback, self-efficacy, age and gender), which the literature indicates should have a significant effect on escalation of commitment.

The data was analyzed using IBM SPSS-20 software. Specifically, analysis of covariance and MEDIATE (Hayes & Preacher's (2012) macro specifically designed for mediation analysis) were used to analyze the data.

In summary, the current research examined attribution bias and overconfidence to help explain their respective effects on escalation of commitment. In addition, an individual's desire to rectify past outcomes was examined as a potential mediator of the other two factors.

The remainder of this document is structured as follows:

- §2 reviews the literature related to our constructs and the theories used to guide the research;

- §3 describes hypotheses development and the research model;

- §4 describes the research methodology (design, measures, and analysis) and study results; and

- §5 provides the main discussion and conclusions, study contributions and limitations, and direction for future research.

CHAPTER 2: LITERATURE REVIEW

In this chapter, the theoretical perspective and extant literature related to this study's constructs of interest are discussed; i.e., escalation of commitment, attribution bias, overconfidence, and desire to rectify past outcomes.

2.1   Escalation of Commitment to a Failing Course of Action

Recalling from the previous chapter, escalation of commitment occurs when the presence of negative project status information, that isn't processed appropriately, results in the continuation of what appears to be a failing course of action (Keil et al., 2000). Said differently, escalation of commitment is the continued commitment of resources (money, time, and or effort) in the face of negative information (Brockner, 1992). Three defining characteristics are typically present within the context of IT project escalation: losses have been incurred, one may either persist or withdraw from the course of action that produced the losses, and the future outcomes of one's actions are uncertain (Staw, 1997, p. 192). In the context of IT project escalation, negative project status refers to significant performance problems in one or more of the following areas: costs, schedule, functionality, or quality (Keil et al., 2000, p. 634). In this research we focus primarily on quality performance problems.

Though there are a plethora of studies that have examined the escalation of commitment phenomenon within various contexts, three theoretical approaches seem to dominate research on escalation of commitment phenomenon within the context of IT projects (Keil et al., 2000): prospect theory (Kahneman & Tversky, 1979) and the sunk cost effect (often referred to as *throwing good money after bad*), approach avoidance theory (Brockner, Shaw, & Rubin, 1979;

Rubin & Brockner, 1975) and the completion effect, and self-justification theory (Staw, 1976) and personal responsibility.

Prospect Theory and the Sunk Cost Effect

Prospect theory (PT) (Kahneman & Tversky 1979; Tversky & Kahneman, 1981), provides a framework for understanding individual decision making under conditions of risk and uncertainty. PT differs from the expected utility model ("the major theory of decision-making under risk" Tversky & Kahneman, 1981, p. 453) in two ways. Whereas the expected utility model posits that decision-making under risk follows the pattern of weighing the utility of each risky outcome by its probability and choosing the prospect that offers the highest utility, PT proposes that (1) the framing of choice problems causes significant shifts in decision preferences wherein outcomes are framed in either positive (gains) or negative (losses) deviations from a neutral reference point (the response to losses is more extreme than the response to gains); (2) outcomes are therefore, valued and weighted differently in terms of probability wherein impossible outcomes are discarded, low probabilities are over-weighted, moderate and high probabilities are under-weighted, and the latter effect is more pronounced than the former. Taken together, PT suggests that individuals exhibit either risk seeking or risk averse behavior depending on the framing of a given situation or problem. Risk averse behavior is posited to surface when choosing between two positive alternatives. Risk seeking behavior is posited to surface when the individual is required to choose between two negative alternatives, such as choosing between a sure loss (e.g., discontinuing a project for which a significant investment of resources has already been expended) and the possibility of a greater loss (a combination of the

initial investment plus more resources spent) in an effort to return to a reference point. Such

behavior is commonly observed in gambling situations (Kahneman & Tversky, 1979).

Whyte (1986) suggests that PT could help explain the sunk-cost effect, which seems to

occur when the decision-maker adopts a negative frame. Such negative mental framing is

posited to promote risk-seeking behavior commonly observed in escalation situations. In short,

the sunk-cost effect relates to the notion that the more resources (e.g., time, money, and effort)

spent on an investment, the more likely a decision maker will escalate commitment.

Approach Avoidance Theory and the Completion Effect

Approach avoidance theory (AAT) suggests that in an escalation situation there exist two

competing forces. One driving force consists of things that encourage persistence (e.g.,

proximity to the goal and the size of the reward for goal attainment), while the other force

consists of things that encourage abandonment (e.g., the cost of persistence). Thus, escalation

behavior is said to occur under AAT when the force encouraging persistence is greater than the

force encouraging abandonment (Brockner & Rubin, 1985).

Decision-makers in an escalation situation act as if they have "too much invested to quit"

(Teger, 1979). Thus, the desire to continue with a goal as time passes, known as the *completion*

effect, surpasses the desire to minimize cost-benefit ratios. As discussed in Keil et al. (2000), the

completion effect suggests that the "motivation to achieve a goal increases as an individual gets

closer to that goal" (Conlon & Garland 1993, p. 403). Research suggests that the completion

effect is indeed a problem with IT projects. For instance, Keil, Mann, and Rai (2000) found that

in a survey of IT auditors the completion effect classified more than 70 percent of runaway

projects.

Self-Justification and Personal Responsibility

Drawing from psychology literature, Staw (1976) was the first to apply Festinger's (1957) theory of cognitive dissonance to organizational escalation behavior. Festinger suggests that cognitive dissonance is the foundation that motivates behavior, which is posited to be caused by the individual's desire to strive toward consistency of beliefs, discard contradictory occurrences of such beliefs, and thus avoid or discount any information that will increase dissonance. In Staw's (1976) seminal work and widely cited *Knee Deep in the Big Muddy,* he was the first to introduce self-justification theory (SJT) as a potential explanation for escalation of commitment. The central premise of SJT is that the more decision makers are responsible for a previously chosen course of action that results in negative consequences, the more likely they are to increase the commitment of resources (e.g., time, effort, and or money) and undergo the risk of further negative consequences despite receiving negative information about the initial decision (Staw, 1976). As Staw (1976) explains, such biasing is said to occur because the individual seeks to psychologically defend him/herself against unfavorable consequences and or rationalize his/her previous behavior (Aronson, 1968, 1972; Festinger, 1957). To test SJT assumptions on escalation of commitment, Staw (1976) invited 240 business school students to participate in a role-playing exercise that simulated a business investment decision to a particular product division. Personal responsibility and decision consequences were manipulated as independent variables. Results indicated that when individuals are personally responsible for negative consequences they are more likely, than individuals not personally responsible for negative consequences, to commit the greatest amount of resources to a previously chosen course of action (Staw, 1976, p. 24).

Since Staw's initial work (1976), researchers have continued to expand on self-justification processes and psychological determinants as an explanation for escalation of commitment by introducing the effect of other variables such as time, where a decrease in commitment has been observed over time (e.g., McCain, 1986; Staw & Fox, 1977), the desire to externally justify actions to others apparently more so than to oneself (Fox & Staw, 1979), and the need to appear rational (Bazerman, Beckun, & Schoorman, 1982). In addition, Caldwell and O'Reilly (1982) found support for the notion that individuals use selective information in a conscious effort to manage or interpret signals of failure.

In summary, self-justification processes are posited to be the underlying causes for escalation behavior (Staw, 1980), and serve as the foundation for psychological explanations, for escalation of commitment including the effect of cognitive biases.

Keil et al. (2000) inform us that in the face of negative feedback, managers are aware of negative information, but choose to ignore it due to certain cognitive biases that can promote escalation. Though a few studies (e.g., Depledge, 2003; Keil et al., 2007) have examined the effect of cognitive biases on escalation of commitment, this research focus still remains relatively unexplored in the literature. To this point Keil et al. (2007, p. 411) state: "…future research may profitably address the effects of other biases." Specifically, researchers have called for the examination of overconfidence, in addition to other cognitive biases, and ask if such biases lead to escalation of commitment (Depledge, 2003; Keil et al., 2007).

Cognitive Bias and Decision-Making

Social cognition refers to "cognitive processes and structures (e.g., self-conceptions, standards, goals) through which individuals assign personal meaning to events, plan courses of

action, and regulate their motivation, emotion, and interpersonal behavior" (Cervone, 1991, p. 372). As part of the cognition process, individuals seek to make sense of their own behavior as well as others. In doing so, justifications are often necessary to achieve the desired perception (James & Mazerolle, 2002).

Managerial decision-making is one instance during which such processes of cognitions play a major role. During decision-making, the decision-maker is typically faced with information that will facilitate the decision-process. Thus, the decision-maker must process the information cognitively (frame and analyze). To illustrate framing, some people view working hard on a demanding task as "being overloaded and stressed", whereas others may frame it as "intrinsically motivated and job involved" (James & Mazerolle, 2002, p. 35). Mental framing serves as input into the process of mental analysis, which entails drawing inferences about the probability of, for example, failing or succeeding at a project. However, within this process of framing and analyzing, Hogarth (1987) informs us that decision-making is always subject to cognitive bias. Cognitive bias is an error in human judgment, which can be caused by social attribution, memory, and statistical error (Shefrin, 2007).

Since little research has been conducted on the effect of cognitive biases on escalation of commitment, this research provided us with the opportunity to add to this limited body of research. Two cognitive biases which have been examined within the context of IT project escalation are selective perception and illusion of control Keil et al. (2007); both of which were found to be positively related to IT project escalation. Thus, in this research we explore other cognitive biases that might play a similar role in IT project escalation. While researchers (e.g., Sage, 1981; Hogarth, 1987) have identified over 20 different cognitive biases, this study focuses on attribution bias and overconfidence. These biases were chosen as a research focus for this

study because they appear to be among the more likely biases to play a role in escalation decisions as discussed by fellow researchers (e.g., see Staw & Ross, 1978; Keil et al., 2007).

2.2   Attribution Bias

Individuals regularly make attributions regarding the cause(s) for their own and others' behaviors. However, in doing so attributions are not always accurately aligned with reality since individuals rarely operate as objective perceivers. Instead, individuals are prone to perceptual errors that lead to biased interpretations of the world they live in (Funder, 1987; Nisbett & Ross, 1980).

The origins of decision-making based on the presence of internal versus external factors attributed to a given setback, can be traced back to attribution theory. Originally developed within the field of social psychology, **"**attribution theory (Jones & Davis, 1965; Jones, Kanouse, Kelley, Nisbett, Valins, & Weiner, 1972; Kelley, 1973) deals with the explanation of effects via the identification of their causes" (Kruglanski, 1975, p. 387). In other words, attribution theory provides an account of how people make causal inferences and how this information affects decision-making (Kelley, 1973). Attribution theory primarily deals with questions of social perception (e.g., If a person fails on a test, does s/he have low ability, or is the test difficult?), and such questions concern the causes of observed behavior (Kelley, 1973).

Within the context of escalation situations, attribution refers to causal information ascribed to a given setback (or success). Causal information is typically categorized as internal versus external (Kelley, 1967) or as endogenous versus exogenous (Kruglanski, 1975). The difference from one categorization to the other mainly depends on the stage of the inference process. The inference process consists of two stages. During the first stage the attributor

identifies the cause (internal versus external) of a given effect (e.g., setback), and the second stage entails the causal explanation (endogenous versus exogenous) or conclusions drawn about the effect once its cause is known (Kruglanski, 1975). For instance, the known cause for a setback in an IT project could relate to factors such as costs, schedule, functionality, or quality (Keil et al., 2000). This research is primarily concerned with the latter classification; i.e., quality issues being attributed to the setback in question and the biases that can arise from such attributions.

Attribution bias refers to the tendency of individuals to attribute their *successes* to their own efforts, abilities or other dispositions (internal factors), and to attribute their *failures* to bad luck, inherent difficulty of the task, and or various environmental factors (external factors) (Bradley, 1978; Miller & Ross, 1975). In short, attribution bias is said to occur when individuals attribute success internally and failure externally (Duval & Silvia, 2002). With attribution bias, the analysis of negative performance feedback is typically driven by external locus of causality (though not always, as discussed shortly) because such causal processing is characterized by low controllability and low temporal stability (Weiner, 1986).

Though attribution research clearly demonstrates that internal success attributions are consistently found (e.g., Miller & Ross, 1975), research has also shown that this effect is not consistent for failures (Duval & Silvia (2002). Specifically, studies have shown that individuals also attribute failure to internal causes (e.g., Ames, 1975; Ross, Bierbrauer, & Polly, 1974; Weary et al., 1982). For instance, in a study examining the effect of self-awareness and possibility of improvement, it was observed that under certain conditions (i.e., when probability for future improvement and self-awareness are perceived to be high), people attribute failure internally (Duval & Silvia, 2002).

Bradley (1978) provides a similar assessment as Duval & Silvia by claiming that under certain conditions people attribute setbacks internally, thus displaying, what is referred to as, counterdefensive attributions. For instance, in the case of public-esteem needs individuals may believe that they are best served by accepting responsibility for negative outcomes; e.g., to appear to be modest or humble (e.g., Wortman, Costanzo, & Witt, 1973). The conditions when this might be the case, Bradley explains, is if the individual "is explicitly told that his performance is the major object of study and if his too positive self-presentation could be invalidated by his own subsequent behavior or by others' present/future assessments of his performance" (p. 66). In this case, with such visibility of the individual's ability or lack there of, the individual is inclined to take personal responsibility for negative outcomes and thus attribute the causes for failure internally. Thus, one could then argue that with a reversal of attribution bias, the analysis of negative performance feedback would be driven by internal locus of causality.

Since it is possible that the cause of poor performance can be the result of internal factors or the result of external factors, one could then ask, *when does an attribution become biased, as both factors (internal and external) constitute a plausible explanation for negative (or positive) performance?* James & Mazerolle (2002) explain that during the attribution process a purely rational model would take into consideration both perspectives, internal and external factors, as plausible explanations for performance. Conversely, biased attributions would favor only one factor (internal or external) as a plausible explanation for performance. A natural follow-up question to the one just examined, would be to ask, *what factors induce attributional biases?*

The attribution literature informs us that several factors, such as gender and certain individual traits (e.g., self-esteem), have shown to produce different attributions. For example,

females tend to attribute their success to luck rather than to ability, and to rate their ability lower more so than males (Bar-Tal, 1978); following failure, individuals with low self-esteem tend to make more internal attributions (Marsh, 1986); and high need achievers attribute their success to internal factors such as ability and effort, whereas low need achievers attribute their failure to lack of ability and success to luck or an easy task (Scapinello, 1988).

Expanding on Scapinello's point, James & Mazerolle (2002) explain that some individuals (e.g., achievement motivated individuals[3]) possess an unconscious tendency "to assume that internal causes are more important than external causes when they make attributions about the causes of performance" (p. 36), regardless of the performance resulting from success or failure. Thus, these individuals are unconsciously biased toward finding that internal factors, such as commitment and effort, are the primary causes of performance. Individuals who attribute success and failure internally tend to frame obstacles as an opportunity to improve and achieve. They tend to think that (a) through training, practice, and experience they can develop the skills to successfully accomplish a demanding task (Dweck & Leggett, 1988); and (b) that successfully accomplishing a demanding task is not only possible, but also controllable through their efforts. This type of framing and analysis in individuals who attribute internally is what gives rise to a self-justification mechanism that promotes persistence on difficult tasks (James & Mazerolle, 2002).

Conversely, some individuals (e.g., individuals who have a strong need to avoid failure) have an unconscious tendency to believe that the primary cause of success or failure on a task is the result of external factors that are beyond their control. Individuals who attribute success and failure externally tend to avoid situations for which the possibility of success is uncertain, as this

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[3] Achievement motivated individuals are those whose motive to achieve overshadows the motive to avoid failure (James & Rentsch, 2004).

creates a high degree of debilitating anxiety for them, which they tend to avoid. Thus, they prefer a strategy of avoidance or withdrawal on tasks that seem too demanding or likely to fail (James & Mazerolle, 2002). In summary, individual differences are likely to produce different attributional biases. Thus, one would expect that such differences would also affect individual decision-making.

In examining some of the antecedents of attribution bias, the literature informs us that decision-makers tend to be more biased in their attributions when they experience high social anxiety and when they are highly responsible for the performance of outcomes. In addition, it is said to occur more often following negative, as opposed to positive, feedback related to the performance of prior decisions (Arkin, Appelman, & Burger, 1980; Brockner, 1979). Put together, it is this type of biasing that leads individuals into making poor decisions, as it prevents them from fully processing and appreciating feedback regarding their performance, and instead it motivates them to defend themselves or self-enhance. Thus, it is a concept closely related to self-esteem. By embarking in the process of self-enhancing or defending self-esteem, biased decision-makers may perceive a negative situation quite differently from reality. Consequently, a high motivation to defend the self against predetermined standards may result in a biased vision of the future so that the decision-maker is more inclined, than those not in need of defending themselves (as would be the case with setbacks being exogenously explained), to seek a self-defending mechanism to their prior course of action (Duval and Silvia, 2002; Scapinello, 1988).

Research examining the effect of attribution on resource allocation and commitment decisions provides insight into IT escalation situations. For instance, Staw & Ross (1978) conducted an experimental simulation in which subjects played the role of a decision maker in

the World Bank and were asked to allocate resources to one of several regions. Their level of

commitment was measured following a financial setback. The factors examined and

experimentally manipulated were: prior success or failure experience and exogenous or

endogenous causal information pertaining to the setback. It was noted in the study however, that

the endogenous-exogenous manipulation consisted of two subfactors: the foreseeability and

persistence of the cause of the setback. These subfactors were always varied together as part of

each manipulation condition so as to achieve a setback either high in foreseeability and

persistence or low in foreseeability and persistence. The exogenous setback was always low in

foreseeability and low in persistence whereas the endogenous setback was always high in both

foreseeability and persistence.

The exogenous factor was represented by a large amount of rain in the region in question.

Examples of endogenous factors were government corruption and high level of illiteracy within

the region where an allocation decision had to be made. The interaction between a prior failure

and a setback attributed to an exogenous factor (i.e., excessive rainfall in the chosen region),

resulted in the greatest amount of resources committed than did the experimental treatment a

prior failure and a setback attributed to endogenous factors (i.e., corruption in the area and

population not responsive to work incentives). Though, in accordance with self-justification

theory, one would expect that being directly responsible for the initial decision of funding the

project would lead to escalation of commitment in the face of negative feedback, the literature

doesn't provide an account for what will happen when individuals are manipulated into believing

that internal versus external factors are the cause for a setback from a self-justification process

(Staw, 1978); a research gap this study addresses.

Typically, in studies examining the effect of attribution bias, participants are asked to

perform some task, manipulated into believing that they performed poorly (or successfully) on the task, and then asked to attribute the causes for the adverse (or positive) outcome. As previously mentioned, the present study takes a different approach by experimentally manipulating subjects into either believing that the cause for a project's setback is due to internal or external factors. We propos that a self-justification mechanism will be triggered when a setback is said to have been caused by internal factors, and thus prompt more escalation, whereas less escalation will occur when a setback is said to have been caused by external factors, as a self-justifying mechanism shouldn't be triggered.

In summary, causal attributions (internal versus external) assigned to setbacks may engender biases that affect decision-making that may lead to escalation of commitment. Thus, if a decision-maker attributes a project's setback internally, this may trigger a self-justification mechanism that can lead to escalation.

2.3   Overconfidence

Overconfidence refers to the tendency to be unjustifiably certain of one's ability to predict accurately. But before further discussion about overconfidence, which typically implies that it always leads to negative consequences, it's important to note, as proposed by Chira, Adams, & Thornton (2008), that overconfidence doesn't necessarily have to be viewed as a negative trait, but rather a positive trait that can lead to survival both in the short and long run. However, the negativity of the bias surfaces in situations when individuals can't appreciate their limitations and therefore, make faulty decisions based on erroneous beliefs.

Overconfidence informs us of individual metaknowledge which "concerns a higher level of expertise: understanding the nature, scope, and limits of our basic or *primary knowledge*"

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(Russo & Schoemaker, 1992, p. 8). As discussed in Russo & Schoemaker, the importance of the metaknowledge versus primary knowledge distinction can be appreciated when, for instance, a person knows *when* to see a doctor or a lawyer (metaknowledge) as opposed to *how much* one knows about law and medicine (primary knowledge). The implication of metaknowledge on business decision-making is based on the notion that individuals draw from metaknowledge when they conclude that they have enough information to make a decision in the present moment. However, if in reality we make a decision when we're not ready, it could lead to costly mistakes (Russo & Schoemaker, 1992).

In general, overconfidence occurs when a decision makers' beliefs about the quality of his/her performance exceeds actual performance (Stone, 1994). Closely related to other constructs such as self-efficacy (Stone, 1994; Whyte, Saks, & Hook, 1997) and overoptimism (Weinstein, 1980), in the present study we operationalize overconfidence as individual miscalibration that is observed when people are asked for a range that is assumed to contain a true value with a certain probability (e.g., 90 percent), but instead they choose extremely narrow confidence intervals (Alpert and Raiffa, 1982; Russo & Schoemaker, 1992). For instance, an example of miscalibration is found in Biais et al. (2005) wherein the behavior of 245 participants were observed in an experimental financial market under asymmetric information. Empirical results suggest that miscalibrated traders had a reduction in trading performance in comparison to calibrated traders.

According to Pallier et al. (2002), there are two prominent theoretical models used to explain the overconfidence and underconfidence phenomenon, namely, the heuristics and biases approach (see, e.g., Kahneman, Slovic, & Tversky, 1982) and the ecological approach (see, e.g.,

Gigerenzer, 1991). In the current research we subscribe to the heuristics and biases model of overconfidence (e.g., Kahneman, Slovic, & Tversky, 1982).

Although the notion of overconfidence has been challenged in previous literature, suggesting, among other factors, that its cause can be attributed to research methodology and experimental design, and that it can be explained by rational information processing, such as Bayesian updating, rather than biased self-evaluations (e.g., Benoît & Dubra, 2009), Merkle and Weber (2011) find empirical support suggesting that overconfidence is indeed "the consequence of a psychological bias" (p. 262). Thus, it is acknowledged that overconfidence is considered among the behavioral biases most readily accepted by economic and finance researchers (Merkle & Weber, 2011).

Overconfidence has been examined within various contexts and has been related to excessive trading volume (Barber & Odean, 2000; Glaser & Weber, 2007; and Odean, 1998), to the emergence of stock market bubbles (Scheinkman & Xiong, 2003; Shiller, 2002), to corporate investment decisions (Gervais, Heaton, & Odean, 2003; Malmendier & Tate, 2005), and to the predictability of market returns (Daniel, Hirshleifer, & Subrahmanyam, 1998). Other areas of research include venture formation and entrepreneurship, which suggests that because new entrepreneurs tend to seek out more information before committing to decisions, than do experienced ones, they exhibit less overconfidence (Cooper, Folta, & Woo, 1995).

Investigation into the factors that explain overconfidence, such as greater information volume, expertise, and gender, are among the factors examined in the literature. For instance, most noted in investment decision-making, security analysts have access to large volumes of information on some industries and companies; particularly companies which are actively trading (Schwenk, 1986). However, as discussed in Schwenk, in a series of studies conducted by

Dreman (1979), significant evidence was found for the claim that when security analyst had

additional information on highly visible stocks, that the additional information did not result in

greater predictive performance related to the stock. In other words, security analysts' forecast

accuracy performance decreased when the analyst had more information about the stock. Thus,

Dreman concluded that an increase in information volume only increased the investor and

advisor's overconfidence in their own ability to predict a company's stock performance at the

expense of decreasing accuracy prediction. Similarly, in their investigation on whether or not

venture capitalists (VC) are overconfident and how such overconfidence affects decision-

making, Zacharakis and Shepherd (2001) also found that as more information becomes available,

people tend to believe they will make a better and more informed decision. However, it was

found that the availability of more information lead to a decrease in VC decision accuracy

(Zacharakis & Shepherd, 2001).

Moreover, experts rather than novices tend to be more overconfident (Griffin & Tversky,

1992; Koehler, Brenner, & Griffin, 2002). And although results are mixed, in general, males, in

comparison to females, tend to be more overconfident (Barber & Odean, 2001; Lichtenstein &

Fischhoff, 1981; Pallier, 2003; Soll & Klayman, 2004).

Research on the relationship between overconfidence and decision-making informs us

that decision makers with higher levels of overconfidence tend not to recognize inaccurate

perception of risk during the decision-making process (Simon & Houghton, 2003; Simon

Houghton, & Aquino, 2000), and may have more trouble in recognizing their irrational way of

information processing and the need to attain more knowledge prior to decision-making (Merkle

& Weber, 2011).

Decision makers with higher levels of overconfidence tend to be less concessionary in the decisions that they make, which can consequently lead to their commitment to a prior course of action (Neale & Bazerman, 1985). This notion is supported in the management literature, which suggests that people high in overconfidence may have a greater challenge in revisiting their prior decision when the competitive environment changes (Moore & Cain, 2007).

Typically, in studies examining overconfidence, participants are asked to provide an estimated lower and upper limit confidence interval to ten questions such that participants are 90 percent certain that the correct answer for each question will fall within the limits provided. By calculating the participant's accuracy rate and comparing it with 90 percent, we obtain their metaknowledge score (Russo & Schoemaker, 1992). Calibrated individuals should, for example, be accurate on 90 percent of the judgments to which they give confidence judgments of 90 percent. Research shows that overconfidence is a common phenomenon. For example, in a series of laboratory studies people were asked to provide confidence intervals around numerical judgments (e.g., "I am 95 percent certain that there are between 500 and 700 pennies in the jar"). The results indicated that it was not unusual "for the actual number of pennies to fall outside the 95 percent boundaries for 50 percent of all subjects" (Bazerman & Neale, 1983, p. 38).

While initial research has theorized a relationship between overconfidence and escalation (e.g., Banff & Ni, 2006), said relationship has not been empirically tested; a research gap the current study addresses.

In summary, overconfidence, is a cognitive bias that affects the tendency to escalate commitment when decision makers overestimate the level of accuracy of their judgments on their ability to yield positive results (Schwenk, 1986).

2.4   Desire to Rectify Past Outcomes (DRPO)

Self-justification theory informs us that after the individual is faced with negative consequences, which have resulted from the individual's own failings, the individual embarks on a process of self-justification to protect his/her ego or self-esteem (Staw & Ross, 1978). In other words, by escalating their commitment to a previously chosen course of action, the decision-maker can prove that their initial decision, for example, to launch a product within a given time frame, is the correct decision. Self-justification theory also states that individuals might increase their commitment in order to protect themselves from psychological distress due to perceived failure.

According to Staw (1978), "the major theoretical contribution of a self-justification mechanism is that it posits a form of retrospective as opposed to prospective rationality." In other words, the individual is more likely to focus upon those events that facilitate the correction or reduction of the magnitude of a previous error rather than focusing prospectively "on new and alternative ways to increase outcomes" (Staw, 1981, p. 44). To clarify, the "new and alternative way" assumed by prospective rationality, would have nothing or little to do with the previous action (e.g., precious decisions made about the project in question) that resulted in a loss, whereas retrospective rationality would entail correcting a past mistake by continuing commitment to a failing course of action. To this point, Staw (1981) proposes that commitment decisions are at least in part determined by a desire to correct or rectify past outcomes.

Formally, desire to rectify past outcomes refers to an individual's innate motivation to correct previous losses s/he is responsible for. The origin of this construct lies in self-justification theory assumptions about decision-makers' desire to psychologically defend themselves against (a) previous decisions that have resulted in negative consequences or (b) to

rationalize previous behavior (Staw, 1976). In other words, an explicit assumption of the self-justification process is that, given negative outcomes from past decisions, individuals become motivated to rectify erroneous judgments by becoming more committed to a previous decision (Staw, 1981). However, this assumption has not been directly tested in the escalation of commitment literature, and thus in this study we propose to address this gap in the literature by operationalizing this assumed desire and refer to it, in Staw's language, as *desire to rectify past outcomes* (hereafter, DRPO).

In summary, DRPO is posited to serve as the mechanism that underlies the relationship between this study's predictor variables and criterion variable. Thus, we posit that DRPO will play a mediating role in the proposed escalation model discussed in the next chapter.

CHAPTER 3: RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

To help answer this study's research questions, in this chapter we discuss the development of the proposed research model and the hypotheses to be tested. As a reminder, the focus of this research is to investigate the following research questions:

RQ1: What effect do attribution bias and overconfidence have on escalation of commitment?

RQ2: Does desire to rectify past outcomes mediate the relationships between attribution bias and escalation and overconfidence and escalation?

The research model (Figure 1) represents four testable hypotheses for this study's escalation of commitment framework, which includes four constructs: *attribution* (predictor variable), *overconfidence* (predictor variable), *desire to rectify past outcomes* (mediating variable), and *escalation of commitment* (criterion variable). The figure also depicts a list of variables that past literature has suggested leads to escalation of commitment, namely: self-efficacy, temporariness of the setback, gender, and age (control variables).

Figure 1: The Research Model
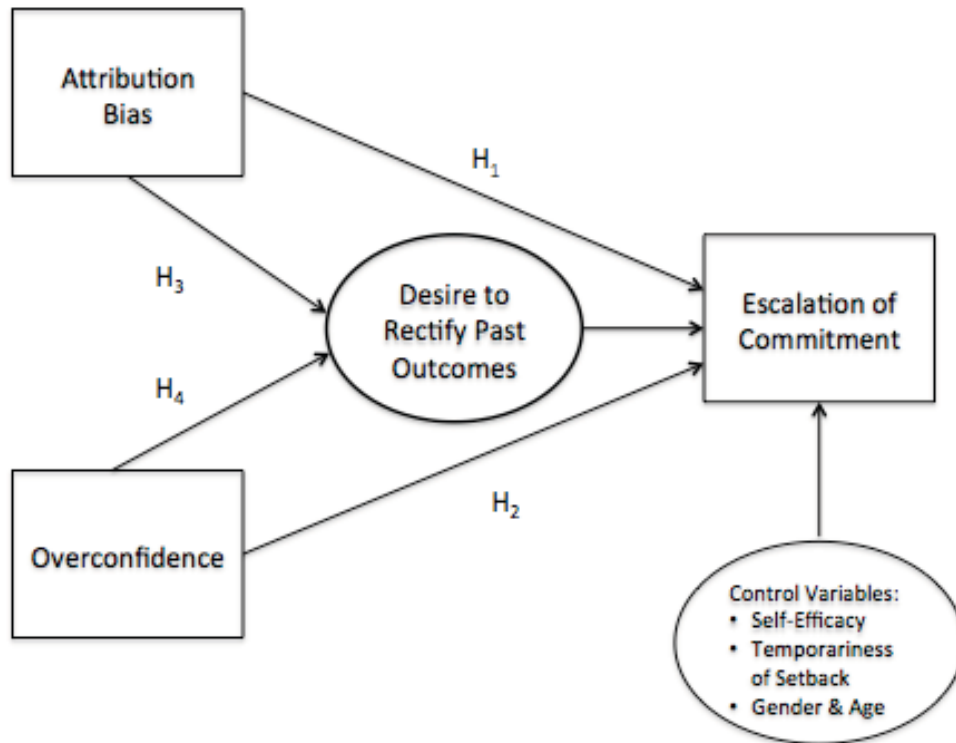
The hypothesized relationships between each predictor variable, mediating variable and the criterion variable are discussed in turn. But first, the contention of how biases can lead to escalation of commitment within the context of IT projects is based on the following argument. One of the primary goals of an IT project manager is to ensure the successful completion of the project while also staying within schedule and budget constraints without sacrificing any of the other goals of the assignment, such as beating competitors to market. As a result, IT managers may become convinced that a buggy product should be launched anyway so as not to lose a first mover advantage and to stay within the prescribed budget and schedule. If IT managers are susceptible to cognitive biases that can impair their reasoning and judgment, this could lead them to attach a higher probability of product success than is realistic, and thus lead them to escalation of commitment.

3.1 Attribution Bias and Escalation of Commitment

Recalling from the previous chapter, there are biases that can arise during the decision-making process depending on the attributions individuals assign to the causes of a setback. For instance, while attribution bias (i.e., the tendency of individuals to attribute their *successes* to internal factors, and to attribute their *failures* to external factors) may arise as a result of negative consequences, it is also known that the reverse, i.e., counterdefensive bias, may also result when attributing failures internally.

According to self-justification assumptions (Staw & Ross, 1978), when individuals are provided with attributional causes for a setback, and such causes are attributed to internal factors, individuals will be motivated to self-enhance or self-protect. For instance, in a launch as planned or re-evaluate decision, of a software product that has been met with a setback (e.g., recently discovered bugs in the software), in which failure may result if the product is launched as planned without correcting the bugs, if the decision maker attributes the bugs to internal causes (e.g., lack of skill in managing the product team and insufficient effort spent on the project), s/he may choose to ignore the feedback and escalate commitment in an effort to self-enhance or self-protect. The underlying mechanism that triggers this effect is based on the notion that when negative results are attributed to internal factors, it leads individuals to engage in retrospective rationality, which can lead to "costly cycles of escalation" (Staw, 1978, p. 44). One mechanism, by which individuals can self-protect from previous decisions that have resulted in negative consequences, is to frame obstacles as an opportunity to improve and achieve goals. In this situation, the individual tends to think that through his/her efforts s/he can successfully accomplish a demanding task (Dweck & Leggett, 1988). Engaging in this form of self-justification is what promotes persistence in challenging tasks (James & Mazerolle, 2002).

On the other hand, if decision-makers attribute the cause of a setback to external factors (e.g. bad luck and inherent difficulty of the project itself), they have little motivation to self-protect, as they were not directly responsible for the setback in question (e.g., the setback could be perceived as being due to factors outside of their control). Thus, their self-image is less likely to be threatened and thus, a self-justification mechanism would not be triggered. This being the case, individuals are less likely to engage in retrospective thinking and more likely to engage in prospective rationality or to think about how to improve in the future. A starting point for prospective rationality might be to become cognizant of the negative feedback provided and thus, decide to re-evaluate the product prior to launching instead of launching it as planned. Thus, the following hypothesis is proposed:

H1: Individuals who attribute the causes of a project's setback to internal factors will be more likely to escalate their commitment than individuals who attribute the causes of the setback to external factors.

3.2   Overconfidence and Escalation of Commitment

Overconfidence could lead to escalation of commitment by various means, such as through the process of probability assessment, lack of risk perception, inaccurate information processing, and misjudgment of knowledge on the part of the decision-maker.

The level of confidence with which a decision-maker evaluates the likelihood of a particular product launch being successful in the marketplace addresses the issue of probability assessment during the decision-making process. For instance, a decision-maker may attach a probability rate of 80 percent that the product launch will be a success. However, as demonstrated in the literature, "people generally tend to be overconfident in judging their

chances of success" (Bazerman & Neale, 1983, p. 38). As such, faced with negative feedback indicating the unlikely success of a product launch, overconfident decision-makers may ignore the feedback since they attached a greater probability of success for the product launch than is realistic. Thus, they will escalate their commitment to their prior decision and launch as planned.

Also, since overconfident decision-makers have difficulty recognizing risk during the decision-making process (Simon & Houghton, 2003; Simon Houghton, & Aquino, 2000), it is likely that an overconfident IT manager who, for example, is trying to decide whether to launch or re-evaluate a troubled product, may have difficulty recognizing the risk of ruining the company's reputation or losing market share by launching a "buggy" product.

Decision makers with higher levels of overconfidence tend to be less flexible or willing to change a previous point of view in the decisions that they make (Neale & Bazerman, 1985). The reason for this is that overconfident individuals tend to gloss over or inaccurately process information that for example, points to a setback in their previous decisions. They may also fail to recognize that a problem exist due to their inability of recognizing their weakness in lack of knowledge. For instance, IT managers may be well equipped and knowledgeable about developing software, however, when a setback is made known, overconfident managers may choose to ignore the new information (e.g., negative feedback about the product's quality) and launch the product as planned because they are unaware that they lack knowledge about, for example, the marketing process and the repercussions of launching a faulty product into the marketplace. This overestimation of their knowledge can have serious consequences for the outcome of decisions. If decision makers had more accurately assessed their level of knowledge so that it reflects a calibrated individual (an individual that is not overconfident), they might have behaved quite differently in terms of remaining committed to their initial decision and

information gathering in order to make a well informed decision that will lead to the successful launch of their product. In short, overconfidence should decrease decision makers' willingness to concede as it prompts them to misjudge the amount of knowledge necessary to de-escalate (or re-evaluate their initial decision).

Given the previous discussion, the following hypothesis is proposed:

H2: Individuals who are more overconfident will escalate their commitment to a greater extent than individuals who are less overconfident.

3.3   The Mediating Role of Desire to Rectify Past Outcomes

Up to this point we've argued that internal attribution and high overconfidence will have a main effect on escalation of commitment. In this section, we argue for the potential mediating role of DRPO on the relationships between attribution bias and escalation and between overconfidence and escalation.

Since it is reasonable to expect that when a project setback is attributed to a decision-maker's own failings s/he will tend to escalate, and similarly that a highly overconfident decision-maker will also tend to escalate; in observing such behavior, a reasonable question to ask is: What might be the driving factor or reasons for this? We propose that a desire to correct previous decisions that have produced negative outcomes (i.e., desire to rectify past outcomes or DRPO) is a possible explanation. The reason for this posited effect is based on self-justification theory assumptions.

According to Staw (1976), an individual may desire to demonstrate rationality to him/herself or restore a sense of consistency between the negative consequences of his actions and or self-concept of rational decision-making (Aronson, 1968). This line of reasoning is not

new, as it has been demonstrated by other lines of research, such as theories of consistency (see Abelson, Aronson, McGuire, Newcomb, Rosenberg, & Tannebaum, 1968), cognitive dissonance (e.g., Festinger, 1957), and the innate desire that individuals have to be correct (Whyte, 1959).

This desire to *make things right* or to be correct, can also be an attempt to prove one's competency to others, for example, "that a costly error was really the correct decision over a longer term perspective" (Staw, 1976, p. 42). This latter form of self-justification, according to Staw, would be more important in an organizational setting where a decision-maker's status in relation to his/her peers is uncertain. Nonetheless, both forms of self-justification can be viewed as face-saving events (Goffman, 1959) or having a desire for social approval (Crowne & Marlow, 1964).

Given the past discussion, it seems reasonable to expect that attribution bias and overconfidence leads to escalation via the mediating path of DRPO. For instance, in the case of an escalation situation, when failure has been attributed internally, individuals are motivated to protect their self-concept, particularly when there is a chance for recouping losses in the long-term. One mechanism by which previous losses or negative outcomes can be rectified is by escalating commitment to a previous course of action, as this would provide the decision-maker with the opportunity to regain and or protect his/her self-image. In the mind of the decision-maker, launching the product on time would provide the opportunity to generate revenue from product sales more quickly, than delaying the launch, and consequently proving that he/she made the correct decision in the first place.

Similarly, people that are overconfident would also be motivated to correct past errors in the face of negative consequences resulting from their decisions. One possible explanation for this tendency is that overconfident people have a strong desire to attain higher social status

(Anderson, Brion, Moore, & Kennedy, 2012) and boost their ego. Thus, in the face of negative

feedback overconfident individuals, who tend to believe that they are competent, will be

motivated to rectify past outcomes to justify their competence, which in turn will boost their ego.

One mechanism by which this desired state of competence could be attained is by escalating

their commitment to their previous decision. Given the previous discussion, the following

hypotheses are proposed:

H3:   Desire to rectify past outcomes will mediate the effect of attribution on escalation.

H4:   Desire to rectify past outcomes will mediate the effect of overconfidence on escalation.

The four hypotheses to be tested are summarized in Table 1: Summary of Hypotheses.

Hypothesis	Description
H1	Individuals who attribute the causes of a project's setback to internal factors will be more likely to escalate their commitment than individuals who attribute the causes of the setback to external factors.
H2	Individuals who are more overconfident will escalate their commitment to a greater extent than individuals who are less overconfident.
H3	Desire to rectify past outcomes will mediate the effect of attribution on escalation.
H4	Desire to rectify past outcomes will mediate the effect of overconfidence on escalation.

Table 1: Summary of Hypotheses

<center>**CHAPTER 4: METHODOLOGY AND RESULTS**</center>

This chapter describes the research setting, subjects, research design, data collection and instrument, operationalization of variables, the data analysis strategy, and study results.

4.1   Research Approach: Setting and Participants

To answer our research questions and test the hypotheses developed in the previous chapter, 160 IT managers were recruited to participate in a web-based role-playing experiment. The minimum target number of subjects (N= 68) was selected *a priori* using the following input parameters: 2 predictor variables, medium effect size, 0.80 power, and 0.05 probability level (online calculator: http://www.danielsoper.com/statcalc3/calc.aspx?id=1). There were a total of 160 participants, 100 men, 59 women, and one participant not reporting their gender or age. The mean age of participants was 47.84, with a median of 48, minimum of 25, and maximum age of 74 (standard deviation = 11.3).

An experimental design was chosen as the most fitting to answer our research questions, for four main reasons. First, extant literature provides a means to determine an appropriate choice for the use of a given methodology. Examples of relevant studies using an experimental design to examine psychological factors and escalation of commitment include: Depledge, 2003; Keil et al., 2007; Biyalogorsky et al., 2006; Staw & Ross, 1978; Staw, 1976 – to name only a few. Second, from a practical point of view, it would be very difficult to examine the effect of attribution and cognitive biases on decision-making using a case study; which would call for actual decision-making. Third, an experimental design allows us to establish internal validity, which is critical when testing theories (Keil et al., 2007). It also allows for a high degree of control over extraneous variables and measurement accuracy, so that causal relationships can be

established within the research model (DeSanctis, 1989). Lastly, a major strength of experimental research lies in its ease of replicability, thus, allowing researchers to replicate the study with another subject group to further validate the experimental results.

4.2   Experimental Design and Procedure

Data collection took place December 2012 through March 2013. Data collection was facilitated by the market research company eSearch.com. The primary role of eSearch.com was to identify a qualified sample of IT Managers with the following selection criteria: a survey response time of at least eight minutes[4] and passing the manipulation check. Each participant was invited via email communication to participate in the study on a voluntary basis. The email invitation described the study's purpose, consent information, and a link to the web-based scenario and survey instrument. SurveyMonkey™, an online survey company, hosted the survey.

Upon arrival to the website, participants were randomly assigned to one of two experimental treatment groups. 80 participants were assigned to the internal attribution experimental treatment and another 80 participants were assigned to the external attribution experimental treatment. After reading the study's instructions they were asked to read one of two hypothetical business scenarios (a modified version of the Keil et al. (2007) describing a troubled software development project for which they are responsible. The content of each scenario was designed to experimentally manipulate the attribution factor being investigated. In other words, attribution bias was not measured, but rather, study participants were assigned to

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[4] The eight-minute response time criterion was selected because pilot test results indicated that this cutoff represented the best measure to ensure quality of data. In other words, more often than not, participants that took less than eight minutes to complete the survey appeared to have rushed through the questions and by doing so not pay full attention to the questions being asked, as indicated by their responses; e.g., answering all 4s (neutral) on a seven point scale, on a major portion of the questionnaire.

either an internal attribution or external attribution treatment condition. In addition, since the overconfidence factor is treated as an individual trait, it was measured using Russo & Schoemaker's (1992) confidence quiz. Using a median split, subjects were classified as exhibiting either high or low overconfidence.

After reading the business scenario, each participant was asked to decide either to re-evaluate the product (which represents de-escalation) or continue with the product launch as planned (which represents escalation of commitment). This measure of escalation of commitment also required participants to indicate how strong their decision is. In addition, the questionnaire was designed to measure each participant's level of overconfidence, capture demographic information and measure control variables: self-efficacy, temporariness of setback, age, and gender. The two experimental treatment scenarios and the complete questionnaire are available in Appendix A and B (respectively).

4.3   Measures

In the current study we developed new measures in addition to using already tested and validated measures based on the literature. However, when necessary existing measures were modified to accommodate the study.

4.3.1   Control Variables

Personal responsibility and degree of project completion are factors that have been shown to have a positive effect on escalation of commitment. Thus, these factors are controlled for through the design of our scenario. Specifically, all study participants regardless of experimental treatment, will read a scenario in which they are explicitly told that they are personally

responsible for the project in question. Further, all participants are informed that the project is

complete at the time a decision (which accounts for any potential completion effect), about

whether or not to continue with the product launch, is required.

In addition, through questionnaire measurement items, we also controlled for: self-

efficacy, temporariness of setback, age, and gender. These factors are discussed in turn.

Self-Efficacy

Self-efficacy "refers to beliefs in one's capabilities to mobilize the motivation, cognitive

resources, and courses of action needed to meet situational demands" (Wood & Bandura, 1989, p

408). Prior research has shown strong support for the positive relationship between self-efficacy

and escalation of commitment. For instance, in a laboratory study where business students

responded to decision dilemmas, Whyte et al. (1997) examined self-efficacy judgments as a

potentially important individual factor that could result in escalation. As predicted by self-

efficacy theory, the results indicate that self-percepts of high efficacy exacerbated the

commitment of funds to a failing course of action whereas low efficacy diminished the effect.

To measure self-efficacy we used Schwarzer and Jerusalem (1995) previously validated,

ten-item scale.

Temporariness of Setback

Temporariness of setback refers to the perceived likelihood that the setback in question

(e.g., lack of skill, ability, bad luck, task difficulty, as described by each experimental treatment

condition) would persist over time. This construct was added as a result of post pilot test

interviews with study participants. During the escalation decision of the pilot test, a couple of

the participants disclosed that they vacillated between whether or not to escalate their commitment as they pondered the temporariness of the setback. Consequently, we decided to measure temporariness of setback to control for this possible confound on the criterion variable, escalation of commitment. Thus, a two item-scale was developed using a 7-point scale (1= strongly disagree, 7= strongly agree:

- I believe that the bugs that were identified are likely to persist over a long period of time (reverse coded).

- I believe that the setback experienced on this project is temporary and easily overcome.

Demographic Information

Previous research has shown there are risk-taking differences resulting from age and gender (Slovic, 1966; Vroom & Pahl, 1971). Since escalation of commitment has been viewed as risk-taking behavior (Brockner, 1992; Whyte, 1986; Wong, 2005), our analysis will control for the age and gender of study participants.

4.3.2 Independent Variables

Two factors, i.e., attribution bias and overconfidence are examined for their potential effect on the criterion variable, i.e., escalation of commitment. Attribution bias (external versus internal) is a manipulated variable via scenario design (a modification of Keil et al., 2007). Overconfidence is measured by obtaining the individuals metaknowledge score. This procedure is facilitated by Russo & Schoemaker's (1992) confidence quiz wherein participants are asked to provide an estimated lower and upper limit confidence interval to ten questions such that participants are 90 percent certain that the correct answer for each question will fall within the

limits provided. By calculating the participant's accuracy rate and comparing it with 90 percent, we obtain their metaknowledge score. Using a median split, subjects are classified as exhibiting either high or low overconfidence. Negative numbers that may result from this calculation, represent an individual that is under-confident.

4.3.3   *Mediating Variable – Desire to Rectify Past Outcomes*

Since desire to rectify past outcomes has not been operationalized in the literature, two new scale items were developed. Specifically, participants are asked on a 7-point scale (1= strongly disagree, 7= strongly agree):

- I feel that it is important for me to try and correct the bugs given how they came about.

- I believe that correcting the bugs is the right thing to do, given the circumstances surrounding their cause.

4.3.4   *The Dependent Variable - Escalation of Commitment*

Typically, escalation of commitment is measured with items that ask survey participants the likelihood that they will continue investing resources into the project in question. In the case of a product development launch, the context within which our scenario was designed, participants are typically asked to what extent are they likely to recommend continuing with the product launch (Biyalogorsky et al., 2006; Keil et al., 2007; Depledge, 2003).

In the current research, the dependent variable, escalation of commitment, is measured with one scale item. The one item is adopted directly from Keil et al. (2007); which asks respondents to indicate, on a 8-point scale (1= Re-evaluate: Definitely, 8= Continue as planned: Definitely), their decision regarding the product launch. Specifically they are asked:

- Please indicate what you will recommend, and how strong that recommendation will be.

  A higher rating or score, on the 8-point scale, would indicate a greater degree of escalation of commitment.

4.3.5   Manipulation Check

To ensure that participants were successfully manipulated by the two experimental treatments (internal versus external attribution), depending on the treatment condition, we assessed whether participants answered the manipulation check question (modified from Scapinello, 1988 and Libby & Rennekamp, 2011) correctly, relevant to the assigned experimental treatment. On a 7-point scale, anchored by *strongly disagree* (1) and *strongly agree* (7), participants were asked:

- I think the bugs discovered result from <u>internal causes</u> such as my own lack of skill in managing the product team and insufficient effort spent on the project. [Internal Attribution Experimental Treatment]

- I think the bugs discovered result from <u>external causes</u> such as bad luck and the difficulty of the project itself. (Reversed coded) [External Attribution Experimental Treatment]

Two additional questions were used to ensure participants were manipulated by their respective treatment. The two questions (modified from Staw and Ross, 1978) were designed to measure a subject's perceived level of personal responsibility for the setback, as implied by the scenario:

- I feel personally responsible for the bugs that were identified in this project.

- I believe that I should be held responsible for the setback that occurred in this project.

Table 2: Summary of Measurement Instrument provides a summary of the measurement

instrument and questionnaire outline.

Question(s)	Measurement		Comments/Source
	Objective	**Style**	
1	Escalation Decision	8-point Likert	Previously validated scale (Keil et al., 2007)
2	Escalation Decision	Freeform narration	Supplementary explanation of most important factor influencing escalation decision (Depledge, 2003)
3-4	Attribution (Manipulation check)	7-point Likert	Modified scale (Scapinello, 1988) and Libby & Rennekamp, 2011)
5-6	Personal Responsibility for Setback (Manipulation check)	7-point Likert	Modified scale (Staw & Ross, 1978)
7-8	Temporariness of Setback	7-point Likert	New scale
9-10	Desire to Rectify Past Outcomes	7-point Likert	New scale
11-20	Self-Efficacy	7-point Likert	Previously validated scale (Schwarzer & Jerusalem, 1995)
21-30	Overconfidence	Confidence quiz	Previously validated (Libby & Rennekamp, 2011)
31-35	Demographics	Selection from predefined list	

Table 2: Summary of the Measurement Instrument and Questionnaire Outline

4.4   Data Analysis

The data was analyzed using IBM SPSS Statistic 20 software. The unit of analysis is the

individual decision-maker, as we are examining the individual's decision to either re-evaluate the

product prior to deciding to launch or to launch as planned.

4.4.1   Data Exploration

In accordance with Field (2013), the first step was to examine the data for normality and possible outliers. Given that our data constitutes a large sample size, greater than 100 cases, the Central Limit Theorem[5] serves as a good indication that our data is normally distributed (Field, 2013). Since our predictor variable overconfidence was measured and not manipulated, and is subject to outliers if a very small number of participants answer a large number of questions correctly, to test for outliers a boxplot analysis was conducted on the variable that feeds into establishing overconfidence level, i.e., the total number of correct answers on the confidence quiz (CQ); which is identified in the data-set as "total correct". The median correct on the CQ was two. According to the boxplot and descriptives of this analysis (see Figure 2: Total Correct Boxplot Showing Extreme Cases), a total of six cases were identified as "extreme cases"; which constituted cases wherein the variable *total correct* was >= 7. Five cases had a total correct equal to 7 and one case had a total correct of 8. These six cases were omitted from further analysis, which resulted in a total sample size of N= 154. Of the 154 participants, 79 remained in the external attribution condition while 75 remained in the internal attribution condition.

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[5] The Central Limit Theorem specifies that there are a number of situations in which we can assume normality regardless of the shape of our data. One such situation is when the sample size exceeds 100 cases (Field, 2013).

Figure 2: Total Correct Boxplot Showing Extreme Cases
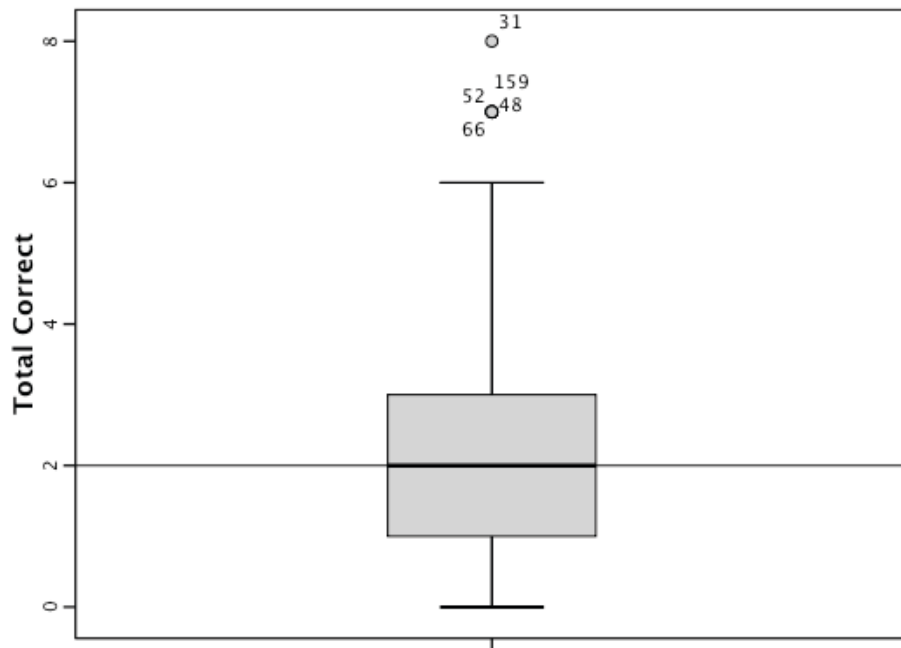
Not all extreme cases are shown on the gragh, as they lie on the same position as another case. These ommited cases are denoted however, by a bold and shaded circle on the gragh. The solid line running across the middle of the boxplot indicates the median total correct for the entire sample.

The mean score for the manipulation check question (which measured the extent to which a participant felt that the setback encountered in the failing project was due to internal causes) of the participants who read the internal attribution scenario was M= 5.60, whereas the mean score for the participants who read the external attribution scenario was M= 2.22. A one-way ANOVA showed that the means are significantly different (F= 1025.39, p= .000) indicating that the scenarios manipulated the participants as intended. A second measure, personal responsibility for the setback, was also used to assess the effectiveness of the manipulation. Similarly, the mean scores for this measure showed that participants assigned to the their respective scenario (internal: M= 5.44 and external: M= 4.37, respectively) were manipulated as intended. A one-way ANOVA showed that the means were significantly different (F= 23.70, p= .000).

4.5   Evaluation of the Constructs

There are three constructs obtained from the literature and used in this research, i.e., Self-Efficacy, Desire to Rectify Past Outcomes, and Temporariness of Setback. These factors, which together comprised 14 items, were evaluated together in one principal components factor analysis with orthogonal rotation (Varimax). The Keiser-Meyer-Olkin measure verified the sampling adequacy, KMO = .828 ('meritorious' according to Hutcheson & Sofroniou, 1999), and all KMO values for individual items were greater than or equal to the acceptable minimum value of .5 (Field, 2013). As can be seen in Table 4: Factor Analysis with All Constructs (after rotation) in Appendix C: Construct Evaluation, the constructs DRPO and Temporariness of Setback loaded as intended. The measures for these two constructs loaded separately from each other showing good discrimination. The measures for the Self-Efficacy (se) construct however, loaded on two factors, as discussed in more detail below. Each construct's factor analysis and scale reliability analysis (Cronbach's α) are discussed in turn. As a reference point, a Cronbach's α greater than .7, denotes that the scale being measured is reliable (Nunnally, 1978).

4.5.1   Self-Efficacy

The construct of self-efficacy is a previously validated scale (Schwarzer & Jerusalem, 1995) comprised of 10 reflective items. The measures are shown in Appendix B: Questionnaire (items 11 to 20). The factor analysis is shown in Table 5: Self-Efficacy Factor Analysis – Appendix C: Construct Evaluation. As previously mentioned, since not all ten items loaded onto one factor, we decided to specify how many factors we wanted to extract (i.e., 1) and ran the analysis again. When this was done, all ten items loaded into one factor with a Cronbach's α .886. However, measure se2 loaded below the acceptable threshold (i.e., .372) and *Cronbach's*

Alpha if Item Deleted indicated an alpha of .905, which is well above the overall α of .886; suggesting that the item should be considered for deletion. Thus, a decision was made to remove the se2 measure from further analysis. Table 6: Self-Efficacy Factor Analysis2, shows the remaining self-efficacy measures load onto one factor with a Cronbach's α of .905.

4.5.2   *Desire to Rectify Past Outcomes (DRPO)*

As previously stated, the DRPO construct is a newly developed construct based on self-justification theory assumptions. It is intended to be composed of two reflective measures. The measures are shown in Appendix B: Questionnaire (items 9 and 10). The factor analysis is shown in Table 6: DRPO Factor Analysis in Appendix C: Construct Evaluation. The two measures load onto one factor with a Cronbach's α of .827.

4.5.3   *Temporariness of Setback*

The Temporariness of Setback is a newly developed construct composed of two reflective measures. The measures are shown in Appendix B: Questionnaire (items 7 and 8). The first item is depicted as ts1_r, indicating that this measure is reverse-coded. The factor analysis is shown is Table 8: Temporariness of Setback Factor Analysis in Appendix C: Construct Evaluation. The two measures load onto one factor with a Cronbach's α = .496. Since the reliability for this scale is well below the acceptable threshold, it was decided to delete one of the measures (i.e., ts1_r) from further analysis, as we felt that the remaining item (ts2) more accurately reflects the construct we are trying to measure.

After remediation, Table 9: Factor Analysis with all Constructs (2) in Appendix C: Construct Evaluation, shows the final loadings of the items that remain and the explained variance for the same.

4.6   Evaluation of the Model

The data were imported into IBM SPSS version 20. There were two major components to data analysis: analysis of covariance (ANCOVA) and mediation analysis. ANCOVA allowed us to examine the main effect hypotheses (H1 and H2), and to test for a possible interaction effect between the attribution and overconfidence factors. Mediation analysis was facilitated by the MEDIATE macro (Hayes & Preacher, 2012), which allows us to examine the hypothesized mediation effects of the DRPO construct. This approach to mediation analysis was selected because it allows the testing of mediation models that include multiple predictors and uses a bootstrapping approach to estimate indirect effects. Mediation is tested, by assessing the values within the confidence interval. If the confidence interval contains zero, then we cannot conclude that mediation has occurred. If the confidence interval doesn't contain zero, then we can conclude that mediation has occurred (Field, 2013, p. 419). Both models were calculated at a 90% confidence interval.

In an attempt to reduce within-group error variance we analyzed the data using ANCOVA (Analysis of Covariance). This technique allows for the inclusion of covariates we believe may explain some of the variance error. But before proceeding with this technique, we must ensure that the effect of a given covariate is independent from the experimental treatment. The reason this assumption must be met prior to conducting the ANCOVA is because when experimental treatments differ on a given covariate, incorporating the covariate into the analysis

will not control for or balance out the difference, instead it biases our interpretation of the results

(Field, 2013). A simple ANOVA was used to test this assumption. The results of the ANOVA

on our two-predictor variables (attribution and overconfidence level) showed that the effect of

our four covariates (self-efficacy, temporariness of setback, age, and gender), are independent

from each combination of our experimental treatments. Thus, we proceeded to run the

ANCOVA.

4.6.1 ANCOVA Results

The ANCOVA was designed to examine the main effects of attribution (internal versus

external) and overconfidence (high versus low) on escalation decision (while controlling for

temporariness of setback, self-efficacy, gender, and age) and to test for a possible interaction

effect. For the criterion variable, escalation of commitment, Table 3 shows the resulting number

of subjects (N) for each cell, the corresponding mean score, and standard deviation (in

parenthesis).

	High Overconfidence	Low Overconfidence
Internal Attribution	N = 44 M = 5.39 (2.07)	N = 27 M = 4.07 (2.27)
External Attribution	N = 45 M = 5.71 (2.03)	N = 32 M = 5.09 (2.36)

Table 3: Descriptive Statistics

There was a significant main effect of attribution on escalation decision at the .1 level, F

$(1, 140) = 2.543$, $p = .056$. However, the observed relationship was in the opposite direction as

hypothesized. There was a significant main effect of overconfidence level on escalation, $F_{(1,140)} = 7.27$, $p = .004$ in the hypothesized direction. There was no significant interaction effect between attribution and overconfidence level on escalation decision, $F_{(1,140)} = 1.005$, *ns*. The covariates, temporariness of setback and gender were not found to be significant, $F_{(1,140)} = 1.51$, $p = .222$, and $F_{(1,140)} = .571$, $p = .451$ (respectively). The covariate, self-efficacy, had a significant effect on escalation decision at the .1 level, $F_{(1,140)} = 2.83$, $p = .095$. The covariate, age, was significantly related to escalation decision, $F_{(1,140)} = 6.51$, $p = .012$. These effects are depicted in Figure 3: ANCOVA Results.

Figure 3: ANCOVA Results

Covariates appearing in the model are evaluated at the following values: ts2 = 5.54, Self-efficacy Avg = 5.894, Gender = 1.64, Age_c = 47.97
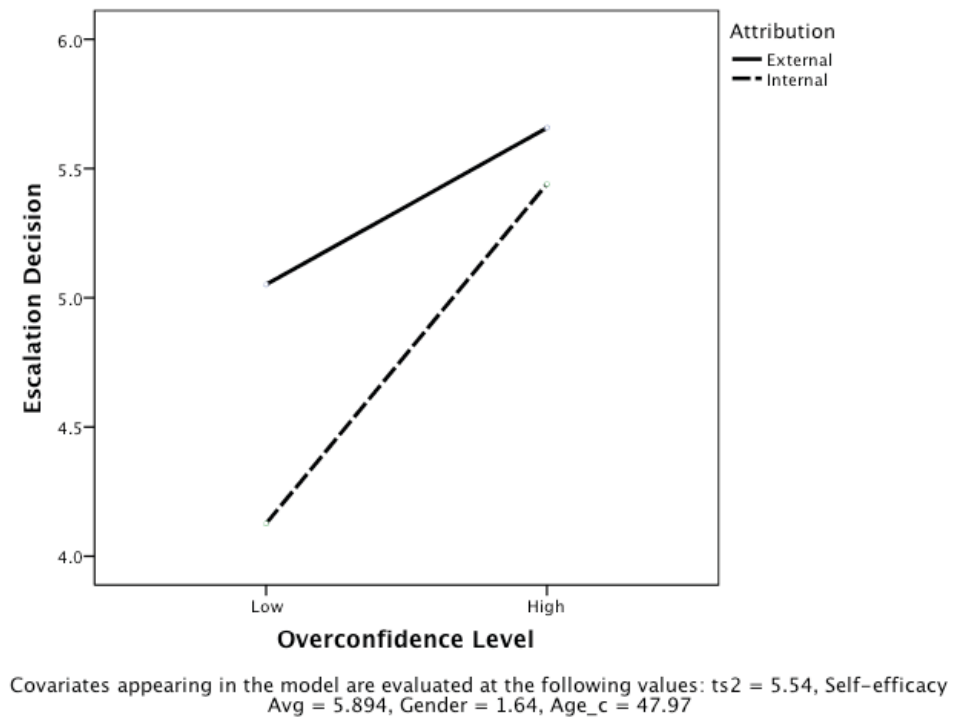
The overall explanatory power of the model is represented by the R^2 value. The overall explanatory power of the ANCOVA indicates that the adjusted $R^2 = .10$, indicating that the

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model accounts for approximately 10% of the variance in escalation decision. The relative effect

of attribution and overconfidence level is assessed using the f^2 effect size. This measure tells us

how much a predictor variable has affected the dependent variable. Cohen (1988) provides the

following guideline to interpret the values of f^2: 0.02, 0.15, and 0.35 are termed *small*, *medium*,

and *large*, respectively. In our model, both predictor variables have a small effect size wherein

$f^2 = .02$ for attribution and $f^2 = .03$ for overconfidence.

4.6.2   Mediation Analysis Results

Mediation analysis was performed to examine whether DRPO mediates the effects of

attribution and overconfidence on escalation. Again, the CI of the indirect effect determines the

significance of the mediation effect. Thus, if the confidence interval doesn't contain zero, then

we can conclude that mediation has occurred (Field, 2013, p. 419). There was a significant

indirect effect of attribution on escalation through DRPO, $b = -.1101$, BCa CI (Bias-Corrected

and Accelerated (BCa) Confidence Intervals (CIs) $[-.271, -.014]$. Note that the confidence

interval for the indirect effect is a BCa boostrapped CI based on 1000 samples. To assess

whether DRPO partially or fully mediates the relationship between attribution and escalation

decision, Baron & Kenny (1986) provide the following guideline. Complete mediation between

X and Y is supported if the effect of X, when controlling for M is zero or not significant. Partial

mediation occurs when the effect of X is merely reduced, but not eliminated (Barry & Kenny,

1986). Thus, we can compare the p-value for the regression results when the mediator variable

DRPO is not included in the model versus when it is. In our model, the results indicate that

when DRPO is not included in the model, attribution is significant at the .1 level ($p = .07$).

However, when DRPO is included in the model, attribution is no longer significant ($p = .135$);

indicating that DRPO fully mediates the effect between attribution and escalation decision.

There was no significant indirect effect of overconfidence level on escalation decision through

DRPO, b = .031, BCa CI [−.089, .173]. Figure 4: Mediation Model, illustrates attribution as a

predictor of escalation decision mediated by DRPO, whereas overconfidence is not mediated by

DRPO.

Figure 4: Mediation Model
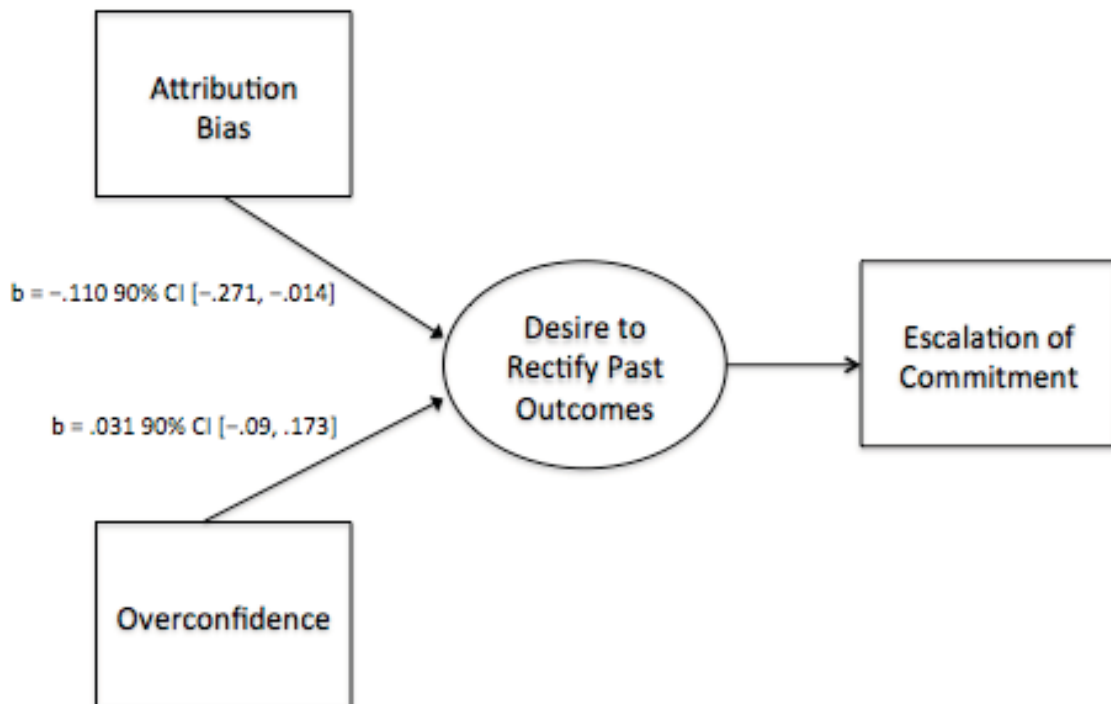
4.7 Evaluation of the Hypotheses

The first hypothesis stated:

H₁: Individuals who attribute the causes of a project's setback to internal factors will

be more likely to escalate their commitment than individuals who attribute the

causes of the setback to external factors.

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This hypothesis was not supported. What is interesting is that the results indicate the opposite effect, wherein attributing the causes of a setback to external causes, tends to lead to escalation of commitment to a greater extent than attributing a setback internally. This reversed effect however, was significant at the .1 level.

The second hypothesis stated:

H_2:   Individuals who are more overconfident will escalate their commitment to a greater extent than individuals who are less overconfident.

This hypothesis was supported, indicating that individuals who exhibit a high level of overconfidence have a greater tendency to escalate their commitment to a failing course of action, than individuals who exhibit a low level of overconfidence.

The third hypothesis stated:

H_3: Desire to rectify past outcomes will mediate the effect of attribution on escalation.

This hypothesis was supported. There was a significant indirect effect of attribution on escalation decision through DRPO at a 90% confidence interval.
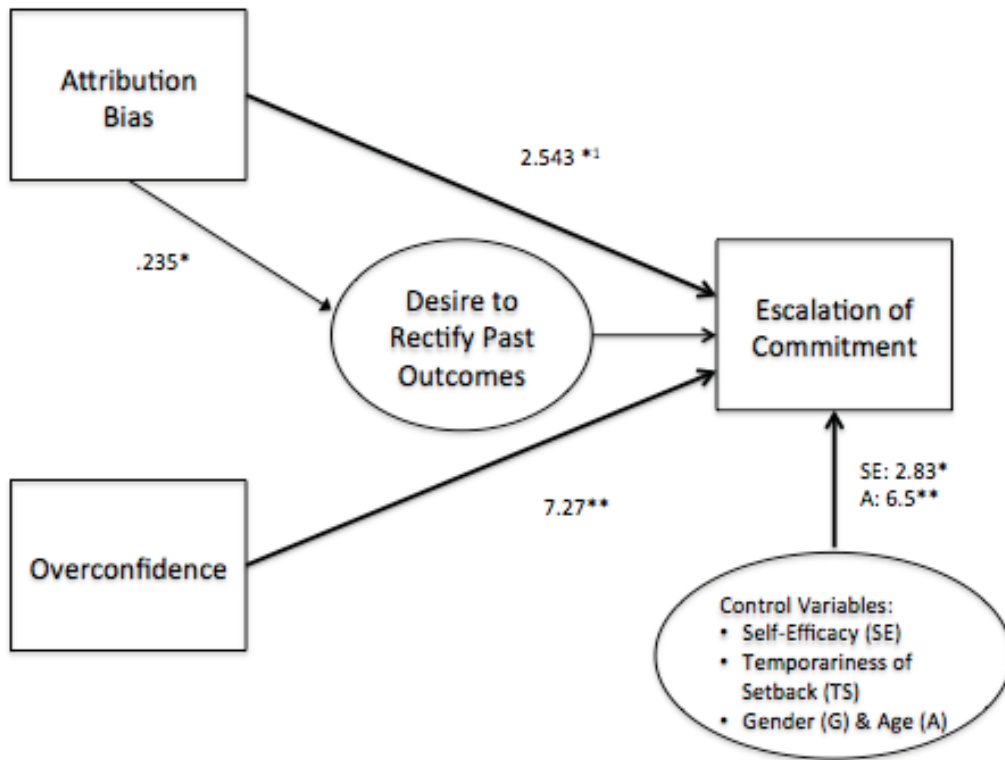
Lastly, hypothesis four stated:

H_4: Desire to rectify past outcomes will mediate the effect of overconfidence on escalation.

This hypothesis was not supported.

4.7.1 Modified Research Model

The modified research model is depicted in figure 5: Modified Research Model

Figure 5: Modified Research Model

$*^1$ p < .1 in the opposite direction as hypothesized, *p < .1, **p < .05

CHAPTER 5: DISCUSSION, CONCLUSIONS, STUDY LIMITATIONS/DIRECCTION FOR FUTURE RESEARCH, AND CONTRIBUTIONS

5.1   Discussion and Conclusions

Two of the four hypotheses tested were supported in this research. The pattern of results obtained in testing H_1 (attribution on escalation) was unexpected. We had hypothesized that participants who attribute the cause of the setback to internal factors would escalate to a greater extent than participants in the external condition. However, the opposite effect was observed. Though the effect was significant, it is a particularly interesting finding, as it runs counter to the prediction we made based on self-justification theory. Thus, our results for H_1 may serve as an impetus that challenges the self-justification theory notion of escalation of commitment.

One possible explanation for the observed effect could be due to the manner in which we constructed our scenario. For example, in our scenario we informed participants that they had two options, to either re-evaluate the project (which would indicate de-escalation) or to continue with the product launch as planned (which would indicate escalation). However, our re-evaluate option also informed participants that they would have four months to assess the problem and then at that time make a decision to either launch the product or not. Providing subjects with this kind of time window could have prompted them to choose to re-evaluate because by doing so they would have the opportunity to redeem their self-image. After all, the internal causes specified in the scenario informed participants that the setback was due to insufficient effort spent on the project or their lack of ability managing the project team. Thus, participants could have viewed this time window as an opportunity to make-up for the insufficient time spent on the project and or to acquire the skills necessary to manage the project better moving forward.

However, a closer examination of our results, which provided participants with the opportunity to explain their escalation decision, did not provide any evidence that this might be the case. In fact, any mention of a time element, among participants in both treatments, had to do with the presence of the competition potentially launching their own product in the near future or that the time to re-evaluate was too long. Thus, the time element caused participants to escalate more so than not in both treatments, not to de-escalate. For example to the first point, one participant in the internal treatment who had escalated, provided the following information as to the primary reason s/he chose to continue with the product launch as planned, "Time is important, and bear in mind that competition is moving." To the second point, another participant who escalated commented, "The amount of time to reevaluate." In the external treatment any mention of time had a similar effect. For instance, one participant commented, "Time to market and beating competitors." Again, these comments were common among participants in both treatments, suggesting that the time factor probably doesn't explain the difference in escalation decision between the two experimental treatments.

The results of our second hypothesis were not surprising, as H_2 was supported. H_2 stated that highly overconfident individuals would escalate to a greater extent than those less overconfident, and in fact, this was the observed result. Thus, the results confirm that individuals who are more overconfident are more likely to escalate their commitment. Though the observed effect size was small ($f^2 = .03$), the interpretation of this effect should be taken with caution, as the observed power (.764), to detect an effect, did not reach the .80 level we expected; which suggests that a larger sample size could have increased the observed power and consequently produce a greater effect size. This limitation is discussed in more detail in our final chapter. Nonetheless, the observed result is an important finding, as it confirms theoretical

predictions relevant to overconfidence and does suggest that more overconfident decision-makers will be more prone to escalation.

Our third hypothesis (H_3) predicted that the effect of attribution on escalation would be mediated by DRPO. This hypothesis was supported at the 90% confidence interval, indicating that a participant's proclivity to escalate can be explained by their desire to rectify past outcomes. This is another important finding as it provides evidence for one of the assumptions made by self-justification theory, which hasn't been tested in the literature up to now.

Our fourth and final hypothesis (H_4) predicted that overconfidence level and its effect on escalation decision would be mediated by DRPO. Surprisingly, this hypothesis was not supported. This was an unexpected result as the literature clearly informs us, for one, that highly overconfident individuals have a strong desire to boost their ego and social status. Since overconfident individuals have a tendency to believe that they are highly competent (Anderson, et al., 2012), one would expect that in the face of negative feedback overconfident individuals would be motivated to rectify past outcomes. One would expect that they would be more willing to escalate in an effort to justify their competence, to boost their ego, and/or to save face. One possible reason why self-justification theory assumptions were not supported for the mediating role of DRPO on the relationship between overconfidence and escalation is that overconfident individuals simply ignore negative feedback, and thus, have no desire to rectify a past mistake. Another explanation could be due to the existence of another theory or theories that may provide a better explanation for a different mechanism, other than DRPO, that serves as a more accurate explanation for the relationship between overconfidence and escalation. This possibility may also explain why the relationship between attribution and escalation decision was the opposite of that which was expected. To conclude, our study findings suggest that cognitive biases are

indeed a complex phenomenon to understand. Thus, our limited understanding of how such

biases affect decision-making, particularly within the context of escalation situations, warrants

further research as discussed in more detail in the next section.

5.2   Limitations and Future Research

As with most research this study has its limitations. First, this study only explores the

effect of two cognitive biases on escalation of commitment. Thus, future research could focus

on examining the effect of other cognitive biases, as outlined by Hogarth (1986) and Sage (1981)

that might also affect on escalation of commitment.

A second limitation has to do with the observed power during the test of between-

subjects effects. None of the variables tested (whether it be an independent variable or a

covariate) generated an observed power of .80; which consequently, makes interpreting study

findings very challenging. For example, attribution had an observed power of .354. This is well

below the intended .80, and thus, could help explain why this factor was only marginally

significant. Overconfidence had an observed power of .764, which was much better but still

slightly below our target threshold. The observed power may be a result of the disparity between

cell sizes, as observed in Table 3: Descriptive Statistics. For example, the cell size for low

overconfidence (internal treatment) is much smaller than for the high overconfidence (internal

treatment; respectively, N = 27 versus N = 44. Similarly, the cell size for the external treatment

was 32 versus 45. The discrepancy in cell sizes is due to the fact that people naturally tend to

exhibit overconfidence.

Clearly, a larger sample size and higher power is needed in order to more confidently test

the relationships proposed in our research model. Thus, future research should incorporate a

greater sample size; which should take into consideration that, according to our results, and consistent with theory (e.g., see Merkle & Weber, 2011), high overconfidence among individuals is common among decision-makers. Thus, a challenge to overcome during future data collection is that for every three individuals, two will be categorized as having high overconfidence.

A third limitation is that this study only examines one facet of overconfidence, i.e., miscalibration, when in fact there exist two other facets (i.e., overestimation and better-than-average effect). Thus, further research is needed in order to examine whether the other two facets of overconfidence impact escalation decisions.

Another limitation related to overconfidence is the issue of whether overconfidence is best conceived of as a specific individual trait, or whether it is something that is best conceived of as being context specific. The literature on this point is mixed. In this study, we treated overconfidence as an individual trait and thus our study findings may not be generalizable to the measurement of overconfidence as a context specific factor. Thus, future research can explore this latter line of reasoning and how context specific overconfidence could lead to escalation of commitment.

The last limitation is related to the scenario's design. For example, in our scenario attribution explanations contain both stable and transient elements; which can make it challenging for subjects to respond to the manipulation. This may also explain why so many subjects failed the manipulation check. In the internal attribution treatment the two attributions identified as being the main cause for the setback were lack of skill and lack of effort in managing the project team. By combining these two attributional causes, the participant may have found it difficult to make an assessment if s/he believes that one cause relates to a temporary setback and one cause relates to a setback that cannot be easily overcome. Further

research is needed in order to separate the two elements and explore them independently. In this study, we deal with this situation by controlling for temporariness of the setback. The fact that the temporariness of setback did not appear to have a significant effect on the escalation decision suggests that our findings can still be meaningfully interpreted.

A post-hoc interview with a participant (assigned to the internal treatment) of the pilot study provided some clues for another potential reason why the failure rate for our manipulation check may have been high. This participant suggested that even though the scenario indicated that internal factors were attributed to the cause of the setback, "...in reality, very rarely, could one attribute failure to only internal factors. There are usually external factors that come into play as well." This participant's response clearly indicates that not all individuals will be biased during decision making; that indeed, some individuals will consider both external and internal factors when making attributions, and thus, when making decisions. Thus, future research may consider rewording the scenario in a manner that, in the participant's words, "the cause of the setback is irrefutable."

Lastly, future research could develop and implement recommendations designed to reduce the effect of overconfidence and/or attribution bias on escalation. For example, managers could be educated on overconfidence and/or attribution bias and then the researcher could measure whether or not education (or whatever intervention was employed) on biases results in a reduction on escalation of commitment.

5.3   Contributions

This dissertation contributes to both research and practice.

5.3.1 Contributions to Research

First, we explore the role of attribution and overconfidence as potential explanations for escalation of commitment behavior. Second, we demonstrate and provide empirical evidence that substantiates the claim that attribution (though marginally so) and overconfidence, are cognitive biases that affect decision-making, specifically, in IT escalation situations.

Another implication for research is that having a better understanding of what factors cause escalation of commitment has the potential of facilitating the development of reliable future research models. In other words, when developing research models, researchers can use studies such as this to serve as a guide in developing models that either control for, or further examine attributional and overconfidence biases.

Another contribution to research is the operationalization of one of the assumptions made by self-justification theory, namely that individuals have an innate desire to rectify negative past outcomes which have resulted as a consequence of the decision-maker's own failings (Staw, 1976). Thus, our research substantiates the mediating role of desire to rectify past outcomes and is the first to provide empirical evidence for this underlying assumption of self-justification theory.

5.3.2   Contributions to Practice

From an *Engaged Scholarship* perspective, this research contributes to practice, as it addresses a real world problem that is of concern to practitioners. This research falls within the

category of informed basic research; which is typically undertaken to "describe, explain, or predict a social phenomenon" (Van de Ven, 2007, p. 27). And although direct contact was not established between the primary research team and potential study stakeholders (e.g., IT managers, IT business leaders, and IT software consumers), this study's design was developed in such a way that study participant feedback was solicited in an effort to garner a better understanding of why escalation in IT projects occurs. For example, one of the questions on the survey instrument asked study participants to explain what was the most influential factor why they decided to launch the product as planned or re-evaluate.

In addition, an important benefit to practitioners is that having a better understanding of which cognitive biases lead to escalation of commitment could help managers develop processes and put controls in place to help minimize the effect of cognitive biases in escalation situations. For example, from our study results, we observed that overconfidence has a greater effect on escalation of commitment than attribution bias. However, these results may be due to either a weak manipulation of attribution, or because in reality overconfidence simply has a greater effect on escalation of commitment than attribution bias. To the latter point, it was clear that individuals with high overconfidence have a greater tendency to escalate their commitment to a failing course of action. Thus, managers can use this information to perform their own due diligence, and make use of an employee's recommendation, to either continue with a troubled project or not, accordingly. However, to make use of our study findings, managers would need to know which of their employees are highly overconfident and staff projects accordingly. To facilitate the process of understanding an employees' proneness to biases, managers can test employees with tools such as the confidence quiz. Though this may be an expensive proposition, it may prove to be cost effective in the long-term, as escalation of IT projects has proven to be a

costly mistake for many organizations. Another suggestion would be to put processes in place to ensure, for example, that not only one person is responsible for making launch or no launch decisions, which may minimize the chances of project escalation due to an overly confident manager making important decisions.

In summary, our study findings could help serve as a foundation for developing new research models, and could also help practitioners develop strategies (e.g., via training, education, etc.) that can serve to help organizations mitigate escalation behavior. At a minimum, this study can serve to educate business leaders of the real world existence of cognitive biases and how these biases can adversely affect business decision-making.

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APPENDIX A: INTERNAL ATTRIBUTION AND EXTERNAL ATTRIBUTION

SCENARIOS

The following scenario is part of a study in business decision-making.

1. Read the scenario completely, and thoroughly before you go to the next page.

2. Adopt the role of the Manager for the project, and then answer each of the questions in order as the Manager would answer.

3. **This is not a test. There are no right answers, and there are no wrong answers.**

Internal Attribution Scenario – Experimental Treatment 1:

ComSoft is an industry leading information systems (IS) vendor. You are ComSoft's Manager for SoftBiz, a product that is being developed based on a proposal that you had made to ComSoft's Executive Committee. Everyone knows that this project is your baby. Because SoftBiz is so revolutionary, the project has always faced both technical and market uncertainty. Nevertheless, potential customers have expressed delight with the product concept and are expecting it to be launched within the next month. However, Comsoft is racing against time as other competitors are planning to launch similar products.

All of the development work on SoftBiz has been completed and the company has publicly announced that the product will ship within the next two weeks. However, a recent development has occurred that has focused everyone's attention on the timing of SoftBiz's release. Specifically, the SoftBiz testing team has just identified some bugs with the system kernel that affect the protocols used for object messaging. ***You attribute the bugs discovered to <u>internal causes</u> such as your own lack of skill in managing the product team and insufficient effort spent on the project.***

Within the hour, you must meet with ComSoft's Executive Committee to recommend whether or not to proceed with launching SoftBiz as scheduled. Based on your review of the project's status, you have identified two possible courses of action. The first course of action is to ***launch SoftBiz as previously scheduled*** without correcting the recently discovered bugs. In the software industry, this course of action is not uncommon as companies routinely release products before they are fully debugged, since many bugs can be corrected with service packs that are issued to customers at a later date. The second course of action is to delay the product launch, initiate a four-month investigation into the extent and nature of the bugs and what it may take to correct them, and then ***re-evaluate the feasibility of launching the product at that time***. Recommending this course of action will mean that ComSoft *risks being beaten to market* by one or more competitors. You must decide which one of these two courses of action to recommend to ComSoft's Executive Committee.

External Attribution Scenario – Experimental Treatment 2:

ComSoft is an industry leading information systems (IS) vendor. You are ComSoft's Manager for SoftBiz, a product that is being developed based on a proposal that you had made to ComSoft's Executive Committee. Everyone knows that this project is your baby. Because SoftBiz is so revolutionary, the project has always faced both technical and market uncertainty. Nevertheless, potential customers have expressed delight with the product concept and are expecting it to be launched within the next month. However, Comsoft is racing against time as other competitors are planning to launch similar products.

All of the development work on SoftBiz has been completed and the company has publicly announced that the product will ship within the next two weeks. However, a recent development has occurred that has focused everyone's attention on the timing of SoftBiz's release. Specifically, the SoftBiz testing team has just identified some bugs with the system kernel that affect the protocols used for object messaging. ***You attribute the bugs discovered to <u>external causes</u> such as bad luck and the inherent difficulty of the project itself.***

Within the hour, you must meet with ComSoft's Executive Committee to recommend whether or not to proceed with launching SoftBiz as scheduled. Based on your review of the project's status, you have identified two possible courses of action. The first course of action is to ***launch SoftBiz as previously scheduled*** without correcting the recently discovered bugs. In the software industry, this course of action is not uncommon as companies routinely release products before they are fully debugged, since many bugs can be corrected with service packs that are issued to customers at a later date. The second course of action is to delay the product launch, initiate a four-month investigation into the extent and nature of the bugs and what it may take to correct them, and then ***re-evaluate the feasibility of launching the product at that time***. Recommending this course of action will mean that ComSoft *risks being beaten to market* by one or more competitors. You must decide which one of these two courses of action to recommend to ComSoft's Executive Committee.

APPENDIX B: QUESTIONNAIRE

Please answer as the Manager of SoftBiz. Mark only one box for each numbered statement. **Exit Survey**

1. Please indicate what you will recommend, and how strong that recommendation will be. (Mark only one box)

Re-evaluate: Definitely	Re-evaluate: Strongly	Re-evaluate: Somewhat	Re-evaluate: Slightly	Continue as planned: Slightly	Continue as planned: Somewhat	Continue as planned: Strongly	Continue as planned: Definitely
○	○	○	○	○	○	○	○

2. In your decision, please identify and briefly explain the ONE, MOST IMPORTANT factor that influenced you:

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3. I think the bugs discovered result from <u>internal causes</u> such as my own lack of skill in managing the product team and insufficient effort spent on the project.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

4. I think the bugs discovered result from <u>external causes</u> such as bad luck and the inherit difficulty of the project itself.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

5. I feel personally responsible for the bugs that were identified in this project.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

6. I believe that I should be held responsible for the setback that occurred in this project.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

7. I believe that the bugs that were identified are likely to persist over a long period of time.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

8. I believe that the setback experienced on this project is temporary and easily overcome.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

9. I feel that it is important for me to try and correct the bugs given how they came about.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

10. I believe that correcting the bugs is the right thing to do given the circumstances surrounding their cause.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

11. I can always manage to solve difficult problems if I try hard enough.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

12. If someone opposes me, I can find the means and ways to get what I want.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

13. It is easy for me to stick to my aims and accomplish my goals.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

14. I am confident that I could deal efficiently with unexpected events.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

15. Thanks to my resourcefulness, I know how to handle unforeseen situations.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

16. I can solve most problems if I invest the necessary effort.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

17. I can remain calm when facing difficulties because I can rely on my coping abilities.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

18. When I am confronted with a problem, I can usually find several solutions.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

19. If I am in trouble, I can usually think of a solution.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

20. I can usually handle whatever comes my way.

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

Use your best estimate to answer the following questions. PLEASE, DO NOT USE OUTSIDE RESOURCES.

Exit Survey

For each of the following questions, provide a low and high estimate such that you are 90 percent certain that the correct answer will fall within these limits. In other words, you should expect that the interval you provide contains the correct answer in 9 out of the 10 questions. **Pay close attention to the units!** For example, distinguish between millions and billions.

Again, please provide your best estimate. This is not a test. DO NOT use outside resources (e.g., Google, colleague, books, etc.) to answer the following questions.

21. What is the average weight of the adult blue whale, in pounds?

Lower Limit:

Upper Limit:

22. In what year was the Mona Lisa painted by Leonardo da Vinci?

Lower Limit:

Upper Limit:

23. How many independent countries were there at the end of the year 2000?

Lower Limit:

Upper Limit:

24. How many bones are in the human body?

Lower Limit:

Upper Limit:

25. How many total combatants were killed in World War I?

Lower Limit:

Upper Limit:

26. What is the air distance, in miles, between Paris, France and Sydney, Australia?

Lower Limit:

Upper Limit:

27. How many books were in the Library of Congress at the end of the year 2000?

Lower Limit:

Upper Limit:

28. How long, in miles, is the Amazon river?

Lower Limit:

Upper Limit:

29. How fast does the earth spin (in miles per hour) at the equator?

Lower Limit:

Upper Limit:

30. How many transistors are in the Pentium III computer processor?

Lower Limit:

Upper Limit:

31. What is your gender?

○ Female

○ Male

32. What is your age?

○ 18 to 24

○ 25 to 34

○ 35 to 44

○ 45 to 54

○ 55 to 64

○ 65 to 74

○ 75 or older

33. The country in which you were born:

34. The number of years you have lived in the United States (whole number only):

35. The number of years, full-time, paid work experience you have (whole number only):

END OF QUESTIONNAIRE

NOTE:
Questions 21-30 (the Confidence Quiz designed to measure overconfidence), according to Libby & Rennekamp (2011, p. 227):

> Allow us to capture a relatively stable measure of individual miscalibration. Since the task asks managers to provide 90% confidence intervals for each question, well-calibrated individuals should provide only one interval (out of 10) that does not include the true answer to the question. As overconfidence increases, individuals provide more intervals that are too narrow (i.e., do not include the true answer).

> Actual answers for the quiz items:
> 21) 250,000 lbs.
> 22) 1513
> 23) 191
> 24) 206 bones
> 25) 8,300,000
> 26) 10,543
> 27) 18,000,000
> 28) 4,000 miles
> 29) 1,044 miles per hour
> 30) 9,500,000

APPENDIX C: EVALUATION OF CONSTRUCTS

Rotated Component Matrix[a]

	Component			
	1	2	3	4
se9	.908			
se7	.843			
se10	.823			
se8	.814			
se5	.795	.321		
se4	.637	.485		
se1		.785		
se2		.721		
se3	.382	.655		
se6	.412	.598		
drpo1			.923	
drpo2			.895	
ts1_r				.864
ts2				.709

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Table 4: Factor Analysis with all Constructs

Component Matrix^a

	Component
	1
se10	.859
se5	.851
se9	.844
se4	.829
se7	.815
se8	.740
se6	.724
se3	.682
se1	.615
se2	.374
Cronbach's α	.886

Extraction Method: Principal Component
Analysis. a. 1 component extracted.

Table 5: Self-Efficacy Factor Analysis

Component Matrix^a

	Component
	1
se10	.854
se5	.848
se9	.843
se4	.816
se7	.806
se8	.729
se6	.696
se3	.648
se1	.607
Cronbach's α	.905

Extraction Method: Principal Component Analysis.
a. 1 component extracted.

Table 6: Self-Efficacy Factor Analysis2

Component Matrix[a]

	Component
	1
drpo2	.923
drpo1	.923
Cronbach's α	.827

Extraction Method: Principal Component Analysis.
a.1 components extracted

Table 7: DRPO Factor Analysis

Component Matrix[a]

	Component
	1
ts2	.823
ts1_r	.823
Cronbach's α	.496

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Table 8: Temporariness of Setback Factor Analysis

Rotated Component Matrix[a]

	Component	
	1	2
se10	.853	
se5	.851	
se9	.846	
se7	.816	
se4	.807	
se8	.727	
se6	.682	
se3	.642	
se1	.597	
drpo1		.935
drpo2		.907
%Total rotated variance explained	47.88	16.02

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization. a.
Rotation converged in 3 iterations.

Table 9: Factor Analysis with all Constructs (2)