This is to certify that the

dissertation entitled

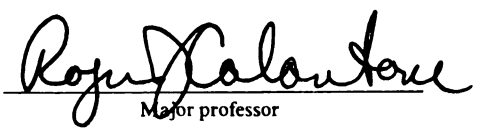
Escalation of Commitment in the New Product Development Process

presented by

Jeffrey Brian Schmidt

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Marketing



Major professor

Date July 1, 1996

ESCALATION OF COMMITMENT IN THE NEW PRODUCT DEVELOPMENT PROCESS

By

Jeffrey Brian Schmidt

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Marketing and Logistics

1996

Professor Roger J. Calantone

ABSTRACT

ESCALATION OF COMMITMENT IN THE NEW PRODUCT DEVELOPMENT PROCESS

By

Jeffrey Brian Schmidt

New product development (NPD) processes typically used by companies feature multiple review points where projects are evaluated and either terminated prior to commercialization or continued on to the next stage of the process. However, for various reasons, NPD projects often are not terminated at these review points when the performance projections are ominous. Rather, projects are carried through to commercialization where they fail in the market at a much higher cost than if they had been terminated earlier.

Using escalation of commitment theory, this dissertation develops and tests the notion that certain factors unrelated to a project's forecasted performance cause individuals to persist and be more committed to a failing NPD project. These factors are: (1) personal responsibility for initiating the project, (2) the innovativeness of the product, and (3) the credibility of the source providing information during the project.

A 2x2x2x3 experimental design was used in which the three between-subjects factors were manipulated to be either high or low, and commitment to a failing NPD project was studied over three stages of the NPD process. A

total of 285 business people drawn from executive MBA programs participated in the research by completing a NPD decision-making experiment and making a series of continuation and related decisions at three stages of a hypothetical NPD project. Subjects in all conditions received identical performance feedback information.

The results show that commitment and willingness to continue a project were generally higher under conditions of high personal responsibility and/or high product innovativeness, as hypothesized. Contrary to expectations, the credibility of the information source had no effect on commitment. Finally, commitment to a failing NPD project generally decreased over the stages of the project, though the effects of personal responsibility and product innovativeness on commitment did not diminish over the project.

This research contributes to NPD research and practice by focusing on the review points, which have received scant research attention. Furthermore, a new theoretical base was used to study the NPD process. The results suggest ways to avoid excessive commitment to NPD projects, potentially reducing new product failure rates.

This dissertation is dedicated to the memory of my maternal uncle, Allan I. (Avraham Yitzchak) Warshawsky who passed away unexpectedly as I was beginning this research project. His premature death all too painfully reminded me what is really important in life.

ACKNOWLEDGMENTS

Completing this degree has been one of the most challenging endeavors of my life. As such, the guidance, assistance, and support of numerous people have made the completion of this degree possible. I would like to express my gratitude to these people:

Dr. Roger Calantone, my dissertation committee chair and mentor throughout the Ph.D. program. He admitted me into the doctoral program, which I believe was the opportunity of a lifetime. Dr. Calantone has given me great latitude and support in my research endeavors. He literally spent hundreds of hours with me brainstorming, analyzing data, and overseeing this dissertation and other research projects. Without his support, the doctoral program would have been far less fulfilling and valuable. I truly appreciate everything he has done for me.

Dr. Cornelia Dröge for all of her advice and guidance concerning academic life and for her rigor and attention to detail.

Dr. Gilbert Harrell for helping me to clarify my ideas and for giving me new ones.

Dr. John Hollenbeck for his rigor and for helping me see things from a different perspective.

his

Uni

degr

beco

Clin

and

resea

this r

ways

suppo

throug

unders

compre

interes

Dr. Robert Nason, Chair of the Department of Marketing and Logistics, for his encouragement, support, and advice throughout the doctoral program.

Dr. Bruce Harte, Director of the School of Packaging at Michigan State University, who encouraged me, inspired me, and convinced me to pursue this degree.

My fellow doctoral students (both past and present) with whom I have become friends and colleagues. I would especially like to acknowledge Steve Clinton and Mitzi Montoya-Weiss for making the doctoral program more rewarding and enjoyable.

All of the individuals who participated in this research. Without them, this research would not be possible.

The Product Development and Management Association partially funding this research.

My mother and stepfather, Bob, who have been towers of support in so many ways throughout my schooling. They made significant financial sacrifices to support my undergraduate education, and their support was unwavering throughout the doctoral program. I am especially grateful to them for trying to understand all of the things that took place over the past several years (e.g., comprehensive exams, publishing, the dissertation process) and for their constant interest and encouragement.

My brother, Mark, for his support throughout this program. While he did not understand why I could not write this "big paper" in a few days, his understanding, encouragement, and levity helped me greatly.

My dad for his support throughout this process. His interest and support in scholarly endeavors is appreciated. Throughout my life, he stressed the importance of higher education.

Above all, I would especially like to acknowledge my wife, Sue, for her constant support, commitment, and love throughout the doctoral program. Sue made substantial sacrifices to make the past several years more manageable, from being the main breadwinner, to photocopying material for me. She made me laugh when I needed it, and encouraged me to go on when I thought I would never complete this task. She truly is one of a kind.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

> If companies can improve their effectiveness at launching new products, they could double their bottom line. It's one of the few areas left with the greatest potential for improvement - *Jerry Wind* (in Power *et al.* 1993, p.77).

1.1. Overview of the Problem

1.1.1. Importance of New Product Development for Firms

New product development (NPD) has been called "one of the riskiest, yet most important, endeavors of the modern corporation" (Cooper 1993, p.4), yet it is essential for the survival and health of companies (Cooper and Kleinschmidt 1987; Urban and Hauser 1993). Companies get a large portion of their sales and profits from products that did not even exist a few years back. For example, in 1982, Booz, Allen, and Hamilton found that 23 percent of firms' profits were derived from products introduced within the past five years. In 1990, the Product Development and Management Association (PDMA) sponsored a study similar to Booz, Allen, and Hamilton's to examine "best practices" among PDMA members. The results of this study showed that 33 percent of companies' sales and 32 percent of profits resulted from products launched in the 1985-1989 period. By 1995, these figures were expected to grow to 39 percent and 46 percent, respectively (Page 1993), indicating that new products are becoming increasingly important to firms.

While vital, NPD is risky since a new product failure can cost hundreds of millions of dollars (Urban and Hauser 1993). Some companies

even bet their survival on particular new products. Unfortunately, new product failure is a common occurrence. Across studies, new product failure rates are consistently around 40%. Booz, Allen, and Hamilton (1982) found a 35% rate of failure for the 1976-1981 period. Over the 1985-1989 period, Page (1993) found that new products fail 42 percent of the time. These rates compare similarly with those in other countries. In a study on Canadian firms in the provinces of Ontario and Quebec, Cooper (1984) found that 33% of new products fail. The failure rate in Japan is around 40%, and in England it is approximately 45% (Edgett, Shipley, and Forbes 1992).

The risks inherent in new product activities are increasing since firms are launching more new products than in the past. While Booz *et al.* (1982) noted that between 1976 and 1982, the median number of new products introduced was five, this number was predicted to double over the next five years. Indeed, over the period from 1985-1989, Page (1993) found that the median number of new product introductions was 12, while the average number was 37.5. These figures were expected to grow to 20 and 45.3, respectively for the 1991-1995 period.

These figures indicate that proficiency in developing new products is becoming even more crucial to firms. As the rate of technological change increases, product lifecycles shrink (Urban and Hauser 1993) and firms commit to major NPD projects at an increasing rate. Faster development cycles, more emphasis on developing new products as evidenced by an

increasing number of launches, and global new product introductions are increasing the risks of developing new products.

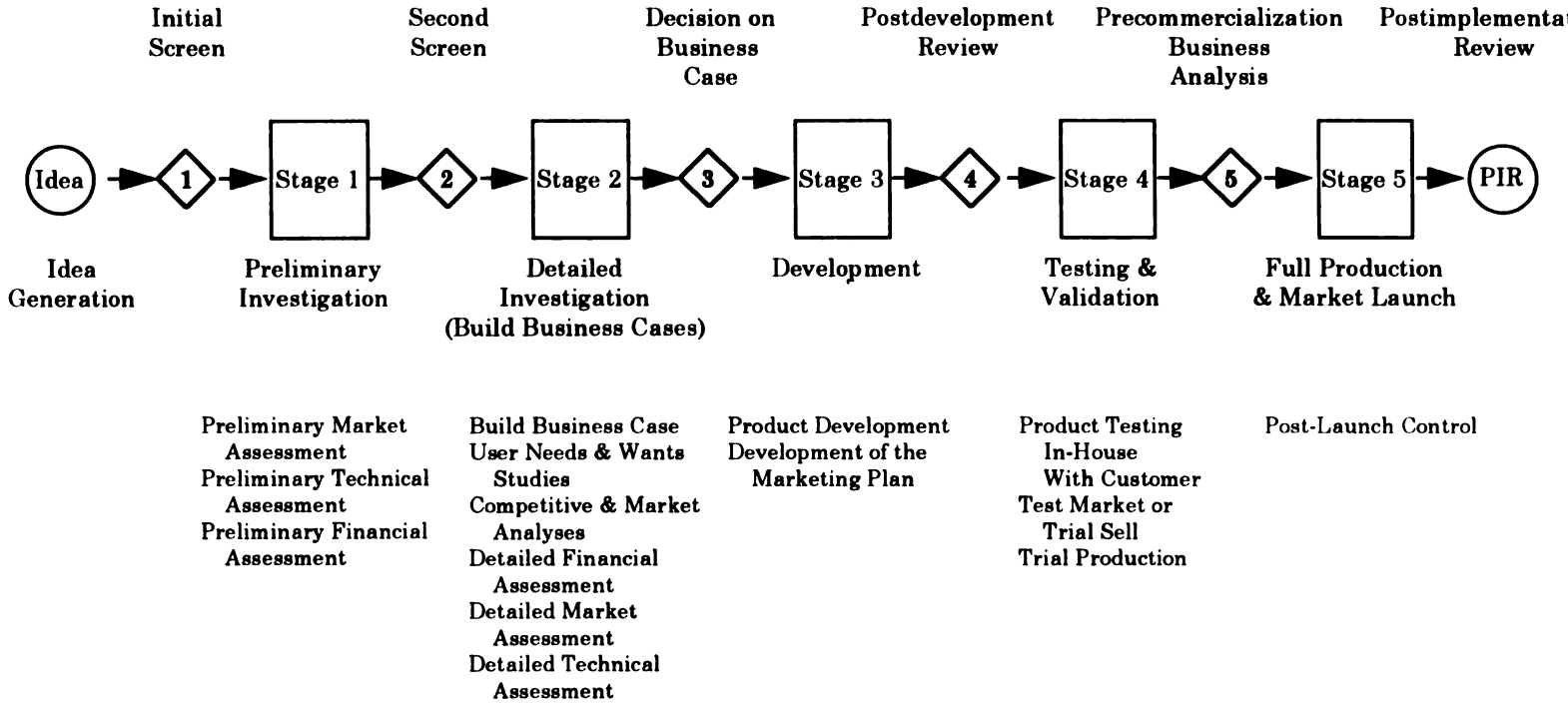
1.1.2. The New Product Development Process

New products are brought to market through a group of activities known as the NPD process. This process begins with the generation of possible new product ideas, and culminates with the launch of the product into the market. The NPD process is conceptualized in different ways by scholars, with varying numbers of steps and types of activities.

One such conceptualization of this process is the stage-gate model (Cooper 1990) shown in Figure 1.1. This NPD process is commonly used in companies today (Cooper 1994). As shown, this model contains five *stages*. In each stage, several activities are undertaken concurrently, and each stage, like the NPD process itself, is interfunctional and may include individuals from the marketing, manufacturing, engineering, and finance areas, as well as other specialists. Among other activities, in each stage information is gathered by these various specialists, and projections are made about the potential market performance of the product. Proceeding each of the five stages is a *gate*. These gates are decision points where managers determine whether to proceed with developing the project or to terminate (i.e., "kill") it based on the projected technical and market performance of the new product.

Figure 1.1
A Stage-Gate Model of the New Product Development Process

Figure 1.1
A Stage-Gate Model of the New Product Development Process



(Source: Adapted from Cooper 1990)

NPD

Klein

the m

Urban

failur

gates

difficu

(1993)

develo

stages

and pe

are no

substa

comme

product

process

new proc

often relu

developing

In terms of resources, the cost to complete each successive stage of the NPD process generally is higher than the previous stage (Cooper and Kleinschmidt 1988), with full production and market launch typically being the most expensive stage. Due to accelerating costs over the NPD process, Urban and Hauser (1993 p.61) claim that "it is important to eliminate failures early before they lead to a major loss in investment."

However, it is likely that too few NPD projects are terminated at the gates since NPD projects create excitement within companies which makes it difficult to kill projects. This is especially true at the later gates. As Cooper (1993) posits, it is much easier to terminate a NPD project before the development stage (i.e., stage 3 in Figure 1.1) than after it. In the later stages, killing a project becomes more difficult since resources are committed and people have become intensely involved. This means that many projects are not killed in the NPD process but instead go on to fail in the market at substantially higher costs than if they had been terminated prior to commercialization.

In summary, NPD is vital for companies, but it is risky since new product failures are common and extremely costly. Throughout the NPD process there are opportunities to terminate a project if it appears that the new product is unlikely to succeed in the market. However, managers are often reluctant to terminate NPD projects due to the momentum inherent in developing new products. This allows projects to continue that are likely to

fail at commercialization when substantially more resources are invested than if they had been terminated earlier in the NPD process.

1.2. The Research Study

1.2.1. Purpose of the Research

The purpose of this research was to investigate managerial decision-making and commitment over the course of a failing new product development project. Specifically, the reluctance to stop a NPD project whose signs increasingly indicated that it was heading for failure was studied. While Balachandra (1984) found that a minimum level of commitment is essential to develop a successful new product, excessive commitment to an NPD project likely makes it difficult to terminate the project, even when there are signs (from marketing research or product testing, for example) of impending failure in the market.

The theoretical foundation for this research is escalation of commitment (or simply escalation) theory from the organizational psychology literature. The escalation literature offers a rich theoretical and empirical base from which to study decision-making and commitment in the NPD process. Escalation situations are characterized by the continued commitment and investment in a course of action, even when confronted with negative consequences resulting from the chosen course of action. Escalation situations invariably involve opportunities to either persist in or withdraw

from the course of action. Each subsequent activity may reverse or compound earlier losses. Although the final outcome (i.e., success or failure) of continuation is unknown in advance, continuation is chosen (Staw and Ross 1987).

Examples of escalation in NPD are common. The Apple Newton Personal Digital Assistant, Coca Cola's Coke II, General Motors' 1991 Chevrolet Caprice Classic, and the RCA SelectaVision videodisc system are just a few examples of new products that performed poorly in the market. However, *prior to their introduction*, there were strong indications that all of these products would fail for either marketing or technical reasons. The issues were dismissed or addressed inadequately, and the products eventually failed in the market costing each company millions of dollars.

In the seminal escalation of commitment research, Staw (1976) found that decision-makers who were responsible for an initial decision (in a series of related decisions) that failed to produce the desired results increased, or escalated, their commitment to the original decision rather than decreasing it, as did individuals that were not responsible for initiating the failing course of action. Staw and Ross (1989, p.578) claim that, "it appears that individuals may have a tendency to become locked into a course of action, throwing good money after bad or committing new resources to a losing course of action." Similar phenomena are called the "too-much-invested-to-

quit syndrome" (Teger 1980) and the "sunk cost effect" (Arkes and Blumer 1985).

Basic accounting and finance courses train individuals to make "rational" decisions by ignoring sunk costs. By definition, sunk costs already have been incurred and therefore should not be considered when making financial calculations and decisions. However, sunk costs may be irrecoverable in reality, but they may not be sunk psychologically and may still enter into decision-making (Fox and Staw 1979; Staw 1981; Staw and Ross 1987). To outside observers, not involved in the project, the risk in pursuing a failing course of action is readily apparent. While economic factors motivate the firm to develop the new product initially, over the stages of a NPD project, non-economic, social, and psychological factors make it increasingly difficult to terminate a NPD project. Furthermore, this commitment in the face of countervailing information is a factor that contributes to new product failure rates.

While the escalation of commitment literature has been developing for nearly two decades, this literature has not been exploited by researchers in marketing (see Armstrong *et al.* 1993 and Boulding, Morgan, and Staelin 1995 for exceptions). Conceptually, there are close parallels between traditional escalation research and NPD since commitment to R&D programs has frequently been studied in the escalation literature. Both NPD projects and R&D programs involve the sequential commitment of resources. As in

traditional escalation research, NPD projects offer opportunities for withdrawal or continuation. Lastly, the ultimate success or failure of the new product is unknown in advance, just as the outcomes of other escalation situations are not known with certainty *a priori*. While Leatherwood and Conlon (1988) suggested that new product decisions should be similar to R&D decisions, escalation theory has only very recently been used to study NPD decision-making. Boulding, Morgan, and Staelin (1995) studied the effects of de-escalation techniques on the new product post-launch decision for a failing new product. However, escalation has not been used to study the *entire* NPD process to determine antecedents of commitment, how commitment differs at the various stages of a failing NPD project, and how commitment changes over the NPD process.

1.2.2. Research Objectives

As stated previously, the purpose of this research was to investigate managerial decision-making at the NPD process gates. Specifically, the research objectives of this dissertation were to:

(1) Establish a conceptual link between the NPD process and escalation of commitment theory;

(2) Test empirically if escalation of commitment occurs in the NPD process;

(3) Determine key antecedents of escalation of commitment in the NPD process;

(4) Determine how the level of commitment changes over the stages of a failing NPD project; and

(5) Suggest normative managerial guidelines for reducing escalation of commitment in the NPD process.

1.2.3. Key Variables

In order to achieve these research objectives, this dissertation research focused on five constructs, which appear below.

(1) *Behavioral commitment to a failing new product development project.*

(2) *Self-reported commitment to a failing new product development project.*

As in previous escalation research, commitment was the dependent variable of interest in this research. Whereas most escalation research measured escalation from a behavioral perspective, this research measured escalation from both behavioral *and* self-reported perspectives. While behavioral commitment was of primary interest, it was felt that measuring commitment from these two perspectives provided a more complete understanding of the phenomena.

While a new product obviously cannot fail until it is actually launched into the market, the information gathered and the forecasts made at each stage of the NPD process provide decision-makers with probable performance in the market. Rather than focusing both on projects that appear to be headed for success as well as on those headed for failure, this research focused on the latter only. Decisions at the gates of NPD projects headed for success are inherently less interesting and dangerous for firms than failing projects and are outside the realm of escalation theory.

(3) *Personal responsibility for initiating a new product development project that is subsequently failing.*

In Staw's (1976) early research, escalation of commitment occurred only when individual's were personally responsible for initiating a course of action that began to fail. Staw reasoned that individuals attempt to justify the correctness of their past decisions to themselves and to others.

(4) *Product innovativeness.*

"New product" is an ambiguous term since some new products are highly innovative, whereas others are simply extensions to existing product lines (e.g., new color of an existing product). In this research, it was expected that the level of innovativeness of the new product would affect decision-makers' commitment to a failing NPD project for various reasons.

(5) *Credibility of the information source.*

Information is gathered throughout an investment project (e.g., NPD project) and provided to decision-makers. If decision-makers receive information that is negative, but the information is provided by a source that is not very believable, then the escalation phenomenon may not be as counter-intuitive as it appears. Although a variety of determinants of escalation have been studied, the effect of the credibility of the information source on commitment has not been studied.

1.2.4. Research Methodology

This research used a decision-making experiment with business professionals to study escalation of commitment in the NPD process. A 2x2x2x3 experimental design was used to study decision-making in the NPD process. Specifically, personal responsibility, product innovativeness, and information source credibility were manipulated to constitute high or low conditions. The stage in the NPD process (development and testing, launch, and post-launch) also was manipulated to determine how commitment changed over the course of a failing NPD project.

1.3. Expected Contributions

This research should be beneficial and interesting to both academic researchers and managers since it determined empirically if escalation of commitment occurs in the NPD process. Furthermore, three key variables (i.e., personal responsibility, product innovativeness, and information source credibility) were studied to determine their effects on commitment in the NPD process. While personal responsibility has been studied in past escalation research, product innovativeness contributes to NPD literature, and information source credibility contributes to the escalation of commitment literature since it has not been included in past research. Finally, this research explored the dynamics of commitment by determining how it changed over the NPD process.

With respect to the academic researchers, this research joins two literature streams- the NPD process literature with the escalation of commitment literature. The escalation of commitment phenomenon appears to be common and very applicable to the study of NPD. Consequently, this represents an opportunity for researchers in marketing to advance the understanding of managerial decision-making in the NPD process. In addition to new product-related phenomena, this theory may subsequently add to the understanding of other marketing-related phenomena.

This research answered several questions, and it opened opportunities for future research. By better understanding the antecedents of escalation of commitment, managers will gain a better understanding of their decision-making in the NPD process. Academics will be able to develop and test strategies for reducing excessive commitment when it is imprudent. Managers may be able to change reward structures, NPD project leadership methods, and organizational cultures, all of which will aid in reducing action chains which lead to unnecessary risk and contribute to new product failure rates.

1.4. Summary and Overview of Dissertation

This chapter provided an overview of this dissertation research. The importance of NPD was emphasized along with the inherent risks in developing new products. The NPD process was illustrated, and the key decision-making points were defined as gates in this process. The purpose of

this research and the research objectives were presented. Escalation of commitment theory was defined and related to the NPD process. Finally, a brief overview of the proposed research methodology was presented.

Chapter 2 reviews the pertinent NPD literature as well as the escalation of commitment literature, which is the theoretical basis for this research. The link between NPD and escalation of commitment is made explicit in this chapter. Finally, research questions and hypotheses are developed for empirical testing.

In Chapter 3, the research design and methodology are presented. The experimental design, manipulations, measures, and the sample is detailed for the decision-making experiment. Chapter 4 presents the results of the statistical analyses of this research. Lastly, Chapter 5 evaluates the findings and the contributions to both theory and practice, presents conclusions, and summarizes the entire research project. Implications for academics and managers are discussed, and limitations and future research opportunities are noted.

CHAPTER 2

REVIEW OF THE LITERATURE

> In too many firms, projects seem to acquire a life of their own. They proceed like an express train, careening down the track, slowing down at the stations (review points), but never intending to stop until they reach their ultimate destination, market launch - *Robert G. Cooper* (1993, p.166).

2.1. Introduction and Overview of Chapter

Chapter 2 lays the theoretical foundation for this research. Since the purpose of this dissertation was to study escalation of commitment in the new product development (NPD) process, key pieces of the NPD and escalation literatures are reviewed. The purpose of the literature review was threefold: (1) to note past accomplishments and to identify opportunities to advance the NPD literature stream; (2) to establish a conceptual linkage between NPD and escalation of commitment; and (3) to formulate research questions and hypotheses for testing.

To achieve these objectives, the relevant NPD literature is reviewed first. Next, the escalation of commitment literature is reviewed to provide the reader with an understanding of the escalation of commitment phenomenon and to highlight key findings of past research. In the third section of this chapter, the linkage between escalation of commitment and NPD is fully developed. Fourth, the research questions are formulated and the research hypotheses to be tested in this dissertation are developed. Finally, a summary of the chapter is provided.

2.2. New Product Development Research

For nearly four decades, researchers have been trying to better understand the factors that lead to new product success. In the late 1960s and throughout the 1970s, research interest in NPD increased. For example, the original Booz, Allen, and Hamilton (1968) research shed much light on how companies transform ideas into new products, how they organize for NPD, and how successful firms are at developing new products. The SAPPHO studies in the 1970s (e.g., Rothwell 1974; Rothwell *et al.* 1974; Szakasits 1974), the NEWPROD studies in the late 1970s and 1980s (e.g., Cooper 1979; Cooper and Kleinschmidt 1987), and Booz, Allen, and Hamilton's (1982) follow-up research are some of the key pieces that advanced this literature stream. With the formation of the Product Development and Management Association in 1976, and with the inception of its journal, *the Journal of Product Innovation Management* in 1984, NPD research has grown rapidly.

From the literature on new product success, Cooper and Kleinschmidt (1987) classified the determinants of new product performance (i.e., success/failure) into the three categories: new product strategy, NPD process, and market environment. In their review of the new product performance literature, Montoya-Weiss and Calantone (1994) added the forth category of organizational-related factors (e.g., reward and compensation systems, resources and skills). This dissertation research centers on the NPD process.

2.2.1. Key Findings in the Literature

Past research has found that the ultimate success or failure of new products is under managers' control (Calantone and di Benedetto 1990; Cooper 1979, 1988; Cooper and Kleinschmidt 1987; Montoya-Weiss and Calantone 1994), and the NPD process-related factors are strongly related to new product performance in the market. Specifically, the number, type, and proficiency of NPD activities are important determinants of new product performance (Booz 1968; Calantone and Cooper 1979; Calantone, di Benedetto, and Divine 1993; Cooper 1975, 1979, 1988; Dwyer and Mellor 1991a,b; Hopkins and Bailey 1971; Montoya-Weiss and Calantone 1994; National Industrial Conference Board 1964; Sanchez and Elola 1991).

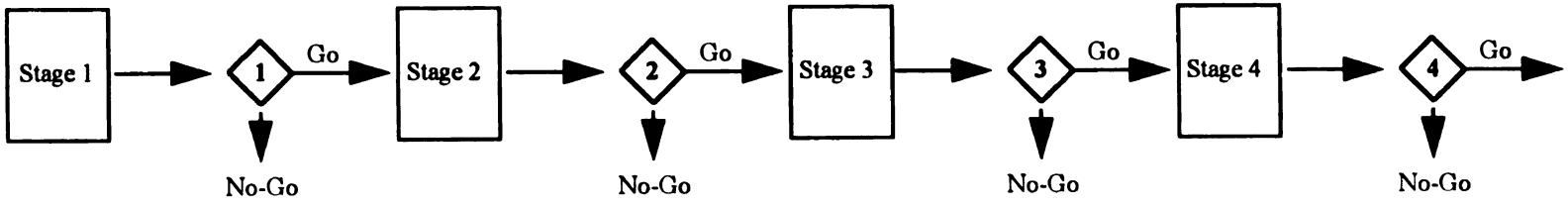
Perhaps counterintuitively, NPD market characteristics are not strongly associated with the performance of new products. Cooper and Kleinschmidt (1993) found many aspects of the market were not related to new product performance in the chemical industry. In the financial services industry, Cooper and de Brentani (1991) found market size and the growth rate of the market to be weakly correlated with new product success. Cooper and Kleinschmidt (1990) found that the competitive situation did not discriminate between successful, unsuccessful, and killed new products. Although Song and Parry (1994) found market characteristics to be important for new product success in China, Cooper and Kleinschmidt (1987, p.178) conclude "the overwhelming evidence from the research is that market

competitiveness is not a decisive determinant of project outcomes." In a quantitative review of the new product performance literature, Montoya-Weiss and Calantone (1994) also concluded that market competitiveness is not strongly associated with new product outcomes.

New product ideas are transformed into product offerings through the NPD process. As shown in Figure 2.1, in a stage-gate NPD process, a wide variety of marketing, technical, and financial activities are undertaken concurrently at each stage of the process (Cooper 1990, 1994; Crawford 1994). The gates, represented by the diamonds in Figure 2.1, are the Go/No-Go points where decisions are made to either continue or to terminate (i.e., "kill") the NPD project and are the focus of this research.

In terms of resources, the latter stages of the NPD process consume more resources, both in terms of time and money (Urban and Hauser 1993). The "up-front" stages (i.e., stages 1 and 2 in Figure 2.1) that take place before the actual development of the product and marketing plans require an average of 13 months to complete and account for 32% of the total elapsed time in developing a new product (Page 1993). Conversely, "back-end" activities which consist of development, testing/validation, and production/launch stages (i.e., stages 3, 4, and 5) combined take nearly 27 months to complete, thereby accounting for more than two-thirds of the development time.

Figure 2.1
A Stage-Gate Model of the New Product Development Process



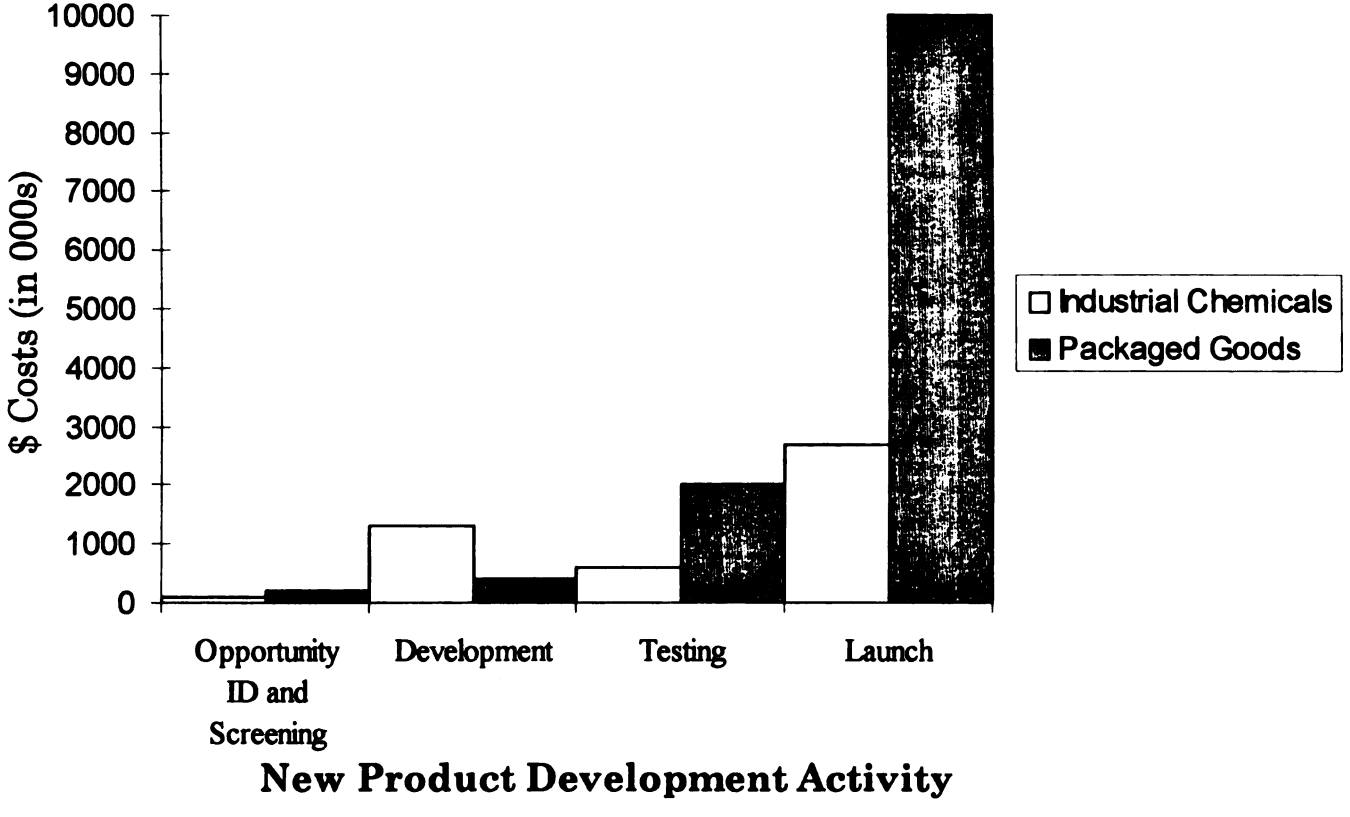
Opportunity Identification	Preliminary Marketing & Technical Assessment	Development & Testing	Commercialization
	Financial Assessment Market Assessment Technical Assessment Build Business Case User Needs & Wants Studies Competitive & Market Analyses	Product Development Development of the Marketing Plan Product Testing In-House With Customer Test Market or Trial Sell Trial Production	Production Distribution Advertising and Promotion

Source: Adapted from Cooper (1990)

Similar findings have been reported by other researchers. In a study that included 60 percent industrial goods, 20 percent consumer durables, and 20 percent consumer packaged goods, Booz, Allen, and Hamilton (1982) found that the cost of opportunity identification and screening was $700,000, development was $4.1 million, testing was $2.6 million, and commercialization was $5.9 million. The acceleration of costs over the NPD process is shown in Figure 2.2 where it is apparent that the later NPD activities, especially launch, are significantly more expensive than the earlier activities. In another study focusing on industrial products, Cooper and Kleinschmidt (1988) also found that the later stages in the NPD process take longer to complete and cost more money. This is even more true for consumer packaged goods since the advertising and promotional campaigns alone for packaged goods may cost hundreds of millions of dollars. For example, the launch of the Gillette Sensor Razor cost over $100 million for advertising and promotion, and the razor had a retail price of $3 (Kuczmarski 1992)!

In sum, the NPD literature reveals three important findings. First, the ultimate performance of new products in the market is under managerial control rather than left solely to the market environment or to chance. Second, the NPD process is an important key to new product success: the number, types, and proficiency of NPD activities impact the success or failure of new products. Most importantly, completing each subsequent stage of the NPD process is significantly more expensive than the previous one.

Figure 2.2
Typical Costs of New Product Development at Each Stage



Source: Urban and Hauser (1993)

2.2.2. Advancing the New Product Development Literature

While the NPD literature has grown to be quite large, there is scant knowledge regarding how decisions are made at each gate in the NPD process. These gates are prominent features of the NPD process, as shown in Figure 2.1, and represent review points that provide the opportunity to continue or cancel a project. Since costs rise at an increasing rate over the stages of a NPD project, the decision to continue or cancel becomes increasingly critical. Unfortunately, in most NPD research studies, these decisions to continue or cancel are lost since most research in this area only has examined projects that were completed.

Two notable studies, however, have focused on NPD projects that were terminated prior to commercialization. In the first study, Balachandra (1984) asked respondents about selected NPD projects at two stages of the NPD process (i.e., at the initial project approval stage or an early "Go" decision point and again at a more recent "Go/No-Go" decision point). In this study, a discriminant model was developed using a variety of variables related to the Go/No-Go decisions. Commitment to the NPD project by employees and management was found to discriminate between Go and No-Go decisions. While some level of commitment is essential for effective NPD, Balachandra did not examine excessive commitment which may be detrimental to effective NPD.

The second study that focused on terminated NPD projects is by Cooper and Kleinschmidt (1990). These researchers recognized the gap in the literature with respect to the level of understanding of new product Go/No-Go decisions. However, this research focused on project characteristics as well as characteristics of the NPD process (e.g., quality of activities, resources expended) and not the NPD process itself. While the results do provide insight as to how successful NPD projects differ from both failures and killed projects, this study just scratched the surface. Much more can be learned about managerial decision-making at the Go/No-Go points.

To advance, the NPD literature must move away from mostly descriptive research to more theoretically-based research. While much of the past NPD research has lacked a strong theoretical orientation (Brown and Eisenhardt 1995), there are opportunities to develop new theories pertaining to NPD. Theory is important for explaining and predicting phenomena (Hunt 1991). Therefore, theories may be developed, or borrowed from other disciplines and adapted, to increase knowledge in the area of NPD.

2.3. Escalation of Commitment Research

Since escalation of commitment (or simply escalation) is the theoretical foundation of this dissertation research, the pertinent escalation literature is reviewed next. The history of this research stream and key findings are presented in this section of the chapter.

Escalation of commitment situations feature continuation in a course of action despite information that indicates the outcomes are unlikely to be successful (Barton, Duchon, and Dunegan 1989). To an unbiased observer, escalation occurs when a decision-maker invests excessively in a course of action- more than the information or circumstances should warrant (McCain 1986). Stated differently, as Staw (1981, p.578) notes, "It appears that individuals may have a tendency to become locked into a course of action, throwing good money after bad or committing new resources to a losing course of action." Most researchers conclude that the escalation phenomenon repre-sents a departure from optimal decision-making (Bazerman 1984).

2.3.1. History of the Research Stream

The escalation of commitment literature developed from the entrapment literature with the research of Staw (1976) twenty years ago. Entrapment situations are defined as "situations in which a decision-maker may continue to expend resources in part to justify previous expenditures" (Brockner, Shaw, and Rubin 1979, p.492). Another name for entrapment research is the too-much-invested-to-quit syndrome (e.g., Teger 1980). Entrapment research is typically conducted with experimental games that involve the investment of resources (e.g., money) for a potential payoff and increasing risk (i.e., decreasing odds of winning or decreasing amounts of the payoffs) over the course of the game.

The "Dollar Auction Game" is a typical entrapment experiment

conducted with a group of people often in a classroom setting. In this experiment, a dollar bill (or some other monetary unit) is auctioned off to the highest bidder. However, unlike traditional auctions, in this game the second highest bidder must also pay his/her final bid. The bidding process usually progresses rapidly, with all but two people dropping out of the bidding as the amount bid goes higher and higher. The top two bidders typically continue bidding in order to avoid being the second highest bidder (and receiving nothing in return for their bid) and possibly to avoid the potential embarrassment of losing. In such games, it is very common for the bidding to far exceed the actual payoff amount. As Shubik (1971, p.110) notes, "experience has shown that it is possible to 'sell' a dollar for considerably more than a dollar."[1]

Related to escalation of commitment is the sunk cost effect (e.g., Arkes and Blumer 1985; Northcraft and Wolf 1984) where prior investments motivate individuals in future decisions. Whereas logic and formal training dictate that sunk costs cannot be recouped and therefore should be disregarded, they continue to carry weight in future decisions. People consider sunk costs relevant to the decision at hand (Whyte 1993).

---

[1] I auctioned a $5 bill in an undergraduate marketing class that I taught in the summer of 1995. As expected, the bidding began and progressed quickly, until only two students were bidding. The bidding went over $5, much to the puzzlement of the others in the class. The final bids were $8.75 and $8.50 for the $5 dollar bill.

While the key elements across these related research streams is they all involve the initial investment of resources and seemingly paradoxical behavior (Goltz 1987), escalation of commitment was chosen as the theoretical base for this research for several reasons. First, research on the sunk cost effect focuses on the *financial* (or economic) aspects of investment decisions. As such, it views decisions solely from a financial perspective. Decisions that are financially sub-optimal are viewed as departing from rationality. Second, sunk cost research is essentially descriptive and lacks a strong theoretical base. Third, entrapment research has subjects play competitive games of some sort. In comparison, escalation research combines economic and non-economic aspects of decision-making in a strong theoretical base, as will be discussed. Escalation of commitment research asks subjects to role-play decision-makers in a series of related investment decisions by examining feedback information and making decisions based on this information. The role-playing methodology of escalation of commitment research is more suitable to the study of NPD decision-making since it more closely parallels the actual tasks of NPD professionals than the socially competitive games of entrapment research.

In Staw's (1976) seminal escalation research, he had undergraduate business students act as Vice President (V.P.) of Finance of Adams & Smith (A&S), a hypothetical corporation. A&S had the two major operating divisions of consumer and industrial products. Using a 2x2 factorial design

in a 2-part experiment, Staw manipulated personal responsibility (i.e., low or high) and project outcomes (i.e., positive or negative). Students were randomly assigned to the treatment groups.

Based on hypothetical data given to the subjects in Part I of the experiment, both of A&S's operating divisions had experienced diminished yearly earnings over a ten year period preceding the experiment. A&S's board of directors believed that an additional $10 million should be allocated to *one* of the two A&S operating divisions to reverse the earnings decline. This experiment required half of the subjects to allocate the additional funding to the division of his/her choice. The other half of the subjects were told that the *previous* V.P. of Finance had made this initial funding decision, but had suddenly passed away from a heart attack. These two situations comprised the experimental manipulation for personal responsibility (i.e., high and low, respectively).

In Part II of the experiment, regardless of the personal responsibility condition, all subjects were provided yearly data on sales and earnings for the five year period following the initial allocation of the $10 million for R&D. For the positive outcome condition, half of the subjects received information that the division chosen for the additional R&D funding performed better than the division not chosen. Conversely, for the negative outcome condition, the other half of the subjects received information that the division chosen for the additional R&D funding performed worse than the

other division. These two situations represent the manipulation for the positive and negative outcome conditions, respectively.

In this part of the experiment, the subjects were told that A&S management felt an even greater need for R&D investment, and they allocated an additional $20 million for R&D. This time, however, subjects were free to allocate the funding to the two A&S divisions in any proportion they saw fit, unlike in Part I where the subjects chose only *one* of the two divisions to receive the increase in R&D funding. The amount of money allocated at this decision point was the dependent variable in the 2x2 analysis of variance (ANOVA).

The results of this experiment were surprising. Subjects allocated the most money in Part II of the experiment when they were *personally responsible* for the initial decision and when the consequences were *negative.* Interestingly, in both responsibility conditions, subjects allocated more money when the consequences were negative than when they were positive. Staw concluded that the significant interaction of personal responsibility and negative outcomes suggested that individuals may escalate their commitment to failing courses of action due to self-justification. Individuals try to justify to themselves and to others their rationality in past decision-making. Increasing resources may improve the situation and prove the "correctness" of earlier decisions (Staw 1976). Subsequent research has supported Staw's finding of escalation of commitment to a failing course of action in a variety

of situations (e.g., Bazerman, Giulano, and Appelman 1984; Bobocel and Meyer 1994; Brockner, *et al.* 1986; Fox and Staw 1979; McCain 1986; Simonson and Staw 1992; Staw 1976; Staw and Fox 1977).

Previous research by Kiesler (1971) and Salancik (1977) indicates that the following six factors increase one's commitment to an act:

(1) The individual's or group's acts are explicit or unambiguous;
(2) The behavior is irrevocable or not easily undone;
(3) The behavior has been entered into freely or has a high degree of volition;
(4) The act has importance for the individual or group;
(5) The act is public or visible to others; and
(6) The act has been performed a number of times.

The first five factors, above, were prominent in Staw's seminal research.

2.3.2. Antecedents of Escalation of Commitment

Since its inception, research in the social and organizational psychology literatures has examined the determinants of commitment to a failing course of action. To make sense of past escalation research, Staw and Ross (1987) classified these determinants into four categories: project, psychological, social, and structural determinants. Each of these four will be discussed below.

Project Determinants. **Project determinants** are the rational or economic components of the project and include such things are market share, estimated sales volumes and profits, and financial performance measures (e.g., net present value, internal rate of return, and return on investment).

For example, projects with low salvage values (i.e., the value of a project that is abandoned prior to completion) typify most NPD projects. The firm earns zero (or negative) financial returns if the project is terminated prior to launching it into the market. Consequently, managers may escalate their commitment by continuing with NPD projects. Similarly, projects with potentially large payoffs, or those with long time horizons between financial investment and return, both of which characterize many NPD projects, make terminating a project more difficult (Northcraft and Wolf 1984; Staw and Ross 1989).

Basic accounting and finance courses train managers to make "rational" decisions by ignoring sunk costs. By definition, sunk costs have already been incurred and are irretrievable, and therefore should not be considered when making financial calculations and decisions. However, while sunk costs may be irretrievable in reality, they may not be sunk psychologically (Fox and Staw 1979; Staw 1981; Staw and Ross 1987) and may still enter into decision-making (i.e., decision-makers may feel "responsible" for them, and in fact, top managers may hold them responsible at some future date).

In addition to the inability to ignore sunk costs when making subsequent investment decisions, other reasons for this paradoxical behavior have been proposed. Outside observers, not involved with the project, often see the futility of pursuing a course of action further. Whereas project

determinants are termed the economic or rational aspects of projects, the other three categories are the non-economic components of escalation.

Psychological Determinants. Numerous **psychological determinants** may either induce errors in decision-making or commit individuals to courses of action (Staw and Ross 1987). While there are several categories of psychological determinants, self-justification and information processing have received the most research attention. While escalation is a complex phenomenon, the mechanism most closely associated with escalation is **self-justification** (Aronson 1984; Bazerman, *et al.* 1984; Brockner 1992; Simonson and Staw 1992; Staw and Ross 1987). This viewpoint stems from Festinger's (1957) theory of cognitive dissonance which holds that people tend to try to reduce sources of cognitive inconsistency (e.g., incongruency between a one's perception or desires and reality). Because of one's unwillingness to admit failure to oneself and others, he/she becomes locked into a previous course of action. Abandoning a previously chosen course of action, even if ineffective, equates to admitting failure, and this may greatly disturb individuals (Brockner *et al.* 1986). As Staw and Ross (1987, p.51) state, "decision-makers may seek to justify an ineffective course of action by increasing their commitment to it" in hopes of reversing the situation.

With respect to information processing, psychological determinants can cause one to misperceive or miscalculate losses and induce errors in

decision-making. Research has shown that individuals can and may **bias information** in the direction of previously held beliefs and preferences (Gilovich 1983; Lord and Lepper 1979; Nisbett and Ross 1980). Furthermore, Staw and Ross (1978) showed that individuals may interpret information differently after a successful outcome compared to an unsuccessful one.

The **framing effect** is another information processing driver of commitment in a course of action. Kahneman and Tversky (1979) coined the term "framing effect" to describe situations where individuals risked more in situations that were described in terms of losses rather than in terms of gains (e.g., 60 percent chance of success versus a 40 percent chance of failure). Individuals are more risk averse when problems are framed in the positive direction and risk seeking when problems are framed in the negative direction. While Bazerman (1984) and Whyte (1986) suggested that the escalation of commitment phenomenon may be explained by the way a problem is framed, Schoorman *et al.* (1994, p.526) concluded that "escalation does not appear to be a product of the framing of the feedback, as has been suggested by the literature." However, to avoid confounding outcome explanations, escalation research should be carefully conducted by framing the problem and information in a neutral manner.

Social Determinants. The third category is **social determinants** which can cause one to stay on a course of action due to social pressures. Social

determinants include, but are not limited to, norms for consistency, face-saving (i.e., external justification) and public identification with a project.

With respect to norms for consistency, Staw and Ross (1980) found that administrators that followed a course of action through completion, rather than changing mid-stream, were rated as more effective leaders. As Staw (1981, p.580) claims, "A lay theory may exist in our society, or at least within many organizational settings, that administrators who are consistent in their actions are better leaders than those who switch from one line of behavior to another." Successful project outcomes also lead people to rate leaders higher than when project outcomes are unsuccessful, as expected. However, the most highly rated administrators were found to be those that remain committed to a *failing* course of action until they turned the situation around and achieved success (Staw and Ross 1980). This "hero effect" appears to be common in Western cultures.

Public identification with a project also makes it difficult to curtail a losing venture. For example, projects may become associated with an individual, a team, or even an organization. Work by Fox and Staw (1979) and Brockner *et al.* (1981) found individuals increase their commitment to prevent loss of face. Stakeholders (e.g., *Wall Street* analysts, channel members, and customers) expect a product to reach the market after they learn that it is in development. Consequently, pulling the plug on a project may cause embarrassment for a manager, a devaluation of a firm's market

value resulting from a fall in the price of the stock, and a general feeling of failure among members of the organization.

Structural Determinants. The last category is **structural determinants**. Whereas project determinants focus on the economic aspects of the project, psychological and social determinants center on the decision-maker and other individuals within and external to the organization. However, structural determinants focus on characteristics of the organization and the organization's culture that may make it difficult to change a course of action. Structural determinants may include capital acquisition and its salvage value, compensation/reward systems, institutionalization of values, missions, and goals, and technical and economic side-bets. For example, technical and economic side-bets are incurred when firms embark on developing innovative new products and technologies. Often firms must make strategic decisions by choosing a particular technology or by making other decisions that are not easily undone. The development and commercialization of new products often necessitates acquiring new equipment or new plants, hiring and training of staff, developing distribution channels, and so on. These are large capital acquisitions that may have long-term ramifications.

Often, "a project is tied integrally to the values and purposes of the firm" (Staw and Ross 1987, p.62). Such institutionalization of values implies that projects are often taken for granted rather than examined objectively.

Structural determinants are strongly related to social determinants. For example, even when an individual decision-maker can take off the institutional blinders, it may be difficult, politically unpopular, and perhaps detrimental to one's career to terminate a project that is supported by upper management or a higher level product champion.

In sum, commitment occurs for a variety of reasons. It has been proposed that a project that involves the outlay of capital over stages (e.g., R&D and NPD projects) is initiated for "rational" (economic) reasons (i.e., project determinants). However, over the project's life, non-economic (i.e., psychological, social, and structural) factors can and may increase commitment to a course of action (Staw and Ross 1987).

2.3.3. Key Findings in the Literature

Staw's (1976) research essentially began the escalation of commitment literature stream, and this seminal study has been replicated and extended in a variety of contexts. The escalation literature has grown to be of fairly modest size, and the key pieces of research are summarized in Table 2.1. Sample sizes and types, experimental methods, tasks, and manipulated independent variables, as well as key findings appear in Table 2.1.

The escalation of commitment phenomenon is robust since Staw's (1976) paradoxical results have been replicated in a variety of contexts by various researchers (e.g., Bazerman, *et al.* 1984; Bobocel and Meyer 1994;

TABLE 2.1
Summary of Selected Studies on Escalation of Commitment

Author (Year)	Determ-inant(s)[a]	Task	Sample[b]	Method[c]	Manipulation(s)	Key Finding(s)
Staw (1976)	P,ψ	R&D funding to 1 of 2 corp. divisions	240 UG	E	Level of personal responsibility. Project outcome.	Commitment greater under high responsibility. Commitment greater under negative outcome conditions. (Interaction effect).
Staw & Fox (1977)	P,ψ	Same as Staw (1976)	96 UG	E	Level of personal responsibility. Level of per-formance in past. Gender. Time.	Same as Staw (1976). More resources allocated when past performance was higher. No gender effect. Investment patterns unstable over time.
Staw & Ross (1978)	P,ψ	Bank allocation officer	120 UG	E	Project outcomes. Endogenous/ex-ogenous cause of negative outcomes.	Greater attention paid to information after failures. Escalation greatest after prior failure & exogenous setback.
Fox and Staw (1979)	P,ψ,S	Similar to Staw (1976)	160 UG	E	Levels of job insecurity & high policy resistance. Gender.	Subjects allocated significantly more resources under conditions of high job insecurity and policy resistance. No interaction effect. No gender effect.

(Continued)

TABLE 2.1 (Cont'd)

Author (Year)	Determ-inant(s)	Task	Sample	Method	Manipulation(s)	Key Finding(s)
Staw & Ross (1980)	P,ψ,S	Performance-ratings of managers	222 (127 UG, 95 P)	E	Consistency in course of action. Project outcome.	Administrators were rated most highly when consistent in course of action & ultimately successful.
Bateman (1986)	P,ψ	Similar to Staw (1976)	◐ 99 UG	E	◐ Success/failure. Probability of success for chosen/ unchosendivision Gender.	◐ Information about success has greater impact after failure. Escalation occurred for males.
	P,ψ,S		● 80 UG	E	● Same as above without the per-formance. manipulation. Causal attributions.	● Men commit more money to failures when they are responsible (rather than exogenous cause). The opposite is true for women.
Garland (1990)	P	Managerial investment decision	407 UG	E	Percentage of project completed.	Willingness to allocate additional resources increased positively & linearly as the per-centage of the project completed increased.
Garland, Sandefur, & Rogers (1990)	P	Oil drilling	◐ 197 E ● 38 E ● 77 UG	M M E	Number of dry wells.	As the number of dry wells increased, subjects de-escalate commitment.
Armstrong, Coviello, and Safranek (1993)	P	Similar to Staw (1976)	◐ 80 GS ● 55 UG ● 105 UG ◐ 127 UG	E E E E	Project outcomes.	No significant occurrences of escalation in any of the experiments.
Bobocel & Meyer (1994)	P,ψ,S	Production strategy	137 UG (males)	E	Public, private and no justification.	Justification (public or private) is needed for escalation.

(Continued)

TABLE 2.1 (Cont'd)

Author (Year)	Determ-inant(s)	Task	Sample	Method	Manipulation(s)	Key Finding(s)
Schoorman, *et al.* 1994	P,ψ	❶Similar to Staw (1976)	187 UG	E	❶Level of personal responsibility. Framing effect.	High responsibility subjects commit more.
		❷Acquisition of firm case	274 UG	E	❷Framing effect. Amt. of information.	Subjects in positive frame were less risky. As the amount of information, increased the framing effect decreased.
Boulding, Morgan & Staelin (in process)	P,S	Launch new product & continue or withdraw from market	102 M	E	Decision aids for Go/No-Go decisions	Escalation in new product decisions causes overcommitment to products that should be withdrawn from the market.

[a]Determinants: (P) = Project; (ψ) = Psychological; (S) = Social; (T) = Structural.
[b]Sample size & type: UG = Undergraduate students; GS = Graduate students; M = Managers; E = Experts.
[c]Method: E = Experiment, M=Mail survey.

Brockner, *et al.* 1986; Conlon and Wolf 1980; Fox and Staw 1979; McCain 1986; Simonson and Staw 1992; Staw and Fox 1977). However, not all researchers have found escalation of commitment to occur. For example, Garland, Sandefur, and Rogers (1990) found that experts in the field of oil drilling de-escalated their commitment as the number of dry wells (a type of "failure") increased. This is not a surprising result when one considers their experimental task. Subjects were placed in various scenarios where the maximum number of oil wells that could be drilled on the parcel of land was five. The subjects were given negative feedback (i.e., the number of dry wells on a particular parcel of land) and asked if they would continue drilling other wells (up to five, maximum). Not surprisingly, Garland *et al.* (1990) found that as the number of dry wells increased, subjects de-escalated their commitment. This study only tapped project determinants and omitted psychological, social, and structural ones. Garland *et al.* (1990, p.726) themselves state, "the fact that our scenarios excluded the type of detailed data and *social pressures* usually present in oil-exploration ventures may have contributed to the overall level of rationality observed" (emphasis added).

In addition, a few other studies failed to replicate Staw's findings (e.g., Armstrong *et al.* 1993; Singer and Singer 1986), and some scholars are critical of the escalation phenomenon. For example, as mentioned previously, Bazerman (1984) and Whyte (1986) suggested that the way a problem is

framed may explain the escalation of commitment phenomenon, although they offered no empirical evidence. Northcraft and Wolf (1984) propose a lifecycle model to guide resource allocation decisions which is essentially discounted cash flow analysis focusing solely on economic determinants.

However, the most glaring oversight of most of these critics is that they typically neglect the notion that escalation of commitment involves two components: (1) the rational or economic aspects of a project, and (2) the non-economic components. The economic aspects are the project determinants, while the non-economic aspects represent the psychological, social, and structural determinants or projects. Both economic and non-economic components are necessary for escalation of commitment to occur (Staw and Ross 1987). Research that omits the non-economic aspects (e.g., Conlon and Wolf 1980; Garland *et al.* 1990; Northcraft and Wolf 1984) are misconstruing the escalation of commitment phenomenon.

Although escalation of commitment is an important area of decision-making research (Bazerman 1984), to date, escalation theory has been relatively untapped by researchers in marketing. In the only study on escalation of commitment published in the marketing literature to date, Armstrong *et al.* (1993) conclude that escalation of commitment does not occur in marketing management decisions and should not be of concern. This research, however, is not without limitations. For example, small sample sizes were used, and there is no evidence that the authors conducted

manipulation checks to insure that their manipulations were effective. Consequently, it seems premature to conclude that escalation of commitment is not a problem in any marketing management decisions.

2.4. Escalation of Commitment in the New Product Development Process

The escalation of commitment literature offers a rich theoretical and empirical base from which to study the NPD process. Conceptually, there are close parallels between traditional escalation research and NPD. First, both involve the sequential commitment of financial resources. Second, as in typical escalation situations, NPD projects offer opportunities for withdrawal or continuation. The gates in the stage-gate process offer opportunities to review a project and terminate it if desired. Third, the ultimate success or failure of the course of action is unknown in advance.

In the past, researchers have hinted at the idea of escalation of commitment in the new product process. For example, Balachandra (1984) notes that "individuals get emotionally involved in the [NPD] project and are very reluctant to terminate it, even if there are many clear signals that the project is not going to be successful" (p.92). Hustad and Mitchell (1982) further developed the idea of the bandwagon effect which was originally proposed by Chambers *et al.* (1971) by claiming that it explains the extraordinary effect people put forth when they are *emotionally involved* in

NPD projects (emphasis added). Multiple, biased revisions of the financial analyses, organizational politics, and mounting sunk costs result in so much money and effort invested, that the new product is carried through to commercialization. Leatherwood and Conlon (1988) suggest that NPD decisions should be similar to R&D decisions with respect to escalation. While escalation of commitment has been tested in a wide variety of situations over the past twenty years, it has only very recently been examined in the context of NPD decisions.

In the first study to explore escalation of commitment and new product decisions, Boulding, Morgan, and Staelin (1995) studied escalation of commitment in the post-commercialization stage and found that escalation occurs in this stage of the NPD process. Boulding *et al.* focused on decision-aids (i.e., "stopping rules") that were hypothesized to reduce commitment in these new product decisions. In a study similar to Staw's (1976), subjects were presented with projected financial performance information and asked to make a decision to either launch or "kill" a hypothetical new product project. The majority of subjects decided to launch the new product since the forecasted performance information provided was very positive. This was designed to create a high level of personal responsibility for the project among all participants. Subjects were again presented with hypothetical financial information supposedly two years after the commercialization of the product. Subjects were again asked to review hypothetical financial

information and decide to continue with the product or to withdraw it from the market. At this stage, however, the financial performance information presented to the subjects was negative. The base condition (i.e., no decision aid), led Boulding *et al.* to conclude that "managers remain committed to a losing course of action in the context of new product introductions... [and] escalation of commitment is a major problem associated with new product introductions" (p.22).

While this paper makes a contribution to the NPD literature, it also has a major limitation. While Boulding *et al.* (1995) focused on commitment in the post-launch control decision, the propensity for escalation of commitment is greatest during the NPD process, not after the product is commercialized. Since the vast majority of costs are incurred during the commercialization stage due to production start-up and large advertising and promotional campaigns, it is important to terminate NPD projects *before* they reach this point. After the product is commercialized, the machinery is purchased, the people are trained, the distribution channels are in place, and the initial advertising campaign is completed. Managers should stop NPD projects prior to commercialization if the projects are headed for failure.

Prior to commercialization, managers rely on marketing research (e.g., test markets), product testing, and financial forecasts to assess the likely success of a new product. After commercialization, managers rely on actual sales and profitability figures. It is expected that commitment to a failing

new product is much less likely after the new product is launched than during the NPD process since as stated by Simonson and Staw (1992, p.420), there is "little doubt that people will withdraw from an investment situation when the *economic facts become sufficiently negative and clear cut*" (emphasis added). Therefore, if one assumes this is true, based on the work of Boulding *et al.* (1995), escalation of commitment during the NPD is a serious problem.

Furthermore, one would expect the level of commitment to change over the NPD process. Cooper (1993) claims that it is easier to kill NPD projects prior to the development stage. "After that point, resources are committed, people become intensely involved..., and so killing a poor project becomes more and more difficult" (Cooper 1993, p.168). Table 2.2 further develops the notion that the level of commitment may change over a NPD project as the various categories of determinants change.

Stage 1 *Promising Future Outcomes.* In the opportunity identification stage, financial considerations drive the new product decisions. Managers commit to and invest in products and processes that fit corporate strategy and that are expected to offer the greatest financial rewards.

Stage 2 *Receipt of Questionable Outcomes.* Psychological determinants appear in the second stage which serve to justify or reinforce the initial decision, while the project determinants diminish as negative information is received. Additionally, other psychological determinants become important

as the project progresses. Decision-makers may bias information or ignore information that lessons the appropriateness of the initial decision.

Table 2.2
Escalation Determinants Over the Stages of a Failing New Product Development Project

Determinant	Stage 1 Opportunity Identification	Stage 2 Marketing & Technical Assessment	Stage 3 Development & Testing	Stage 4 Commer-cialization	Stage 5 Post-Commer-cialization
Project	++	+	0	-	--
Psychological	n/a	+	+	0	0
Social	n/a	n/a	+	+	0
Structural	n/a	n/a	n/a	+	+

Key: ++, +, 0, -, -- = strongly positive, positive, neutral, negative, and strongly negative effects on escalation, respectively.

(Adapted from Staw and Ross 1987)

Stage 3 *Receipt of Negative Outcomes.* By the third stage of the NPD project, social determinants (in addition to psychological determinants) put pressure on the organization to maintain the present course of action. Stakeholders in the company often react negatively to a sudden change in strategy, and/or the firm may become identified with a certain line of business. Therefore, the decision-maker may opt to "save face" and to avoid

appearing indecisive by deciding to follow the initial course of action. Still more resources are devoted to reinforcing the initial decision.

Stage 4 *Receipt of Highly Negative Outcomes.* By the fourth stage, psychological determinants diminish as the person responsible for the initial decision recedes in the memory of higher level managers and stakeholders. However, the social and structural determinants pressure the decision-maker to maintain the present course of action decision. The subject firm has made significant investments in plants and equipment (i.e., economic and technical side-bets), distribution channels, advertising and promotional campaigns, and inventory. Perhaps tax abatements have been given over the years which makes a production facility very costly to close down and difficult due to legal ramifications.

Stage 5 *Post-Commercialization Control.* After the product has been commercialized, *actual* (rather than forecasted) financial performance feedback is available to decision-makers. The effects of the other categories of determinants lessen as the financial viability of keeping the product on the market becomes the most important determinant of maintaining or terminating the product. At this point the losses are sufficiently negative and obvious such that termination of the project is the obvious solution.

2.5. Research Questions and Hypotheses

Based on the objectives set forth for this dissertation and the review of the literature, the following eight research questions were addressed by this research:

(1) Does the level of personal responsibility for initiating a NPD that is subsequently failing affect the level of commitment to that project?

(2) Does the level of product innovativeness affect the level of commitment to a failing NPD project?

(3) Does the level of credibility of the source that provides information during a failing NPD project affect the level of commitment to that project?

(4) For different levels of product innovativeness, does the level of personal responsibility for initiating a NPD project that is subsequently failing affect the level of commitment to that project?

(5) For different levels of information source credibility, does the level of personal responsibility for initiating a NPD project that is subsequently failing affect the level of commitment to that project?

(6) For different levels of product innovativeness, does the level of information source credibility affect the level of commitment to a failing NPD project?

(7) For different levels of personal responsibility and product innovativeness, does the level of information source credibility affect the level of commitment to a failing NPD project?

(8) How does the level of commitment to a failing NPD project change over the NPD process?

These research questions were addressed by the research hypotheses which follow. For the between-subjects hypotheses, the hypotheses end in either "a", "b", or "c" to denote stages 2, 3, and 4, respectively, as shown in

Figure 2.1. Table 2.3 summarizes the research questions and the corresponding hypotheses.

2.5.1. Between-Subjects Hypotheses

In Staw's (1976) seminal escalation research, he found that individuals that were personally responsible for initiating a course of action that was performing poorly escalated their commitment to their original decision. Conversely, for individuals that did not make the original investment decision, no significant difference was found in the amount invested for positive and negative outcomes. The finding that personally responsible individuals escalate their commitment to a failing course of action has been replicated by other researchers in a variety of decision-making experiments (e.g., Boulding *et al.* 1995; Schoorman *et al.* 1994; Staw and Fox 1977; Whyte 1991). Since self-justification is a key mechanism believed to lead to escalation, it is logical that personal responsibility induces self-justification, which leads to escalation of commitment. The relationship between personal responsibility and escalation was expected to hold in NPD contexts at the decision-making points prior to commercialization. After the product was commercialized, the financial loss was actual rather than forecasted. Additionally, the loss was sufficiently large and obvious, so no significant difference in commitment was expected at the post-commercialization stage.

Table 2.3
Summary of Research Questions and Corresponding Hypotheses

Research Questions	Hypotheses[a]	Effects
1) Does the level of personal responsibility for initiating a NPD that is subsequently failing affect the level of commitment to that project?	H1a,b,c H2a,b,c	PR → BC[b] PR → SRC[b]
2) Does the level of product innovativeness affect the level of commitment to a failing NPD project?	H3a,b,c H4a,b,c	PI → BC[b] PI → SRC[b]
3) Does the level of credibility of the source that provides information during a failing NPD project affect the level of commitment to that project?	H5a,b,c H6a,b,c	ISC → BC[b] ISC → SRC[b]
4) For different levels of product innovativeness, does the level of personal responsibility for a NPD project that is subsequently failing affect the level of commitment to that project?	H7a,b,c H8a,b,c	PR*PI → BC[b] PR*PI → SRC[b]
5) For different levels of information source credibility, does the level of personal responsibility a NPD project that is subsequently failing affect the level of commitment to that project?	H9a,b,c H10a,b,c	PR*ISC → BC[b] PR*ISC → SRC[b]
6) For different levels of product innovativeness, does the credibility of the source of the information received during a failing NPD project affect the level of commitment to that project?	H11a,b,c H12a,b,c	PI*ISC → BC[b] PI*ISC → SRC[b]
7) For different levels of personal responsibility and product innovativeness, does the credibility of the source of the information received during a failing NPD project affect the level of commitment to that project?	H13a,b,c H14a,b,c	PR*PI*ISC → BC[b] PR*PI*ISC → SRC[b]
8) How does the level of commitment to a failing NPD project change over the NPD process?	H15-H28	All of the above * NPD[c]

Key: [a]a,b, and c represent hypotheses for stages 2, 3, and 4, respectively.
[b]Between-subjects effect hypothesized to be positive for stages 2 and 3 and zero for stage 4.
[c]Within-subjects effects hypothesized to decrease over stages 2, 3, and 4.

PR = personal responsibility for initiating a NPD project that is subsequently failing.
PI = product innovativeness.
ISC = information source credibility.
BC = behavioral intention measure of commitment.
SRC = self-reported measures of commitment.
NPD = stage of the NPD process (i.e., 2, 3, 4).

H1a,b,c: Under a condition of high personal responsibility, individuals will have a higher level of behavioral commitment to a failing NPD project than under a condition of low personal responsibility at stages 2 and 3, with no significant difference at stage 4.

H2a,b,c: Under a condition of high personal responsibility, individuals will have a higher level of self-reported commitment to a failing NPD project than under a condition of low personal responsibility at stages 2 and 3, with no significant difference at stage 4.

New products differ with respect to the degree of "newness"; not all new products are innovative. Radical innovations and incremental improvements represent opposite ends of the spectrum. Highly innovative products offer new, unique, or superior solutions to users' needs, and they may create markets that did not exist previously. Such innovations may stem from technological discontinuities (Foster 1990) which essentially create new generations of technology with performance superior to that of the previous technology. The Sony Walkman, integrated circuit, and radial tire are examples of this type of product. In contrast, incremental improvements include line extensions, repositionings, cost reductions, and "me-too" products. These products may or may not be new to the firm, but they definitely are not new to the market. Also, the marketing and manufacturing methods for such products are well known to the firm or industry.

New product development managers, employees, and even entire organizations have a tendency to become enamored with innovative new products. These individuals see the potential benefits that users can gain

from such products. In addition, radical innovations provide the possibility of hitting a 'home run.' Innovative new products may provide the opportunity to define the market or technological standards, create barriers to competitor's entry, and provide above-normal economic returns. Not surprisingly, past research repeatedly has shown that product superiority is critical to achieving new product success (Cooper 1979; Cooper and Kleinschmidt 1987; Song and Parry 1994). Cooper (1993, p.58) notes that "superior products that deliver real and unique advantages to users tend to be far more successful than 'me-too' products with few positive elements of differentiation." From this discussion, it was expected that individuals would escalate their commitment under conditions of high product innovativeness compared to low product innovativeness at stages 2 and 3.

H3a,b,c: Under a condition of high product innovativeness, individuals will have a higher level of behavioral commitment to a failing NPD project than under a condition of low product innovativeness at stages 2 and 3, with no significant difference at stage 4.

H4a,b,c: Under a condition of high product innovativeness, individuals will have a higher level of self-reported commitment to a failing NPD project than under a condition of low product innovativeness at stages 2 and 3, with no significant difference at stage 4.

In all escalation of commitment research, information is provided to the subjects to assist them in making investment decisions in the experiments. Likewise, in actual NPD projects, decision-makers receive information to assist them in making decisions. However, researchers have

not yet examined how the credibility of the information source affects the level of commitment. Though individuals bias information to fit previously held beliefs and preferences (Gilovich 1983; Lord and Lepper 1979; Nisbett and Ross 1980; Taylor and Brown 1988), if information is received from credible sources, then decision-makers will be more likely to believe it (Hewgill and Miller 1965; Miller and Hewgill 1966). When negative information is received from credible sources, it is more difficult to discount it. When negative information is presented to decision-makers from a source that is not credible, the decision-maker will find it easier to discount or ignore the information and continue in the present course of action.

H5a,b,c: Under a condition of low information source credibility, individuals will have a higher level of behavioral commitment to a failing NPD project than under a condition of high information source credibility at stages 2 and 3, with no significant difference at stage 4.

H6a,b,c: Under a condition of low information source credibility, individuals will have a higher level of self-reported commitment to a failing NPD project than under a condition of high information source credibility at stages 2 and 3, with no significant difference at stage 4.

The relationship between the level of personal responsibility (PR) and commitment may be moderated by the level of product innovativeness (PI). It is hypothesized that individuals escalate their commitment if they are personally responsible for initiating a project that is subsequently performing poorly or if the product is innovative. Therefore, individuals in the high PR -

high PI condition should have the highest level of commitment while those in the low PR - low PI condition should have the lowest commitment.

H7a,b,c: With respect to the level of behavioral commitment to a failing NPD project, there will be a significant, positive interaction effect between the levels of personal responsibility and product innovativeness at stages 2 and 3, and no significant interaction at stage 4.

H8a,b,c: With respect to the level of self-reported commitment to a failing NPD project, there will be a significant, positive interaction effect between the levels of personal responsibility and product innovativeness at stages 2 and 3, and no significant interaction at stage 4.

The relationship between PR and commitment may be moderated by the level of the credibility of the information source. Since escalation of commitment is less likely to occur under conditions of low PR, the credibility of the information source should have little impact on the level of commitment. Under high PR, subjects receiving information from sources with low credibility will have the highest level of commitment. Since individuals bias information to fit preexisting beliefs and desires, under conditions of high PR, negative information is likely to be biased, discounted, or ignored since the individual desires to justify the correctness of his/her decision. If the source providing the information is not credible, then the information is more easily overlooked, and escalation of commitment should be greatest. In situations where the source of the information is credible, it will be more difficult to ignore or bias the information, and commitment will be higher than under low PR situations but will be lower than under low ISC

conditions. However, this difference was predicted to disappear under conditions of high PR. Consequently, under high PR conditions, escalation should occur equally for high and low ISC. If information is received from credible sources, then decision-makers will be more likely believe it (Hewgill and Miller 1965; Miller and Hewgill 1966). When information is from credible sources, it is more difficult to discount negative information. When negative information is presented to decision-makers from a source that is not credible, the decision-maker will find it easier to discount or ignore the information and continue in the present course of action. These relationships are stated formally in hypotheses 9 and 10 below.

H9a,b,c: With respect to the level of behavioral commitment to a failing NPD project, there will be a significant, negative interaction effect between the levels of personal responsibility and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

H10a,b,c: With respect to the level of self-reported commitment to a failing NPD project, there will be a significant, negative interaction effect between the levels of personal responsibility and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

The relationship between PI and the level of commitment to a failing NPD project may be moderated by the level of ISC. Under conditions of low PI, escalation of commitment is less likely to occur. Consequently, ISC should have little impact on commitment in such scenarios. However, commitment is hypothesized to be greater for innovative products than for marginally innovative products. Furthermore, under conditions of low PI and high ISC,

commitment to a failing NPD project will be lower than under conditions of high PI and low ISC.

H11a,b,c: With respect to the level of behavioral commitment to a failing NPD project, there will be a significant, negative interaction effect between the levels of product innovativeness and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

H12a,b,c: With respect to the level of self-reported commitment to a failing NPD project, there will be a significant, negative interaction effect between the levels of product innovativeness and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

A three-way interaction between PR, PI, and ISC was hypothesized in this research. However, Iversen and Norpoth (1987) note it is difficult to understand the meaning of large interactions since theories in the social sciences are typically not developed well enough. Nonetheless, a three-way interaction is expected since at a minimum, under the condition of high PR, high PI, and low ISC, commitment should be greater than under the condition of low PR, low PI, and high ISC.

H13a,b,c: With respect to the level of behavioral commitment to a failing NPD project, there will be a significant interaction effect between the levels of personal responsibility, product innovativeness, and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

H14a,b,c: With respect to the level of self-reported commitment to a failing NPD project, there will be a significant interaction effect between the levels of personal responsibility, product innovativeness, and information source credibility at gates 2 and 3, and no significant interaction at gate 4.

2.5.2. Within-Subjects Hypotheses

Since the last research question centers on the how commitment changes over the NPD process, hypotheses were developed for the effects of PR, PI, and ISC on commitment over the three stages of the NPD process (i.e., stages 2, 3, and 4 in Figure 2.1). Essentially, each main and interaction effect that was presented previously was hypothesized to interact with the stage of the NPD process. The within-subjects hypotheses are summarized in Table 2.4.

While most escalation research examined the level of commitment over only a single period, Staw and Fox (1977), Garland (1990), and Garland, *et al.* (1990) examined escalation over multiple periods. Staw and Fox found the dollar amount invested in R&D remained fairly constant over the repeated trials under conditions of low PR. Under conditions of high PR, commitment significantly decreased at period 2, and then significantly increased in period 3, resulting in a U-shaped curve. From this study, Staw and Fox concluded that commitment did not diminish over repeated trials despite consistently negative feedback. However, there are three issues that need to be noted before applying these findings to NPD situations. First, while the performance feedback in Staw and Fox's experiment was negative in all conditions, this feedback did not grow significantly more ominous over repeated trials but remained fairly constant. Second, this study centered on

R&D funding of business units and not a specific project with definitive ending point. Third, as with Staw's (1976) original experiment, the dependent variable was the dollar amount allocated by the subjects in contrast to NPD projects in which the costs required for the next stage are generally known and decision-makers are able to authorize continuation or termination of the project.

Table 2.4
Summary of Within-Subjects Hypotheses

Hypotheses	Effects
H15	PR*NPD → BC
H16	PR*NPD → SRC
H17	PI*NPD → BC
H18	PI*NPD → SRC
H19	ISC*NPD → BC
H20	ISC*NPD → SRC
H21	PR*PI*NPD → BC
H22	PR*PI*NPD → SRC
H23	PR*ISC*NPD → BC
H24	PR*ISC*NPD → SRC
H25	PI*ISC*NPD → BC
H26	PI*ISC*NPD → SRC
H27	PR*PI*ISC*NPD → BC
H28	PR*PI*ISC* NPD → SRC

Key:
PR = personal responsibility for initiating a NPD project that is subsequently failing
PI = product innovativeness
ISC = information source credibility
NPD = stage in the new product process (i.e., 2, 3, 4)
BC = behavioral intention measure of commitment
SRC = self-reported measures of commitment

Garland (1990) found that the willingness to allocate money to a risky project increased positively and linearly as the project moved closer to completion. However, the only information that Garland presented to subjects at each stage in this experiment was the amount of money that had already been spent on the project and the percent of the project already completed. Two factors may account for the individuals continuing the project. First, the lack of *any* performance feedback failed to indicate that the project should be terminated. Second, the project was framed in terms of the percent completed. Taken together, the "logical" decision was to continue the project.

A final noteworthy study that examined commitment over stages is Garland *et al.* (1990). These researchers found the likelihood of authorizing funds to drill the next oil well decreased linearly as more non-producing wells were drilled. While this study has some shortcomings, as noted previously, the performance feedback was increasingly negative and there was a definitive end to the project (i.e., a set maximum number of oil wells that could be drilled).

From these studies, insight can be gained as to how commitment changes over the stages of a failing NPD project. If the performance feedback grows increasingly negative, the project has a specific ending point, and the costs required to complete each stage are known, as is the case with failing NPD projects, commitment will likely decrease and converge between the

various experimental conditions over the project. As the project progresses, with increasingly negative performance information and rapidly accelerating costs, high PR individuals will find it increasingly difficult to bias or ignore negative information and remain committed. Likewise, under conditions of high PI (or low ISC), the actual performance feedback after a product is commercialized will dominate the effects of PI (or the credibility of the information source) thereby decreasing commitment to that project.

2.6 Summary

This chapter provided the theoretical foundation for this dissertation research. The literature review achieved three objectives: (1) noted past accomplishments and opportunities to advance NPD research, (2) established a conceptual link between NPD and escalation of commitment, and (3) acted as a base to develop the research questions and hypotheses.

Chapter 3 details the research design employed in this dissertation research. Included in Chapter 3 are details on the experimental subjects, sample size, experimental instrumentation and procedures, and steps taken to statistically analyze the data.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

> Random experiments provide a strong basis for hypothesis testing, that is, they allow the rigorous testing of causal hypotheses, and represent the most desirable, though sometimes unattainable, conditions for hypothesis testing (Wildt and Ahtola 1978, p.18).

3.1. Design of Study and Overview of Chapter

Since most threats to internal validity can be reduced by means of controlled experiments (Cook and Campbell 1979), a new product development (NPD) decision-making experiment was used to test the research hypotheses developed in Chapter 2. Experimental designs have been infrequently used in NPD research (Montoya-Weiss and Calantone 1994), perhaps because researchers in this area tend to concentrate on external validity or because the research questions are better addressed with other methodologies. However, internal validity is essential to establishing true causal relationships (Cook and Campbell 1979).

In this research, a 2x2x2x3 experimental design was used. While most escalation studies use a single, behavioral dependent variable, two constructs were used in this research which are believed to better account for the escalation of commitment phenomenon. The first construct is behavioral commitment and is similar to that used by other researchers that studied escalation of commitment. The second construct is the level of self-reported

commitr

The ind

for init

innovat

source

process

constitu

subject

design

procedu

sample

presen

Next, t

analyz

3.2.

3.2.1.

busine

[1] Hereaf
fail un
feedbac
is likely

commitment to a NPD project that appears to be heading towards failure[1]. The independent variables are: (1) the level of personal responsibility (PR) for initiating a NPD project that is subsequently failing, (2) the level of innovativeness of a new product (PI), and (3) the level of credibility of the source (ISC) providing new product performance information during the NPD process. All three independent constructs were manipulated so as to constitute *either* a high or low condition, thus forming an eight-cell, between-subjects design. In addition, a repeated measures (i.e., within-subjects) design was used which required each subject to repeat the experimental procedure at three sequential stages in a hypothetical NPD project.

In this chapter, the type of experimental subjects is described, and the sample size calculations used in the planning stages of the research are presented. In addition, the experimental tasks and instrument are detailed. Next, the experimental procedures are delineated. Statistical procedures for analyzing the experimental data are outlined.

3.2. Experimental Subjects

3.2.1. Source of Subjects

Most escalation of commitment studies have used undergraduate business and psychology students as experimental subjects. However, a few

---

[1] Hereafter referred to as a 'failing' NPD project for brevity. While a product cannot fail until it is actually commercialized, the forecasted product performance feedback (from product and market testing, for example) can indicate that failure is likely.

studies have used different populations. For example, graduate students have been used in a small number of studies (e.g., Armstrong *et al.* 1993; Whyte 1991, 1993) with the notion that graduate students have more training in decision-making and therefore are more like actual managers.

In this dissertation research, the experimental subjects were business people that were currently attending part-time (i.e., executive) MBA programs. This population was chosen to insure that the manipulations and financial information contained in the experiment were effective and meaningful, as well as to increase the external validity of the experiment. Boulding, Morgan and Staelin (1995) likewise used managers in executive programs as experimental subjects in their study on de-escalation techniques in NPD.

Business schools in three Michigan universities were specifically selected to participate in this research since they have large executive MBA programs with students who have substantial professional work experience, are employed full-time, and only take classes part-time. Michigan State University's MBA program does not meet these criteria, and was not used in this research as a source of subjects.

3.2.2. Sampling Procedure

A convenience sample was used in this research. Professors at the selected universities were requested to participate in this study by allowing

the author to administer a NPD decision-making experiment in their classes. Participation was voluntary, although participating individuals had the opportunity to win a cash prize (described in section 3.5).

3.2.3. Power Analysis and Sample Size

Researchers in marketing and other social sciences often conduct research projects with little forethought given to the sample size they should be seeking (Cohen 1988; Sawyer and Ball 1981). When the sample size is too small, the null hypothesis may not be rejected when it should be rejected. When the sample size is excessive, resources have been unnecessarily expended. Consequently, the procedures developed by Cohen (1988) for calculating sample size were used in the planning stages of this research.

The power of a statistical test (i.e., $1-\beta$) is the probability of correctly rejecting a false null hypothesis. The power is determined by: (1) the significance criterion (i.e., the α level and directionality of the test), (2) the sample size, and (3) the effect size (i.e., the degree to which the phenomenon exists) (Cohen and Cohen 1983). Cohen (1965) claims that power analysis should be used be used in the planning stages of the experiment for any logical choice of sample size.

The following parameters were used in calculating the sample size for this research. First, a significance level of $\alpha = 0.05$ was chosen. Cohen (1988) recommends that a power value of 0.80 typically should be used. For

all calculations, this convention was followed in planning the experiment. Second, with respect to the effect size, Cohen and Cohen (1983) note that effect sizes may be determined from past empirical research. Alternatively, there are instances where the effect size is not known. For example, in new areas of research the effect sizes will be unknown. Such is the case with this study since two of the three experimental manipulations used in this research were quite different than those used in previous escalation research.

To overcome the lack of past research findings useful to guide the sample size decision, Cohen (1988) develops somewhat subjective levels of effect sizes (i.e., small, medium, and large) for several types of statistical tests commonly used in the social sciences. To be conservative, in all sample size calculations that follow, a moderately small effect size was assumed.

Two behavioral intention measures of commitment were used in this research. One measure was continuous, and the other measure was the dichotomous Go/No-Go measure. It was planned that the continuous dependent measure would be analyzed using ANOVA and the dependent Go/No-Go measure using Chi-square tests. Therefore, sample sizes were computed for both types of statistical tests.

Cohen (1988) suggests the following effect sizes (f) for ANOVA:

Small effect sizes: $f = 0.10$;
Medium effect sizes: $f = 0.25$;
Large effect sizes: $f = 0.40$.

To be conservative, an effect size of 0.20 was selected in the ANOVA sample size calculations. Further justification for using these effect sizes comes from Staw's (1976) original escalation of commitment research which found main effects in the area of 0.25-0.30 and an interaction effect of about 0.15. The results of the ANOVA sample size calculations appear in Table 3.1.

Table 3.1
Power Analysis for ANOVAs

	Specifications							
Effect	α	u	f	# of cells	power	n from table	n/cell	N
PR	0.05	1	0.20	24	0.80	99	9.2	220
PI	0.05	1	0.20	24	0.80	99	9.2	220
ISC	0.05	1	0.20	24	0.80	99	9.2	220
PR*PI	0.05	1	0.20	24	0.80	99	9.2	220
PR*ISC	0.05	1	0.20	24	0.80	99	9.2	220
PI*ISC	0.05	1	0.20	24	0.80	99	9.2	220
PR*PI*ISC	0.05	1	0.20	24	0.80	99	9.2	220
PR*NPD	0.05	2	0.20	24	0.80	81	11.0	264
PI*NPD	0.05	2	0.20	24	0.80	81	11.0	264
ISC*NPD	0.05	2	0.20	24	0.80	81	11.0	264
PR*PI*NPD	0.05	2	0.20	24	0.80	81	11.0	264
PR*ISC*NPD	0.05	2	0.20	24	0.80	81	11.0	264
PI*ISC*NPD	0.05	2	0.20	24	0.80	81	11.0	264
PR*PI*ISC*NPD	0.05	2	0.20	24	0.80	81	11.0	264

a = significance level
u = degrees of freedom
f = effect size

For the chosen significance level (α), effect size (f), number of degrees of freedom (u), and level of power, the sample size was read from Cohen's

(1988) sample size tables. Then, the suggested number of observations per cell was calculated by the following formula:

$$n_c = \frac{(n' - 1)(u + 1)}{\text{number of cells}} + 1$$

where n_c represents the number of observations recommended per cell, n' is the number read from the sample size table, and u is the degrees of freedom. As shown in Table 3.1, the sample sizes suggested for the various statistical ANOVA tests ranged from 220 to 264.

For Chi-square tests, Cohen (1988) suggests the following effect sizes (w).

Small effect sizes: $w = 0.10$;
Medium effect sizes: $w = 0.30$;
Large effect sizes: $w = 0.50$.

Again, to be conservative, a moderately small effect size of 0.20 and $\alpha = 0.05$ were used in calculating the Chi-square sample sizes. For a given significance level (α), effect size (w), number of degrees of freedom (u), and level of power, the sample size was read directly from Cohen's (1988) Chi-square sample size tables. The results of the sample size calculations for the Chi-square tests appear in Table 3.2. As shown in this table, the sample sizes suggested for the various Chi-square tests ranged from 196 to 273.

Having equal cell sizes is important for ANOVA calculations and interpretation (Iversen and Norpoth 1987). Consequently, based on the

res

siz

hav

son

val

log

thu

results of the power analysis calculations, it was determined that a sample size of 280 would be sought with each of the eight experimental conditions having 35 subjects (or as close as possible). While power analysis may seem somewhat arbitrary since the researcher has some discretion in choosing the values of the parameters, it should be noted that power analysis is more logical than randomly choosing the size of the sample or using a rule-of-thumb.

Table 3.2
Power Analysis for Chi-Square Tests

	Specifications				
Effect	**α**	**u**	**w**	**power**	**N**
PR	0.05	1	0.20	0.80	196
PI	0.05	1	0.20	0.80	196
ISC	0.05	1	0.20	0.80	196
PR*PI	0.05	1	0.20	0.80	196
PR*ISC	0.05	1	0.20	0.80	196
PI*ISC	0.05	1	0.20	0.80	196
PR*PI*ISC	0.05	1	0.20	0.80	196
PR*NPD	0.05	2	0.20	0.80	241
PI*NPD	0.05	2	0.20	0.80	241
ISC*NPD	0.05	2	0.20	0.80	241
PR*PI*NPD	0.05	2	0.20	0.80	241
PR*ISC*NPD	0.05	2	0.20	0.80	241
PI*ISC*NPD	0.05	2	0.20	0.80	241
PR*PI*ISC*NPD	0.05	3	0.20	0.80	273

a = significance level
u = degrees of freedom
w = effect size

3.3.

3.3.1.

the h

experi

Baten

Schoo

reviev

initia

(i.e.,

Indiv

divis

decis

prod

expe

thei

eithe

divis

decis

alloca

3.3. Experimental Tasks

3.3.1. Staw's Seminal Research

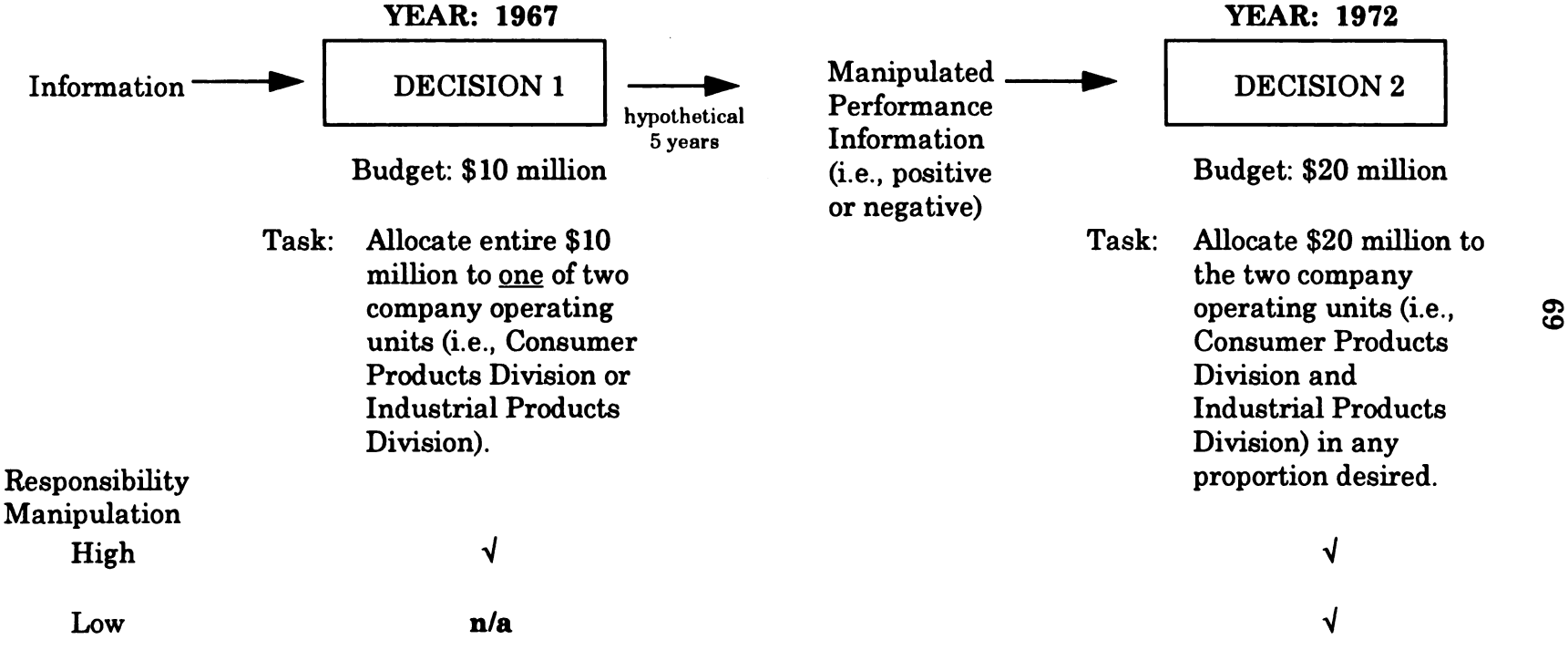
Staw's (1976) original escalation of commitment research centered on the hypothetical Adams and Smith (A&S) case, which is the basis for experimental tasks in many escalation studies (e.g., Armstrong *et al.* 1993; Bateman 1986; Bazerman, *et al.* 1984; Fox and Staw 1979; McCain 1986; Schoorman, *et al.* 1994; Staw and Fox 1977). Consequently, it is important to review Staw's experimental design, which is illustrated in Figure 3.1.

In this seminal study, Staw manipulated personal responsibility for initiating a course of action (i.e., high or low) along with project performance (i.e., positive or negative), thus constituting a 2x2 factorial design. Individuals were required to allocate R&D funding among two company divisions. In the high PR condition, individuals made the initial funding decision by allocating $10 million to *either* the industrial or consumer products division and then justified their decisions in writing. Then, the experiment indicated that five years had past since the subjects had made their initial R&D funding decisions. Subjects were randomly presented with either positive or negative performance feedback for the chosen company division for the past five years and were asked to make another R&D funding decision. Unlike the first decision, this time individuals were permitted to allocate $20 million among the two company divisions in any proportion they

FIGURE 3.1
Staw's Classic Escalation of Commitment Research Design

FIGURE 3.1
Staw's Classic Escalation of Commitment Research Design

Research design: 2 x 2 factorial design (personal responsibility, high or low x performance, positive or negative)



Notes:
In the high personal responsibility condition, subjects make both decisions.
In the low personal responsibility condition, subjects make the second decision only.
Dependent variable: Dollar amount committed to previously chosen alternative on decision 2.

Source: Staw (1976)

desired. The dependent variable was the dollar amount allocated to the project at this second decision.

In the low PR condition, individuals did not make the initial R&D funding choice. Instead, they were told that their predecessor had made the initial funding decision and had died unexpectedly of a heart attack. Individuals in this condition made only the second funding decision, which was the dependent variable of interest, and were therefore not personally responsible for initiating the course of action. It is important to note that within the manipulated project performance conditions, the feedback information provided to subjects in both the high and low PR conditions was identical.

3.3.2. The Current Research

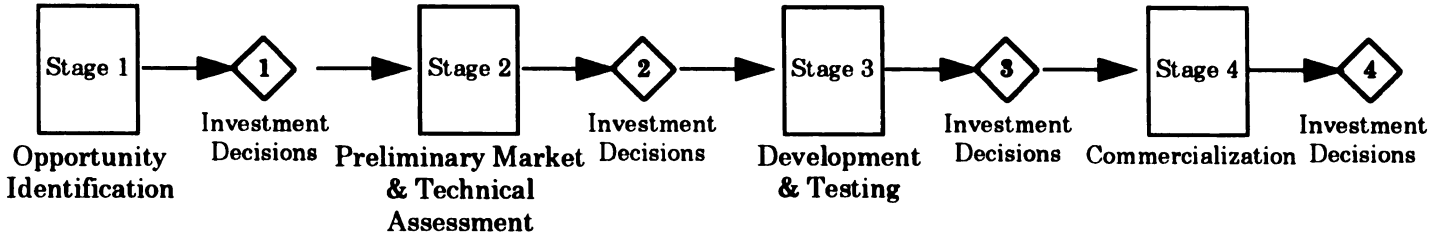
While subjects were presented with information and asked to make and explain decisions like the A&S case, the tasks in this research centered on NPD in Exxel Electronics Corp., a hypothetical corporation. There are several differences between this research and Staw's research. For example, all subjects received negative performance feedback in the current research since, by definition, escalation of commitment occurs only when the outcome is negative. Staw and Fox (1977), Boulding, Morgan, and Staelin (1995), and others, likewise used negative performance feedback exclusively in their scenarios. While many researchers examined isolated decisions, this research covered three decision-making periods to determine how

commitment changed over the NPD process. Finally, the independent variables, the nature of the decision-making task, and the amounts of the financial feedback were different and were event-based rather than time-based.

The experimental task in this research was to complete a hypothetical NPD decision-making exercise by making a series of decisions at three stages of a hypothetical NPD project (see Figure 3.2). At the completion of stages 2, 3, and 4, subjects in all eight conditions received *identical* performance feedback information on annual sales, profits, and market share of the new product. This information was *forecasted* feedback at stages 2 and 3 and *actual* feedback at stage 4. The performance feedback information increasingly indicated that the new product was headed for failure (i.e., likely to fall short of the hurdle rates set by management). Other financial information provided to subjects included the costs incurred in the NPD process to date (i.e., sunk costs) and the approximate cost to complete the next stage of the NPD process. At each stage, subjects were asked to indicate their likelihood of funding the next stage of the NPD process and to explain their funding decisions. In addition, subjects indicated their Go/No-Go preference and answered questions about their level of commitment to the project as well as manipulation check questions and provided demographic information.

FIGURE 3.2

FIGURE 3.2
Overview of Experimental Task



Costs per Stage	$0		$500,000		$3,175,000		$12,000,000	
Cumulative Costs	$0		$500,000		$3,675,000		$15,675,000	
Personal Responsibility								
High		√		√		√		√
Low		n/a		√		√		√
Forecasted Performance Feedback	(+)		(-)		(-)		(-)	
Justification for Decision		√		√		√		√
Manipulation Checks		√		√		√		√
"Demographics"								√

Note: Subjects in the high personal responsibility condition began the exercise at stage 1, while those in the low personal responsibility condition began at stage 2.

3.4. Instrumentation

In this section, the pilot study is briefly described and measures are presented for the dependent constructs used in the final research. In addition, the three manipulations are presented. Next, the type of product performance feedback is reviewed along with the rationale for the measurement. Finally, manipulation check items are presented.

3.4.1. Pilot Study

Prior to finalizing the experiment and administering it to the population of interest, a pilot study was conducted using 28 undergraduate business students. The primary purposes of the pilot study were to determine whether the manipulations were effective (i.e., in the expected direction and of sufficient size) and to identify potential problems with the experimental treatments and instruments so that modifications could be made. While the results of the pretest indicated that the manipulations were effective, a few minor changes were made to strengthen them. Based on the pretest results, the scenarios were changed slightly, a few items were revised or deleted from the final instrument, and the experimental procedures were refined.

3.4.2. Measures of Dependent Constructs

As noted by Binder (1985), commitment may be defined from either a behavioral or a cognitive perspective. Researchers have not, however,

distinguished between behavior and cognition in escalation of commitment research since most previous escalation research has measured commitment from a behavioral perspective only. Typically, the sole dependent variable is the dollar amount committed to the hypothetical project of interest. However, in the current research, rather than grouping both types of phenomena under the rubric of escalation of commitment, a distinction was made between behavior and cognition, which is important for potentially better understanding escalation. Consequently, commitment was measured from both behavioral (intentions) and self-reported (cognitive) perspectives. The measures for these constructs appear in Table 3.3. Measures 1 and 2 are behavioral intention measures rather than behavioral measures. Since repeated measures analysis involves measuring the same unit (i.e., person) repeatedly, the results of the pretest indicated a prohibitively large sample size would be needed to obtain the desired 280 responses at stage 3 of the exercise due to attrition over the three stages of the experiment.

Commitment, however, is a matter of degree rather than just a matter of state (Kiesler 1971). Consequently, five additional measures of commitment were used in this research which captured the respondents self-reported level of commitment. Most of these measures were adapted from previous escalation of commitment research to fit new product contexts.

Table 3.3
Construct Measurement and Variable Names

Item	Measurement	Selected References	Variable Name
Behavioral Commitment			
1. How likely is it that you would authorize the funds required to complete the next stage of the NPD process?	11-point percentage scale	Garland 1990	FUND
2. Given the opportunity, I would (a) stop this project, or (b) continue this project	Go or stop	Balanchandra 1984; Boulding *et al.* 1995.	GOSTOP
Self-Reported Commitment			
1. I am committed to this new product.	7-point Disagree/Agree scale	n/a	COMMIT
2. I would feel guilty if I stopped funding this new product development project.	7-point Disagree/Agree scale	Binder 1985	GUILTY
3. I will stick with this new product no matter what problems are encountered.	7-point Disagree/Agree scale	Binder 1985	STICK
4. I feel a sense of loyalty to this new product.	7-point Disagree/Agree scale	Binder 1985	LOYALTY
5. It would be difficult to persuade me to change my previous investment decisions.	7-point Disagree/Agree scale	Binder 1985	CHANGE

3.4.3. Manipulations of Independent Variables

Based on the review of the literature and discussions with NPD managers, the following three independent variables were chosen: (1) the level of personal responsibility for initiating a NPD project that is subsequently failing, (2) the level of innovativeness of the new product, and (3) the level of information source credibility. PR was manipulated to be either high or low like in Staw's (1976) research and several other escalation of commitment studies (e.g., Bazerman *et al.* 1984; McCain 1986; Staw and Fox 1977; Staw and Ross 1978; Whyte 1991; Whyte 1993). PI and ISC were also manipulated to be either high or low. However, these have not been tested in past escalation research. The manipulations are described below.

Personal Responsibility. PR for initiating a course of action that is subsequently failing induces the self-justification mechanism that seems to underlie the escalation phenomenon (Bazerman *et al.* 1984; Brockner 1992; Staw 1976; Staw and Ross 1987a). As such, many researchers have included this variable in their research. Boulding *et al.* (1995) manipulated PR to be high for all subjects in their experiment. While they only studied post-launch Go/No-Go decisions, Boulding *et al.* had their subjects make an initial Go/No-Go decision at the commercialization stage of the NPD process. Subjects were given very positive financial performance projections to induce them to make a "Go" decision thereby forming a high PR condition since only individuals that commercialized the product were used in the analysis. Even

with very positive performance information, eleven percent of the individuals in this study opted to not launch the new product.

In the present research, individuals in the *high* PR condition were responsible for choosing one of two new product ideas to develop (at stage 1 in Figure 3.2) since they were instructed that resource constraints precluded development of both potential products. These individuals then justified their choice in a open-ended response which was given to the author as he administered the experiment. Individuals in the high PR condition then received Part II of the exercise which was printed with two different colored covers. Depending on which product was chosen, they were given either blue or green booklets. However, the information contained in both colored booklets was identical. It was felt that *having* the subjects actually make a choice that *appeared* to have negative consequences was a stronger manipulation for PR than simply *telling* subjects that they chosen to develop a product and were therefore personally responsible for the failing project.

Conversely, individuals in the *low* PI condition assumed leadership of a NPD project (at gate 2 in Figure 3.2) in which their predecessors initiated the project prior to being transferred to Europe to assume other responsibilities. Individuals in this condition received experimental booklets that were self-contained. The PR manipulations appear in Table 3.4.

Table 3.4
Personal Responsibility and Product Innovativeness Manipulations

Low PR Condition

You have been reassigned to the position of Product Development Manager for Exxel's automotive group. Your predecessor came up with the idea to develop the new airbag sensor. Prior to being transferred to Exxel's European operations, your predecessor recommended to top management that this new sensor be developed. You are assuming leadership responsibility for the new product project, which is currently at state 2 (i.e., preliminary market and technical assessment). (*Note*: In the low personal responsibility condition, product innovativeness was manipulated using the airbag sensor only.)

High PR Condition (With Low PI Condition)

As Product Development Manager, you have the option of developing one (1) of two potential new products. One product is an airbag sensor, and the other product is an anti-lock brake sensor. Both of the products are described, below.

Product 1 - Airbag Sensor. The proposed new airbag sensor will offer incremental advantages over the existing one since it will be identical in form and function to Exxel's existing sensor. However, this new sensor has a marginally more efficient design. Consequently, it will be a little smaller and will cost slightly less to produce (i.e., 2.0 percent).

Product 2 - Anti-Lock Brake Sensor. The proposed new anti-lock brake sensor will offer incremental advantages over the existing one since it will be identical in form and function to Exxel's existing sensor. However, this new sensor is slightly more durable and will cost a little less to produce (i.e., 1.5 percent).

High PR Condition (With High PI Condition)

As Product Development Manager, you have the option of developing one (1) of two potential new products. One product is an airbag sensor, and the other product is an anti-lock brake sensor. Both of the products are described, below.

Product 1 - Airbag Sensor. The proposed new airbag sensor is highly innovative and will offer substantial advantages over the existing one. Unlike the current sensor, which is silicon-based, the new sensor will incorporate a radically new diamond sensor technology which will make it resistant to all corrosive materials, elements, and weather conditions. While current sensors are reliable, the new sensor will be a vast improvement and will continue to work properly for decades. This is extremely important since an airbag sensor must work perfectly; it cannot deploy an airbag in the absence of a collision, nor can it fail to deploy in a collision. Automakers face potentially huge lawsuits if an airbag system fails. In addition, with advances in industrial diamond fabrication, the new sensor will be substantially smaller (i.e., 75%).

Product 2 - Anti-Lock Brake Sensor. The proposed new anti-lock brake sensor will offer substantial advantages over existing sensors due to its highly innovative design. This new sensor has a radically new architecture and will cost substantially less to produce (i.e., 85%) thereby making it economically feasible to offer high-performance anti-lock brakes on lower priced cars. In the past, high performance anti-lock brake systems were found only on luxury cars. This is a significant advance since the average stopping distance will be shortened considerably due to these brakes, thereby reducing the number of traffic accidents and saving lives.

Product Innovativeness. In this research, escalation of commitment was compared for a highly innovative new product versus a marginally innovative new product. To minimize the confounding effect of using products from different product categories, the hypothetical products chosen for this research were both from the automobile electronics industry. In the *high* PI condition, the innovative new products offered substantial performance, size, or cost advantages over existing products, while in the *low* PI condition, the products were line extensions that offered very marginal size or cost reductions. The PI manipulations also appear in Table 3.4.

Information Source Credibility. As with PR and PI, the level of information source credibility was manipulated so as to constitute either a high or low condition. In the *high* condition, information sources were credible since they possessed the requisite qualifications and had been accurate in past NPD projects. In the *low* condition the information sources were not credible since they lacked skills and had been inaccurate in past NPD projects. The ISC manipulations appear in Table 3.5.

Stage of the NPD Process. The within-subjects condition required each subject to repeat the decision-making exercise at three stages (i.e., 2, 3, and 4 in Figure 3.2) of a NPD project. As previously noted, subjects in the high PR condition made an additional decision (at stage 1) by choosing one of two products to develop. It is important to note that the information presented to subjects in all eight conditions was identical at each stage.

Table 3.5
Information Source Credibility Manipulation

Low ISC Condition Throughout the NPD process, managers receive information to help them make the financial investment decisions. In Exxel Electronics, this information is provided by Exxel's sales force personnel, most of whom have had little formal training in marketing research. Additionally, Exxel's sales force has, in the past, provided information that has proven to be extremely unreliable and inaccurate in past new product projects.
High ISC Condition Throughout the NPD process, managers receive information to help them make the financial investment decisions. In Exxel Electronics, this information is provided by nationally-known, prestigious marketing research firms, advertising agencies, and consultants. Additionally, these sources have, in the past, provided information that has proven to be extremely reliable and accurate in past new product projects.

3.4.4. New Product Performance

New products are fraught with market and technical uncertainty. Will the product perform as intended in the field? Will consumers buy the product and be satisfied with it? These are just some of the many concerns managers have when developing new products. To reduce such uncertainty, information is gathered and analyzed at each stage in the NPD process to predict the likely performance of the product in the market. Each stage in the NPD process should increase managers' confidence in the ultimate success of the product (Cooper 1993). Until the product is commercialized, however, managers must base their investment decisions on *forecasted* performance information. In addition, early decisions in the NPD process must be made without very reliable information (Cooper 1983). As the

product moves closer to commercialization, the information becomes more accurate as the market and technical uncertainties generally are reduced. However, only after the product is commercialized is *actual* performance information available. Consequently, in this decision-making exercise, subjects received *forecasted* performance information before product commercialization (i.e., stages 2, and 3). After commercialization (i.e., stage 4), subjects received *actual* performance information.

At the start of the experiment, subjects were given market share and profit objectives to assess the performance of the new product. Subjects were instructed that top management at Exxel Corporation mandated that all new sensor products must achieve a 30 percent market share and must be profitable. At the completion of each stage of the NPD project, individuals received performance feedback on market share, sales, and profits, as shown in Table 3.6. In addition, other information about events in the NPD process was provided at the stage. These events represented non-economic (i.e., psychological, social, and structural) determinants of escalation. For example, at stage 2 all subjects were informed that the President of Exxel announced the new sensor at a press conference and *Wall Street* Analysts and automobile manufacturers were excited about the new sensor. Such events are realistic since similar events occur in actual NPD projects.

Table 3.6
Performance Feedback at Each New Product Development Stage

Performance Measure	Stage 2	Stage 3	Stage 4
Annual Sales	$24.5 mil.	$21.5 mil.	$17.1 mil.
Annual Profits	$2.2 mil.	$0.7 mil.	($1.5 mil.)
Market Share	28%	24%	19%
Sunk Costs	$0.5 mil.	$3.675 mil.	$15.675 mil.
Costs to Continue	$3.175 mil.	$12.0 mil.	$250,000

The performance information grew progressively more ominous over the course of the NPD project. After the product was commercialized, the achieved market share was substantially below top management's mandate, and the product clearly was losing money. Care was taken to objectively present the performance feedback in the experimental booklet so as to "frame" (Kahneman and Tversky 1979) the experiment in a neutral fashion and let the individuals decide on the performance of the project for themselves. Specifically, the performance results were simply presented, but not interpreted, and no reference was made to the performance relative to management's hurdles.

It is important to note that while the performance information (i.e., project determinants) was negative at stages 2, 3, and 4, the non-economic

feedback (i.e., psychological, social, and structural determinants) was positive at each stage. That is, the economic determinants signaled imminent failure and thus should have motivated individuals to stop the NPD project since the hurdles set by top management were increasingly unlikely to be achieved. However, the non-economic determinants may have motivated individuals in some of the conditions to continue the project. Boulding *et al.* (1995) likewise presented all subjects with identical information, some of which was positive and some negative. Taylor and Brown (1988) posited that individuals ignore or distort negative information to fit desired outcomes. Boulding *et al.* (1995) indeed found this to be the case, since in their research, negative information was interpreted positively 133 times whereas it was correctly perceived as negative only 3 times under conditions of high PR.

3.4.5. Instrument

The first page of the experimental booklet was a decorative cover sheet that provided space for subjects to write in their university identification numbers. These numbers were used to insure that no student completed the exercise more than one time and to identify the prize winning individual. The next page provided some background information on the stage-gate NPD process and some basic information on the particular sensor in non-technical terms. The manipulations for PR, PI, and ISC also were contained in the

front part of the experimental booklets as were top management performance mandates.

At each stage, the feedback information presented in Table 3.6 was provided to subjects. Questions measuring behavioral and self-reported commitment followed. Finally, six manipulation check questions, two for each treatment, concluded each of the three stages. The manipulation check questions are shown in Table 3.7.

The last two pages of the instrument contained demographic questions. Specifically, subjects were asked to report their gender and provide information about their work experience and NPD experience. These measures were collected to potentially increase the precision of the experiment by statistically removing their effects on commitment since gender and experience may be related to the subjects' investment decisions. For example, escalation of commitment has been found to be greater for men than women (Bateman 1986), although others have found no difference in the escalation of commitment between men and women (Fox and Staw 1979; Staw and Fox 1977).

Likewise, some researchers have found escalation of commitment differs depending on one's age and work experience (e.g., Garland *et al.* 1990; Staw and Ross 1980), while others have found no difference (Armstrong *et al.* 1993; Fox and Staw 1979). Consequently, subjects were asked to report their years of work experience (WORKEXP), and years of NPD experience

Table 3.7
Manipulation Check Measures and Variable Names

Item	Measurement	Selected References	Variable Names
Personal Responsibility			
1. The initial decision to develop this new product was mine. (R)	1-to-7 Disagree to Agree scale	Binder 1985	PR1
2. My predecessor initiated this new product project before I took it over.	1-to-7 Disagree to Agree scale	n/a	PR2
Product Innovativeness			
3. This new product offers minimal advantages over existing products. (R)	1-to-7 Disagree to Agree scale	n/a	PI1
4. This new product is revolutionary.	1-to-7 Disagree to Agree scale	n/a	PI2
Information Source Credibility			
5. During Exxel's past new product projects, the source(s) that provided feedback information was (were) accurate.	1-to-7 Disagree to Agree scale	n/a	ISC1
6. The source(s) that provides feedback information during Exxel's new product projects is (are) not credible. (R)	1-to-7 Disagree to Agree scale	n/a	ISC2

Note: R indicates scale that is reversed.

(NPDEXP) to be used as possible covariates in the statistical analyses. Lastly, following Boulding *et al.* (1995), subjects were asked to report the largest amount of money that they were responsible for investing in a project when acting as the primary decision-maker (INVEST).

3.5. Experimental Procedures

In accordance with Michigan State University requirements, an application for approval to use human subjects in this research was completed and submitted to the University Committee on Research Involving Human Subjects (UCRIHS). The UCHRIS approval letter is contained in Appendix A.

Written instructions that included informed consent information were given to the subjects who were told that the purpose of this experiment was to examine investment decision-making under varying amounts of information. This procedure is identical to the one employed by Staw (1976) and is frequently used in escalation of commitment research. The subjects were instructed that participation in the experiment was strictly voluntary, and they may elect to discontinue participating in the experiment at any point without prejudice. In addition, to encourage individuals to participate and to more closely simulate the consequences of actual business decisions, as well as to increase involvement in the experiment, subjects were told that the individual who made the optimum decisions in the experiment would

receive a cash prize of $200; in the event of a tie, the winner would be chosen at random.

Based on the information presented to subjects in all conditions, the "optimum" decision was to terminate the NPD project prior to commercialization since the performance information increasingly fell short of the objectives set by management. This is similar to the research of Boulding *et al.* (1995, p.12) who noted that in their research "the good decision is to withdraw the product."

The subjects were randomly assigned to one of the eight conditions. The decision-making experiment was administered in classrooms during class sessions at the participating universities. The author traveled to each class to personally administer the experiment, answer questions, and so on. Subjects took the NPD decision-making exercise seriously since on average, they spent approximately 30 minutes completing the exercise. During this time, the subjects used calculators and appeared to be very engaged in the exercise. Conversely, in the pretest, undergraduate students spent about 20 minutes completing an exercise that was very similar in content and length. At the completion of the experiment, all experimental materials were collected.

3.6. Statistical Procedures

Several steps were necessary to transform the subjects' responses into data for statistical analyses. Each completed experimental booklet was

visually inspected to determine if the subject properly completed the exercise. In addition, post-experimental inquiry was used to reduce the effects of demand artifacts (Sawyer 1975) or hypothesis guessing (Cook and Campbell 1979). At the completion of experiment, the subjects were asked in an open-ended question to state what they believe was the purpose of the experiment. Those few individuals that correctly identified a research question were eliminated from the sample.

After visually inspecting the experimental booklets, the subjects' responses were keyed into the Michigan State University IBM 3090 mainframe computer by the author. Each questionnaire was re-checked by the author as a verification step. The data was then analytically inspected, corrected, and analyzed using SAS software (version 6.07) and SPSS for Windows® (version 6.1).

3.6.1. Preliminary Statistical Analyses

Several preliminary statistical analyses were conducted prior to testing the research hypotheses presented in Chapter 2. First, under conditions of high PR subjects were asked to choose which one of two new products should be developed. Forty-three percent of the subjects chose to develop the airbag sensor compared to 57 percent for the brake sensor. The subjects in these groups were not equally distributed across the four high PR conditions. Consequently, t-tests were used to determine if the subjects

choosing to develop the airbag sensor differed significantly with respect to their answers compared to those choosing the brake sensor. Since the results indicated that there were no significant differences between two groups ($p \leq 0.05$), they were combined in subsequent analyses.

The effectiveness of each of the three experimental treatments was tested using two questions, as shown previously in Table 3.7. The two manipulation check measures for each treatment were summed together for each of the three NPD stages. T-tests were used to determine whether the means differed for the high and low treatment conditions.

3.6.2. Statistical Analyses for Between-Subjects Hypotheses

Table 3.8 links the research questions and hypotheses with the statistical tests that were performed to evaluate the hypotheses. As previously shown in Table 3.3, two measures captured behavioral commitment. The continuous measure (FUND) was used as the dependent variable in analysis of variance (ANOVA) analysis at each of the three NPD stages. ANOVA is useful for statistically comparing means from multiple groups or experimental conditions.

Likewise, the dichotomous GOSTOP variable was used as the dependent measure in ANOVA analyses at stages 2, 3, and 4. Unlike the ANOVAs that used the continuous variable FUND as the dependent variable, these ANOVAs were computed using the categorical modeling

Table 3.8
Summary of Research Questions, Corresponding Hypotheses, and Statistical Tests

Research Questions	Hypotheses[a]	Effects	Statistical Tests
1) Does the level of personal responsibility for initiating a NPD that is subsequently failing affect the level of commitment to that project?	H1a,b,c H2a,b,c	PR → BC[b] PR → SRC[b]	ANOVA, χ^2 test MANOVA
2) Does the level of product innovativeness affect the level of commitment to a failing NPD project?	H3a,b,c H4a,b,c	PI → BC[b] PI → SRC[b]	ANOVA, χ^2 test MANOVA
3) Does the level of credibility of the source that provides information during a failing NPD project affect the level of commitment to that project?	H5a,b,c H6a,b,c	ISC → BC[b] ISC → SRC[b]	ANOVA, χ^2 test MANOVA
4) For different levels of product innovativeness, does the level of personal responsibility for initiating a NPD project that is subsequently failing affect the level of commitment to that project?	H7a,b,c H8a,b,c	PR*PI → BC[b] PR*PI → SRC[b]	ANOVA, χ^2 test MANOVA
5) For different levels of information source credibility, does the level of personal responsibility for initiating a NPD project that is subsequently failing affect the level of commitment to that project?	H9a,b,c H10a,b,c	PR*ISC → BC[b] PR*ISC → SRC[b]	ANOVA, χ^2 test MANOVA
6) For different levels of product innovativeness, does the credibility of the source of the information received during a failing NPD project affect the level of commitment to that project?	H11a,b,c H12a,b,c	PI*ISC → BC[b] PI*ISC → SRC[b]	ANOVA, χ^2 test MANOVA
7) For different levels of personal responsibility and product innovativeness, does the credibility of the source of the information received during a failing NPD project affect the level of commitment to that project?	H13a,b,c H14a,b,c	PR*PI*ISC → BC[b] PR*PI*ISC → SRC[b]	ANOVA, χ^2 test MANOVA
8) How does the level of commitment to a failing NPD project change over the NPD process?	H15-H28	All of the above * NPD[c]	ANOVA[d], χ^2 test[d] MANOVA[d]

Key: [a]a,b, and c represent hypotheses for stages 2, 3, and 4, respectively.
[b]Between-subjects effect hypothesized to be positive for stages 2 and 3 and zero for stage 4.
[c]Within-subjects effects hypothesized to decrease over stages 2, 3, and 4.
[d]Repeated measures statistical tests for within subjects effects.
PR = personal responsibility for initiating the NPD project.
PI = product innovativeness.
ISC = information source credibility.
BC = behavioral intention measure of commitment.
SRC = self-reported measures of commitment.
NPD = stage of the NPD process (i.e., 2, 3, 4).

procedures in SAS (i.e., the CATMOD procedure) via marginals using contingency tables as input and Chi-square statistics to interpret the results. This categorical modeling procedure is basically a generalization of ANOVA to categorical dependent variable and is more powerful than the basic Chi-square test.

Although no hypotheses were formulated regarding the total number of Go decisions that would be recommended under the various experimental conditions, a new variable labeled 'SUMOFGO' was computed by summing the number of Go decisions individuals made over the three NPD stages. This variable was used as the dependent variable in a CATMOD (ANOVA) analysis.

MANOVA was used to analyze to determine the level of self-reported commitment to a failing NPD project. The five measures shown in Table 3.3 were used to measure self-reported commitment. MANOVA is an extension of ANOVA in that multiple dependent variables are inherent in MANOVA rather than a single dependent variable as with ANOVA. MANOVA was used rather than multiple ANOVAs to maintain control over the experiment-wide error rate and since there was multicollinearity among the dependent variables. Hair *et al.* (1992) note that under such conditions, MANOVA is more powerful than separate ANOVAs.

3.6.3. Statistical Analyses for Within-Subjects Hypotheses

Each of the three types of statistical analyses discussed previously were used to test the within-subjects hypotheses. However, to test these hypotheses, repeated measures ANOVA, CATMOD ANOVA, and MANOVA were used. Repeated measures analysis is used for assessing differences in means when multiple observations are taken on the same experimental unit (i.e., person in this research).

3.7. Summary

This chapter described the research design used in this dissertation. A 2x2x2x3 (personal responsibility x product innovativeness x information source credibility x stage in the NPD process) was used. Next, the rationale for the chosen sampling population was noted and the target size was computed. Subjects were business people with at least two years of professional work experience currently attending executive MBA programs. The target sample size was 280 (35 per cell). Furthermore, the experimental treatments, measures, and procedures were presented. Finally, statistical methods were described for testing the research hypotheses. The results these statistical analyses are presented in Chapter 4.

CHAPTER 4

RESULTS

> Individuals get emotionally involved in the [new product development] project and are very reluctant to terminate it, even if there are many clear signals that the project is not going to be successful (Balachandra 1984, p.92).

4.1. Introduction and Overview of Chapter

The sole purpose of Chapter 4 is to present the results of this dissertation research since Chapter 5 discusses the results and implications. Chapter 4 is organized as follows. First, the sample size and characteristics are detailed. The results of the manipulation checks are presented next. Following the manipulation check results, the statistical analyses are presented, first for the between-subjects statistical analyses and then for the within-subjects analyses. The results for the tests for potential confounds and covariates appear next in this chapter. Subsequently, the statistical results are related back to the research questions and hypotheses. Finally, the results are briefly summarized.

4.2. Sample Size and Characteristics

The sample size and characteristics are shown in Tables 4.1 and 4.2, respectively. As shown in Table 4.1, a total of 285 usable responses were obtained. Across the eight experimental conditions, the number of subjects in each cell was balanced with 35 or 36 individuals in each condition. The

Table 4.1
Sample Size By Treatment

Condition Number	*Manipulations*			*Sample Size*
	Personal Responsibility	*Product Innovativeness*	*Information Source Credibility*	
1	Low	Low	Low	36
2	Low	Low	High	36
3	Low	High	Low	36
4	Low	High	High	36
5	High	Low	Low	36
6	High	Low	High	35
7	High	High	Low	35
8	High	High	High	35
Total				285

Table 4.2
Sample Characteristics

Characteristic	*Mean*	*Minimum*	*Maximum*
Number of years of professional work experience	7.2	2	30
Number of years of new product development experience	1.6	0	18
Largest dollar amount committed to a project when acting as the primary decision maker	$1.51 mil.	$0	$40 mil.

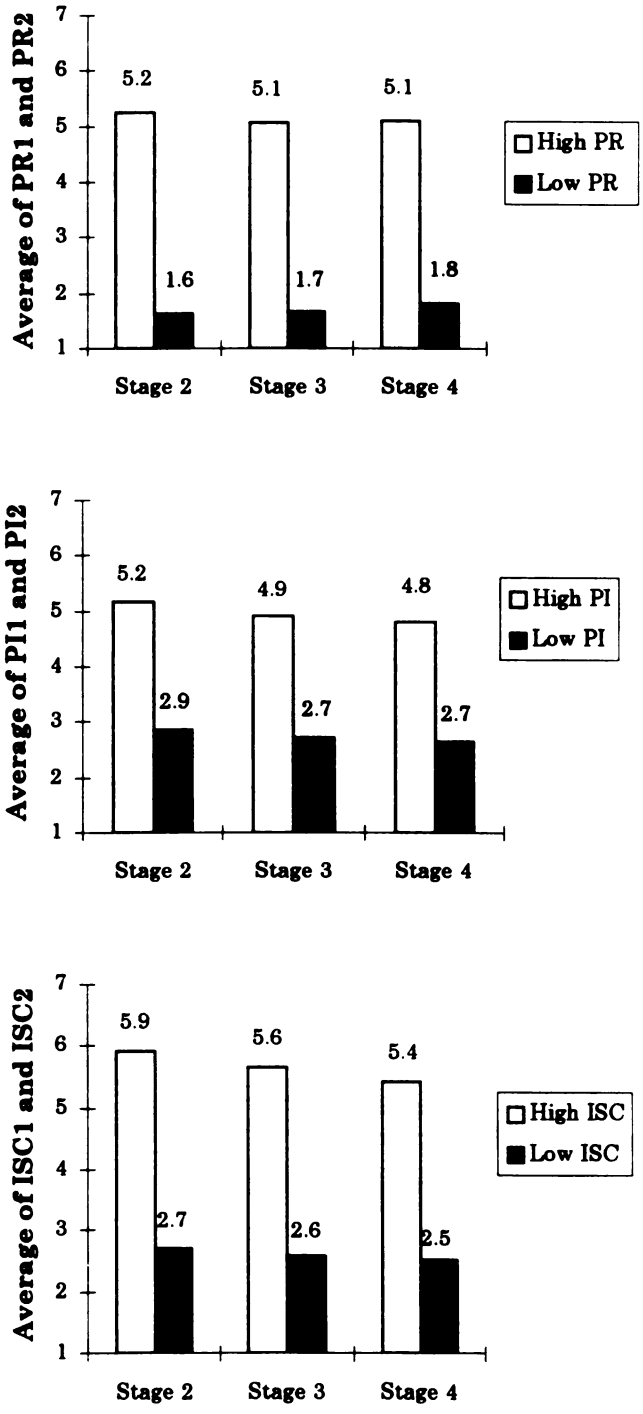
sample was approximately 60 percent male (n=175) and 40 percent female (n=110). Table 4.2 reveals that on average, individuals had 7.2 years of professional work experience with a minimum of 2 years. The largest dollar amount committed when acting as the primary decision-maker averaged over $1.5 million dollars. Lastly, the mean number of years of new product development (NPD) experience was 1.6. These figures indicate that individuals that participated in this experiment had significant work experience and financial decision-making experience.

4.3. Manipulation Checks

Figure 4.1 depicts the results of the manipulation checks. As shown, the means for the high personal responsibility (PR), high product innovativeness (PI), and high information source credibility (ISC) conditions were significantly higher than those for the low conditions ($p \leq 0.001$) across the three NPD stages. This indicates that the experimental treatments were effective and remained strong over the three stages of the experiment.

To determine the relative strength of the manipulations, the treatments were correlated with each of the dependent variables, as shown in Table 4.3. At stage 2, the correlations revealed that, in general, PR was the most strongly correlated with the dependent measures while ISC was the weakest. In stages 3 and 4, PI generally was most strongly correlated with the dependent measures while ISC remained the weakest.

Figure 4.1
Manipulation Check Results



Note: All manipulation checks were significant at $p \leq 0.001$

Table 4.3
Experimental Treatments and Dependent Variables Correlations

Stage 2:	Variable	PR	PI	ISC
	FUND	.203	.064	-.047
	GOSTOP	.177	.115	-.052
	COMMIT	.253	.120	-.026
	GUILTY	.067	.073	.066
	STICK	.163	.028	.057
	LOYALTY	.237	.011	.011
	CHANGE	-.021	.117	.023
Stage 3:				
	FUND	.110	.148	.021
	GOSTOP	.104	.142	-.043
	COMMIT	.141	.185	-.001
	GUILTY	.060	.128	.017
	STICK	.156	.146	.029
	LOYALTY	.186	.193	.034
	CHANGE	-.070	.064	.027
Stage 4				
	FUND	.013	.018	-.001
	GOSTOP	.002	.016	.002
	COMMIT	.067	.093	.037
	GUILTY	.026	.069	.046
	STICK	.089	.059	-.012
	LOYALTY	.085	.131	.052
	CHANGE	-.062	-.007	.018

Note: All numbers represent point biserial correlations (r_{pb}) except for the dichotomous GOSTOP variable which represent phi (ϕ) coefficients.

4.4. Statistical Analyses Results

4.4.1. Between-Subjects Results

In this section, the results are presented for the between-subjects statistical tests which include ANOVA, categorical (CATMOD) ANOVA, and MANOVA analyses. Table 4.4 contains the results for the ANOVA analyses that used FUND as the dependent variable. A separate ANOVA was computed for each NPD stage. At stage 2, individuals in the high PR condition were significantly more likely to authorize the funds to complete stage 3 of the NPD project than those under low PR conditions ($\bar{x}_{high} = 6.7$, $\bar{x}_{low} = 5.5$, $p \leq 0.001$), as expected. In addition, the PR-PI interaction was significant ($p \leq 0.05$). As shown in Figure 4.2, under the low PR-low PI condition, individuals were significantly less likely to fund the NPD project than in the other three conditions. Surprisingly, likelihood of funding was highest under conditions of high PR and *low* PI (although this difference was not significant at $p \leq 0.05$). This is discussed further in Section 5.2.4. None of the other main or interaction effects was significant ($p \leq 0.05$) at stage 2.

As predicted, at stage 3, individuals in the high PI condition were significantly more likely to authorize the funds to complete stage 4 of the NPD project than those in the low PI condition ($\bar{x}_{high} = 3.8$, $\bar{x}_{low} = 2.9$, $p \leq 0.01$). While individuals in the high PR condition were more likely to authorize

Table 4.4
Likelihood of Funding ANOVA Summary Table

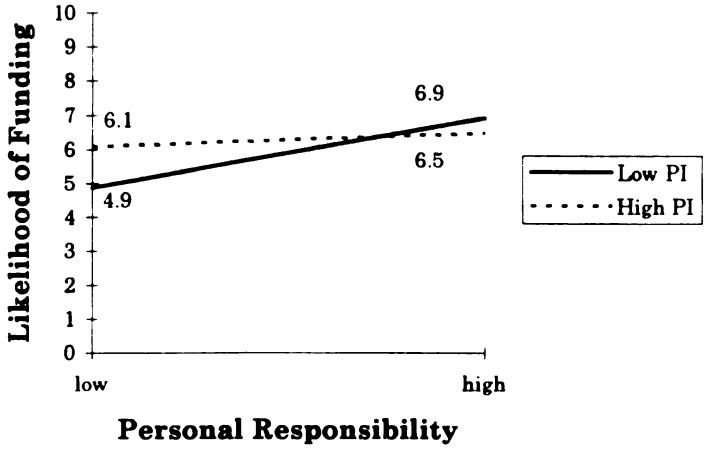
Dependent Variable: **FUND**

	Source	*Sum of Squares*	*d.f.*	*Mean Square*	*F*	*Effect Size*	*Significance*
Stage 2	Model	180.64	7	25.81	2.92		**
	PR	107.21	1	107.21	12.15	.042	***
	PI	10.48	1	10.48	1.19	.004	-
	ISC	5.79	1	5.79	0.66	.002	-
	PR*PI	48.46	1	48.46	5.49	.019	*
	PR*ISC	6.37	1	6.37	0.72	.003	-
	PI*ISC	0.25	1	0.25	0.03	.000	-
	PR*PI*ISC	1.17	1	1.17	0.13	.000	-
	Error	2444.81	277	8.83			
	Total	2625.45	284				
Stage 3	Model	130.73	7	18.68	2.17		*
	PR	31.42	1	31.42	3.65	.013	-
	PI	54.91	1	54.91	6.38	.022	**
	ISC	1.01	1	1.01	0.12	.000	-
	PR*PI	2.25	1	2.25	0.26	.001	-
	PR*ISC	0.16	1	0.16	0.02	.000	-
	PI*ISC	3.51	1	3.51	0.41	.001	-
	PR*PI*ISC	37.18	1	37.18	4.32	.015	*
	Error	2385.92	277	8.61			
	Total	2516.65	284				
Stage 4	Model	37.00	7	5.29	0.41		-
	PR	0.62	1	0.62	0.05	.000	-
	PI	1.15	1	1.15	0.09	.000	-
	ISC	0.00	1	0.00	0.00	.000	-
	PR*PI	0.84	1	0.84	0.07	.000	-
	PR*ISC	5.87	1	5.87	0.45	.002	-
	PI*ISC	27.87	1	27.87	2.15	.008	-
	PR*PI*ISC	0.47	1	0.47	0.04	.000	-
	Error	3576.40	276	12.96			
	Total	3613.39	283				

***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

funds than those in the low PR condition ($\bar{x}_{high}$ = 3.7, $\bar{x}_{low}$ = 3.0), this difference was not significant (p>0.05). In fact, at stage 3, the effect of PI was nearly twice that of PR. The only other effect that was significant at stage 3 was the PR-PI-ISC interaction. As expected, individuals in condition 7 (i.e., high PR, high PI, low ISC) were most likely to fund the NPD project ($\bar{x}$ = 4.2) while those in condition 2 (i.e., low PR, low PI, high ISC) were least likely to fund it ($\bar{x}$ = 2.1) A Duncan multiple range test revealed that subjects in conditions 7, 4, and 8 were significantly more like to fund the NPD project than those in condition 2 (p≤0.05). By stage 4, none of the main effects nor interaction effects are significant, as hypothesized.

Figure 4.2
Personal Responsibility - Product Innovativeness Interaction for Likelihood of Funding at Stage 2



In addition to the likelihood of funding, behavioral commitment also was measured by the dichotomous Go/No-Go decision (i.e., GOSTOP). The results of the categorical ANOVA analyses that used GOSTOP as the dependent variable are shown in Table 4.5. At stage 2, the PR and PI main effects were significant. Under the condition of high PR, 84.4 percent of the individuals recommended continuing with the project on to stage 3 compared to 69.4 percent for those under the low PR condition ($p \leq 0.01$). Similarly, under the high PI condition, 81.7 percent recommended continuation while 72.0 percent made No-Go decisions under the low PI condition ($p \leq 0.05$).

The PR-PI interaction, which was also significant at stage 2 ($p \leq 0.05$), is depicted in Figure 4.3. The pattern shown in this figure is similar to the one found for the ANOVA analysis that used FUND as the dependent variable. Under low PR and low PI, on average, subjects were approximately 20 percent less likely to make Go decisions than under the other three scenarios.

By stage 3, individuals in all experimental conditions were less likely to make Go recommendations than at stage 2. However, under the high PI condition, 43.3 percent of the sample opted for continuation of the NPD project in contrast to 29.6 percent under the low PI condition ($p \leq 0.01$). Again, by stage 4, none of the effects was significant ($p \leq 0.05$).

Table 4.5
Go/No-Go Decision Summary Table[a]

Dependent Variable: **GOSTOP**

	Source	*Degrees of Freedom*	*Chi-Square*	*Significance*
Stage 2	PR	1	9.55	**
	PI	1	3.99	*
	ISC	1	0.82	-
	PR*PI	1	4.12	*
	PR*ISC	1	0.82	-
	PI*ISC	1	0.09	-
	PR*PI*ISC	1	0.07	-
	Intercept	1	91.56	***
Stage 3	PR	1	3.30	-
	PI	1	6.14	**
	ISC	1	0.55	-
	PR*PI	1	0.05	-
	PR*ISC	1	0.92	-
	PI*ISC	1	1.26	-
	PR*PI*ISC	1	0.33	-
	Intercept	1	515.44	***
Stage 4	PR	1	0.00	-
	PI	1	0.08	-
	ISC	1	0.00	-
	PR*PI	1	0.00	-
	PR*ISC	1	2.43	-
	PI*ISC	1	3.26	-
	PR*PI*ISC	1	0.01	-
	Intercept	1	402.35	***

[a]Computed using the CATMOD procedure in SAS via marginals.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

Figure 4.3
Personal Responsibility - Product Innovativeness Interaction for Go and No-Go Decisions at Stage 2

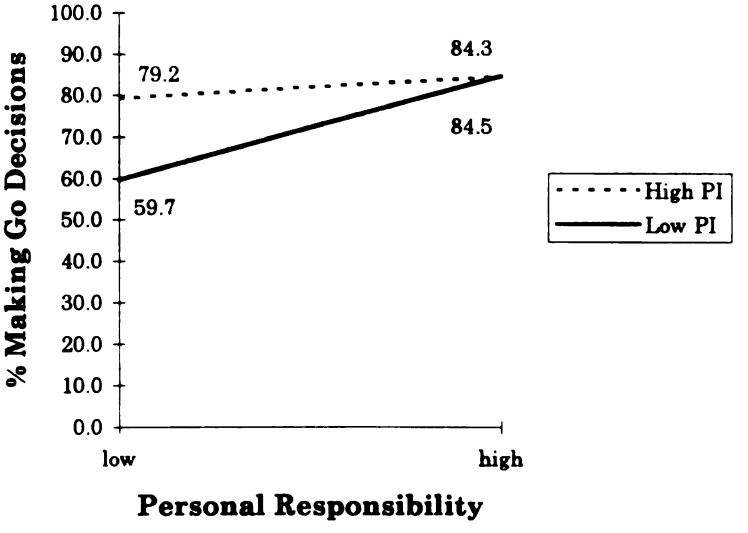


Table 4.6 contains the results of the categorical ANOVA that used SUMOFGO as the dependent variable. The results show that on average, individuals in the high PI condition opted for significantly more Go decisions than individuals in the low PI condition ($\bar{x}_{high} = 1.7$, $\bar{x}_{low} = 1.4$, $p \leq 0.05$), while the main effect of PR misses being significant ($\bar{x}_{high} = 1.7$, $\bar{x}_{low} = 1.4$, $p > 0.05$). Also, Table 4.6 shows that the interaction of PR and PI was significant ($p \leq 0.05$). Figure 4.4 reveals that individuals in the low PR-low PI condition make significantly less Go decisions.

Table 4.6
Total Number of Go Decisions Summary Table[a]

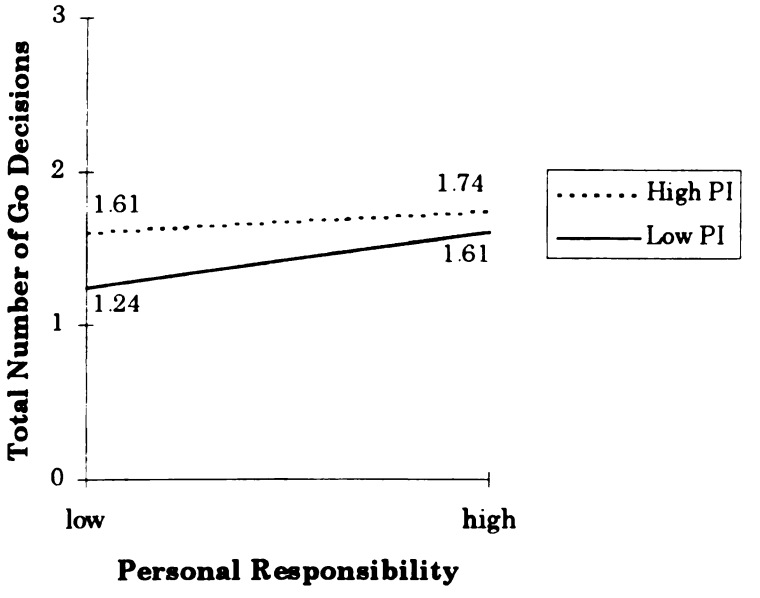
Dependent Variable: **SUMOFGO**

Source	*Degrees of Freedom*	*Chi-Square*	*Significance*
PR	3	7.44	-
PI	3	8.99	*
ISC	3	0.82	-
PR*PI	3	10.10	*
PR*ISC	3	1.78	-
PI*ISC	3	7.14	-
PR*PI*ISC	3	1.19	-
Intercept	3	849.90	***

[a]Computed using the CATMOD procedure in SAS via marginals.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

Multivariate analysis of variance (MANOVA) was also used to test the between-subjects effects. Several preliminary tests were conducted prior to analyzing the self-reported measures of commitment using MANOVA. An assumption of MANOVA is the equivalence of covariance matrices across groups (known as the homogeneity or symmetry assumption). Researchers in business frequently fail to report whether this assumption was satisfied, especially for repeated measures analysis (cf. Bergh 1995; LaTour and Miniard 1983). To verify that the treatment-difference variances were equal, three tests were conducted. Two univariate tests, the Bartlett-Box F test and Cochran's C, indicated that the symmetry conditions were not violated

Figure 4.4
Personal Responsibility - Product Innovativeness Interaction for the Total Number of "Go" Decisions



($p \leq 0.05$). Furthermore, the more stringent multivariate Box's M test also revealed that the symmetry conditions were not violated ($p \leq 0.05$).

The results of the MANOVA analyses for the self-reported measures of commitment were quite similar to those found for the behavioral intentions measures. As shown in Table 4.7, individuals in the high PR condition reported a significantly higher level of commitment to the failing NPD project than those in the low PR condition ($p \leq 0.001$). No other effect was significant at stage 2. At stage 3, individuals in both the high PR and high PI conditions exhibited a significantly higher level of self-reported commitment to the

Table 4.7
Self-Reported Commitment MANOVA Summary Table

Source	*Hotelling's Trace Value*[a]	*Exact F*	*d.f.*	*Error d.f.*	*Effect Size*	*Significance*
Stage 2						
PR	0.093	5.08	5	272	.085	***
PI	0.033	1.78	5	272	.032	-
ISC	0.011	0.57	5	272	.010	-
PR*PI	0.021	1.12	5	272	.020	-
PR*ISC	0.011	0.605	5	272	.011	-
PI*ISC	0.006	0.32	5	272	.006	-
PR*PI*ISC	0.011	0.59	5	272	.011	-
Stage 3						
PR	0.056	3.08	5	273	.053	**
PI	0.050	2.73	5	273	.048	*
ISC	0.004	0.24	5	273	.004	-
PR*PI	0.010	0.56	5	273	.010	-
PR*ISC	0.018	1.00	5	273	.018	-
PI*ISC	0.023	1.23	5	273	.022	-
PR*PI*ISC	0.021	1.15	5	273	.021	-
Stage 4						
PR	0.019	1.03	5	273	.019	-
PI	0.021	1.13	5	273	.020	-
ISC	0.010	0.55	5	273	.010	-
PR*PI	0.005	0.27	5	273	.005	-
PR*ISC	0.045	2.44	5	273	.043	*
PI*ISC	0.033	1.80	5	273	.032	-
PR*PI*ISC	0.012	0.67	5	273	.012	-

[a]In every instance, Hotelling's trace, Wilks' lambda, Pillai's criterion, and Roy's greatest characteristic root calculated the same F value.

***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

failing NPD project ($p \leq 0.01$ and $p \leq 0.05$, respectively). As with behavioral commitment, by stage 4, none of the effects was significant ($p \leq 0.05$).

4.4.2. Within-Subjects Results

The within-subjects results center on how commitment differs over the stages of the NPD project. Repeated measures ANOVA, CATMOD ANOVA, and MANOVA were used to analyze the data. The results of these analyses are described below.

The results of the repeated measures ANOVA for likelihood of funding appear in Table 4.8. The univariate and multivariate tests yielded consistent results across all within-subjects conditions. Consequently, for brevity, only the multivariate Hotelling's trace value is reported. As shown in Table 4.8, the results revealed that PR was the only significant between-subjects effect ($p \leq 0.05$). More importantly, two of the within-subjects effects were significant. First, the effect of the stage of the NPD process on the likelihood of funding was significant ($p \leq 0.001$). Figure 4.5 reveals that overall, individuals were less likely to fund a failing NPD project at stages 3 and 4 than at stage 2. The interaction of PR and NPD stage was significant also ($p \leq 0.05$). Figure 4.6 illustrates that the likelihood of funding the NPD project generally decreased and converged for the high and low conditions over the NPD process. While the effect of PI did not significantly diminish over the NPD process, it had nearly the same effect sizes as PR.

Table 4.8
Likelihood of Funding Repeated-Measures ANOVA Summary Table

Dependent Variable: **FUND** (for Stages 2, 3, and 4)

Source	*Sum of Squares*	*d.f.*	*Mean Square*	*F*	*Effect Size*	*Significance*
Between-Subjects						
PR	92.69	1	92.69	4.73	.017	*
PI	45.95	1	45.95	2.35	.008	-
ISC	0.72	1	0.72	0.04	.000	-
PR*PI	28.96	1	28.96	1.48	.005	-
PR*ISC	0.10	1	0.10	0.00	.000	-
PI*ISC	14.94	1	14.94	0.76	.003	-
PR*PI*ISC	20.35	1	20.35	1.04	.004	-
Error	5406.15	273	19.59			

Source	*Hotelling's Trace Value*[a]	*Exact F*	*d.f.*	*Error d.f.*	*Effect Size*	*Significance*
Within-Subjects[b]						
NPD	1.008	138.59	2	275	.502	***
PR*NPD	0.022	3.06	2	275	.022	*
PI*NPD	0.020	2.76	2	275	.020	-
ISC*NPD	0.005	0.74	2	275	.005	-
PR*PI*NPD	0.015	2.01	2	275	.014	-
PR*ISC*NPD	0.006	0.82	2	275	.006	-
PI*ISC*NPD	0.008	1.10	2	275	.008	-
PR*PI*ISC*NPD	0.193	2.65	2	275	.019	-

[a]In every instance, Hotelling's trace, Wilks' lambda, Pillai's criterion, and Roy's greatest characteristic root calculated the same F value.
[b]NPD = stage of the new product development process.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

Figure 4.5
Likelihood of Funding Over the NPD Process

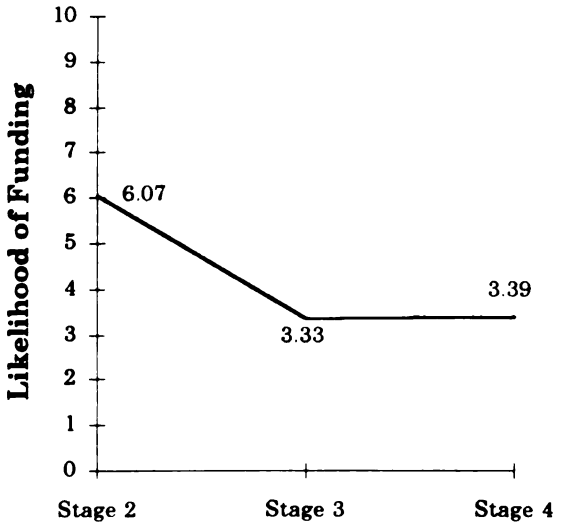
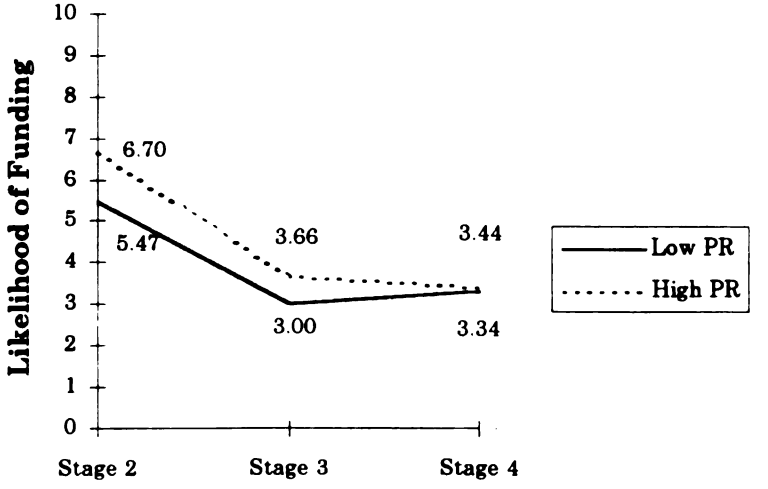


Figure 4.6
Repeated Measures ANOVA Results of Personal Responsibility - NPD Stage Interaction



The results of the repeated measures CATMOD ANOVA appear in Table 4.9. Both PR and PI were significant ($p \leq 0.05$) between-subjects effects. This indicates that overall (i.e., across the three NPD stages simultaneously), individuals in these high conditions were likely to recommend Go decisions and continue the project than those in the low conditions. Figure 4.7 shows that the percents of individuals making Go decisions in the high and low PR conditions converge over the NPD process, though not significantly ($p > 0.05$). A nearly identical result was found for PI, as shown in Figure 4.8. In both the high PR and high PI conditions, individuals generally were less likely to make Go decisions over the NPD process. However, under the low PR and low PI conditions, subjects slightly increased their willingness to make Go decisions from stage 3 to 4. With respect to the within-subjects effects, only the main effect of the stage of the NPD process was significant ($p \leq 0.001$). Figure 4.9 shows that overall, subjects were less likely to made Go decisions at stages 2 and 3 than at stage 4.

Finally, the repeated measures MANOVA results are reported in Table 4.10. As with the categorical ANOVA analysis, PR and PI were significant between-subjects effects ($p \leq 0.01$ and $p \leq 0.05$, respectively) indicating that across the three stages of the NPD process, individuals in the high PR and high PI conditions reported a higher level of commitment to the failing NPD project. No other significant between-subjects effect was found ($p \leq 0.05$). With respect to the within-subjects effects, the main effect of the stage of the

Table 4.9
Go/No-Go Decisions Over the NPD Process Summary Table[a]

Dependent Variable: **GOSTOP** (for Stages 2, 3, and 4)

Source	*Degrees of Freedom*	*Chi Square*	*Significance*
Between-Subjects			
PR	1	4.03	*
PI	1	4.07	*
ISC	1	0.41	-
PR*PI	1	0.93	-
PR*ISC	1	0.73	-
PI*ISC	1	2.36	-
PR*PI*ISC	1	0.10	-
Intercept	1	552.15	***
Within-Subjects[b]			
NPD	2	188.99	***
PR*NPD	2	5.25	-
PI*NPD	2	4.12	-
ISC*NPD	2	0.81	-
PR*PI*NPD	2	3.60	-
PR*ISC*NPD	2	4.33	-
PI*ISC*NPD	2	1.32	-
PR*PI*ISC*NPD	2	0.36	-

[a]Computed using the CATMOD procedure in SAS via marginals.
[b]NPD = stage of the new product development process.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

Figure 4.7
Repeated Measures CATMOD ANOVA Results of Personal Responsibility Over the NPD Process

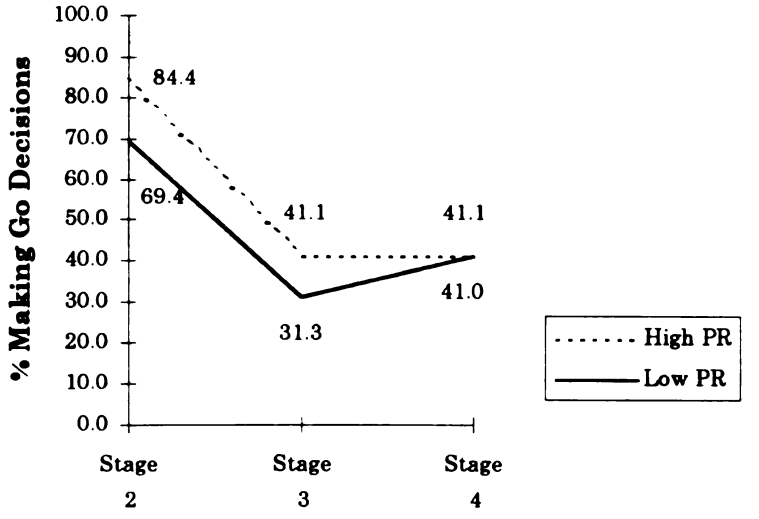


Figure 4.8
Repeated Measures CATMOD ANOVA Results of Product Innovativeness Over the NPD Process

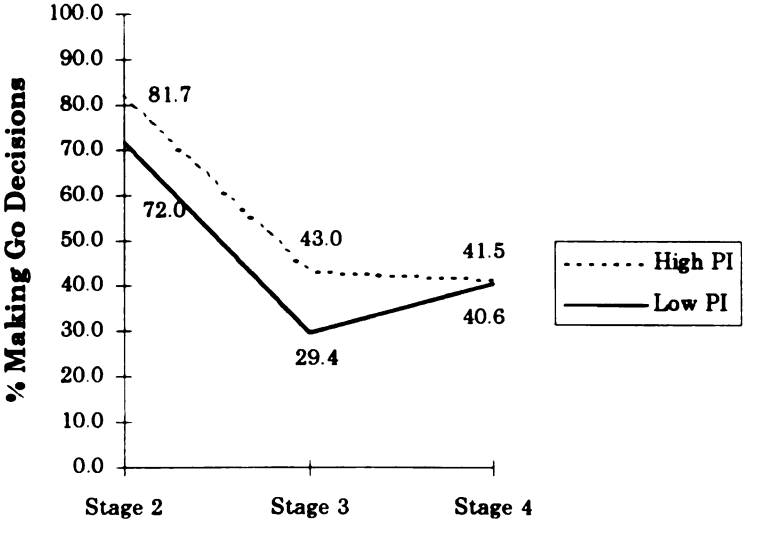
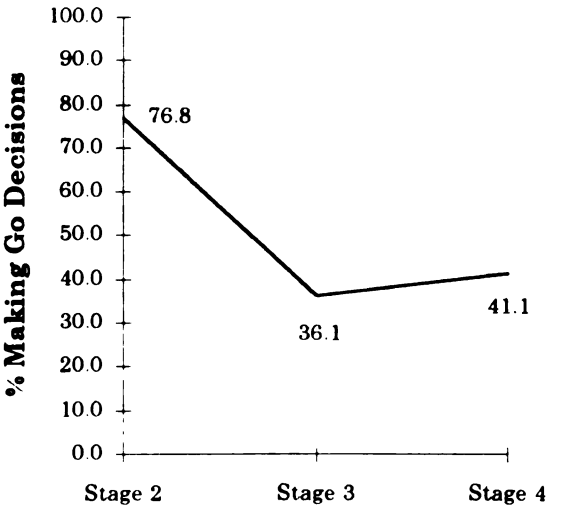


Figure 4.9
Repeated Measures CATMOD ANOVA Results Over the NPD Process



NPD process was significant ($p \leq 0.001$). Over the course of the NPD project, individuals generally reported a lower level of commitment to the project. No other significant within-subjects effect was found ($p \leq 0.05$).

4.4.3. Potential Contaminants and Covariates

Several additional analyses were undertaken to insure the results of the data analysis were accurate. These tests focused on the experimental task , gender, and experience. The results of these analyses appear below.

Experimental Task

To insure that the Go/No-Go decisions made at one stage of the exercise did not act as an unintended manipulation (by canceling the high

Table 4.10
Self-Reported Commitment Repeated Measures
MANOVA Summary Table

Source	*Hotelling's Trace Value*[a]	*Exact F*	*Error d.f.*	*d.f.*	*Effect Size*	*Significance*
Between-Subjects						
PR	0.061	3.31	5	272	.057	**
PI	0.045	2.44	5	272	.043	*
ISC	0.005	0.25	5	272	.004	-
PR*PI	0.012	0.66	5	272	.012	-
PR*ISC	0.028	1.51	5	272	.027	-
PI*ISC	0.019	1.04	5	272	.019	-
PR*PI*ISC	0.011	0.59	5	272	.011	-
Constant	15.276	830.99	5	272	.939	***
Within-Subjects[b]						
NPD	0.875	23.36	10	267	.467	***
PR*NPD	0.041	1.08	10	267	.039	-
PI*NPD	0.043	1.15	10	267	.041	-
ISC*NPD	0.030	0.79	10	267	.029	-
PR*PI*NPD	0.020	0.53	10	267	.020	-
PR*ISC*NPD	0.038	1.01	10	267	.036	-
PI*ISC*NPD	0.066	1.76	10	267	.062	-
PR*PI*ISC*NPD	0.041	1.09	10	267	.039	-

[a]In every instance, Hotelling's trace, Wilks' lambda, Pillai's criterion, and Roy's greatest characteristic root calculated the same F value.
[b]NPD = stage of the new product development process.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

PR manipulation) and affect decisions at subsequent stages of the exercise, the manipulation checks were recalculated for stages 3 and 4 controlling for the Go/No-Go decision made at the preceding NPD gate. The results showed that the PR manipulation was still highly effective regardless of individuals' earlier Go/No-Go decisions ($p \leq 0.001$).

Gender

The sample consisted of approximately 60 percent males and 40 percent females. A Chi-square determined that the men and women were distributed evenly over the eight experimental conditions ($p \leq 0.05$). A second Chi-square test determine that the men and women essentially made the same Go/No-Go decisions ($p \leq 0.05$) across the eight experimental conditions.

Furthermore, for each experimental condition, t-tests were used to compare the mean responses for men and women over each of the dependent variables used in this study. Although a few significant differences were found, the number of differences was less than expected by chance alone, and no significant pattern was discerned. Finally, all of the analyses were redone adding gender as a factor. The results were unchanged substantively since gender did not exert main effects nor interaction effect in any of the analyses.

Additional analyses were conducted to determine if experience had any effect on commitment. The number of years of work experience (WORKEXP) and NPD experience (NPDEXP), as well as the largest dollar amount

committed when acting as the primary decision-maker (INVEST) were used in these analyses. The results appear below.

Number of Years of Work Experience

By design, the analysis sample included only those individuals with at least two years of professional work experience. Using ANOVA, the mean number of years of work experience was compared for the eight experimental conditions. Duncan multiple range tests revealed that individuals in condition 1 ($\bar{x}$ = 5.5 years) had significantly less work experience than those in conditions 3 ($\bar{x}$ = 9.1 years) and 7 ($\bar{x}$ = 8.8 years) ($p \leq 0.05$). However, correlation analysis of WORKEXP with the continuous measures of behavioral and self-reported commitment revealed low correlations that were generally negative in direction, below 0.20 and not significantly different from zero ($p > 0.05$).

New Product Development and Financial Investing Experience

Nearly 40 percent of the individuals in the sample had at least one year of NPD experience, and 47 percent of the individuals had acted as the primary decision-maker in a financial investment decision. Chi-square tests revealed no significant difference in the distribution of individuals with NPD experience or financial investing experience over the eight experimental conditions ($p \leq 0.05$). T-tests were then used to compare the mean responses for each of the continuous dependent variables used in this study for

individuals possessing these experiences to those lacking them. Although more differences were found than expected by chance alone, no discernible pattern was found. Then, using ANOVA, the means of both NPDEXP and INVEST were compared for the eight experimental conditions. Duncan multiple range tests revealed no significant difference across the experimental conditions ($p \leq 0.05$) and no pattern was revealed for the years of NPD experience. For INVEST, individuals in condition 1 ($\bar{x}$ = \$3.7 million) had significantly more investing experience than those in conditions 8 ($\bar{x}$ = \$0.9 million), 2 ($\bar{x}$ = \$0.4 million), and 4 ($\bar{x}$ = \$0.2 million). However, correlation analyses of NPDEXP and INVEST with all of the continuous dependent variables revealed very few significant correlations and no pattern in terms of directionality for conditions one through 7. However, for condition 8 (high PR, high PI, low ISC), NPDEXP was significantly and negatively correlated with several of the dependent variables.

Summary

Wildt and Ahtola (1978) and Green (1978) note a covariate can improve the precision of data analysis only if the covariate is correlated with the dependent variables. The stronger the correlation, the more variance the covariate explains. As a rule of thumb, the correlation between a potential covariate and the variable of interest should exceed 0.3. (Cochran 1957). As noted above, WORK, NPDEXP, and INVEST generally exhibited low

correlations that were below this threshold with nearly all of the dependent variables. Nevertheless, all of the analyses were redone using these three variables as covariates, first individually, then in combination. The results of the ANCOVAs (analysis of covariance), MANCOVAs (multivariate analysis of covariance), and repeated measures ANCOVA and MANCOVA revealed that the results were not changed substantially, and in nearly every case, the covariate was insignificant. Therefore, covariates were not used in the final results presented in this chapter.

4.5. Results Related to Research Questions and Hypotheses

Since each research question had multiple research hypotheses, many of which had multiple statistical hypotheses, the results of this research are summarized in Table 4.11 to assist the reader in making sense of the results. The table is organized around research questions. The stage in the NPD project is denoted by either stage 2, 3, or 4 representing the gate after the marketing and technical assessment, development and testing, and commercialization stages, respectively. The dependent variable(s), corresponding statistical test, statistical results, and research conclusion are also listed in the table for each hypothesis.

Table 4.11
Summary Results Table by Hypothesis

	NPD	*Dependent Variable(s)*	*Statistical Test*	*Statistical Result*	*Hypothesis Support*
Effect: PR					
H1a	2	FUND	ANOVA	***	Yes
H1a	2	GOSTOP	CATMOD ANOVA	**	Yes
H2a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	***	Yes
H1b	3	FUND	ANOVA	-	No
H1b	3	GOSTOP	CATMOD ANOVA	-	No
H2b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	**	Yes
H1c	4	FUND	ANOVA	-	Yes
H1c	4	GOSTOP	CATMOD ANOVA	-	Yes
H2c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes
Effect: PI					
H3a	2	FUND	ANOVA	-	No
H3a	2	GOSTOP	CATMOD ANOVA	*	Yes
H4a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H3b	3	FUND	ANOVA	**	Yes
H3b	3	GOSTOP	CATMOD ANOVA	**	Yes
H4b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	*	Yes
H3c	4	FUND	ANOVA	-	Yes
H3c	4	GOSTOP	CATMOD ANOVA	-	Yes
H4c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes
Effect: ISC					
H5a	2	FUND	ANOVA	-	No
H5a	2	GOSTOP	CATMOD ANOVA	-	No
H6a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H5b	3	FUND	ANOVA	-	No
H5b	3	GOSTOP	CATMOD ANOVA	-	No
H6b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H5c	4	FUND	ANOVA	-	Yes
H5c	4	GOSTOP	CATMOD ANOVA	-	Yes
H6c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes

Table 4.11 (continued)

	NPD	*Dependent Variable(s)*	*Statistical Test*	*Statistical Result*	*Hypothesis Support*
Effect: PR*PI					
H7a	2	FUND	ANOVA	*	Yes
H7a	2	GOSTOP	CATMOD ANOVA	*	Yes
H8a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H7b	3	FUND	ANOVA	-	No
H7b	3	GOSTOP	CATMOD ANOVA	-	No
H8b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H7c	4	FUND	ANOVA	-	Yes
H7c	4	GOSTOP	CATMOD ANOVA	-	Yes
H8c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes
Effect: PR*ISC					
H9a	2	FUND	ANOVA	-	No
H9a	2	GOSTOP	CATMOD ANOVA	-	No
H10a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H9b	3	FUND	ANOVA	-	No
H9b	3	GOSTOP	CATMOD ANOVA	-	No
H10b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H9c	4	FUND	ANOVA	-	Yes
H9c	4	GOSTOP	CATMOD ANOVA	-	Yes
H10c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes
Effect: PI*ISC					
H11a	2	FUND	ANOVA	-	No
H11a	2	GOSTOP	CATMOD ANOVA	-	No
H12a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H11b	3	FUND	ANOVA	-	No
H11b	3	GOSTOP	CATMOD ANOVA	-	No
H12b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H11c	4	FUND	ANOVA	-	Yes
H11c	4	GOSTOP	CATMOD ANOVA	-	Yes
H12c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes

Table 4.11 (continued)

	NPD	*Dependent Variable(s)*	*Statistical Test*	*Statistical Result*	*Hypothesis Support*
Effect: PR*PI*ISC					
H13a	2	FUND	ANOVA	-	No
H13a	2	GOSTOP	CATMOD ANOVA	-	No
H14a	2	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H13b	3	FUND	ANOVA	*	Yes
H13b	3	GOSTOP	CATMOD ANOVA	-	No
H14b	3	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	No
H13c	4	FUND	ANOVA	-	Yes
H13c	4	GOSTOP	CATMOD ANOVA	-	Yes
H14c	4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	MANOVA	-	Yes
Effect: PR*NPD					
H15	2,3,4	FUND	R.M. ANOVA	*	Yes
H15	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H16	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No
Effect: PI*NPD					
H17	2,3,4	FUND	R.M. ANOVA	-	No
H17	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H18	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No
Effect: ISC*NPD					
H19	2,3,4	FUND	R.M. ANOVA	-	No
H19	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H20	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No
Effect: PR*PI*NPD					
H21	2,3,4	FUND	R.M. ANOVA	-	No
H21	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H22	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No

Table 4.11 (continued)

	NPD	*Dependent Variable(s)*	*Statistical Test*	*Statistical Result*	*Hypothesis Support*
Effect: PR*ISC*NPD					
H23	2,3,4	FUND	R.M. ANOVA	-	No
H23	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H24	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No
Effect: PI*ISC*NPD					
H25	2,3,4	FUND	R.M. ANOVA	-	No
H25	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H26	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No
Effect: PR*PI*ISC*NPD					
H27	2,3,4	FUND	R.M. ANOVA	-	No
H27	2,3,4	GOSTOP	R.M. CATMOD ANOVA	-	No
H28	2,3,4	COMMIT, GUILTY, STICK, LOYALTY, CHANGE	R.M. MANOVA	-	No

Notes: NPD = stage of the new product development process.
R.M. = repeated measures.
***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, - = no significant difference.

4.5.1. Personal Responsibility and Commitment

Personal responsibility had a significant effect on the level of commitment to a failing NPD project. As hypothesized, at stage 2, high PR individuals were more behaviorally committed as they were more likely to fund the next stage of the NPD project and made a significantly higher percentage of Go decisions (H1a), although no effect was found at stage 3 (H1b). Furthermore, high PR led to higher levels of self-reported

commitment at stages 2 and 3 (H2a and H2b). At stage 4, the levels of commitment converged for both high and low PR conditions, and no significant difference was found, as hypothesized in H1c and H2c. Over the NPD process, the effect of PR on the likelihood of funding diminished slightly (H15), but the effects on the Go/No-Go decisions and self-reported commitment stayed constant (H15 and H16, respectively).

4.5.2. Product Innovativeness and Commitment

Commitment to a failing NPD project was significantly greater for the more innovative product compared to the less innovative one. At stage 2, individuals in high PI conditions made significantly more Go decisions than individuals in low PI conditions (H3a) but were not significantly more likely to fund the project (H3a). At stage 3, subjects in high PI conditions were more likely to fund the failing NPD project and make Go decisions (H3b), and they were more psychologically committed to the project (H4b). As expected, at stage 4, no significant difference in commitment was found between individuals in high and low PI conditions (H3c, H4c). Interestingly, the within-subjects results revealed that the effect of PI did not diminish over the NPD process (H17, H18).

4.5.3. Information Source Credibility and Commitment

Contrary to expectations, the credibility of the source providing information during a failing NPD project did not significantly affect one's

commitment to that project. As shown in Table 4.11, H5a,b and H6a,b were not supported. Hypotheses H5c and H6c were supported since no significant difference in the level of commitment was expected at stage 4 and none was found. In addition, all of the two-way interactions that included ISC revealed no significant effect on the levels of behavioral or self-reported commitment (H9-H12).

4.5.4. Personal Responsibility, Product Innovativeness, and Commitment

The interaction effect of PR and PI was significant at stage 2 for both statistical tests of behavioral commitment (H7a) but not for self-reported commitment (H8a). High PR and high PI, alone or in combination, was sufficient to cause one to recommend that the failing NPD project be continued. Likewise, though not hypothesized, subjects in the low PR-low PI condition made significantly less GO decisions over the project's life. At stages 3 and 4, the PR-PI interaction was not significant (H7b,c, H8b,c).

4.6. Summary

In this study, 285 professionals drawn from executive MBA programs participated in a NPD decision-making experiment. The results show that commitment was higher under conditions of high personal responsibility and/or high product innovativeness, as hypothesized. Contrary to expectations, the credibility of the source providing information during the

NPD project had no effect of commitment. Finally, commitment to a failing NPD project generally decreases over the stages of the project, though the effects of personal responsibility and product innovativeness on commitment generally do not diminish over the NPD process.

CHAPTER 5

DISCUSSION

> If at first you don't succeed, try, try again. Then quit. No use being a damn fool about it. (W.C. Fields)

5.1. Introduction and Overview of Chapter

The final chapter of this dissertation is organized into five sections. First, an overview of the study is presented and significant research findings are discussed. The contributions to both theory and managerial practice follow. Limitations of this research are suggested, and directions for future research are offered. A brief conclusion closes this chapter.

5.2. Overview of Study and Significant Findings

The purpose of this dissertation research was to study decision-making in the new product development (NPD) process. Anecdotal evidence and interviews with NPD professionals suggested that NPD projects are difficult to stop once they begin since individuals and organizations devote considerable financial and psychological resources to them. Furthermore, new products often create excitement within companies. While the stages of the NPD process have studied extensively, there has been scant research attention directed at the gates (decision-making points) in the NPD process.

The theoretical base for this research is escalation of commitment theory from the social and organizational psychology literatures. Escalation

of commitment situations are characterized by continued investment in a course of action despite negative feedback.

The escalation of commitment literature was reviewed, as well as key pieces of the NPD literature, and a conceptual link was established between the two areas. Based on the literature review and interviews conducted with NPD professionals, three factors were selected that were believed to be key drivers of escalation of commitment in NPD: (1) personal responsibility (PR) for initiating a NPD project that is subsequently failing, (2) product innovativeness (PI), and (3) the credibility of the source providing information (ISC) during a NPD project. Each of these was manipulated so as to constitute *either* a high or low condition, thus forming an eight-cell, between-subjects design. In addition, a repeated measures (i.e., within-subjects) design was used which required each subject to repeat the experimental procedure at three sequential stages in a hypothetical NPD project.

Commitment was the dependent construct of interest, and it was operationalized in two ways. In this research, as in most escalation of commitment research, commitment was measured from a behavioral perspective (Binder 1985). Commitment was also measured from a self-reported or cognitive manner. Approaching commitment from both perspectives was thought to give a more complete understanding of the phenomenon.

A 2x2x2x3 decision-making experiment was used to test the research hypotheses. Subjects were 285 business professionals drawn from executive MBA programs. Subjects were randomly assigned to one of the eight experimental conditions which manipulated PR, PI, and ISC. Based on financial and qualitative information that was identical for each of the conditions, subjects made Go/No-Go and funding decisions and reported their level of commitment to a hypothetical failing NPD project. Subjects made these decisions at the gates following the preliminary marketing and technical assessment, development and testing, and commercialization stages of the NPD process (i.e., stages 2, 3, and 4, respectively). The key findings are discussed below.

5.2.1. Personal Responsibility and Commitment

The finding that PR induces escalation of commitment has been reported by other researchers in various decision-making experiments (e.g., Boulding *et al.* 1995; Schoorman *et al.* 1994; Simonson and Staw 1992; Staw 1976; Staw and Fox 1977; Staw and Ross 1978; Whyte 1991). This research shows that prior to the commercialization stage, individuals that are personally responsible for selecting a new product to develop and initiating that project generally reported a significantly higher level of commitment to that product. Furthermore, given identical performance information, early in the NPD process (i.e., stage 2), these individuals were less likely to stop the

failing NPD project than the individuals that assumed responsibility for the project after it began. At stage 3, while individuals in the high PR condition were no more likely to continue or fund the project than those in the low PR condition, they still reported a higher level of commitment to the failing project.

An important finding of this research is that the effect of PR on commitment generally did not diminish over the stages of the NPD process. Self-justification is the mechanism most closely associated with escalation of commitment (Aronson 1984; Bazerman, *et al.* 1984; Brockner 1992; Staw and Ross 1987). Individuals try to justify to themselves (and others) the correctness of previous decisions. This retrospective rationality causes decision-makers to focus on past decisions to try to reduce their negative outcomes rather than focusing on future outcomes. Furthermore, the need to justify past decisions was not reduced significantly over the course of failing NPD project.

At all three stages in the present experiment, the financial feedback information indicated that the new product would fall short of the mandated hurdle rates. Since individuals in high and low PR conditions were given identical performance feedback information, individuals in the high PR condition likely either (1) distorted or ignored the negative financial information, or (2) focused on the non-financial information that was encouraging, but unrelated to performance. Past research has shown that

self-justification causes individuals to bias information to fit previously held beliefs and preferences (Gilovich 1983; Lord and Lepper 1979; Nisbett and Ross 1980; Taylor and Brown 1988). Boulding *et al.* (1995) found that individuals that remained committed to a failing new product biased information by interpreting negative information *positively* in 133 of 136 instances at the post-commercialization stage.

At the post-commercialization stage, no difference was found in the behavioral or self-reported commitment between high and low PR subjects. At this point, the performance figures were actual rather than forecasted and had grown even more ominous. This supports the notion by Simonson and Staw (1992, p.420) that individuals withdraw from an investment situation when the "economic facts become sufficiently negative and clear cut." Nonetheless, killing the new product after commercialization results in much larger financial losses than stopping it prior to launch.

Boulding, Morgan, and Staelin (1995) reported that all 15 individuals in their high PR baseline condition opted to keep the product on the market even though it was failing. The present research offers some hope that NPD managers do not completely ignore risk. Whereas Boulding *et al.* only had subjects make a single Go/No-Go decision after the product was commercialized, in the current research, subjects made three Go/No-Go decisions over the entire NPD process. At stage 4, about 42 percent of

individuals in the high PR condition made Go decisions- nearly identical to percent opting for continuation in the low PR condition.

5.2.2. Product Innovativeness and Commitment

Prior to the commercialization stage, commitment to a failing NPD project was significantly higher for the more innovative product compared to the less innovative one, as hypothesized. At stage 2, individuals in the high PI condition were more likely to make Go decisions. By stage 3, these individuals were more likely to fund the project, continue the project, and reported a higher level of commitment to the project. As with PR, after commercialization, no effect on commitment was found.

Again, the performance feedback and cost information provided in the experiment was identical across all conditions. Consequently, the highly innovative product did not offer any greater financial benefit than the marginally innovative product. Based on the results, one must infer that the negative information was ignored or distorted.

However, in *actual* NPD projects, financial and non-financial factors may cause commitment to innovative new products. For example, from the financial side, innovative new products stand a better chance for success. Cooper and Kleinschmidt (1991) found that highly innovative products stand approximately a ten percent better chance of success compared to low innovative products. Also, radical innovations provide the possibility of

being wildly successful, whereas incrementally innovative products virtually never do. Furthermore, in actual NPD projects, innovative products offer the opportunity to be first to market, and intangible benefits, as well as financial ones, may accrue to companies that reach the market first with innovative products. For example, positive company goodwill may be generated by being the leader. Also, for technological products, first-movers have the opportunity to define the market or technological standards.

In this research, it appears that individuals were more committed to the innovative product simply because it was innovative. Several individuals in the high PI condition reasoned that the product offers advantages over rival products and should be commercialized. The results of this research suggest that NPD managers, employees, and even entire organizations may have a tendency to become enamored with innovative new products. Scientists, engineers, and marketers may spend years developing an innovative new product. These individuals see the benefits that users can gain from the new product.

As with PR, the effect of PI on commitment did not diminish over the NPD process. Even when confronted with negative performance information, individuals did not significantly reduce their commitment to the failing NPD project.

5.2.3. Information Source Credibility and Commitment

Contrary to expectations, the credibility of the source providing information during a failing NPD project had no effect of the level of commitment to that project. Research has shown that information received from credible sources is more likely to be believed (Hewgill and Miller 1965; Miller and Hewgill 1966). Consequently, commitment was hypothesized to be lower under conditions of high ISC. However, the business professionals in this research apparently were still able to discount or ignore the negative performance information.

Having recently taken courses in accounting and finance, individuals participating in this research seemed to strongly focus on the financial information provided in the experiment, regardless of the credibility of the source providing the information. In every experimental setting, the author observed numerous individuals evaluating financial information with their financial calculators. In addition, many of the completed experimental booklets had the results of the financial calculations in the margins, or subjects provided them in the open-ended questions to justify their decisions. Almost none of the subjects indicated concern about the credibility of the source of the information or the information itself.

One possible explanation for the lack of an ISC effect is that the individuals did not feel that the consequences of their decisions demonstrated their ability. Brockner and Rubin (1985) note that when

outcomes are perceived to reflect ability, individuals may more carefully evaluate the information available.

A second plausible explanation is that experiment itself may have acted as an unintended manipulation on the credibility of the information source. At each stage of the experiment the performance feedback turned further negative. For individuals in the high ISC condition, the revisions in the forecasted (or actual) performance information may have reduced the credibility of the information source, thereby diminishing the difference between the high and low ISC conditions. However, for two reasons, this is not a feasible explanation of the lack of an ISC effect. First, the manipulation checks indicated that the ISC manipulation was effective at all three stages of the experiment. Second, additional statistical analyses were conducted which reduced this possibility. Since performance forecasts change over the stages of a NPD project (Cooper 1993), the data were re-analyzed by splitting the sample into those with and without NPD experience. It was thought that individuals possessing NPD experience would realize that performance forecasts change over the life of the project as more information is gathered and the product moves closer towards commercialization, and such changes do not necessarily imply the information source is not credible. Consequently, the ISC manipulation would not be diminished for these individuals. In contrast, rather than viewing these changes in forecasts as a normal occurrence during NPD

projects, individuals lacking NPD experience might view the changing forecasts as a sign that the source of information is not credible- even in the high ISC condition. The manipulation checks revealed that the ISC manipulation was effective for individuals possessing *and* lacking NPD experience. Furthermore, as stated in Chapter 4, no pattern of differences in mean responses was found between these two groups for any of the dependent variables used in this study. Consequently, the experimental design is an unlikely explanation for the lack of an ISC effect.

A final potential explanation for the lack of ISC having an effect on commitment may be the ISC manipulation was not strong enough to exert an effect. While the manipulation checks indicated that the ISC manipulation was effective, it consistently was the weakest of the three manipulations. Post-hoc power analyses revealed the power levels of the main ISC effects were very small. For example, while a power level of 0.80 was used in the planning stages of this research as recommended by Cohen (1988), the actual power levels obtained for the ANOVA analyses were 0.17, 0.05, and 0.03 for stages 2, 3, and 4, respectively. For the MANOVA analyses, the power levels were 0.23, 0.10, and 0.21 for stages 2, 3, and 4, respectively. For every type of statistical analysis used, the effect size, and consequently power level, of ISC was much lower than that of PR and PI.

If one assumes that the credibility of the source of information is directly related to the credibility of the information itself, then the results of

this research show that "simply giving managers better information will not necessarily lead to better [new product] decisions" (Boulding *et al.* 1995, p.6). Escalation of commitment stems from economic and non-economic factors (Simonson and Staw 1992; Staw and Ross 1987). The information that individuals use to make NPD and other investment decisions centers on the economic factors of the project (e.g., sales, profits, market share). Consequently, perhaps one should question the value of information from high-priced marketing research firms and consultants in theNPD process. The results of this research suggest that resources should be directed at reducing the effects of commitment from non-economic factors prior to increasing the quality, accuracy, and timeliness of information used to make new product decisions. Otherwise, this better information may not have much impact on decision-making.

5.2.4. Personal Responsibility, Product Innovativeness, and Commitment

At the preliminary marketing and technical assessment stage of the NPD project (i.e., stage 2), *either* high PR or high PI was sufficient to cause individuals to continue the project on to the development and testing stage (i.e., stage 3). This finding indicates that an appropriate level of commitment must be maintained by developing de-escalation techniques to address the

PR issue and the PI issue. Such potential techniques are discussed in Section 5.2.6.

5.2.5. Commitment Over the New Product Development Process

While overall, commitment to a failing NPD project generally decreased over the stages of the project, the effects of PR and PI were not significantly reduced over the project. While a sizable decrease in behavioral commitment occurred from stage 2 to stage 3, commitment essentially remained constant from stage 3 to stage 4. Interestingly behavioral commitment actually increased in the low PR and low PI conditions from stage 3 to stage 4. While the hypothesis that commitment would decline and converge over the NPD process was supported, it was thought that individuals in the high PR and high PI conditions would reduce their commitment faster then those in the low PR and low PI conditions with no concomitant increase in commitment for the low PR and low PI conditions. One potential explanation for the increase in commitment for individuals in the low PR conditions is that over the stages of the NPD process, these individuals felt an increasing level of PR for the project. Even though individuals in the low PR condition did not initiate the NPD project, individuals that made continuation decisions started to feel more responsible for the predicament they were in.

5.2.6. General Discussion

The results of this research suggests ways that escalation of commitment in NPD can be reduced. For example, to reduce the effect of PR for initiating a project that subsequently performs poorly, the project leadership can be rotated over the stages of the NPD project. Changing decision-makers at subsequent stages of a project has been found to be an effective way of reducing escalation of commitment (Bazerman *et al.* 1984 1987) since it prevents the self-justification effect that is closely associated with the escalation of commitment phenomenon (Aronson 1984; Bazerman, *et al.* 1984; Brockner 1992; Simonson and Staw 1992; Staw and Ross 1987). When project leadership is rotated, decision-makers can focus on the financial aspects of the NPD project without needing to justify to themselves and others the correctness of their previous decisions. In the current research, prior to commercialization, individuals that were not responsible for initiating a NPD project that was subsequently failing were less committed to it. Boulding *et al.* (1995) similarly found that individuals that were not responsible for making the launch decision were more likely to leave the product on the market. Simonson and Staw (1992) also found that individuals were more likely to change their course of action when there was less pressure for self and external justification.

However, by changing the leadership, the role of the product champion is diminished. Product champions maintain momentum and enthusiasm in

the NPD project, muster resources, and push past roadblocks (Crawford 1994). As Balachandra (1984) found, a certain level of commitment among new product team members and top management is vital for new product success. However, excessive commitment by product champions may be detrimental.

Simonson and Staw (1992) and Boulding, Morgan, and Staelin (1995) found when individuals committed to a stopping criteria prior to receiving negative feedback, commitment was lower. However, in the present research, having clearly defined performance hurdles was not found to reduce commitment under high PR conditions in this research. Perhaps this is due to fact the performance criteria were imposed rather than selected by the decision-makers. In actual NPD projects, the psychological, social, and structural forces that drive escalation may or may not be powerful enough to cause one to ignore the stopping rules. A more critical issue though, is the practicality of allowing NPD managers to define the performance hurdles. Typically, top management and the finance area have substantial input into setting the hurdle rates for important NPD projects. Consequently, it may not be feasible to allow NPD managers complete autonomy in setting these goals.

There are other possible solutions to reducing escalation of commitment in NPD. For example, reward structures may be modified to be more tolerant of failure. Simonson and Staw (1992) found that accountability

for the decision process rather than the decision outcome reduced escalation of commitment. There are difficulties in using such a de-escalation technique though. Evaluating NPD managers on their decisions rather than the performance of the new products requires more time and effort by upper management. The forecasts, decision options, and other pertinent information must be reviewed by higher levels of management to determine if the decision process was appropriate. This may not be the best use of managerial resources. Furthermore, information is filtered before reaching the higher levels of an organization (Janis 1975), making this technique difficult to implement. This technique also usurps NPD managers power since upper levels of management will be scrutinizing their decisions. Fox and Staw (1979) note that whenever managers feel compelled to defend their actions against critics, most likely they will be less flexible in their decision-making.

For highly innovative products, strategies must be developed to focus attention on the financial aspects of the project rather than the intangibles or the upside potential. By using NPD teams for making decisions rather than an individual, the effects of PR and PI on commitment may be reduced. The use of cross-functional NPD teams has increased greatly over the past decade or so. One could posit that decision-making by NPD teams should reduce the likelihood of escalation of commitment for two reasons. First, the members of a cross-functional team have different training, level of decision-making

experience and education, and so on. This diversity may increase the number of issues and alternatives considered when making NPD decisions thereby increasing the effectiveness of the decisions. Second, team decisions should dilute the level of PR that each team member feels for the decision.

Alternatively, NPD teams may exhibit a greater tendency to escalation their commitment to a failing NPD project. While PR was been repeatedly shown to lead to escalation of commitment (cf. Boulding *et al.* 1995; Schoorman *et al.* 1994; Staw and Fox 1977; Whyte 1991), the mechanism that underlies the escalation of commitment phenomenon is self-justification. Reducing PR is one way to reduce the self-justification effect. However, NPD teams may also desire to prove to themselves and others the correctness of their earlier decisions. This means that escalation of commitment may occur in group decisions as well as individual ones. Furthermore, the groupthink literature suggests that groups take greater risks than individuals (Janis 1972, 1982; Janis and Mann 1977; Steiner 1972). In group situations, responsibility is diluted among the group members, but the desire to justify their decisions may be no less than in individual decisions. In a replication of Staw's (1976) research where escalation was examined for both individuals and groups, Bazerman, Guillano, and Appelman (1984) found that escalation of commitment occurs in individual *and* group decision making situations. Future research is needed to determine whether groups escalation their commitment more or less than individuals.

5.3. Contributions

This research contributes to the literature in several ways. First, through a review of key pieces of the new products and escalation literatures, a conceptual link between the NPD process and escalation of commitment theory was established. Second, understanding of decision-making at the NPD gates has been increased. In the past, the stages of the NPD process have been studied substantially more than the decision-making points (gates) of the NPD process. However, the gates are prominent features of typical NPD processes and offer excellent opportunities for improving the effectiveness of developing new products.

Third, this research measures commitment from both behavioral and cognitive (i.e., self-reported) perspectives. Most past research has measured commitment from the behavioral perspective only, often using a single variable. While the results of the current research are generally consistent across both types of commitment, this dual perspective increases our understanding of the phenomenon.

Fourth, this research introduces a new theoretical base to the study of the NPD process. Much of the past NPD and new product performance research have been atheoretical (Brown and Eisenhardt 1995). Theory is important for explaining *and* predicting phenomena (Hunt 1991) and for advancing the NPD literature (Brown and Eisenhardt 1995).

Fifth, this research used a controlled experiment which is rare in NPD research (Montoya-Weiss and Calantone 1994). Typically, mail surveys using retrospective questioning have been used to increase the understanding of new product performance (i.e., success and failure). The limitations of this methodology have been briefly noted by Brown and Eisenhardt (1995). However, experiments offer greater internal validity (Cook and Campbell 1979) and allow the establishment of true causal relationships.

This research also contributes to managerial practice in several ways. First, an empirical test showed that escalation of commitment can occur in the NPD process. Furthermore, personal responsibility and product innovativeness were shown to be key drivers of escalation of commitment in the NPD process while the credibility of the information source had no impact on commitment.

Second, this research shows that it is often difficult to stop NPD projects prior to commercialization as commitment decreases rapidly in the early stages of a NPD project but then levels off (and may even slightly increase) at the commercialization stage. As evidenced in Garland's (1990) research, individuals may feel that if the project is nearly complete, than it should be launched regardless of how bleak the odds of success. This reinforces the need to stop NPD projects early in the process when costs are relatively low.

Third, this research suggests normative managerial guidelines for maintaining an appropriate level of commitment in the NPD process. Methods to reduce PR for initiating a NPD project that was subsequently failing may reduce commitment to the project. Likewise, strategies for focusing attention on the economic aspects of highly innovative new products may prevent escalation of commitment. Techniques such as rotating responsibility over the life of the project, rewarding individuals for their decision process rather than decision outcome, encouraging decision-makers to establish a minimum performance level by specified points in the NPD process, and group decision-making potentially may reduce escalation of commitment in the NPD process.

5.4. Limitations

An inherent limitation of this research and all escalation of commitment research that uses decision-making experiments is that the stakes are low in hypothetical situations (Brockner *et al.* 1986; Garland *et al.* 1990; Staw and Ross 1987). In "real-world" decisions, the outcomes are potentially more damaging to one's self-esteem and career (Brockner *et al.* 1986) and the pressures to escalate commitment are greater. To partially overcome these limitations, strong manipulations were used along with manipulation checks, and a sizable financial reward was paid to increase subjects' involvement and effort in the experiment. Regardless, in any

experimental setting it is impossible to simulate the anxiety, pressure, and consequences of being held responsible for a multi-million dollar new product failure.

The individuals that participated in this research were employed full-time and were concurrently pursuing their MBA degrees. Consequently, the results of this research are likely to be even more dramatic in actual business decisions. On average, managers are less educated (or less recently educated) in formal decision-making and financial analysis than the executive MBAs that participated in this research. For example, the finance and accounting courses required in nearly all MBA programs train people in financial analysis and decision-making. When completing this experiment, individuals seemed to focus heavily on the financial information presented to them. Consequently, the results of the experiment are a conservative test of the level of escalation of commitment in NPD. In other words, the experiment used in this research is likely a conservative test of the research hypotheses; escalation of commitment in NPD is likely to be more of a problem in the actual new product decisions.

5.5. Directions for Future Research

The propensity to escalate in NPD situations may not be the same in other countries. The U.S. has a strongly individualistic culture that values consistency in decision-making (Fox and Staw 1979). Staw and Ross (1980)

found that individuals that remain committed to a course of action in spite of negative information and eventually achieve success were rated as better leaders by managers than those who ultimately failed or changed their strategy and succeeded. While this "hero effect" seems to pervade American culture, it is likely to contribute to escalation of commitment. In collectivist cultures (such as the Asian cultures), escalation of commitment may be less of a problem. Future research should focus on determining if escalation of commitment occurs to the same extent in other countries. If not, then perhaps some insight can be gained into ways to minimize the effects of this phenomenon in U.S. companies.

While two key drivers of escalation of commitment in the NPD process have been verified, others remain for future testing. Future research can expand the level of knowledge of escalation of commitment in NPD by focusing on four categories of determinants. These categories are: (1) the individual decision-maker (e.g., individuals in high generalized self-confidence [GSC] versus low GSC), (2) the firm (e.g., efficacy in past NPD projects), (3) the project (e.g., the level of riskiness), and the market in which a firm competes (level of industry competition). Finally, de-escalation strategies need to be developed after uncovering more determinants of escalation.

5.6. Conclusion

Two key factors were found to cause escalation of commitment in the NPD process, personal responsibility and product innovativeness. Individuals that are responsible for initiating a NPD project that is heading for failure are more likely to continue with the project and are more committed to it than those that did not initiate the project, given the same financial performance. Likewise, innovative new products are more likely to be carried through commercialization than less innovative new products even with identical financial performance. Furthermore, either personal responsibility or an innovative new product will lead to an increase in behavioral and self-reported commitment to a failing NPD project. The effects of PR and PI generally do not diminish over the NPD process.

Escalation of commitment in the NPD process contributes to the new product failure rate since it may result in decision-makers being more likely to carry a failing project through commercialization, hence, failing in the market. Since costs generally rise over the NPD process with commercialization being the costliest stage (Calantone and Montoya-Weiss 1994), it is important to terminate NPD projects early in the process (Cooper 1993). However, escalation of commitment translates into NPD projects being more likely to be continued on the subsequent stages of the NPD process at higher costs despite the warning signs.

APPENDIX A

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN SUBJECTS (UCRIHS) APPROVAL

MICHIGAN STATE
UNIVERSITY

December 18, 1995

TO: Jeffrey Schmidt
N370 North Business Complex

RE: IRB#: 95-630
TITLE: ESCALATION OF COMMITMENT IN THE NEW PRODUCT DEVELOPMENT PROCESS: A CONTRIBUTING FACTOR OF NEW PRODUCT FAILURE
REVISION REQUESTED: N/A
CATEGORY: 1-C
APPROVAL DATE: 12/18/95

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revisions listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)432-1171.

Sincerely,

David E. Wright

David E. Wright, Ph.D.
UCRIHS Chair

DEW:bed

cc: Roger Calantone

OFFICE OF
RESEARCH AND GRADUATE STUDIES

University Committee on Research Involving Human Subjects (UCRIHS)
Michigan State University
232 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX: 517/432-1171

LIST OF REFERENCES

LIST OF REFERENCES

Arkes, H.R. and C. Blumer (1985), "The Psychology of Sunk Costs," *Organizational Behavior and Human Decision Processes*, 35: 124-40.

Armstrong, J. Scott, Nicole Coviello and Barbara Safranek (1993), "Escalation Bias: Does It Extend to Marketing?," *Journal of the Academy of Marketing Science*, 21 (Summer), 247-53.

Aronson, Elliot (1984), *The Social Animal.* New York: W.H. Freeman. 4th Edition.

Balachandra, R. (1984), "Critical Signals for Making Go/No-Go Decisions in New Product Development," *Journal of Product Innovation Management*, 1 (April), 92-100.

Barton, Sidney L., Dennis Duchon and Kenneth J. Dunegan (1989), "An Empirical Test of Staw and Ross's Prescriptions for the Management of Escalation of Commitment Behavior in Organizations," *Decision Sciences*, 20 (3), 532-44.

Bateman, Thomas S. (1986), "The Escalation of Commitment in Sequential Decision Making: Situational and Personal Moderators and Limiting Conditions," *Decision Sciences*, 17 (Winter), 33-49.

Bazerman, Max H. (1984), "The Relevance of Kahneman and Tversky's Concept of Framing to Organizational Behavior," *Journal of Management*, 10 (Fall/Winter), 333-43.

Bazerman, Max H., Toni Giulano and Alan Appelman (1984), "Escalation of Commitment in Individual and Group Decision-making," *Organizational Behavior and Human Performance*, 33: 141-52.

Bergh, Donald D. (1995), "Problems with Repeated Measures Analysis: Demostration with a Study of the Diversification and Performance Relationship." *Academy of Management Journal* 38 (December): 1692-1708.

Binder, David Lloyd (1985). *Resource Allocation: The Escalation of Commitment or Cognitive Bolstering?* Unpublished Ph.D. Dissertation. The Ohio State University.

Bobocel, D. Ramona and John p. Meyer (1994), "Escalating Commitment to a Failing Course of Action: Separating the Roles of Choice and Justification," *Journal of Applied Psychology*, 79 (June), 360-3.

Boulding, William, Ruskin Morgan and Richard Staelin (1995), "Knowing When to Say When: Improving the Stop/No-Stop New Product Decision," Work in Progress.

Bowen, Michael G. (1987), "The Escalation Phenomenon Reconsidered: Decision Dilemmas or Decision Errors?," *Academy of Management Review*, 12 (January), 52-66.

Booz, Allen and Hamilton (1968), *Management of New Products*. New York: Booz, Allen and Hamilton, Inc.

Booz, Allen and Hamilton (1982), *New Product Management for the 1980's*. New York: Booz, Allen and Hamilton.

Brockner, Joel (1992), "The Escalation of Commitment to a Failing Course of Action: Toward Theoretical Progress," *Academy of Management Review*, 17 (January), 39-61.

Brockner, Joel, Robert Houser, Gregg Birnbaum, Gregg Birnbaum, Kathy Lloyd, Janet Deitcher, Sinaia Nathanson, Jeffrey Z. Rubin (1986), "Escalation of Commitment to an Ineffective Course of Action: The Effect of Feedback Having Negative Implications for Self-Identity," *Administrative Science Quarterly*, 31 (March), 109-26.

Brockner, Joel, Jeffrey Z. Rubin and E. Lang (1981), "Face-Saving and Entrapment," *Journal of Experimental Social Psychology*, 17, 68-79.

Brockner, Joel and Jeffrey Z. Rubin (1985), *Entrapment in Escalating Conflicts*. New York: Springer-Verlag.

Brockner, Joel, M.C. Shaw and Jeffrey Z. Rubin (1979), "Factors Affecting Withdrawal from an Escalating Conflict: Quitting Before it's too Late," *Journal of Experimental Social Psychology*, 15, 492-503.

Brown, Shona L. and Kathleen M. Eisenhardt (1995), "Product Development: Past Research, Present Findings, and Future Directions," *Academy of Management Review*, 20 (April), 343-78.

Calantone, Roger J. and Robert G. Cooper (1979), "A Discriminant Model for Identifying Scenarios of Industrial New Product Failure," *Journal of the Academy of Marketing Science*, 7 (Summer), 163-83.

Calantone, Roger J. and C. Anthony di Benedetto (1990), "Canonical Correlation Analysis of Unobserved Relationships in the New Product Process," *R&D Management*, 20 (January), 3-20.

Calantone, Roger J., C. Anthony di Benedetto and Richard Divine (1993), "Organisational, Technical, and Marketing Antecedents for Successful New Product Development," *R&D Management*, 23 (October), 337-51.

Calantone, Roger and Mitzi Montoya (1994), "Product Launch and Follow-On," In *Managing New Technology Development*. W.E. Souder and J.D. Sherman (eds.), New York: McGraw-Hill, Inc., 217-47.

Chambers, J.C., S.K. Mullick and D.A. Goodman (1971), "Catalytic Agent for Effective Planning," *Harvard Business Review*, (January-February), 110-119.

Cochran, W.G. (1957), "Analysis of Covariance: Its Nature and Uses," *Biometrics* 13:261-81.

Cohen, Jacob (1965), "Some Statistical Issues in Psychological Research," in *Handbook of Clinical Psychology*, B.B. Wolman, (eds.), New York: McGraw-Hill, 95-121.

Cohen, Jacob (1988), *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc. 2d Edition.

Cohen, Jacob and Patricia Cohen (1983), *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates. 2d Edition.

Conlon, E.J. and J. McLean Parks (1987), "Information Requests in the Context of Escalation," *Journal of Applied Psychology*, 72 344-50.

Conlon, E.J. and G. Wolf (1980), "The Moderating Effects of Strategy, Visibility and Involvement on Allocation Behavior: An Extension of Staw's Escalation Paradigm," *Organizational Behavior and Human Performance*, 26, 172-92.

Cook, Thomas D. and Donald T. Campbell (1979), *Quasi-Experimentation: Design and Analysis Issues for Field Settings*. Chicago: Rand McNally College Publishing Company.

Cooper, Robert G. (1975), "Why New Industrial Products Fail," *Industrial Marketing Management*, 4 (December), 315-26.

Cooper, Robert G. (1979), "The Dimensions of Industrial New Product Success and Failure," *Journal of Marketing*, 43 (Summer), 93-103.

Cooper, Robert G. (1983), "A Process Model for Industrial New Product Development," *IEEE Transactions on Engineering Management*, EM-30 (February), 2-11.

Cooper, Robert G. (1984), "The Performance Impact of Product Innovation Strategies," *European Journal of Marketing*, 18 (5), 3-54.

Cooper, Robert G. (1988), "Predevelopment Activities Determine New Product Success," *Industrial Marketing Management*, 17 (August), 237-47.

Cooper, Robert G. (1990), "Stage-Gate Systems: A New Tool for Managing New Products," *Business Horizons*, 33 (May-June), 3.

Cooper, Robert G. (1993), *Winning at New Products: Accelerating the Process from Idea to Launch*. Cambridge, MA: Addison-Wesley. 2nd Edition.

Cooper, Robert G. (1994), "Third Generation New Product Processes," *Journal of Product Innovation Management*, 11 (January), 3-14.

Cooper, Robert G. and Ulricke de Brentani (1991), "New Industrial Financial Services: What Distinguishes the Winners." *Journal of Product Innovation Management* 8 (June): 75-90.

Cooper, Robert G. and Elko J. Kleinschmidt (1987), "New Products: What Separates Winners from Losers?," *Journal of Product Innovation Management*, 4 (September), 169-84.

Cooper, Robert G. and Elko J. Kleinschmidt (1988), "Resource Allocation in the New Product Process," *Industrial Marketing Management*, 17 (August), 249-62.

Cooper, Robert G. and Elko J. Kleinschmidt (1990), "New Product Success Factors: A Comparison of 'Kills' Versus Success and Failures," *R&D Management*, 20 (January), 47-63.

Cooper, Robert G. and Elko J. Kleinschmidt (1991), "The Impact of Product Innovativeness on Performance." *Journal of Product Innovation Management* 8 240-51.

Cooper, Robert G. and Elko J. Kleinschmidt (1993), "Major New Products: What Distinguishes the Winners in the Chemical Industry." *Journal of Product Innovation Management* 10 (March): 90-111.

Crawford, C. Merle (1994), *New Products Management*. Burr Ridge, MA: Irwin. 4th Edition.

Dwyer, Larry and Robert Mellor (1991a), "New Product Process Activities and Project Outcomes," *R&D Management*, 21 (January), 31-42.

Dwyer, Larry and Robert Mellor (1991b), "Organizational Environment, New Product Process Activities, and Project Outcomes," *Journal of Product Innovation Management*, 8 (March), 39-48.

Edgett, Scott, David Shipley and Giles Forbes (1992), "Japanese and British Companies Compared: Contributing Factors to Success and Failure in NPD," *Journal of Product Innovation Management*, 9 (March), 3-10.

Festinger, L. (1957), *A Theory of Cognitive Dissonance*. Evanston, IL: Row, Peterson.

Foster, Richard N. (1990), "Timing Technological Transitions," In *Readings in the Management of Innovation*. Michael L. Tushman and William L. Moore (eds.), Cambridge, MA: Ballenger, 2d. Edition, 215-28.

Fox, Frederick V. and Barry M. Staw (1979), "The Trapped Administrator: Effects of Job Insecurity and Policy Resistance Upon Commitment to a Course of Action," *Administrative Science Quarterly*, 24: 449-70.

Garland, Howard (1990), "Throwing Good Money After Bad: The Effect of Sunk Costs on the Decision to Escalate Commitment to an Ongoing Project," *Journal of Applied Psychology*, 75 (December), 728-31.

Garland, Howard, Craig A. Sandefur and Anne C. Rogers (1990), "De-Escalation of Commitment in Oil Exploration: When Sunk Costs and Negative Feedback Coincide," *Journal of Applied Psychology*, 75 (December), 721-7.

Gilovich, T. (1983), "Biased Evaluation and Persistence in Gambling," *Journal of Personality and Social Psychology*, 44 (June), 1110-26.

Goltz, Sonia (1987). *A Learning-Based Explanation of Escalation of Commitment, Sunk Cost, and Entrapment*. Unpublished Ph.D. Dissertation. Purdue University.

Green, Paul E. (1978), *Analyzing Multivariate Data.* Hinsdale, IL: The Dryden Press.

Hair, Joseph F. Jr., Rolph E. Anderson, Ronald L. Tatham, and William C. Black (1992), *Multivariate Data Analysis With Readings.* New York: Macmillan Publishing Company. 3d Edition.

Hewgill, M. and G. Miller (1965), "Source Credibility and Response to Fear-Arousing Communications," *Speech Monographs*, 32, 95-101.

Hopkins, D. S. and E. L. Bailey (1971), "New Product Pressures," *The Conference Board Record*, 8 (June), 16-24.

Hunt, Shelby D. (1991), *Modern Marketing Theory: Critical Issues in the Philosophy of Marketing Science.* Cincinnati, OH: South-Western Publishing Co.

Hustad, Thomas P. and Ted J. Mitchell (1982), "Creative Market Planning in a Partisan Environment," *Business Horizons*, 25 (March-April), 58-65.

Iversen, Gedmund R. and Helmut Norpoth (1987), *Analysis of Variance.* Newbury Park, CA: Sage Publications.

Janis, Irving L. (1972), *Victims of Groupthink.* Boston, MA: Houghton Mifflin.

Janis, Irving L. (1982), *Groupthink.* Boston: Houghton-Mifflin.

Janis, Irving L. and Leo Mann (1977), *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment.* New York: Free Press.

Kahneman, D. and A. Tversky (1979), "Prospect Theory: An Analysis of Decisions Under risk." *Econometrica* 47 (March), 263-91.

Kiesler, C.A. (1971), *The Psychology of Commitment.* New York: Academic Press.

Kuhn, Thomas S. (1970), *The Structure of Scientific Revolutions.* Chicago, IL: The University of Chicago Press. 2d Edition.

Kuczmarski, Thomas D. (1992), *Managing New Products: The Power of Innovation.* Englewood Cliffs, NJ: Prentice Hall. 2d. Edition.

LaTour, Stephen A. and Paul W. Miniard (1983), "The Misuse of Repeated Measures Analysis in Marketing Research." *Journal of Marketing Research* 20 (February): 45-57.

Leatherwood, Marya L. and Edward J. Conlon (1988), "The Impact of Prospectively Relevant Information on Persistence in a Project Following Setbacks," in *Advances in Information Processing in Organizations*, L.S. Sproull and P.D. Larkey (eds.), Greenwich, CT: JAI Press, 207-19.

Lord, C., L. Ross and M.R. Lepper (1979), "Biased Assimilation and Attitude Polarization: The Effects of Prior Theories on Subsequently Considered Evidence," *Journal of Personality and Social Psychology*, 37: 2098-109.

McCain, Bruce E. (1986), "Continuing Investment Under Conditions of Failure: A Laboratory Study of the Limits to Escalation," *Journal of Applied Psychology*, 71 (May), 280-4.

Miller, G. and M. Hewgill (1966), "Some Recent Research on fear-Arousing Message Appeals," *Speech Monographs*, 33 277-91.

Montoya-Weiss, Mitzi M. and Roger J. Calantone (1994), "Determinants of New Product Performance: A Review and Meta-Analysis," *Journal of Product Innovation Management*, 11 (November), 397-417.

National Industrial Conference Board (1964), *Why New Products Fail.* New York: National Industrial Conference Board.

Nisbett, R. and L. Ross (1980), *Human Inference: Strategies and Shortcomings of Social Judgment.* Engleweed Cliffs: Prentice-Hall.

Northcraft, G. and G. Wolf (1984), "Dollars, Sense, and Sunk Costs: A Lifecycle Model of Research Allocation Decisions," *Academy of Management Review*, 9, 225-34.

Page, Albert L. (1993), "Assessing New Product Development Practices and Performance: Establishing Crucial Norms," *Journal of Product Innovation Management*, 10 (September), 273-90.

Power, Christopher, Kathleen Kerwin, Ronald Grover, Keith Alexander and Robert D. Hoff (1993), "Flops: Too Many New Products Fail. Here's Why- and How to do Better," *Business Week*, (August 16), 76-82.

Rothwell, Roy (1974), "The 'Hungarian Sappho': Some Comments and Comparison." *Research Policy* 3, 30-8.

Rothwell, Roy, C. Freeman, A. Horsley, V.T.P. Jervis, A.B. Robertson and J. Townsend (1974), "SAPPHO Updated- Project Sappho Phase II." *Research Policy* 3: 258-91.

Ross, Jerry and Barry M. Staw (1986), "Expo 86: An Escalation Prototype," *Administrative Science Quarterly*, 31 (June), 274-97.

Salancik, G.R. (1977), "Commitment and the control of Organizational Behavior and Belief," in *New Directions in Organizational Behavior*, B.M. Staw and G.R. Salancik (eds.), Malabar, FL: Robert E. Krieger, 1-54.

Sanchez, Angel Martinez and Luis Navarro Elola (1991), "Product Innovation Management in Spain," *Journal of Product Innovation Management*, 8 (March), 49-56.

Sawyer, Alan G. (1975), "Demand Artifacts in Laboratory Experiments in Consumer Research," *Journal of Consumer Research*, 1 (4), 20-30.

Sawyer Alan G. and A. Dwayne Ball (1981), "Statistical Power and Effect Size in Marketing Research," *Journal of Marketing Research*, 18 (August), 275-90.

Schoorman, F. David, Roger C. Mayer, Christina A. Douglas and Christopher T. Hetrick (1994), "Escalation of Commitment and the Framing Effect: An Empirical Investigation," *Journal of Applied Social Psychology*, 24 (6), 509-28.

Shubik, M. (1971), "The Dollar Auction Game: A Paradox in Noncooperative Behavior and Escalation," *Journal of Conflict Resolution*, 15 109-11.

Simonson, Itamar and Barry M. Staw (1992), "Deescalation Strategies: A Comparison of Techniques for Reducing Commitment to Losing Courses of Action," *Journal of Applied Psychology*, 77 (August), 419-26.

Singer, Ming S. and Alan E. Singer (1986), "Individual Differences and Escalation of Commitment Paradigm." *The Journal of Social Psychology* 126 (April): 197-204.

Song, X. Michael and Mark E. Parry (1994), "The Dimensions of Industrial New Product Success and Failure in State Enterprises in the People's

Republic of China." *Journal of Product Innovation Management* 11 (March): 105-118.

Staw, Barry M. (1976), "Knee-Deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Course of Action," *Organizational Behavior and Human Performance*, 16 (June), 27-44.

Staw, Barry M. (1981), "The Escalation of Commitment To a Course of Action," *Academy of Management Review*, 6, 577-87.

Staw, Barry M. and Frederick V. Fox (1977), "Escalation: The Determinants of Commitment to a Chosen Course of Action," *Human Relations*, 30 (May), 431-450.

Staw, Barry M. and Jerry Ross (1978), "Commitment to a Policy Decision: A Multi-Theoretical Perspective," *Administrative Science Quarterly*, 23 (March), 40-64.

Staw, Barry M. and Jerry Ross (1980), "Commitment in an Experimenting Society: A Study of the Attribution of Leadership From Administrative Scenarios," *Journal of Applied Psychology*, 65 (June), 249-60.

Staw, Barry M. and Jerry Ross (1987), "Behavior in Escalation Situations: Antecedents, Prototypes, and Solutions," in *Research in Organization Behavior*, L.L. Cummings and B.M. Staw (eds.), JAI Press, 39-78.

Staw, Barry M and Jerry Ross (1989), "Understanding Behavior in Escalation Situations," *Science*, 246 (October 13), 216-220.

Steiner, J.D. (1972), *Group Processes and Productivity*. New York: Academic Press.

Szakasits, Georges D. (1974), "The Adoption of the SAPPHO Method in the Hungarian Electronics Industry." *Research Policy* 3 (1), 18-28.

Taylor, Shelley E. and Jonathon D. Brown (1988), "Illusion and Well-Being: A Social Psychological Perspective on Mental Health," *Psychological Bulletin*, 103 (2), 193-210.

Teger, Allan I. (1980), *Too Much Invested to Quit*. New York, NY: Pergamon Press.

Urban, Glen L. and John R. Hauser (1993), *Design and Marketing of New Products*. Englewood Cliffs, NJ: Prentice Hall. 2d Edition

Whyte, Glen (1986), "Escalating Commitment to a Course of Action: A Reinterpretation." *Academy of Management Review* 11 (April): 311-21.

Whyte, Glen (1991), "Diffusion of Responsibility: Effects on the Escalation Tendency," *Journal of Applied Psychology*, 76 (June), 408-15.

Whyte, Glen (1993), "Escalating Commitment in Individual and Group Decision-making: A Prospect Theory Approach," *Organizational Behavior and Human Decision Processes*, 54 (April), 430-55.

Wildt, Albert R. and Olli T. Ahtola (1978), *Analysis of Covariance*. Beverly Hills, CA: Sage Publications.

LIST OF GENERAL REFERENCES

LIST OF GENERAL REFERENCES

Alred, Edward Clayton 1982. *Escalation of Commitment and its Effects on the Decision-Making Process of Community-College Administrators.* Unpublished Ph.D. Dissertation. The Univeristy of Texas at Austin.

Blalock, H.M. (1960), *Social Statistics.* New York: McGraw-Hill.

Brockner, Joel (1992), "The Escalation of Commitment to a Failing Course of Action: Toward Theoretical Progress." *Academy of Management Review* 17 (January): 39-61.

Brockner, Joel, Jeffrey Z. Rubin, J. Fine, T. Hamilton, B. Thomas and B. Turetsky (1982), "Factors Affecting Entrapment in Escalating Conflicts: The Importance of Timing." *Journal of Research in Personality* 16, 247-266.

Calantone, Roger J. and C. Anthony di Benedetto (1990), *Successful Industrial Product Innovation: An Integrative Literature Review.* Westport CT: Greenwood Press.

Craig, Angie and Susan Hart (1992), "Where to Now in New Product Development Research?" *European Journal of Marketing* 26 (11): 3-49.

Fox, Harold W. (1985), "Strategies for New-Product Research and Development." *SAM Advanced Management Journal* 50 (Winter): 26-30.

Garland, Howard (1990), "Throwing Good Money After Bad: The Effect of Sunk Costs on the Decision to Escalate Commitment to an Ongoing Project." *Journal of Applied Psychology* 75 (December): 728-31.

Girden, Ellen R. (1992), *ANOVA Repeated Measures.* Newbury Park, CA: Sage Publications.

Griffin, Abbie and Albert L. Page (1993), "An Interim Report of Measuring Product Development Success and Failure." *Journal of Product Innovation Management* 10 (September): 291-308.

Norusis, Marija J. (1994), *SPSS Advanced Statistics 6.1.* Chicago: SPSS Inc.

O'Brien, Ralph and Mary Kister Kaiser (1985), "MANOVA Method for Analyzing Repeated Measures Designs: An Extensive Primer." *Psychological Bulletin* 97 (March): 316-33.

Rudestam, Kjell Erik and Rae R. Newton (1992), *Surviving Your Dissertation: A Comprehensive Guide to Content and Process.* Newbury Park, CA: Sage Publications.

SAS/STAT User's Guide. Cary, NC: SAS Institute Inc. Version 6, 4th Edition.

Schaubroeck, John and Elaine Davis (1994), "Prospect Theory Predictions When Escalation Is Not the Only Chance to Recover Sunk Costs." *Organizational Behavior and Human Decision Processes* 57, 59-82.

Schmidt, Jeffrey B. and Roger J. Calantone (1996), "Managers Can't Say 'No' to a Really New Product." Working paper; Kansas State University.

Schmidt, Jeffrey B. and Roger J. Calantone (1996), "Escalation of Commitment in the New Product Development Process." Working paper; Kansas State University.

Singer, Ming S. and Alan E. Singer (1986), "Individual Differences and Escalation of Commitment Paradigm." *The Journal of Social Psychology* 126 (April): 197-204.

Staw, Barry M. and Jerry Ross (1987), "Knowing When to Pull the Plug." *Harvard Business Review* 65 (March/April): 68-74.

Staw, Barry M. and Jerry Ross (1988), "Good Money After Bad." *Psychology Today* 22, 30-33.

Wind, Yoram and Vijay Mahajan (1988), "New Product Development Process: A Perspective for Reexamination." *Journal of Product Innovation Management* 5 (December): 304-10.