An Examination of the Determinants of Perceived Risk and Acceptability of Hazardous Products and Activities

by

Janet E. Oglethorpe

Dissertation submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in General Business

in

Marketing

APPROVED:

Kent B. Monroe, Chairman

James E. Littlefield

Edward F. Fern

Noreen M. Klein

Raymond H. Myers

July 22, 1988

Blacksburg, Virginia

An Examination of the Determinants of Perceived Risk and Acceptability of Hazardous Products and Activities

by

Janet E. Oglethorpe

Kent B. Monroe, Chairman

Marketing

(ABSTRACT)

This research sought to better understand the antecedents of consumers' perceptions of risk (health and safety risks specifically), and the relationship between the perceived risk of an option, and judgments about the acceptability of that option. The specific objective of the proposed research was to build a model of risk perception and risky option acceptability for hazardous products and activities (i.e., that present downside risks to a consumer's health and safety), using several variables that have been postulated to be important, using a multiple linear regression model building approach. One goal was to integrate the study of perceived risk in consumer behavior with various concepts and models of risk perception and risk acceptability from the behavioral decision sciences, an integration suggested previously by Jacoby (1981). Emphasis was placed on conceptual and methodological issues that confront researchers from either domain that need to be resolved if risk is to occupy a central place in marketing theory. Two of the variables included in the study of the determinants of perceived risk comprise the conceptual definition of perceived risk used in this research: probability of a negative outcome, and severity of a negative outcome. Specifically, both were hypothesized to be positively correlated with perceptions of risk.

Six additional variables were also examined as determinants of perceived risk. Given the definition of risk used in this research, these variables relate to either or both of the constructs probability and severity, and implicitly were also hypothesized to be significant determinants of risk perception. The variable examined that relates to probability exclusively was controllability. Specifically, a negative relationship was hypothesized between the perceived risk of a product and the controllability of the negative outcome associated with that product. Variables which relate to severity exclusively include reversibility, dreadedness, and immediacy. Specifically, judgments of negative consequences as immediate, dreaded, and irreversible were hypothesized to be positively correlated with perceptions of risk. Finally, two variables that relate to both probability and severity included availability and catastrophic potential. Specifically, there should be a positive relationship between the perceived risk of a product and the availability and catastrophic potential of the negative outcome associated with that product. All hypotheses with the exception of those relating to immediacy were supported; the hypotheses relating confidence to acceptability was only partially supported. All variables with the exception of immediacy were concluded to belong in a comprehensive model of perceived risk and option acceptability.

Acknowledgements

First, I wish to express my sincere appreciation to each of my committee members for guidance throughout the dissertation process. Kent Monroe, as chairman, provided consistent professional and personal guidance throughout the process. As committee members, Ed Fern, Noreen Klein, Jim Littlefield, and Ray Myers each brought something unique to my education; they deserve a great deal of credit for this work. Although Camille Schuster could not be a part of this project to the finish, she too deserves credit and appreciation. Geoff Vining, as the statistical consultant on this research, could not have been more thorough, more patient, nor more generous with his help and support. To all those people above who shaped this research, I express my appreciation.

I also want to express thanks to two close friends and fellow students who made this process, dare I say it, fun. The good times shared with Sue DelVecchio and Charles Bodkin over the past few years will never be forgotten. I look forward to reunions where we will again dance the "dissertation walk", and look back and laugh again.

The friend who has made all the difference, though, is Nestor Sanchez. He has helped and supported me through each and every step of this research, and has enriched my life in a way that no one else could.

Finally, and above all, I wish to thank my parents, Tom and Elma, who have done everything and more for me every day of my life. I am as proud of them as I know they are of me. It is to them that this work is dedicated.

Table of Contents

List of Tables

List of Illustrations

Chapter 1

Introduction

Introduction and Overview

Transactions and trades, and implicitly consumer behavior, have been referred to as paradigmatic examples of riskless decisions under certainty (Kahneman and Tversky 1984). This construal is consistent with traditional economic theory and its assumption that a consumer can evaluate, with perfect information and knowledge of preferences, the precise amount of utility gained and lost in a transaction. However, such an orientation ignores the substantial body of marketing knowledge that has accumulated since Bauer initially proposed that "consumer behavior involves risk in the sense that any action of a consumer will produce consequences which he cannot anticipate with anything approximating certainty, and some of which at least are likely to be unpleasant" (1960, p. 24).

The concept of risk in consumer decision making has become very well accepted; indeed, it is a central concept of this thesis. The essence of the concept is that various risks to consumers exist, that consumers do perceive them, and that their perceptions influence their decision making and behavior. The current research seeks to better understand the antecedents of consumers' perceptions of risk, and the relationship between the perceived risk of an option and judgments about the acceptability of that option.

The purpose of this chapter is to (1) present an argument for risk as a central theory in marketing, (2) define the construct of perceived risk as it is used in this research, (3) describe the ideas of perceived risk and the acceptability of risky options as they have been approached in marketing and the behavioral decision sciences, (4) characterize risky decisions, (5) delineate the specific objectives of the current research examining the determinants of perceived risk and the acceptability of hazardous products and activities, and (6) describe the theoretical, methodological, and substantive contributions of the research.

Risk as a Central Theory in Marketing

An argument can be made that risk should be considered a core component within any theory of marketing. Indeed, risk has been described as one of a necessary set of central, "metaenvironmental" theories, each of which encompasses critical features of the exchange process central to marketing (Ingene and Hughes 1985). Arguments supporting risk as one of these metaenvironmental theories include: (1)

"it is a common thread which runs through [all decision making] and is worth pulling out for inspection" (Bauer, 1960, p.89); (2) it can provide a "systematic explanation of the workings and interrelationships of much of what occurs in marketing" (Hugstad and Taylor, 1979, p.451); (3) its successful application in economics, finance, psychology, and the decision sciences makes it likely that it can contribute to the development of marketing thought; (4) it provides a framework for integrating the economic/financial and the social/psychological schools of marketing into a single theoretical perspective; (5) it can be applied to both "the supply and the consumption sides of marketing"; and (6) as a broadly based verifiable theory, it can help marketing achieve the status of a science (Hunt 1976; Anderson 1983).

The assessment of risks associated with consumer products involves both risk perception and risk evaluation. Risk perception may be thought of as the identification of product hazards, i.e., the potential negative consequences that could occur as the result of the use of a product, and the assessment of their probability (Slovic, Fischhoff and Lichtenstein 1977). Risk evaluation is the complex process of anticipating individual consumers' responses to risk; this could be termed the "acceptability of risk" (Otway 1973; Rowe 1977).

This distinction between the two major aspects of risk assessment becomes important in discussions of product safety. A product is perceived to be safe when its risks are judged to be acceptable (Lowrance 1976). As such, safe hardly means free of risk.

Perceived Risk

Since 1960 there has been a proliferation of studies on perceived risk in consumer behavior so broad and in such a variety of contexts that it has been called a "middle-range research tradition" in consumer behavior (Robertson and Ward 1973, p.21). Despite the importance that perceived risk has been credited with in terms of explaining consumer behavior, the most noticeable response to criticisms of its research tradition (cf. Ross 1975; Nicosia 1969) has been a decreasing number of published research studies examining its role (Hughes 1985). Indeed, in his 1981 presidential address to the Association for Consumer Research, Olson (1981, p.IX) suggested that perceived risk was in a group of "theories, concepts, hypotheses, and ideas that have been dropped from favor when the going got tough, many of them probably prematurely". Possible reasons for this diminishing interest are discussed in Chapter II. Nevertheless, the concept of perceived risk is a very appealing one. It is easy for a person to bring to mind occasions when risk was in some way considered in a decision process, and consider the risks of various purchase options. The purchase of insurance is a fairly typical example; it is hard to imagine the purchase of insurance occurring without some consideration of risk. More subtle, but no less relevant, is the example of the purchase of a bicycle helmet. Such a protective device only exists because of the risk inherent in bicycle riding, and the purchase of a helmet is a direct behavioral response to the acknowledgement of that risk.

Implicit in Bauer's proposal that "consumer behavior involves risk in the sense that any action of a consumer will produce consequences which he cannot anticipate with anything approximating certainty, and some of which are likely to be unpleas-

ant", is the basic orientation that has been the perspective since risk became an area of research interest to marketers. Specifically, risk has been driven by an "uncertainty times consequences" orientation, meaning that people's perceptions of risk are comprised of some combination of the uncertainty of a negative consequences' occurrence, and the severity of that consequence. Various minor modifications on that theme have emerged, and an argument to define risk more simply as "loss expectation", that is, as a construct in its own right rather than as a function of other constructs, has been made (Stone and Winter 1985). What has also remained consistent throughout is the assumption that a person's subjective perception of risk is the relevant issue, and the term perceived risk has become the norm when referring to consumer risk.

The literature of economics, statistics, and psychology contains a number of different definitions of risk. Foremost among these are: (a) risk is the probability of a loss, (b) risk is the size of a possible loss, (c) risk is a function, mostly the product, of probability and size of loss, (d) risk is equal to the variance of the probability distribution of all possible consequences of a risky course of action, (e) risk is the semivariance of the distribution of all consequences, taken over the negative consequences only, and with respect to some adopted reference value, and (f) risk is a weighted linear combination of the variance and the expected value of the distribution of all possible consequences (Vlek and Stallen 1980). The following chapter will develop some of the difficulties in defining risk, a word whose meaning has been fraught with confusion and controversy in every discipline in which it is a construct (Fischhoff, Watson and Hope 1984). Although this controversy is typically recognized, the definition usually follows the custom of the particular scientific discipline in which it is used. In the current research, perceived risk is defined as an individ-

ual's subjective feeling that there is some probability, excluding zero and 1.0, that an undesired outcome will result from exercising an alternative. That is, there is some non-zero chance that choosing an alternative may lead to an undesired result or outcome.

Acceptability of Risky Alternatives

Paralleling the ongoing research on perceived risk in the consumer behavior literature is a relatively new area of research in the behavioral decision sciences, risk analysis, directed toward explaining risk ***acceptability*** as well as risk perception. The domain of risk analysis is a consequence of growing concern with subjective measures of risk assessment, and why peoples' perceptions of risk so frequently differ from either what is 'known' about the actual risk of certain activities, or with the best available expert assessments of risk. Current research has been motivated by the need to explain people's extreme aversion to some hazards, their indifference to others, and the discrepancies between these reactions and experts' recommendations.

Assuming that an individual has assessed the riskiness of a proposed activity, product, or technology, he still must decide whether those risks are acceptable. It is important to point out, however, that while the term "risk acceptability" has been used consistently throughout, it is in fact the acceptability of an alternative that entails risk that has actually been measured (e.g., Rethans and Albaum 1981; Slovic et al. 1980). Consumers have been asked, for example, whether a power mower has an acceptable risk, and not whether a 1 in 100 chance of suffering bodily injury is

an acceptable risk, as the term "risk acceptability" would strictly imply. This seemingly semantic distinction is important conceptually in that an evaluation of a product or activity's risk is a different issue from the evaluation of a product or activity's acceptability, and methodologically when considering issues of construct validity and measurement. However, for purposes of convention and consistency, it should be noted that the term "risk acceptability" in this research refers to the acceptability of an option that entails risk.

Acceptability refers to individual's evaluations of and responses to perceived risk, and can be construed on two levels: individual and societal. At the individual level, acceptability of the risk of an alternative implies that the individual would, at least in principle, be willing to select and carry out the alternative. The current research will define acceptability as an individual's evaluation of the attractiveness of an alternative, making the assumption that evaluation is positively correlated with behavioral intention, and that behavioral intention is positively correlated with eventual behavior.

At the societal level, an individual can make a judgment about whether a risky alternative is acceptable to society, acceptability meaning that the product, activity, or technology need not be further regulated or altered in any substantive way. The evaluation of societal risk is essentially a normative and political activity, involving the judging of the acceptability of product risks. Use of the term "acceptability" emphasizes the fact that risk management decisions are relativistic and judgmental, raising such questions as: "Acceptable to whom?" and "Acceptable on what terms?" The Consumer Products Safety Commission is charged with protecting the public against unreasonable risk of injury. Clearly the Commission's decisions should re-

flect public attitudes and values as to what constitutes acceptable levels of risk associated with consumer products (Rethans and Albaum 1981).

Characteristics of Risky Decisions

As implied in the above discussion concerning the acceptability of risky products, decisions that entail risk are complex in that the risks of an activity, product, or technology are hardly their only consequences; the alternatives wouldn't exist if they didn't provide some benefit to someone. Risky decisions do not concern risk in isolation; rather, they are choices of alternatives, alternatives that have a variety of relevant features, only one of which is risk. Thus, when an alternative is chosen it does not necessarily mean that it has a desirable level of risk (Fischhoff et al. 1981; Green 1980; Otway and von Winterfeldt 1982). Those adopting it might prefer less risk, but be unable to obtain it at an acceptable price. Similarly, a risky product may be so beneficial that it is judged as acceptable despite the risks involved.

In addition, risk itself is seldom just a singular consequence. For example, a technology capable of causing fatalities may do so in several ways (e.g., acutely or chronically). What is more, there exists a variety of psychological states that may arise as an outcome of consideration of a risky option, for example, the concern over threatening events that plague people even if they never happen. Concern about events can cause a variety of responses, both beneficial (e.g., the creation of innovative, safer alternatives), and detrimental (e.g., stress-related disorders) (Fischhoff 1984).

An analysis of risk needs to specify which consequences, for example, mortality, personal injury, or psychological distress, will be included (Fischhoff 1984). This need has been acknowledged in consumer behavior, in the recognition that there are multiple *types* of risk, for example, psychological, social, financial, safety, and functional risks. These types of risk are commonly referred to in the literature as *components* of risk (e.g., Jacoby and Kaplan 1972; Kaplan, Szybillo and Jacoby 1974; Shimp and Beardon 1982). Furthermore, as there are a variety of psychological states that may arise as an outcome of consideration of a risky option (as discussed above), so are there a variety of possible social consequences, financial consequences, and so on. Of the many types of risk, this research focuses on health and safety risks specifically.

Objectives of this Research

The overriding purpose of this research is to integrate the study of perceived risk in consumer behavior with various concepts and models of risk perception and risk acceptability from the behavioral decision sciences, an integration suggested previously by Jacoby (1981). Emphasis is placed on conceptual and methodological issues that confront researchers from either domain that need to be resolved if risk is to occupy a central place in marketing theory. The specific objective of the current research is to build a model of risk perception and risky option acceptability for hazardous products and activities (i.e., that present downside risks to a consumer's

health and safety), using several variables that have been postulated to be important, using a multiple linear regression model building approach.

The general framework illustrating how several variables are suggested to relate to risk perception and alternative evaluation in the current research is presented in Figure 1. The framework suggests a number of variables that influence risk perception. In addition to probability and severity, which, as the two constructs that comprise the definition of risk, would be important determinants, there are: availability, controllability, immediacy, reversibility, dreadedness and catastrophic potential of outcome. Variables suggested to influence acceptability include perceived benefits, perceived risks, and confidence that the information about risks can be obtained.

Vlek and Stallen's (1981, p. 239) assessment of risky decisions provides useful insight at this point: "...Although such dimensions are global and abstract at first sight, they clearly hint at important psychological attributes of risky situations. On the one hand, they are suggestive of heuristic attributes of such decision-theoretic variables as probability and (dis)utility. On the other, they point at a wider perspective for judging risky activities than a rational decision analysis is capable of accommodating." Chapter II develops more fully the conventional rational decision analysis to which they are referring, and explains the proposed framework for studying risky decisions.

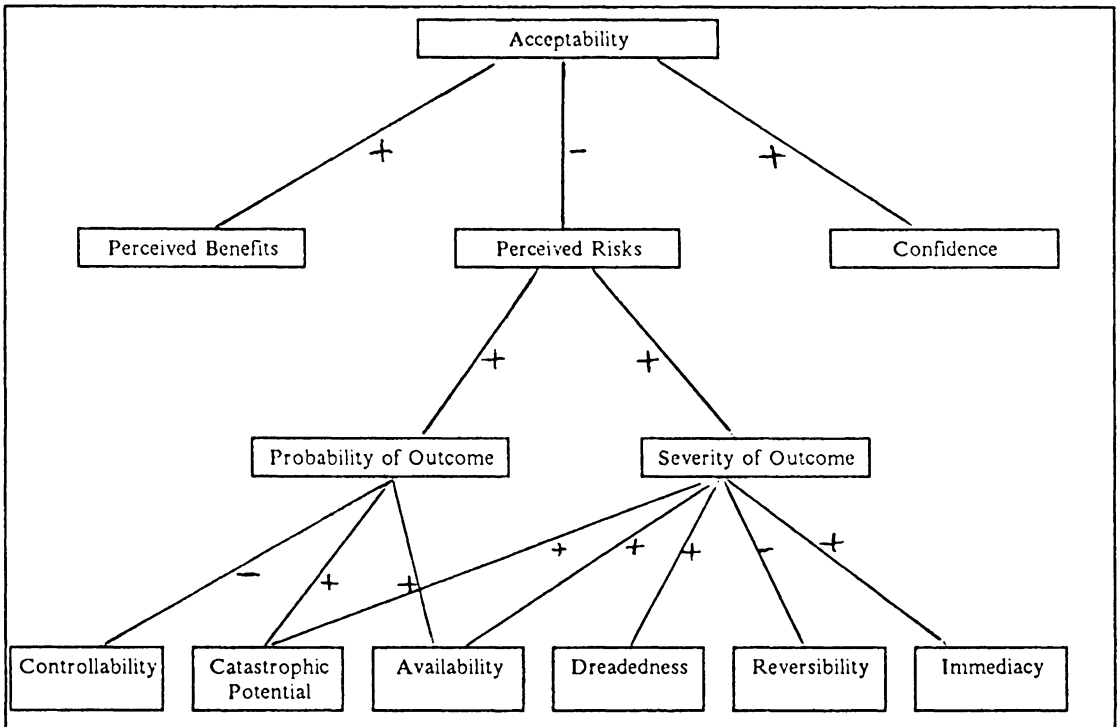

Figure 1. Model of Perceived Risk and Acceptability

Key Issues in the Domain Addressed in This Research

The purpose of this section is to highlight several of the key issues addressed in this research and provide an overview of the justification for the study. These issues are explored and discussed in depth with relevance to the research findings in the final chapter. The first key issue in the domain addressed in this research is conceptual. The concept of perceived risk in consumer decision making has become well accepted and appears in nearly every consumer behavior textbook. The essence of the concept is that various risks to consumers exist, that consumers do perceive them, and that their perceptions influence their decision making and behavior. However, as will become apparent in the following chapter, little is known about the determinants of consumers' perceptions of product risks, and the determinants of their judgments of acceptability of those risky products. While numerous variables have been suggested to be important in the determination of consumers' subjective judgments of risk and acceptability, and while certain relationships between those variables and judgments have been hypothesized and empirically tested, the research area remains primarily exploratory. Existing empirical results are meager and equivocal, with different studies indicating not only different variables as being important, but even conflicting directions of relationships. Given the definitional problems associated with the various constructs, and the ambiguity associated with the dependent measures (i.e., perceived risk vs. risk acceptability), these inconsistent results are not surprising.

The second key issue addressed in this research is methodological. First, a contribution needed to be made in establishing the construct validity and measure-

ment of the constructs involved. Second, one approach to understanding the antecedents to perceived risk and acceptability that has appeared in the literature has been multiple linear regression. However, there have been numerous problems and shortcomings associated with its use; those problems are discussed in Chapter II. Two of the most important problems relate to model selection; several useful criteria for selection of the best model have been ignored, and collinearity among the regressor variables has been undiagnosed.

The third key issue is the area is substantive. Substantively, the stakes in research on consumer perceptions and acceptance of risk are high. The acceptance and viability of new technology-based products, the willingness of consumers to accept health-related treatments, and public concern with safety and health all indicate the need for risk analysis research. As our society becomes increasingly technological, continued advances in technology will be needed to sustain the high standards of living that people have come to expect. Despite the demand and benefits, every new technology has its own set of risks and benefits. As articulated by Douglas and Wildavsky (1982, p.51):

> "Try to read a newspaper or news magazine, listen to radio, or watch television: on any day some alarm bells will be ringing. What are Americans afraid of? Nothing much, really, except the food they eat, the water they drink, the air they breath, the land they live on, and the energy they use. In the amazingly short space of 15-20 years, confidence about the physical world has turned to doubt. Once the source of safety, science and technology have become the source of risk."

Overview of Chapter II

The next chapter overviews perceived risk from the vantage points of both consumer behavior and the behavioral decision sciences, including those studies

where the two viewpoints have been integrated. It then describes a series of conceptual and methodological issues relative to behavioral research on risk that need to be addressed if knowledge is to advance. Finally, it describes the variables assessed in this research, and describes the relationships that are examined.

Overview of Chapter III

Chapter III details the research design and methodology that is used. Specifically, it reviews the multiple linear regression model, outlines the research design, including sampling plan, stimuli used, measure and survey development, pretest procedures and results, and data collection procedure.

Overview of Chapter IV

Chapter IV describes the analyses used and the associated findings. A respondent profile is described, and assessment of the measurement instrument is made. Model selection procedures are described and performed for perceived risk and acceptability for the entire sample, as well as for two subpopulations (faculty and classified staff).

Overview of Chapter V

Chapter V discusses the findings and conclusions that can be drawn. Theoretical, methodological and managerial implications are discussed, limitations and boundaries of the study are identified, and suggestions for future research are made.

Summary

This research builds models of risk perception and acceptability for hazardous products and activities. Several variables that have been postulated to be important determinants of risk perception and the acceptability of hazardous options are proposed to be used in a multiple linear regression model building approach. Such modeling is a necessary step in the development of a theory of perceived and acceptable risk, in that it will reveal relationships that can be used for further theory development and testing. These relationships will also be useful to marketing practitioners in decisions concerning communication and product design.

Chapter 2

Conceptualization and Review of Literature

Introduction

A pervasive theme of the current research is that research in perceived risk in consumer behavior would benefit from the integration of several key concepts from the study of perceived risk in the behavioral decision sciences. Although this integration was first suggested by Jacoby in 1981, little has actually been done since then. The essence of research on perceived risk in consumer behavior is based on the assumption that various types of risks to consumers exist, that consumers do perceive them, and that their decision making and behavior are a result of their perceptions of risk. There are several ideas from the behavioral decision sciences that need to be incorporated into the realm of consumer behavior in order for that integration to be made.

One specific notion that needs to be recognized is that consumer decisions are choices among options, each with a variety of relevant features, only one of which is risk. In other words, perceived risk is only one factor that influences consumers' evaluations and choices. Research in the behavioral decision sciences directed toward understanding how people determine the acceptability of risky options provides useful theoretical and empirical bases to support research in consumer behavior. Acceptability refers to those factors inherent in a product, activity or technology that influence individual and societal assessments and acceptance of that product, activity, or technology. One of those factors is indeed perceived risk, but there are others, for example, the degree to which the option is perceived to be beneficial.

A second notion is the importance of better understanding how people make determinations of risk, that is, what variables are determinants of a person's judgment that a product, activity, or technology is risky. Research in consumer behavior begins with the assumption that consumers perceive risk and react to that perception; little is understood about how that initial determination of risk is made. Efforts toward understanding that determination have constituted a central focus of research in perceived risk in the behavioral decision sciences.

Before going further into review of the literature from both the behavioral decision sciences and consumer behavior, it is necessary to explain more fully the various definitions of risk that exist in the literature from economics, statistics and psychology, and that have influenced the concept of risk in marketing. The foremost of these are presented in Vlek & Stallen (1980), and are briefly reviewed below with respect to the following simple decision tree (Figure 2):

Figure 2 represents the choice between two options with analgous structures: A and A'. Each option is characterized by an uncertain event whose outcome is ei-

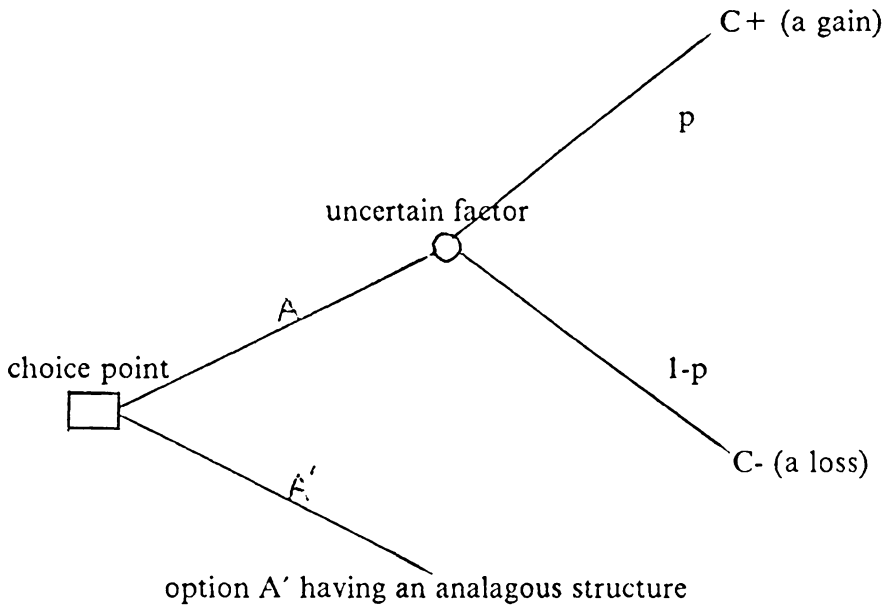

Figure 2. Decision Tree

ther a gain or a loss. There is a probability p to obtain a gain of C+, which has the utility u(C+). With a probability 1 - p one may obtain a loss of C-, which has utility u(C-). The following six definitions are given with respect to Figure 2, where R(Ai) is the risk function for the definitions 1-6.

(1) "Risk" is the probability of loss. In Figure 2, Risk(A1) = 1 - p.

(2) "Risk" is the size of loss. In Figure 2, Risk(A2) = u(C-), the evaluated negative consequence.

(3) "Risk" is expected loss, i.e., the product of the probability and the (dis)utility of the possible loss. With reference to Figure 2, Risk(A3) = (1 - p)u(C-).

(4) "Risk" is the variance of the probability distribution over the utilities of all possible consequences. From Figure 2, Risk(A4) = p(1-p){u(C+) - u(C-)}. This definition takes losses and gains into account.

(5) "Risk" is a semi-variance of the utility distribution mentioned under 4, taken with respect to a selected reference point, e.g., the average expected loss. (A formal definition cannot be given with reference to Figure 2, as it contains only one possible negative consequence.) This definition is similar to the preceding one, but it is restricted to undesired consequences. It also adds an extra dimension to definition 3, in that one may not only consider the expected loss, but also the average squared deviation of the possible losses around their mean value (the expected loss).

(6) "Risk" is a linear function of the expected value and the variance of the distribution of consequences, where a free (personal) parameter (θ) is the relative weight assigned to each of these components. With respect to Figure 2, Risk(A6) = $\theta R(A4) + (1 - \theta)E(A)$, where R(4A) is as given above, and E(A) = pC+ + (1-p)C-, assuming that C+ and C- are expressed in terms of some standardized value scale.

Definitions 1, 2, and 3 allow for separate analyses of distinct risks of an activity; however, they do not give any information about the overall attractiveness, or the acceptability, of the risky option being considered, in that no evaluation of benefits, or upside risk, has taken place. The latter three definitions recognize that risky options may vary in acceptability, or attractiveness, even when their expected values are identical.

This research defined risk in a way that is consistent with the definition that has become to a large extent conventional: "...nevertheless, people keep speaking of risks and dangers, and we presume that what they mostly mean is something captured by either ... the probability of a loss, the potential size of a loss, and/or some combination of these two" (Vlek and Stallen 1981, p. 238). Specifically, risk is defined here as the probability, excluding zero and one, that a negative consequence will result from the use of a product or the participation in an activity. What has also been consistently agreed upon and has become conventional to assume is that a person's subjective perception of risk is what is relevant, and use of the term perceived risk has become the norm when referring to consumer risk.

The remainder of this chapter is organized into six sections. The first two sections overview the literature in perceived risk from the vantage points of (1) the behavioral decision sciences and (2) consumer behavior. The third section reviews those studies in which the two approaches are integrated. Section four then identifies and discusses a set of critical conceptual issues that are relevant to the existing behavioral research on risk, from the vantage points of both consumer behavior and the behavioral decision sciences. In the same vein, section five addresses methodological issues. Section six outlines an integrative research agenda for risk in consumer behavior, and specifically details those research questions whose examina-

tion is proposed in the current research. Finally, a summary of Chapter II is presented and the relevant issues of the current research are highlighted.

Overview of Perceived Risk in Behavioral Decision Research

Like so many aspects of consumer behavior, consumer decision making is a true interdisciplinary field of study with important contributions having been made from economics, statistics, psychology, and mathematics. It has been suggested that the roots of decision theory lie in economics and statistics (Pitz 1977), and in fact, economic and statistical models have been the ones most emphasized in decision making literature. Increasingly, the inadequacy of these models has become apparent. It has become evident that people do not always follow the prescriptive models laid out by economics and statistics, and that in order to develop a theory of how consumers make decisions, it is necessary to understand cognitive operations and processes such as perception. Thus, at the outset, it is useful to briefly review the basic models in behavioral decision theory, noting the evolution from a reliance on economic models to an emphasis on concepts drawn from cognitive psychology.

Expected Value Theory: Decision making under risk has been studied extensively since its inception back in the 18th century when French noblemen asked their court mathematicians to advise them how to gamble (Coombs, Dawes and Tversky 1970). The basic problem remains essentially the same: to compute the expected value of each alternative and to choose the one with the higher expected value. The

expected value of an alternative or a gamble is the sum of its outcomes, each weighted by its probability of occurrence. Gambles can be either favorable, unfavorable, or fair, according to whether their expected values are positive, negative, or zero.

Expected Utility Theory: Following the expected value rule would mean that all favorable bets would be accepted and all unfavorable bets would be rejected. This is not, however, what people necessarily do. Given this inconsistency, Daniel Bernoulli in 1738 formulated the expected utility principle. The expected utility of a gamble, with outcomes $X_1, ..., X_n$ obtained with probabilities $P_1,..., P_n$, equals $EP_iU(X_i)$, *where* $U(X_i)$ is the utility of the ith outcome. The decision rule associated with expected utility theory is that the gamble with the highest expected utility is chosen. It is thus based on the principle of expectation, but the objective scale of value is replaced with a subjective scale of utility. The model is thus more general and helps to resolve the difficulties associated with the expected value model (Coombs, Dawes and Tversky 1970).

The advantages of expected utility theory include that (1) it allows individuals to have different utilities for money and thus different preferences among gambles, and (2) it assumes that the utility of any additional dollar diminishes with an increase in capital, i.e., the utility function is concave. This latter advantage can explain not only the rejection of favorable gambles but also the acceptance of some unfavorable ones.

The principle of expected utility combines this general notion of utility maximization with the assumption that the utility of a gamble equals the expected utility of its outcomes. Theoretically, then, if available gambles are repeated over and over again, then the one with the highest expected utility would yield the highest

utility in the long run. Consider though, the generalization and application of this expected utility principle to unique decision making situations. In particular, consider the likelihood of such long run utility maximization behavior in the context of consumer decision making. Without some justification for such behavior, the theory's application is questionnable. Modern utility theory, formulated by vonNeumann and Morgenstern in 1947, provides the justification for the expected utility principle in the form of an axiomatic foundation.

Modern Utility Theory: Modern utility theory has been the dominant paradigm of the study of risky choice, and has become both a descriptive and a normative standard in the field (Corstjens and Gautschi 1983). It introduces the concept of risk, while maintaining the classic economic utility maximization structure. Briefly, the basic foundation of economic utility theory is of decision makers as rational problem solvers, acting in accordance with those normative principles set out by microeconomic theory to reach an optimal solution to a problem. The theory consists of a set of axioms about preferences among gambles. The main contribution of modern utility theory is in providing justification by way of these axioms for the Bernoullian expected utility principle. Because this justification does not depend on long run considerations it is applicable to unique decision making situations that are characteristic of consumer behavior. While several of these axioms are uncontroversial, psychological interpretation of others raises problems; there are simply too many counter-examples and convincing evidence that people do not always obey them. Such evidence pervades the decision making literature (Kahneman and Tversky 1984). Thus, the interpretation of utility theory as a behavioral model needs to be supplemented by a psychological theory that accounts for the situational variables that affect risky choices. In addition, if decision making under risk is viewed

as a choice between prospects or gambles, then the application of expected utility theory is based on the following tenets:

a. asset integration: a prospect is acceptable if the utility from integrating the prospect with one's assets exceeds the utility of those assets alone. Thus, the domain of the utility function is a final state of wealth rather than gains or losses.

b. risk aversion: the preference for a certain prospect (x) to any risky prospect with expected value x.

Kahneman and Tversky (1979) argue that the first tenet is psychologially unrealistic, and that the true determinant of subjective value is a change in wealth rather than an ultimate state of wealth. As such, any psychophysical analysis of outcomes should be applied to gains and losses rather than to total assets. They also present evidence that is incompatible with the notion of risk aversion, and is instead supportive of the idea that certainty increases the aversiveness of losses as well as the desirability of gains. Thus, risk aversion holds in the domain of gains, but not in the domain of losses.

Prospect Theory: In response to questions about the value of expected utility theory, Tversky and Kahneman (1979) developed an alternative descriptive model of micro-economic decision making behavior called prospect theory. They began their development with illustrative examples of survey questions, typically scenarios, designed to highlight discrepancies between actual behavior and behavior that would be predicted by expected utility theory. From these scenarios several empirical generalizations were proposed: (1) gains are treated differently from losses; with risk seeking observed for losses and risk aversion observed for gains, (2) certain outcomes

are overweighted relative to uncertain outcomes, and (3) the structure of the problem may effect choices.

At the outset, a prospect is defined as a gamble that yields outcome X_i with probability P_i, *where* $P_1 + P_2 + ... + P_n = 1$. In essence, a prospect is a gamble (X,P,Y,Q) that pays X with probability P and Y with probability Q. The decision making process itself is suggested as being comprised of two distinct stages -- an editing stage and an evaluative stage. In the former, the decision maker may transform the original presentation of a problem into a simpler form, i.e., the problem is "framed". In the latter stage, the decision maker assigns a value to each of the edited, or transformed, prospects and the one with the highest value is chosen. V denotes the overall value of an edited prospect, and is expressed in terms of two scales: v and *pi*. The first scale reflects the subjective value of that outcome. Since outcomes are defined relative to a reference point which serves as the zero point of the value scale, v thus measures the value of deviations from that reference point, i.e., gains and losses. The second scale, P_i, reflects the effect of each probability on the overall value of the prospect. It is not, however, a probability measure; rather, it associates with each probability p a decision weight (p). Note the similarity of prospect theory to expected utility theory; in prospect theory the objective probabilities are replaced by subjective decision weights, and the utility function is replaced by a value function that is defined over changes in wealth rather than final asset position. The latter distinction is crucial, particularly in light of the following essential characteristics of the value function:

a. It is defined over gains and losses with respect to a neutral reference point, with changes in the reference point offering the possibility of alteration of choices.

b. It is concave for gains and convex for losses, this shape being based on the psychophysical principle that the difference between 0 and 50 seems greater than the difference between 500 and 550. This concavity explains the empirically observed risk-seeking choices for losses and risk averse choices for gains.

c. The value function is steeper for losses than for gains; that is, the displeasure of a loss is greater than the pleasure associated with an equivalent gain.

The value function of prospect theory is illustrated in Figure 3.

Judgments Under Ambiguity: Still another model in the domain's evolution is the descriptive model of how people make judgments under ambiguity proposed by Einhorn and Hogarth (1985), ambiguity resulting from having limited knowledge of the process that generates outcomes. Their model postulates an anchoring-and-adjustment strategy for assessing probabilities that involves an initial assessment and an adjustment to reflect the ambiguity in the situation. The authors note the similarity between their model and prospect theory.

This research, in its examination of the determinants of the acceptability of risky alternatives, is consistent with both Kahnemann and Tversky's prospect theory, and Einhorn and Hogarth's model of judgment under ambiguity. First, both postulate the decision making process as a two-stage process of editing and evaluation, and anchoring-and-adjustment, respectively. One focus of the current research is the recognition that perception of risk and judgments about a risky option's acceptability are two separate aspects of a decision, and as such may be considered as analagous to the two stages in the other models. Second, the editing stage of prospect theory consists of the application of several operations that organize and reformulate the options so as to simplify subsequent evaluation and choice. For example, simplification might involve the rounding of probabilities, the discarding of extremely un-

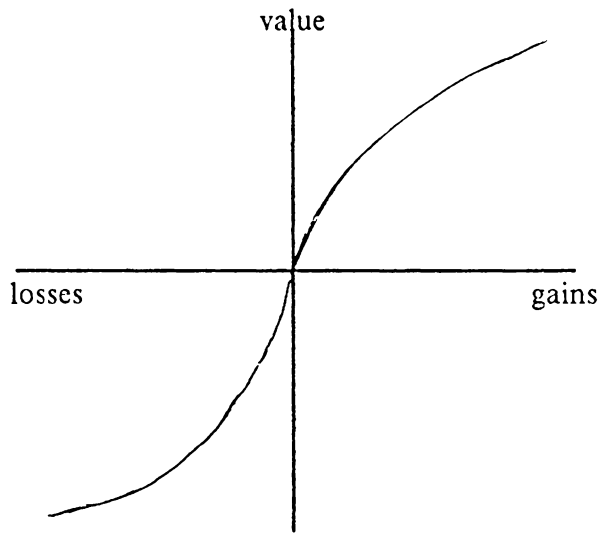

Figure 3. Value Function of Prospect Theory

likely outcomes, or the rejection of dominated alternatives. Many inconsistencies of behavior result from the editing of prospects. For example, some intransitivities of choice are explained by a simplification process that eliminates small differences between prospects (Tversky 1969). The variables in this research that are modeled as influencing an individual's perceptions of risk may be considered as analagous to the editing operations of prospect theory, or the adjustment operation of Einhorn and Hogarth's model. Third, the current research is consistent with prospect theory's consideration of "decision weight". Specifically,

> The decision weight associated with an event will depend primarily on the perceived likelihood of that event, which could be subject to major biases. In addition, decision weights may be affected by other considerations, such as ambiguity or vagueness (p.289).

Again, this is consistent with the proposed model of variables that influence an individual's perceptions of the probability of a negative outcome's occurrence.

Risk Assessment: A related domain of research related to risk, often referred to as "risk assessment" or "risk analysis", in the behavioral decision sciences is one that has emerged from a growing concern about societal risks and the need for assessing the public perception and acceptance of risk (Slovic, Fischhoff, and Lichtenstein 1980). Similar to the problems with utility theory discussed above, behavioral decision research has noted that people's perceptions of risk frequently differ from either what is "known" about the risk associated with the activity, or with expert assessments of the risk involved. Moreover, research has shown that choices and evaluative judgments of the same alternatives by the same people differ, sometimes quite dramatically (Slovic, Fischhoff and Lichtenstein 1982).

A growing body of researchers, most notably Paul Slovic and his colleagues, are concerned with subjective measures of risk assessment, and why peoples' perceptions of risk so frequently differ with either what is 'known' about the actual risk of certain activities, or with the best available expert assessments of risk. Their re-

search has been motivated by the need to explain people's extreme aversion to some hazards, their indifference to others, and the discrepancies between these reactions and experts' recommendations. Their overall research agenda is quite broad; it includes the questions summarized in Table 1 (adapted from Slovic, Fischoff and Lichtenstein 1980). Subsequent discussion is built around this table.

Quantification of Perceived Risk and Determinants of Risk Perception

Two oft cited studies, the first by Fischoff (1978) and the second by Slovic, Fischoff and Lichtenstein (1980) were directed towards the quantification of perceived risk and the determinants of risk perception. These studies are described here in detail, in that they can be considered seminal and in many ways prototypical of research in the area.

A central question was to ask whether, when judging the risk inherent in a technology, people were referring only to the (possibly misjudged) number of people it could kill or also to other, more qualitative features of the risk it entails.

Four different groups of people were asked to rate 30 activities, substances, and technologies according to the present risk of death from each (Fischoff 1978, Slovic et al. 1980a). Three groups were from Eugene, Oregon; they included 30 college students, 40 members of the League of Women Voters (LOWV), and 25 business and professional members of the "Active Club", a civic group. The fourth group, referred to as the "expert" group, was composed of 15 persons selected nationwide for their professional involvement in risk assessment. Individuals were asked "to consider the risk of dying (across all U.S. society as a whole) as a consequence of this activity or

Table 1. Research Agenda: Risk Assessment in Behavioral Decision Research

Quantification of Perceived Risk and Determinants of Risk Perception:

1. What are the determinants of perceived risk? By what concepts do people characterize risks, and how are those concepts related to their attitudes and behavior towards different technologies? Are perceptions of risk governed by interpretations of fact or are they also affected by emotional factors? How are perceptions affected by the methods used to assess them?

2. How and why do laypersons' perceptions of risk differ from those of experts? How accurate are their perceptions, and do they know enough to be able to make their own decisions in the marketplace? Might the environment be structured in such a way that they are misled?

3. What information is needed to foster enlightened behavior with regard to risk issues? What are the roles of the media and the schools (and I would add the marketplace) in educating people about risk?

4. What is the role of judgment in technical assessments of risk, and how well do experts assess the limits of their own knowledge?

5. How do people perceive the benefits of risky products, activities, and technologies? In that most questions asked about risk perceptions have analogs with benefit perceptions, how can the latter be measured and integrated with characteristics of risk to provide a more complete understanding of behavior?

Risk Acceptability:

6. What determines the relative acceptability of hazardous products, activities, and technologies, and how are assessments of risks and benefits combined subjectively to determine acceptability?

7. What makes a risk analysis valid or trustworthy? Some analyses are uncontroversial and readily accepted; others are contradictory and doubted. Are differences due to the specific hazards involved, the methods of analysis, the way people are involved in the decision-making process, or the way in which results are communicated?

technology." They were to order the items from least to most risky and to assign numerical risk values by giving a rating of 10 to the least risky item and making the other ratings accordingly. Although there were many similarities among the three groups of lay-people, there were strong differences as well. For example, nuclear power was rated as highest in risk by the LOWV and student groups, but only eighth by the Active Club. The students viewed contraceptives as riskier and mountain climbing as safer than did the other lay groups. Experts' judgments of risk differed markedly from the judgments of laypeople. The experts viewed electric power, surgery, swimming and X-rays as more risky than did the other groups and they judged nuclear power, police work and mountain climbing to be much less risky.

A series of additional studies was conducted to answer the question of what exactly people meant when they said that a particular item was risky. First, were people, when asked to judge risk, simply estimating frequency of death? Objective technical fatality estimates for 25 of the items were compared with estimates of perceived risk. Experts' judgments were so closely related that the researchers concluded that they both knew what the technical estimates were and also defined the risk of an item the same way. The risk judgments of laypeople were only moderately related to the annual death rates, raising the possibility that risk may not be perceived as synonymous with fatalities.

Second, the possibility that laypeople based their risk judgments on subjective fatality estimates which were inaccurate was investigated. Additional groups of students and LOWV members were asked "to estimate how many people are likely to die in the U.S. in the next year (if the next year is an average year) as a consequence of these 30 activities and technologies." If laypeople in fact equate risk with annual fatalities, their own estimates of annual fatalities, no matter how inaccurate, should

be very similar to their judgments of risk. There was, however, only a low to moderate agreement between these two sets of judgments (r = .60 for LOWV and .26 for students). It was concluded then that laypeople incorporate other considerations besides annual fatalities into their concept of risk.

Third, to examine the role played by expectations of disaster in determining risk judgments, respondents were asked to indicate for each item "how many times more deaths would occur if next year were particularly disastrous rather than average." Other than for nuclear power people saw little potential for disaster.

Fourth, to get at other determinants of risk perceptions respondents were asked to rate the 30 items via a bipolar 1-7 point scale on nine qualitative characteristics that have been hypothesized to be important (Lowrance 1976). Those characteristics were whether the risk was voluntary, chronic/catastrophic, common/dreaded, severity of consequences (measured as certainly not fatal), known to those exposed, immediate, known to science, controllable, and new. Across all 30 items, ratings of dread and of the severity of consequences were closely related to lay judgments of risk. Experts' judgments of risk were not related to any of the nine qualitative risk characteristics.

Finally, the hypothesis that some hazards are feared more than others because the deaths they produce are somehow worse than deaths from other activities was examined. The judged "seriousness" of death was not closely related to the perceived risk of death, and the differences between the relative seriousness of a death from each of the 30 items was slight.

Further research extended these studies to a broader set of 90 hazards and 18 risk characteristics. In this design, some people judged only ***risks***, others judged only ***benefits*** and others rated the hazards on five of the risk characteristics. Risks and

benefits were rated on a 0-100 scale from "not risky" to "extremely risky" and "not beneficial" to "extremely beneficial". After rating the hazards with regard to risk, respondents were asked to rate the degree to which the present risk level would need to be adjusted to make the risk level acceptable to society. Instructions stated that "the acceptable level of risk is not the ideal risk. Ideally, the risks should be zero. The acceptable level is a level that is "good enough," where "good enough" means you think that the advantages of increases in safety are not worth the costs of reducing risk by restriction or otherwise altering the activity".

The 18 risk characteristics included eight from the earlier study. Controllability from that study was split into two separate constructs representing control over the occurrence of a mishap and control over the consequences given that something did go wrong. The remaining characteristics included whether the hazard was globally catastrophic, whether risks and benefits were equitable among societal groups, threatening to future generations, not easily reduced, of increasing risk, affecting the individual personally, observable, and the number of people exposed. Again, all characteristics were rated on a bipolar 1-7 scale representing the extent to which the characteristic described the hazard.

Factor analysis showed that the pattern of intercorrelations could be represented by three underlying dimensions. The first was ***dread***, comprised of risks whose severity was believed not to be controllable, are dreaded rather than common, catastrophic, hard to prevent, fatal, inequitable, threatening to future generations, not easily reduced, increasing, involuntary, and threatening to the respondent personally. The second, ***familiarity***, was comprised of the characteristics of observability, knowledge, immediacy of consequences, and familiarity. The third factor was dominated by a single characteristic, the ***number*** of people exposed.

This three-dimensional factor structure differs considerably from the two-dimensional structure which was obtained from ratings of 30 hazards on 9 characteristics (Fischoff 1978), with one factor labeled ***severe*** (certain to be fatal) and another labeled ***high technology*** , which had been found to be consistent across four different groups of lay and expert respondents (Slovic 1980a).

It is useful as well to outline in some detail a large-scale study (Vlek and Stallen 1981) conducted in the The Netherlands whose goals and methods were similar to those described above. The goals were (1) to clarify the concepts of riskiness, beneficiality, and acceptability of activities with uncertain consequences; (b) to systematically describe comparative judgments, along these variables, of activities sampled from three different categories: private life, transportation, and industry; (c) to explore various hypotheses concerning interrelationships among primary risk evaluation variables, in particular the frequently cited idea that judgments of acceptability are, or should be, based on a weighing of benefits against risks; and (d) to describe possible contrasts in the various judgmental variables among several sampled subgroups of the population.

The research design allowed (1) essential risk variables to be judged in methodologically different but related tasks, and (2) direct judgments of explicit risk aspects to be compared with implicit risk dimensions inferred from multidimensional scaling analyses. A set of 26 risky activities were judged with respect to several aspects of risky decision problems. Response methods used were: constrained categorical Q-sorting, complete rank ordering, n-point scale rating, similarity group sorting, frequency estimation, answering open questions, and answering personal and attitude questions.

In brief, ***size of potential accident,*** and ***controllability*** factors were found to play a prominent role in determining risk judgments. In looking for contrasts among groups of respondents, the researchers found that women weighted the size of a potential accident more heavily as a basic dimension of riskiness than men. The authors reason that this result is not surprising, given that men hold the more controlling positions in our society. They also reported that "acceptability" correlates more strongly with "beneficiality" than with "riskiness" across a set of activities.

Section Summary

The focus of research in the behavioral decision sciences related to risk perception has been to understand what people actually mean when they say that a particular item is risky, and to identify those variables that influence their determinations of risk. The admittedly tentative conclusions offered by Slovic et al. (1980) are that (1) people incorporate other considerations besides fatality into their concept of risk, and (2) many of the variables hypothesized to be important determinants of perceived risk are highly interrelated across hazards, indicating that they can be combined into higher- order characteristics or "factors." Three factors, labeled Dread, Familiarity, and Exposure, seem able to account for most of the interrelations among the variables in the Slovic et al. (1980) study; two factors, labeled Severe and High Technology, accounted for most of the interrelations in the Fischoff (1978) study; finally, factors labeled Size of Potential Accident and Controllability accounted for most of the interrelations in the Vlek and Stallen (1981) study. Clearly these conclusions are highly tentative.

The variety of observed dimensions of risk in the studies discussed here indicate that the particular set of hazards and the particular set of risk characteristics under study can have an important effect on the nature of the observed "dimensions of

risk." It seems to be that risk is differently understood in connection with different activities, products, and technologies. What remains to be determined are those "particularities", a determination that requires both further conceptual development of the construct as well as development of an appropriate methodology to study it. Furthermore, there is evidence that risk is differently perceived by different groups of people.

One problem common to the studies described in this section is the large number (90, 30, and 26 respectively) and variety of different products, activities, and technologies which the subjects were asked to judge. This number and variety could interfere with their ability to think thoroughly about each single stimulus, and may have forced them to simplify the underlying basis of their judgments. Vlek and Stallen (1981) suggest as an alternative to such broad explorations that we study the *process* by which perceived risks and benefits of specific activities come about.

A final common problem with the above studies is that subjects were asked to rank order, categorize, and rate stimuli which are difficult to compare, for example, the large-scale storage of liquified natural gas and driving a car. Such comparative judgments are meaningful only to the extent that the underlying dimensions of the risks of both stimuli do indeed overlap.

Risk Acceptability

It is important to note at the outset that, while the expression "risk acceptability" is used pervasively throughout the literature, what that expression actually refers to is the acceptability of a product, activity or technology that entails risk; that

is, it is not the risk that is judged as acceptable, but rather the option. This seemingly semantic distinction becomes important when assessing issues of construct validity and measurement; nonetheless, for the sake of convention, the term "risk acceptability" refers throughout this review to the acceptability of the option that entails risk. Determining which risks or levels of risk are acceptable has become an increasingly troublesome issue. In general, discussions of risk have not distinguished between the generation of probabilistic data by experts and the interpretation and meaning that individuals attach to such data (Covello, Menkes and Nehnevajsa 1982). This problem reflects the general and pervasive problem in the social sciences of distinguishing between objective and subjective phenomenon. This problem is discussed in detail subsequently.

A basic premise within the domain is that risk acceptance is ultimately inseparable from cognitive processes of perceived risk (Covello et al. 1982). As such, it is necessary to study the complex decision process that individuals engage in when faced with a prospective risky situation or hazard. It is assumed that such decisions involve consideration of all the costs and benefits believed to be associated with a phenomenon, and might thus be considered as personal, intuitive cost-benefit analyses. However, empirical evidence indicates that consumers find it difficult to trade off the greater perceived benefits of one brand that also has associated with it greater perceived risks (Bettman, Payne and Staelin 1986). They point out as well that this difficulty in trading off risks and benefits is increased to the extent that risk information is either not readily available to the consumer, and/or is not presented in an easily interpreted form. Studies concerned with these processes, as well as decisions and actions based on them, are within the scope of risk-analysis research. Such studies might deal with the identification of specific factors that individuals consider

in interpreting risk, the relative importance given to psychological or social factors influencing decisions about risk acceptability, and the causes or correlates of differences among groups in their evaluations of risk acceptability.

An assumption that is frequently made regarding risk acceptability is that there is some sort of morally justifiable and equitable balance between risks, costs, and benefits, a philosophical issue. Clearly, there are individual differences that must be recognized, but even when ideological arguments regarding risk management are considered there exist diametrically opposed positions. On one hand, it can be argued that the only acceptable level of risk is no risk, i.e., that human life is an absolute sanctity. On the other hand, it has been asserted that a risk-free society, were it definitionally possible, would be a society without vitality (Wildavsky 1980).

Furthermore, evidence abounds (Kahneman and Tversky 1981; Slovic et al. 1982) that subtle aspects of how information is presented can significantly change people's responses, including what options they deem as acceptable or unacceptable. Thus, the choice of information formulation involves issues of law, ethics, and politics as well as behavioral decision theory (Slovic et al. 1984).

Again, Vlek and Stallen empirically investigated the dimensions underlying acceptability as they did for risks. They isolated two dimensions, one they called ***personal necessity of benefit and inevitability of risks,*** (inevitable risks requiring "organized safety" against them, e.g. immunization) and the other they called ***scale of production and/or distribution of benefits and size of potential accident.*** These results were somewhat ambiguous; roughly one half of their group believed that large-scale benefits and sizeable potential accidents increase the total acceptability of the relevant stimuli. The other half believed that acceptability is greatest for activities having small scale benefits and limited potential accidents.

Section Summary

Three empirical studies on the determination of the acceptability of product risks exist in the consumer behavior literature; these are discussed in a subsequent section. For the time being, in summary, it is important to distinguish between risk estimation and risk evaluation, the latter being a relativistic judgment of acceptability. Although empirical results are meager and equivocal, they suggest that people may incorporate into their acceptability judgments dimensions other than perceived physical risk.

Overview of Perceived Risk in Consumer Behavior Research

Definitions

At the outset, it is necessary to explicate the basic paradigm of perceived risk as it was originally stated by Bauer (1960) and elaborated by Cox (1967). Perceived risk was modeled as having two primary structural dimensions, those being ***uncertainty*** and ***consequences,*** with the emphasis being on subjective (perceived) risk and not "real world" (objective) risk. More specifically, the consequences component was defined as a function of "the amount that would be lost (i.e., that which is at stake) if the consequences of an act were not favorable", and the uncertainty component was defined as an "individual's subjective feeling of certainty that the consequences

will be unfavorable" (Cox 1967,p. 37). The amount at stake "...is a function of the importance or magnitude of the goals to be attained, the seriousness of the penalties that might be imposed for nonattainment, and the amount of means committed to achieving the goals" (p.38). Whereas uncertainty and consequences determine the amount of perceived risk, "the nature of the risk perceived should be a function of the nature of the buying goals involved" (p. 38). Bauer presented perceived risk as not only related to consumers' pre-decision information acquisition and processing activity, but also to post-decision processes.

This two-factor view of risk implies that risk might be reduced by either or both (1) reducing the amount at stake (e.g., the potential for gain, penalties for failure), and (2) increasing the degree of certainty that loss will not occur. It is noteworthy that throughout this literature, the focus has been on risk as the ***negative*** consequences of behavior, to the exclusion of the potential for gain. This point is elaborated further in Section IV.

The relationship between the two dimensions, uncertainty and consequences, has been most often assumed to be multiplicative, but empirical work has supported an additive combination rule, or "cognitive algebra" (Bettman 1973), and provided evidence that the use of merely one component of perceived risk, i.e. uncertainty, leads to better prediction of brand preference than the use of both components in a multiplicative model (Peter and Ryan 1976). The problems and implications of the relationship between the two dimensions is also discussed in more detail in Section IV.

Since its introduction, most research in the domain has employed this two dimensional structure of perceived risk (or some close variant of it). This research is consistent with the two-dimensional structure that has predominated work in the

area. While these two dimensions, uncertainty and consequences, typify research in consumer risk, (e.g., Cunningham 1967) some researchers have varied the two dimensional definition such as uncertainty and importance (e.g., Schiffman 1972; Arndt 1968a), and some have used just one dimension (e.g., uncertainty only, Arndt 1968b). This point is further elaborated in Section IV of this chapter.

What has often happened with definitional issues for risk in the consumer behavior literature is that the construct has taken on a meaning via the method of operationalization, a situation that Bagozzi (1979) referred to as the "doctrine of operationalism." This practice, in general, has the effect of impeding theory development, which best progresses when conceptual definitions form the basis for operational definitions. However, while researchers in this area have not been rigorous in specifying their conceptual definition of perceived risk, their operational definitions have reflected the same expectancy-value framework originally conceptualized by Bauer. Furthermore, the conceptual meaning of risk is difficult to articulate without seeming operational, probably because of its dual-attribute structure. Bagozzi's (1984) discussion of types of definitions that can contribute to the conceptual meaning of a theoretical concept is useful at this point. He defines an *attributional definition* as one that specifies the attributes, characteristics, or properties of a concept. He uses an expectancy-value model of an attitude toward an act, defined as the sum of the products of beliefs about the consequences of the act times the evaluations of those consequences, as an example of an attributional definition. Perceived risk has a similar attributional definition; each attribute is an abstract construct, each a necessary component of the definition, and together sufficiently defining the concept.

The most well-articulated point of departure from the conventional two-dimensional structure was made by Bettman (1973), who substituted ***importance*** for consequences: "...the risk inherent in a brand choice situation within a product class will depend upon the degree to which a buyer believes he can construct a reasonable decision rule for making a brand choice, and the importance to him of making a satisfactory choice within that product class" (p. 184-185). (This idea is interesting in that it implies that risk can be modified from the decision *process* itself, as well as from the various options an individual faces.) Ross (1975) pointed out the difficulty of addressing the issue empirically, since the debate may reflect differences of opinion in what the conceptual definition of risk is, thus leading to different views of its fundamental dimensional structure. Nevertheless, while the particular two dimensional structure may have varied across studies, all remain essentially consistent with the conceptual expectancy-value framework originally laid out by Bauer.

Another fundamental contribution made by Bettman (1973) was his distinction between two different types of risk: "inherent" and "handled." "Inherent risk is the latent risk a product class holds for a consumer, the innate degree of conflict the product class arouses in the consumer. Handled risk is the amount of conflict a product class engenders when the buyer chooses a brand from that product class in his usual buying situation. Thus, handled risk includes the effects of information and risk reduction processes as they have acted on inherent risk" (Bettman, 1973, p. 394.)

Components of Perceived Risk

A further development in the theory of perceived risk was the concerted effort to determine those consequences which are common to most consumers and most product classes; to date, seven types of risky consequences have been discussed. These types of risky consequences have come to be known as the "components" of perceived risk. These seven components include physical, performance, financial, social, psychological, time, and opportunity cost.

Jacoby and Kaplan (1972) were the first to address the fundamental structure of risk, and identified five components: financial, performance, physical, psychological, and social. Price was found to be the variable that ordered twelve diverse consumer products on overall risk perception, and performance risk correlated most highly with overall perceived risk. Correlation analysis showed that, averaging across the twelve products, the risk components, in order of importance, were performance, financial, social, psychological, and physical. A multiple regression equation predicting overall perceived risk from component risk scores accounted for 74 percent of the variance in this criterion. A cross-validation on a new sample two years later (Kaplan, Szybillo, and Jacoby 1974) showed negligible differences from the original structure. It has become almost universal to see these original five components discussed in introductory consumer behavior textbooks, and they have been essentially taken as given in recent empirical work (e.g., Shimp and Beardon 1982).

Other components have been uncovered, although these are cited less often. For example, Roselius (1971) identified time loss as another component of perceived risk. Finally, Zikmund and Scott (1973) identified still another risk component, "future opportunity lost", in their factor analysis of data collected via personal inter-

views with housewives to evoke specific risk consequences associated with eight different product classes. This component refers to the expectation that an improved or lower priced alternative might be available at a future time which would be precluded by a current purchase.

Research in the behavioral decision sciences has focused exclusively on physical risk in its emphasis on risks to consumers' health and safety; such too is the focus of the current research.

Major Streams of Research

When in 1975 Ross critically reviewed the perceived risk literature, there had been four major streams of research on perceived risk: (1) new product adoption as a function of perceived risk (Arndt 1967b; Cunningham 1967b; Schiffman 1972), (2) modes of shopping as a link between risk perceptions toward products and how those products are purchased (Spence, Engel, and Blackwell 1970; Lutz and Reilly 1973), (3) relationships between personality and perceptions of risk (Cunningham 1967a; Popielarz 1967; Schiffman 1972; Barach 1969; Zikmund and Scott 1973), and (4) a host of studies examining the many strategies, such as brand and store loyalty and word-of-mouth information sharing and opinion leadership, for reducing (or relieving) risk (Roselius, 1971; Lutz and Reilly 1973; Zikmund and Scott 1973; Jacoby and Kaplan 1972; Kaplan, Szybillo and Jacoby 1974; Newton 1967; and McMillan 1972, Arndt 1967; Cunningham 1967; Roselius 1971).

Dwindling research activity since Ross' review in 1975 has included the use of the theory of perceived risk to aid in the development of consumer information

Components of Perceived Risk

A further development in the theory of perceived risk was the concerted effort to determine those consequences which are common to most consumers and most product classes; to date, seven types of risky consequences have been discussed. These types of risky consequences have come to be known as the "components" of perceived risk. These seven components include physical, performance, financial, social, psychological, time, and opportunity cost.

Jacoby and Kaplan (1972) were the first to address the fundamental structure of risk, and identified five components: financial, performance, physical, psychological, and social. Price was found to be the variable that ordered twelve diverse consumer products on overall risk perception, and performance risk correlated most highly with overall perceived risk. Correlation analysis showed that, averaging across the twelve products, the risk components, in order of importance, were performance, financial, social, psychological, and physical. A multiple regression equation predicting overall perceived risk from component risk scores accounted for 74 percent of the variance in this criterion. A cross-validation on a new sample two years later (Kaplan, Szybillo, and Jacoby 1974) showed negligible differences from the original structure. It has become almost universal to see these original five components discussed in introductory consumer behavior textbooks, and they have been essentially taken as given in recent empirical work (e.g., Shimp and Beardon 1982).

Other components have been uncovered, although these are cited less often. For example, Roselius (1971) identified time loss as another component of perceived risk. Finally, Zikmund and Scott (1973) identified still another risk component, "future opportunity lost", in their factor analysis of data collected via personal inter-

views with housewives to evoke specific risk consequences associated with eight different product classes. This component refers to the expectation that an improved or lower priced alternative might be available at a future time which would be precluded by a current purchase.

Research in the behavioral decision sciences has focused exclusively on physical risk in its emphasis on risks to consumers' health and safety; such too is the focus of the current research.

Major Streams of Research

When in 1975 Ross critically reviewed the perceived risk literature, there had been four major streams of research on perceived risk: (1) new product adoption as a function of perceived risk (Arndt 1967b; Cunningham 1967b; Schiffman 1972), (2) modes of shopping as a link between risk perceptions toward products and how those products are purchased (Spence, Engel, and Blackwell 1970; Lutz and Reilly 1973), (3) relationships between personality and perceptions of risk (Cunningham 1967a; Popielarz 1967; Schiffman 1972; Barach 1969; Zikmund and Scott 1973), and (4) a host of studies examining the many strategies, such as brand and store loyalty and word-of-mouth information sharing and opinion leadership, for reducing (or relieving) risk (Roselius, 1971; Lutz and Reilly 1973; Zikmund and Scott 1973; Jacoby and Kaplan 1972; Kaplan, Szybillo and Jacoby 1974; Newton 1967; and McMillan 1972, Arndt 1967; Cunningham 1967; Roselius 1971).

Dwindling research activity since Ross' review in 1975 has included the use of the theory of perceived risk to aid in the development of consumer information

(Grunert 1980), the application of the concept of perceived risk to buying influence in industrial firms (Upah 1980), the predictive performance of four models based on the dimensions of perceived risk (Evans 1982), the analysis of consumer information demand derived from perceived risk (Dedler et al. 1981), the effect of extrinsic cues on perceived risk (Shimp and Beardon 1982), the moderating effects of perceived risk on consumer information use and confidence (Wendler 1983), examination of the issue of criterion-related validity (Brooker 1984), the phenomenon of "risky shift" in dyadic decision making (Coughlin and O'Connor 1984), the instrumental role that 'quality' plays in risk-reduction strategies (Day and Castleberry 1986), issues of measurement and construct validity (Hughes 1985; Stone and Winter 1985), perceived risk as a mediator in repetition-affect relationships (Poiesz 1986), and clothing related risk perceptions of disabled people (Bounds, Feather & Vann 1986). Despite the fact that Ross in his 1975 review specifically outlined areas for future research, subsequent research cannot be categorized as belonging to any identifiable research stream. The domain has progressed in a piecemeal fashion. However, two of the more recent efforts, i.e., Stone and Winter (1985) and Hughes (1985), are directed specifically at issues of measurement and construct validity, issues that are central to the development of any research program.

Research Integrating Consumer Behaviors' and the Behavioral Decision Sciences' Approaches

During the past few years, several research efforts have been made to integrate the two research domains of consumer perceived risk with risk analysis from the behavioral decision sciences. Rethans and Albaum (1981) presented a first attempt to

explore consumer perceptions of the acceptability to society of the hazards associated with consumer products. Their two research objectives were (1) to determine consumers' subjective perceptions of product risks and (2) to examine the relevance of their emerging model of risk acceptance to the judgments of the acceptability of product risks.

A sample of 75 respondents were asked to rate a set of consumer products on a series of seven point scales, which included societal hazard and acceptability scales as well as scales representing the risk characteristics. These characteristics and their hypothesized linear relationships with acceptability perceptions include: voluntariness (+), knowledge (+), control (+), necessity (+), foreseeability(+), exposure (+-), ease of reduction (-), user error(-), injury frequency (-), severity of injury (-), and risk to children(-).

On an absolute level, the majority of products were considered to bear risks which were perceived to be acceptable. When the respondent's ranking of the hazardousness were compared with the acceptability rankings, the presence of an inverse relationship between risk and acceptability was suggested ($r = -.62$). The major rank discrepancies suggested that risk acceptability was not only influenced by perceived risk but by other considerations as well. For example, swimming pools, knives, and snow skis were considered to be quite hazardous from a societal perspective, yet were considered to be quite acceptable.

Correlational analysis was done to explore the relationship between perceived risk and the acceptability of risk on the one hand, and the qualitative risk characteristics on the other. The majority of the observed correlations conformed to the direction of the influence hypothesized, with exceptions including foreseeability,

voluntariness, and ease of reduction. The authors attributed these first two relationships to a lack of construct validity; no explanation for the third was offered.

The final analysis attempted to develop a formula to specify acceptability of product risks as a function of twelve risk characteristics by way of a stepwise regression analysis in which acceptability formed the dependent variable and the risk characteristics constituted the independent variables. The entry sequence of characteristics was necessity, user error, voluntariness, knowledge, and foreseeability, which together explained about 84% of the variance in acceptability. The usual cautions in interpreting the results of stepwise regressions apply to this analysis (see *Methodological Issues* section for a discussion of these cautions); however, the authors argue that the variables entered in the model do have theoretical justifications in the risk assessment literature (e.g., Ross 1975 and Green & Brown 1978). It should be noted again, however, that very little theory exists to suggest the relative importance of factors.

Bechtel and Ribera (1983) pursued this effort one step further by exploring the differential predictive power of perceptual risk components in accounting for the acceptability of risk to society in population segments differing in their value orientations. Their analysis was actually a secondary analysis of data made available by Paul Slovic, data that are described above. These authors characterize the League of Women Voter and student groups as liberal, and the business professionals as conservative based on their voting behavior relative to nuclear power (thus the rationale for describing the three segments as having distinct value orientations).

Risk acceptability was measured as in the Slovic et al. study above, with the one difference that in the present analysis the data were dichotomized into two categories of acceptability. In each group the proportion of "acceptable" responses was

transformed to its logit, which is the log odds of an "acceptable" response. Since the logit of .5 = 0, if more than half of the group regard a hazard as "acceptable", the measure takes a positive value (and vice versa). These logits are the dependent variables in the analyses.

The nine attributes used were those postulated by several writers as being characteristics of perceived risk (Starr 1969; Lowrance 1976; Rowe 1977), and were essentially the same as those discussed previously. Subjects rated each hazard on 7-point semantic differential scales; further manipulation converted the dependent and independent variables to a common metric.

Thus there were three sets of group scales for analysis, each one consisting of a segment-specific acceptability scale of thirty hazards (the dependent variable) and nine segment-specific attribute scales for these hazards (the independent variable). In each segment the dependent variable was regressed upon the nine independent variables across the thirty hazards. The "seemingly unrelated regressions" obtained from the SYSREG procedure in the SAS computer package was used. The only attributes which attained statistical significance were the common-dread dichotomy and the immediacy of effect. These two attributes are very highly loaded upon the separate factors of "dread risk" and "unknown risk" which Slovic, Fischoff, and Lichtenstein (1981) discovered among the set of characteristics.

Bechtel and Ribera allow that the components uncovered were not embedded in any theoretical framework solid enough to permit a priori hypothesis generation; thus, their last analysis was exploratory to find the particular functional forms, e.g., linear, optimal, etc., linking the common and delay attributes to acceptability, forms which would then be available as hypotheses for subsequent testing. The particular structures revealed were purely monotone in the League of Women Voters and the

students. However, these two monotone relations were in the opposite direction than expected. Specifically, the more common the risk the more acceptable, and the more delayed the effect the less acceptable. Among the business professionals, common showed a similar, albeit weaker, relationship to that of the other two segments, but delay entered quadratically, suggesting the existence of an optimal point of acceptability on this second attribute.

Dardis and Stremel (1981) investigated the issue of risk acceptability in a consumer context. They argue that the attainment of zero risk to consumers is questionable both from the standpoint of desirability and feasibility, their arguments echoing those of Wildavsky (1980) who asserted that a risk-free society is a society without vitality, and Kaplan and Garrick (1981) who assert that "we may make risk as small as we like by increasing the safeguards but may never, as a matter of principle, bring it to zero". Moreover, they suggest that the frequent, but they maintain unfortunate, argument is that any risk is acceptable as long as the expected benefits are greater than the expected costs. This argument neglects the costs of developing risk reduction strategies for consumption activities. The costs of obtaining such information may be far greater than the potential benefits. Towards the goal of providing policy makers with a method for assessing risk, these researchers developed a methodology for assessing risk and applying it to a selected consumption activity in order to demonstrate the feasibility and utility of risk-benefit analysis. This applied research is interesting in that there was an assignment of economic consequences to various types of injuries, thus permitting comparison between products with more than one type of injury.

Rethans and Hastak (1982) investigated the content and structure of product and technological hazard information in consumer memory. They used a free

elicitation procedure to differentiate between linguistic thoughts and image-based thoughts; these thoughts were then classified as episodic or semantic. Content analyses of both verbal and imagery protocols suggested that episodically oriented thoughts and images were stored in memory and thus might be influencing hazard perceptions. They thus concluded that research on information representation should go beyond the sole use of linguistic information and the exclusive focus on semantic memory.

Section Summary

The predominant focus of interest in empirical work integrating the two broad domains has been risk acceptability. This is not surprising, given Bechtel and Ribera's description of risk acceptability as being "at the crossroads of marketing, consumer behavior, and environmental psychology" (1983, page 590). Specific research goals of primary interest have been (1) to better understand the relationship between consumers' perceptions of product risks and judgments of product acceptability to society, and (2) to better understand the relationship between consumers' perceptions of product acceptability to society with several qualitative characteristics of risk that have either been hypothesized or empirically demonstrated as being important. As in the behavioral decision sciences, there have been largely inconsistent and ambiguous results. Reasons for the lack of consistent and clear results are discussed in a subsequent section of this chapter.

Questions such as "how safe is safe enough?, and "acceptable to whom on what terms?" remain to be answered. These questions are broad in scope, ranging from the

intensely personal to the broadly social. Furthermore, it is intuitively plausible that personal and social standards of acceptability evolve over time, and vary according to context.

Conceptual Issues Relative to Behavioral Research on Risk

Among the reasons for the waning interest in perceived risk in consumer research may be the apparent lack of consistent results as well as the difficulties associated with behavioral research on risk. However, a careful assessment of the two research domains suggests that some of the difficulties encountered in this research area may be due to some unresolved conceptual issues. In this section some of these conceptual issues are discussed. It should be noted that in some cases these issues represent both conceptual and methodological concerns, the two being impossible to completely segregate.

1. The risk/perceived risk dichotomy of perceived risk as a subset of the "larger" objective risk may be inaccurate and misleading.

As such, this issue is actually both conceptual and methodological. Throughout both bodies of literature, measures of risk tend to fall into two broad categories: those that purport to calculate the risk of a process or event, and those that rely upon the perceptions of those assessing the risk (Kasper 1980). Measures of the first type employ experimental evidence, long-term experience, or sophisticated analytical calculations to describe actual or potential risks and are usually framed in terms of

probabilities. Measures of the second type describe what people ***think*** the risks of a particular activity are. Kasper (1980) laments what he calls a problem of nomenclature in this regard, with some people labeling the categories as "objective" and "subjective", and others, "somewhat arrogantly, calling them 'real' and 'imagined'" (p.72). The dichotomy is a well accepted one, and the two measures often disagree; examination of the reasons for the disparity are necessary. [Stone and Winter (1985) essentially discount arguments for the dichotomy and argue that no qualifier at all is really necessary, but that 'inferred' is a preferable qualifier to 'perceived'.] Also at issue is the question of whether those components of risk suggested in consumer behavior can be assessed, either objectively or subjectively. Psychological or social risk are clearly more elusive components than is fatality. As this is an issue of considerable controversy (although it is not the intent of the current research to resolve it), consider the two dimensions of risk assessment/measurement, objective and subjective, in more detail.

Objective Assessment: Before it is possible to assess and understand differences between objective and subjective risk, it is first necessary, of course, to be able to measure objective risk. This has been attempted quantitatively by ***experience*** , and by the use of ***calculations.*** Experience refers to the collection of data that are easily recognized and counted, for which there is a clear cause and for which there exists a body of available statistics (Slovic et al. 1982). Highway fatality statistics fall in this class. Although this is a relatively non-controversial method of risk assessment (although certainly not to philosophers of science who would question the very premise of objectivity; Morgan 1983), few risks fall into this class.

Calculations are used for the larger number of risks where experience is not extensive enough to be more than a partial guide. Here, assessors may use projective

methods to predict highly uncertain effects. Such calculations are the basis for most arguments for the safety of nuclear power, for example, where the (very small) probability of various occurrences in nuclear power plants are presented.

Efforts have been made as well to quantify the risks of consumer products. The Consumer Product Safety Commission developed a ranking system in 1973 and revised it in 1975 that was essentially an index of frequency and severity of injury. Because that scale used severity values that were in no way related to the economic consequences of a particular type of injury, that index was replaced in 1978 by an index representing numbers of injuries involving various products. That index has also been criticized on several counts (Dardis and Stremel 1981). First, neither index considers the number of products in use nor the degree of product usage by the consumer. Second, consumption benefits are ignored.

The appeal of objective measures of risk is the supposed reduction of subjectivity in the decision making process. The key word here is ***supposed***, in that the process remains very judgmental. There remains, for example, subjectivity in the choice of questions to be asked, issues considered, and methods used. For example, in the hazard index employed by the Consumer Products Safety Commission, the Commmission has noted that "a product does not have to be high on this list to receive Commission action but those high on the index are more likely to receive early attention" (U.S. Consumer Product Safety Commission 1976). Clearly this decision rule is ambiguous. Furthermore, even the most analytical of methods may be inaccurate because of problems in the data base or in the method itself. Thus, quantitative risk assessments remain subjective despite the appearance of greater accuracy that comes with the use of "precise" numbers. Even when statistical data are available, the hard facts can only go so far towards communication of that information,

and the development of policy. Edward Burger, director of Georgetown University's Institute for Health Policy Analysis is quoted (Washington Post, May 21, 1986): "There are a lot of pressures for simple numerical answers -- from regulators, lawyers, economists, the public itself. There's a strong push to put numbers on risk, and yet those numbers often are so fuzzy that they can give a misleading impression of accuracy and confidence." For example, Bernard Cohen, a physicist at the University of Pittsburgh, has compiled a life expectancy reduction scale that ranks hazards according to how much they shorten the average American's life. Such scales are considered seriously flawed by many risk analysts and ridiculed by some as "kindergarten lists". Slovic (Washington Post, May 21, 1986) comments that purely statistical comparisons between a nuclear plant meltdown and walking across the street fail to account for important ***qualitative*** differences in the two types of risk. He maintains that scientists who try to emphasize the smallness of a risk by comparing it to one crouton in a five-ton salad or a drop in a railroad tank car only succeed in making the risk more easily imaginable. At some point subjective judgments, either by experts or consumers, are a major component in risk assessment.

Related to this issue is that of the choice of summary statistic used. For every dimension of risk assessed, some quantitative summary statistic is necessary; the choice of that summary statistic can affect the purported relative riskiness of technologies. Crouch and Wilson (1982) point out, for example, that today's coal mines are much less risky than those of thirty years ago in terms of accidental deaths per ton of coal, but are more risky in terms of accidental death per employee. The difference is measures is explained by increased productivity and fewer employees. Furthermore, Fischhoff et al. (1984) argue persuasively that the choice of summary statistic is a very value-laden decision. For example, a criterion of loss of life ex-

pectancy places a premium on early deaths, ascribing particular worth to the lives of young people.

Subjective Assessment: Behavioral risk perception research originated in studies of judgment and decision-making that began with attempts to operationalize the axiomatic formulations of utility theory (Slovic et al. 1982). A major development in this area was the discovery of a small set of mental strategies, or heuristics, that people use to make sense out of an uncertain world (Tversky and Kahneman 1974). Although these rules are valid in some circumstances, in others they lead to large and persistent biases with serious implications for risk assessment (Slovic et al. 1980). These heuristics are outlined briefly below:

Availability is a heuristic that people use when they judge an event as likely or frequent if instances of it are easy to imagine or recall (Slovic et al. 1982). Availability is affected by frequency of occurrence; as such it is an appropriate cue. However, it is also affected by such factors as vividness or severity. Much of the information to which people are exposed provides a distorted picture of hazards (Slovic et al.1982). On the other hand, ***lack*** of availability may cause people to ***overestimate*** the safety of a hazard, such that what is out of sight is out of mind.

Overconfidence in one's ability to accurately estimate a hazard is what Slovic et al. (1982) call a "particularly pernicious aspect of heuristics" (p. 185) in that people are typically very confident in judgments based upon their estimates. They suggest that the psychological basis for this unwarranted certainty seems to be that people do not realize that the assumptions upon which their judgments are based are quite tenuous.

Desire for certainty represents another source of overconfidence in addition to that described above. People have difficulty thinking about and resolving the

risk/benefit conflicts even in simple gambles, and one way to reduce the associated anxiety is to deny that uncertainty (Slovic et al. 1982). This bias is consistent with Kahneman & Tversky's prospect theory (1979) which holds that the psychophysics of chance induces overweighting of certainty when a decision maker evaluates the utility of an outcome.

"It won't happen to me," or personal optimism such that people tend to consider themselves immune to many hazards, is a heuristic that Slovic et al. (1982) designate as potentially tragic. The determinants of such personal optimism are not well understood.

Reconciling divergent opinions about risk is problematic in that research indicates that people's beliefs, once formed, change very slowly, and are extremely persistent in the face of contrary evidence (Nisbett & Ross 1980). Initial impressions tend to structure the way that subsequent evidence is interpreted, with new evidence deemed reliable if it is consistent with an initial belief, and unreliable otherwise.

In summary then, the many difficulties in ascertaining "objective" risk estimates, and of finding conceptual and practical means of reconciling them with "subjective" risk perceptions that may be highly biased, makes this a particularly troublesome issue that spans the conceptual, methodological and even philosophical aspects of behavioral research.

2. The equating of risk and uncertainty, while convenient, is not conceptually valid, and these two constructs should be separated for research purposes (Stone and Winter 1985).

"Uncertainty" and "risk" have distinctly different definitions, with risk having a known probability distribution of outcomes and uncertainty associated with an un-

known distribution of outcomes. Nonetheless, marketing researchers have tended to use the two concepts synonymously.

To further unify the conceptual and linguistic framework for quantifying and making precise the idea of risk, it is also necessary to differentiate between the notions of "risk" and "hazard" (Kaplan and Garrick 1981). They point to the dictionary definitions of hazard and risk as useful, with hazard defined as "a source of danger" and risk as the "possibility of loss or injury" and the "degree of probability of such loss." As such, a hazard simply exists as a source, with risk including the likelihood of conversion of that source into actual delivery of loss, injury, or some form of damage. To cite their example, the ocean can be said to be a hazard, but the attempt to cross it represents a risk. Influencing that likelihood are the various "safeguards" that a person may use to avoid the conversion of a hazard into a loss, injury, or damage. Consider the following illustrative example: A bicycle is often considered a "risky" product. In and of itself it is not, but riding it is certainly hazardous. The use of a bicycle helmet, however, greatly reduces the likelihood of a serious head injury in the event of a collision or accident. As such, the use of a helmet as a safeguard against the hazards of bicycle riding reduces the overall risk of the activity. Included under the heading of safeguards is the idea of simple awareness. In other words, awareness of risk reduces risk.

3. Comparisons among research studies on risk are difficult because different researchers conceptualize risk uniquely; furthermore the operationalizations almost always become the definition for the construct.

Note again the close interface between the conceptual and methodological aspects of this issue. This third, and crucial, issue is essentially a restatement of Ross's (1975) conclusion over ten years ago that research in perceived risk is fraught with

what he called the 'criterion and construct definition problem.' While this definitional problem is inherent in research associated with hypothetical constructs, the problem in perceived risk research appears to be more troublesome and less adequately dealt with than in programmatic research in other areas. Ross' criticism of the way risk has been conceptualized still applies: "the manner in which the construct [of perceived risk] has been operationally and even conceptually defined has varied so much across the studies, that efforts at synthesis are hampered by questions of 'are these two studies really talking about the same thing?' More often than not, the answer is, no" (Ross 1975 p.1). As Hughes notes more recently (1985, pg.5), despite repeated "efforts by marketing scholars such as Taylor (1974), Ross (1975), Peter and Tarpey (1975), Zikmund et. al. (1973), and Vann (1984) to summarize, categorize, review, and criticize the various conceptualizations and measures of perceived risk in the literature, the concept remains essentially ambiguous."

In the past, the expectancy component has been treated probabilistically and usually viewed in terms of uncertainty/certainty. The 'value' component has been less consistent; even when viewed the same way by different researchers, the researchers have ***used*** the term differently. For example, when "importance" has been chosen for risk's value component, it has been associated with the "importance" of the product to the consumer (Lutz and Reilly 1973), as well as in terms of the seriousness of the consequences to the consumer (Zikmund and Scott 1974). Consequences could alternately be measured in terms of the dangers the consequences pose to the consumer, or in terms of the relevance of the consequences to the consumer. Furthermore, as stated earlier, what has consistently happened with definitional issues for risk in the consumer behavior literature is that the construct has taken on a meaning via the method of operationalization, where the entire meaning of the

theoretical concept has been derived from its measurement. Table 2 lists several definitions of the global concept of perceived risk (as opposed to the components of perceived risk described more fully later), and examples of published works in which they have appeared.

Stone and Winter (1985) take a position toward less cognitive stress for consumers by viewing risk in terms of ***loss expectation*** and not in expectancy-value fashion. They contend that risk must be defined and developed as a construct in its own right, rather than as it has traditionally been defined such as "consequences times their respective probabilities" or some such variation on an expectancy-value theme. With risk more simply conceptualized as loss expectation, they suggest the following criterion example as being appropriate: "Overall, I would be concerned about experiencing a loss for any of several reasons if I bought _____ for myself within the next year." The following passage (Sjoberg 1980, p.302) supports their argument:

> "The word risk is well known to be rather ambiguous and many more or less specific meanings have been attributed to it. There are three broad classes of meaning: those concerned with the probability of negative events, those concerned with these negative events themselves, measured in some suitable way, and those concerned with a joint function of probability and consequences, most often their product ...Perceived risk is seldom well pictured by the product of probability and consequences and the use of this product is inspired by thinking in economics. It can many times be quite misleading...It is unfortunate, therefore, that one often finds it to be suggested as the definition of risk..."

Despite these authors' argument that they have replaced the expectancy-value framework with a conceptual definition that is less complex, their definition of risk as "loss expectation" nonetheless keeps the expectancy value framework intact, in that their single construct still encompasses the constructs of expectancy (expectation) and value (loss). However, they contend that the construct can be measured with a single question. This research is consistent with their argument, in that perceived risk was measured as a construct in its own right.

Table 2. Some Defintions of Perceived Risk

Definition	Examples of Use
Consequences	Spence, Engel and Blackwell 1970
Uncertainty x Consequences	Cunningham 1967 Copley and Callum 1971 Hisrich, Dornoff and Kernan 1972 Ross and Kraft 1979 Zikmund and Scott 1977
Uncertainty x Importance	Arndt 1967, 1968a Schiffman 1972 Bettman 1972, 1973
Uncertainty	Arndt 1968b Locander and Hermann 1979
Uncertainty x Fairness	Evans 1982

Although the construct of perceived risk is well accepted in the marketing literature, only limited attention has been paid to measurement and construct validity issues (Hughes 1985). The perceived risk model has been described as being similar in many ways to multiattribute attitude models, and as such, susceptible to many of the same measurement and analysis problems (Upah 1980). These issues and problems, including the multiplication and summation of components and the relative usefulness of importance weights (which are analogous to the magnitude of loss components of risk) have been discussed in detail by Wilkie and Pessemier (1973). Furthermore, Hughes (1985) notes that the absence of any explicit measurement error theories has complicated interpretation of the results of these studies in the area.

In any case, systematic attempts at formalizing the structure of perceived risk may clarify both conceptual and methodological issues and thus provide a firm foundation for both theory building and systematic empirical research in areas in which this concept is thought to play a major role (Hughes 1985).

4. The boundaries of the theory of perceived and acceptable risk have yet to be delineated.

Ingene and Hughes (1985) argue that the most important conceptual weakness of much perceived risk research in marketing has been its definitional focus upon ***routinized response behavior.*** Marketers have been implicitly concerned with products with which consumers are reasonably familiar (e.g., spaghetti), and the research methodology employed has conceptually concentrated on routinized purchase behavior to the exclusion of extensive or even limited problem solving. On the other side of the coin, research in the behavioral decision sciences has focused on more ***global, technological hazards,*** such as nuclear power. Perhaps these extremes represent boundaries of the theory, but little attention from consumer researchers has fo-

cused on the "middle ground", that is, on products that represent clear potential for losses and gains without being catastrophic, in our efforts to validate the conceptual structure of perceived risk. In addition, although much discussion in risk perception has focused on technologies and activities, many of the risks that worry people in everyday life are not usually conceived of in this way. Thus, a comprehensive representation of the perception of risk should also include economic and psychological risks, such as bankruptcy or divorce (Fischhoff et al. 1981).

The framework in which perceived risk is studied may present another of the theory's boundaries. Arguing that much of the confusion surrounding the study of perceived risk could be reduced by recognizing several perceived distributions on each risk dimension rather than just one, Vann (1984) proposed a multi-level framework that presumes that perceived outcome distributions are cognitively represented at multiple levels of abstraction. Specifically, Vann presented a hierarchical framework suggesting that consumers' perceptions of different aspects of a brand's performance are subordinate to their perceptions of the overall level of a brand's performance, and that their brand perceptions are subordinate to their perceptions of product categories. Vann assumes that the framework suggested applies to all of the components of risk (i.e., performance, financial, physical, psychological, social, and time).

5. Research in marketing has failed to consider positive consequences (Ingene and Hughes 1985).

When, for example, durable goods are the research focus, consumers may not be familiar with the performance of currently available brands even when they own an older model of one of those brands. Expectations about consequences may thus be exceeded just as they may be unfulfilled. In such a case, reference to a "familiar

brand" may have little validity. Further, with the concentration on routinized purchase behavior to the exclusion of extensive or even limited problem solving, it is reasonable to assume that consumers know what to expect from a product and face uncertainty with respect to downside possibilities. Hughes' (1985) example is useful: an unfamiliar brand of dry spaghetti may be tasteless, but it is not likely to be significantly inferior to a familiar brand.

Related to the above conceptual issue is the argument that perceived risk may be best conceptualized as expected negative utility (Peter and Ryan 1976). Negative utility is seen as a function of one's expectation of attribute-specific loss and the evaluation of that loss. Expectations of loss are subject to disconfirmation in both a positive sense (when the loss does not occur or is less severe than anticipated) or in a negative sense (when it is more severe than anticipated). Although most often the structural dimensions of risk, i.e., uncertainty and consequences, have been measured with respect to loss, Peter and Tarpey (1975) proposed a net perceived return model where net perceived return equals perceived risk minus perceived return, and perceived return is measured similarly to perceived risk except that uncertainty and consequences are measured with respect to gain.

6. The way in which consumer choices are framed relative to benefits or losses has not been considered.

Framing is defined as a decision maker's conception of the acts, outcomes, and contingencies associated with a particular choice, with the frame controlled partly by the formulation of the problem (Tversky and Kahneman 1982). A given decision problem can be framed in more than one way; this situation is analagous to different perspectives on a visual scene. Just as changes in visual perspectives can change the apparent relative size of objects, so can a change in a decision frame change the

relative desirability of options. Subtle changes in the way that risks are expressed relative to gains and losses can have a major impact on perceptions and decisions.

The systematic reversal of preference by variations in framing are known as "framing effects, numerous examples of which have been demonstrated by Tversky and Kahneman (1981) and Slovic et al. (1982a). One common pattern is that people are risk averse relative to gains, and risk taking relative to losses. Such effects can be explained in terms of the nonlinear value function proposed by Kahneman and Tversky (1979) in their theory of risky choice, prospect theory. In any case, the fact that such differences in how risks are presented can have such marked effects suggests that those responsible for consumer information and marketing communications have considerable ability to manipulate perceptions and behavior.

7. The social and behavioral risk-analysis issue concerning the relationship between risk-aversion and risk-taking has not been addressed.

Risk aversion is commonly taken to be the dominant mode in human behavior, but risk-taking also exists among a large number of individuals. It is generally assumed that a person is either a risk-taker or a risk-avoider, with deliberate risk-taking being a minority phenomenon and thus, in statistical terms, representing "deviant" behavior. Covello et al. (1982) lament that so little effort has been made to understand the conditions under which individuals and groups take chances. The same issue has also been addressed in the marketing literature, i.e., whether people actually use risk ***enhancement*** strategies as well as risk reduction strategies (Ross 1975). Tversky and Kahneman (1979) have also tackled this issue in their prospect theory, indicating that in gain circumstances people tend to be risk averse, whereas in loss situations people tend to be risk takers.

Isen, Pratkanis, and Slovic (1984) have demonstrated support for the counter-intuitive conclusion that "positive affect", or "good mood", increases the tendency to prefer low-risk over high-risk options. They suggest that positive affect tends to promote conservativeness or self-protection in risk preference and social behavior, and that it may play a similar role in consumer behavior in, for example, decisions regarding the expenditure of a large sum of money or the purchase of products that either have a large amount of risk "inherent" in them or appeal to adventurousness.

8. Perceived risk as a multi-component construct is well accepted in both marketing and the behavioral decision sciences; however, the particular component structure has yet to be validated in either discipline, and no attempt at integration has been made.

Various authors in marketing have attempted to decompose global, or overall, risk into components. The most commonly used components are those which are associated with financial, social, physical, time, performance and psychological aspects of the perceived risk of a product or brand. Although it is conventional to use the word components, it is probably more accurate to call it a classification of types of outcomes. The most prevalent composition rule is the summation of component risk measures to obtain a measure of overall risk. Similarly, authors in the behavioral decision sciences have sought to determine the specific components of risk in their factor analyses showing the patterns of intercorrelations of risk characteristics. Their efforts have uncovered such underlying determinants as dread, unfamiliarity, number of people exposed, severity, and degree of technology involved. Furthermore, this idea is closely aligned with that of Fischhoff (1984) in his argument of risk as a multidimensional construct, including such dimensions as mortality, morbidity, and concern. Again, this issue interacts with its methodological counterparts -- that of measurement and statistical analyses used.

Related to this issue is the question addressed by Bettman, Payne and Staelin (1986) of what happens when people are asked to integrate multiple items of risk information into an overall judgment of risk. Consumers might integrate the multiple risks associated with a product into an overall judgment of risk, and then use that overall judgment in evaluation and choice, or alternatively compare products directly on a risk-by-risk basis. They cite as initial research on this issue Svenson (1985), who asked subjects to judge the cumulative risk of dying during a year for a set of persons, each characterized by different levels of risk for three different periods during the year. He found that some subjects used simple strategies that completely ignored the importance of different exposure times, and that others did try to incorporate all the relevant information through an anchoring and adjustment process. However, even for these subjects, there was a tendency to overestimate cumulative risks that included a period of short exposure to a high risk. Bettman, Staelin and Payne (1986) note that this result is consistent with the general result from decision research that people find it difficult to combine multiple items of information and therefore may be biased in forming perceptions of the overall risk associated with a product that has multiple risks. It should be noted that Svenson's research raises as well the question of cumulative versus single-use risk.

The other side of this issue is the effectiveness and meaningfulness to consumers of summary measures of risk, which would reduce the task of integrating risk information. Work by Russo and Staelin et al. (1985) in the area of nutritional point-of-purchase displays suggests that summary ratings of nutrition information by themselves were used less than lists containing complete nutritional information, and that summary ratings combined with more decomposed ratings were used less than the decomposed ratings. Clearly more research is needed in the areas of integrating

several risk measures or components, and the effectiveness of overall risk ratings that integrate multiple types of risk (Bettman, Staelin and Payne 1986).

9. Examination of consumer products as interventions, or mediators, or reducers of the risk of hazardous behaviors or technologies has not been made.

Marketing scholars have looked at the perceived risk of products, not of behaviors or technologies. The behavioral decision sciences has looked primarily at the risks of behaviors or technologies, and less at products. In the context of marketing, risk reduction has been approached from the standpoint of examining the behaviors that people engage in and the choices that they make to reduce the perceived risk of a particular product, for example, buying from a familiar store, or buying a familiar brand. What neither has looked at specifically is the use of products as interventions, or mediators, for risky behaviors and technologies. Examples of products as risk interventions/mediators/reducers are contraceptives, condoms as a prevention against sexually transmitted diseases, sun-protection creams and lotions as a protection against skin cancer, and helmets as a protection against motorcycle and bicycle head injuries. These products, or "safeguards", are of interest in that their very use implies that a consumer is aware of the existence of a particular type of risk inherent in their behavior or use of a technology.

It has previously been argued that every product, activity, or technology has associated with it both benefits and costs, or risks. That a consumer uses a product, behaves a certain way, or makes use of a particular technology implies that the consumer is aware of at least a subset of the associated benefits; however, we cannot make the same assumption about costs/risks. When a consumer uses a product to mediate risks, however, we can infer that they are aware of at least a subset of those

risks, even if we cannot make inferences about the accuracy or completeness of their risk "knowledge."

10. The meaning and use of the term "acceptability" is ambiguous and inconsistent.

Risk acceptability has been problemmatic in the literature in that acceptability can variously refer to personal acceptability, such that something is judged as personally acceptable to an individual, and as social acceptability, such that something is judged as being acceptable to society at large.

In addition to this distinction, there is the additional complication of how to define each one. Personal acceptability has been proposed (Vlek and Stallen 1980) to refer to (1) an individual's willingness, in principal, to carry out an option, and (2) the attractiveness of an option to an individual. Social acceptability has been the dependent variable actually used in existing empirical work (Slovic, Fischoff and Lichtenstein 1980; Bechtel and Ribera 1983; Rethans and Albaum 1981). The first two of these studies asked respondents to "consider the risk of dying (across all U.S. society as a whole) as a consequence of this activity of technology." The subject subsequently selected one of the following response options: a) "Could be riskier: It would be acceptable if it were ____ times riskier;" b) "It is presently acceptable;" and c) "Too risky: To be acceptable, it would have to be ____ times safer." For analyses, (a) and (b) were regarded as "acceptable" responses, while (c) was "unacceptable". Prior to making these responses, subjects read through the following instructions which, although lengthy, are included here to fully portray the meaning of risk acceptability used:

> The acceptable level of risk is not the ideal risk. Ideally, the risks should be zero. The acceptable level is a level that is "good enough," where "good enough" means you think the advantages of increased safety are not worth the costs of reducing risk by restricting or otherwise altering the activity. For example, we can make drugs "safer" by restricting their potency; cars can be made safer, at a cost, by improving their construction or requiring regular safety inspection. We may, or may not, believe such restrictions are necessary.
>
> If an activity's present level of risk is acceptable, no special action need to be taken to increase its safety. If its riskiness is unacceptably high, serious action, such as legislation to re-

strict its practice, should be taken. On the other hand, there may be some activities or technologies that you believe are currently safer than the acceptable level of risk. For these activities, the risk of death could be higher than it is now before society would have to take serious action.

Furthermore, the meaning of acceptability can range from passive acquiescence to a conscious choice of an option based on some cost/benefit tradeoff. Similarly, acceptance may refer to either a cognitive or a behavioral state, the former involving a mental acceptance or approval, the latter involving the willingness, at least in principal, to engage in a behavior, purchase a product, or be exposed to a technology.

A final point that needs to be made is that, while the term "risk acceptability" has been used consistently throughout the literature, it is in fact the acceptability of an option that entails risk that has actually been discussed and researched (e.g., Rethans and Albaum 1981; Slovic et al. 1980). This distinction becomes more than semantic when questions of construct validity and measurement are raised.

11. Variables proposed as determinants of perceived risk and acceptability are ambiguously defined and have been used inconsistently.

There are several qualitative characteristics of risk which have been hypothesized to be important in judgments of risk (Lowrance 1976) which have conventionally been used in research aimed at understanding the determinants of people's perceptions of risk and judgments of acceptability. To reiterate, these characteristics have included voluntariness, immediacy of effect, knowledge about risk by scientists and by those exposed to it, control over risk, newness, the degree to which the risk is chronic or catastrophic, the degree to which the risk is common or dreaded, and the severity of consequences. The measures themselves have conventionally been bipolar 1-7 scales. The indicators, as they have been used in past research, appear in Appendix A. Other characteristics that have been used, although less frequently,

include injury frequency, threat to children, personal exposure, product necessity, forseeability, user error, degree of exposure, and threat to future generations.

Needed in this area are assessments of construct validity of these variables. One can imagine several problems. For example, one may "control" risk by several means: avoidance, abstinence, or the use of a safeguard. Furthermore, to control risk by avoidance or abstinence implies that exposure to the risk is to some extent voluntary, leading to the question of whether the regressor variables are indeed independent constructs. As another example, severity of consequences has been operationally measured as the likelihood of fatality. It is unlikely that this mono-dimensional measure is appropriate for such stimuli as food preservatives, cosmetics and caffeine. Variables suggested as determinants of perceived risk and acceptability need to be better conceptualized and operationalized in order to be used and interpreted with any degree of confidence.

Methodological Issues Relative to Behavioral Research on Risk

The domain, while having been approached in many well-conceived and interesting ways, appears to have lacked the structural guidance of a systematic program of research, particularly in marketing. Furthermore, developing valid operationalizations and measures of the underlying constructs of risk represents a considerable challenge. This section discusses methodological issues that contribute

to that challenge. (While these methodological issues are not unique to this domain, they have nonetheless impeded progress in this area).

1. Representations of Risk Perception

Representations of risk perceptions may take several forms, for example spatial models such as ordinal multi-dimensional scaling and principal-components factor analysis, and tree models. ***Factor-analytic representations*** are useful because many of the qualitative risk characteristics are correlated with each other. Investigation of these interrelationships by means of factor analysis has shown that the broader domain of characteristics can be condensed to two or three higher-order characteristics or factors. ***Multi-dimensional scaling*** is an alternative approach of having people rate the similarity of product choices with regard to risk and constructing a dimensional representation of the similarity space. ***Tree representations*** exhibit a distinct hierarchy of clusters which can be interpreted in terms of common and unique features of product risks.

Just as there are different representations of risks, there are several means of data collection to construct these representations. For example, subjects might be asked to make similarity judgments, conditional predictions, or dimensional evaluations. Although all three tasks provide judgmental data about the proximity between risks, the tasks differ from each other in several important ways. First, similarity judgments and conditional predictions are both explicitly comparative. In contrast, dimensional evaluation is noncomparative. Second, the dimensional evaluation measure is compositional in that the overall proximity between risks is defined by the correlation between their ratings. Judgments of similarity and conditional predictions are holistic in that subjects are free to identify, weigh, and combine features as they see fit. Similarity, however, is based on a subjective criterion of corre-

spondence, that can be idiosyncratically defined by the respondent, whereas prediction is defined with respect to an objective standard -- for example, the number of fatalities. Thus, the evaluation task restricts judgment to a fixed set of global dimensions, combining them according to a well-defined rule, whereas the comparative tasks to not constrain either the set of attributes or the composition rule.

Johnson and Tversky (1984) argue that the particular risk assessment task may tap different aspects of people's knowledge about risk and therefore call for different formal representations. Thus, the nature of the task will at least partly determine the compatibility among the data sets and the correspondence between data and models, and needs to be explicitly considered when designing an empirical test. They empirically investigated the perceived relations among prevalent causes of death using three different types of data: judgments of similarity, conditional predictions, and ratings of risks on evaluative dimensions. These data were then used to compare the three classes of representations discussed above.

Johnson & Tversky found that the comparative tasks (similarity judgments and conditional predictions) tended to agree with each other ($r = .76$) , but judged the agreement between these data and the dimensional evaluations to be rather low ($r = .36$ for similarity and $r = .42$ for prediction). Furthermore, the comparative tasks were better described in terms of discrete feature models, whereas the evaluation data were better accounted for by multidimensional scaling and factor analysis. Diagnostic properties that were used to make that conclusion included (1) a subjective assessment of interpretability, (2) traditional criteria of goodness of fit, and (3) several more specific, technical criteria whose description are beyond the scope of this review, but whose results were consistent with (1) and (2).

It is useful, then, to consider the strengths and weaknesses of the various tasks and to consider their relevance to the study of risk perception. The dimensional evaluation has several advantages. First, it is easy to use with even a large set of stimuli, for example, Slovic's (1980) study of 90 stimuli. Second, it is a structured task that focuses subjects' attention and reduces the impact of irrelevant considerations. However, the scales are typically confined to global dimensions that apply to all risks; subjects may thus overlook features that apply only to a subset of stimuli.

Comparative tasks provide a more direct measure of the proximity between risks in which the identification and the weighting of the relevant attributes are performed by the subject. As such, the subject is not constrained by the scales selected by the investigator, but the judgments are susceptible to various effects that may or may not be relevant to the study of risk.

2. The Psychometric Paradigm

Cognitive psychology forms the conceptual foundation for research in risk perception. Methodologically, psychophysical scaling methods and multivariate analysis have been used to produce empirical measures of risk attitudes and perceptions (Slovic et al. 1982). (See, for examples, Slovic, Fischoff and Lichtenstein 1984, p. 187). In this psychometric paradigm, researchers in the behavioral decision sciences have typically asked people to judge the current and/or desired riskiness (or safety) of sets of hazardous activities, substances, and technologies, and to indicate their desires for risk reduction and regulation of these hazards. These judgments have then been related to judgments about other properties, such as the hazard's status on characteristics that have been hypothesized to account for risk perceptions and attitudes, (e.g., controllability, voluntariness), the benefits that each hazard provides

to society, the number of deaths caused by the hazard in either an average or a disastrous year, and the seriousness of such death relative to death due to other causes.

Similarly, research into the paradigm of perceived risk in marketing has focused upon direct questioning of respondents, an approach consistent with the inductive realism which characterizes much of marketing research (Anderson 1983). Assessing the public's knowledge under this cognitive psychology paradigm would seem straightforward; simply ask people for an estimate of the probability of, for example, dying of toxic shock syndrome through the use of a particular contraceptive device. Their responses could then be compared with the best available technical estimates, and deviations could be interpreted as showing the extent of the respondents' lack of knowledge of the associated risks. There are numerous constraints on this method, however; these constraints are discussed below.

a. First, the questions must address pertinent topics about which it is possible for people to have relevant information.

b. Second, the question must be clear, free of jargon, and have well-defined terms. Consider, for example, the degree of difficulty in answering a question such as the one posed by Slovic et al. (1982) in their study of 90 hazards and 18 risk characteristics. Instructions stated that "the acceptable level of risk is not the ideal risk. Ideally, the risks should be zero. The acceptable level is a level that is "good enough," where "good enough" means you think that the advantages of increases in safety are not worth the costs of reducing risk by restriction or otherwise altering the activity". Regardless of the sample used, this question is complex and involves quite abstract reasoning. Hughes (1985) points out as well that several measures of perceived risk that have been used in marketing are generally acknowledged to be amenable only with fairly sophisticated respondents within a controlled environment

such as a laboratory or classroom (e.g., Woodruff 1972; Pras and Summers 1978; Humphreys 1983).

c. Third, knowledge must be requested in a form that is compatible with people's customary way of thinking about a topic. Fischoff and MacGregor (1983) considered this issue in detail in their study of judged lethality and response modes. Their premise was that if people's mental representation of knowledge is different from the formulation requested by an interviewer, the translation necessary in both retrieving the information from memory and in expressing it would obscure their actual level of knowledge. The often used method of "convergent validation", that is, eliciting judgments in several ways and trusting only consistent patterns that emerge, they criticize for being too conservative and for not taking a position on how knowledge is mentally represented or on how best to extract it. Their goal was thus to determine people's 'core knowledge,' that knowledge that emerges however questions are posed.

Four formally equivalent response modes were used to elicit laypeople's beliefs regarding the lethality of various potential causes of death, the response modes being death rate, number of deaths, survival rate, and number of survivals. Results showed that respondents had a core of beliefs about lethality that yielded similar orderings regardless of response mode used. However, both the magnitude and the reliability of responses were sensitive to the precise response mode used, with the survival rate question producing particularly low and unstable responses.

Fischoff and MacGregor acknowledge the need for continued multi-method analysis before interpreting the responses produced with any one response mode, and do not argue that they have assured convergence via their method. Rather than having a coherent core of knowledge, people might have known different things

about death rates, survival rates, numbers died, and numbers survived. If so, "responses to four such response modes would then tell four different stories. Assessing what people know would require evoking each perspective" (p.235).

d. Differences in responses as a function of question framing must be recognized (Tversky and Kahneman 1982). As such, framing represents both a conceptual and a methodological issue. Subtle changes in the way that risks are expressed can have a major impact on perceptions and decisions. One dramatic recent example of this comes from a study by McNeil et al. (1982), who asked people to imagine that they had lung cancer and had to choose between two therapies, surgery or radiation. Then, some subjects were presented with the cumulative probabilities of surviving for varying lengths of time after the treatment. Other subjects received the same cumulative probabilities framed in terms of dying rather than surviving. Framing the statistics in terms of dying dropped the percentage of subjects choosing radiation therapy over surgery from 44% to 18%. The effect was as strong for physicians as for laypersons.

e. It is necessary to have a measure of perceived risk which would be applicable in different types of consumer research settings. One promising measure was the straightforward one presented by Jacoby and Kaplan (1972), a paper and pencil test, brief and adaptable to field research data collection projects, and containing most of the components of risk that consumers would consider. The scale was administered initially to a student sample who had been instructed regarding the nature of perceived risk (Jacoby and Kaplan 1972). A cross-validation study was successful with a different student sample (Kaplan, Szybillo and Jacoby 1974).

Brooker (1984) has raised several questions regarding their measurement procedure (although not with the measure itself). First, although the scale demonstrated

adequate criterion-related validity and some aspects of internal consistency were explored in those studies, respondents were not naive and were aware of the nature of the measure being administered. Familiarity with the concept may have allowed the students to respond to scale questions more easily than would be the case with a naive population. Second, it also might lead to unusually favorable validity estimates (Brooker cites Rosenthal and Rosnow 1969).

Grunert (1980) notes that a more reliable and valid set of measurement tools are necessary; for example, different scales to measure the intensity of risk consciousness need to be tested (he suggests magnitude scaling).

Hughes (1985) systematically explored some of these measurement and construct validity issues with respect to measures of perceived risk that would be applicable for use by marketing practitioners in conjunction with field research. The analysis examined dimensionality, reliability, discriminant and predictive ability within the context of multiple indicator latent variable models using LISREL, Version VI (Joreskog and Sorbom 1981). Results indicated that the constructs of consequences and uncertainty are not independent, but do achieve discriminant validity when analyzed via a two construct factor analysis model.

In Lehmann's (1982) comments regarding Evans' (1982) work examining the predictive performance of four models based on the dimensions of perceived risk, he noted that the reliability coefficients appeared to have been calculated across the six dimensions of risk, and that since they are supposed to be independent, the fact that they were highly related suggests either severe measurement problems or that the assumption of independence is not justified.

3. Issues of Uses of Statistical Analyses

Certainly, statistical analyses have become increasingly sophisticated, early work relying mainly on correlation analyses, with multiple regression and factor analyses now common approaches. The appropriateness of these methods needs to be assessed.

Sequential model building algorithms such as stepwise regression have been frequently used in this research stream (Jacoby and Kaplan 1972; Wendler 1983; Brooker 1984; Coughlin & O'Conner 1984; Rethans and Albaum 1981; Bechtel and Ribera 1983). Several cautions should be noted regarding their use (Myers 1986). First, they should not be viewed as a "black box" which produces one final model but rather as an exercise that allows the user to examine, evaluate and compare the performance of several models. Second, sequential procedures can be particularly ineffective with data sets involving collinearity. The existence and impact of collinearity has been essentially ignored (an exception being Brooker (1984) who acknowledged the intercorrelations between risk components), but intuitively would seem a likely contaminant in this domain. Seemingly, this empirical question should be addressed. Third, the final result in such algorithms is very much dependent on the F-values chosen for entry and exit of variables; these values and their implications have been neither reported nor discussed in the literature. Beyond the limitations of stepwise procedures, the other available criteria for model building such as cross validation and conceptual predictive criteria (e.g., Mallow's Cp statistic) have been ignored.

Residual analyses to determine the violation of model assumptions, and influence diagnostics to assess the degree to which specific data points may be influencing final results, are virtually non- existent.

4. Idiographic vs. Nomothetic Methods of Research

Idiographic research deals with behavior at the individual level, and includes such data collection methods as the analysis of letters and subjective biographical reports. Nomothetic research deals with aggregate data, and as such is more consistent with the goals of logical positivism, which views the primary aim of science as the development of universal laws. Both methods have inherent strengths and weaknesses that make them more or less appropriate in different situations.

It should be noted that most psychometric studies in perceived risk have been based on correlations among mean ratings of risk and risk characteristics across different stimuli, and as such represent nomothetic research efforts. Relationships revealed this way presumably indicate how ***society as a whole*** responds to hazards. Such relationships need not hold true at the level of ***individual respondents*** evaluating a single technology.

Objectives of the Current Research

Overview

The literature reviewed in this chapter suggests an emerging model of risk perception and acceptability. While earlier risk research has concentrated upon *identifying* the factors that contribute to *perceived* risk (Lowrance 1976, Rowe 1977), recent efforts are being directed toward *explaining* risk *acceptability* in terms of these factors (Slovic, Fischhoff, and Lichtenstein 1980; Bechtel and Ribera 1983; Rethans and Albaum 1981). While this effort has followed a logical progression, and has

been based on well-reasoned approaches, the fact remains that it has taken place in a relatively atheoretical mode. Existing theory is weak and lacking in terms of propositions and explicit hypotheses. Methodologies have been limited to non-relational, descriptive, survey research, and existing substantive knowledge is tentative. While these would be harsh criticisms in a better theoretically developed domain, such is the nature of research at the stage where perceived and acceptable risk finds itself.

One approach that has been taken in the latter three studies cited above has been a multiple regression approach to assess the differential predictive power of perceptual risk factors in accounting for the acceptability of risk. As such, regression has been used as a variable screening device to determine which independent variables explain a reasonable amount of variation in the response. While regression analysis with variable screening as the objective is an appropriate technique, its use in existing research has limitations; those limitations have been discussed in a previous section of this chapter.

Given the state of existing theory and knowledge, and the problems associated with the execution of predominant methodologies, it was decided that a valid approach was to proceed in a primarily exploratory vein in an effort to better understand the constructs of perceived risk and acceptability of risky options, both their meaning and their determinants. Thus, the primary objective in the current research was to build formal models of risk perception and risky option acceptability for products and activities that are hazardous to health and safety using a multiple linear regression modeling approach. Implicit in this primary objective is the necessity of conceptually and methodologically delineating the constructs of perceived risk and acceptability, or assessing the construct validity of the dependent variables, and of

assessing the independence of the regressor variables. Such modeling is a necessary step in the development of a theory of perceived risk and acceptability, in that it can reveal relationships that can be used for further theory development and testing. Furthermore, this research takes a more methodologically rigorous approach to multiple linear regression modeling than has been taken previously, in its use of a multitude of variable selection and model performance criteria, diagnosis of multicollinearity, and residual analysis, such that the relationships that are revealed can be accepted with increased confidence. Rather than assuming that one model can be constructed for all products, and using aggregated data across all products, models are built for individual products to look for commonalities and consistencies.

The Model

The model-building proposed is comprised of two separate stages. The first stage is to model the determinants of perceived risk, i.e., to model the variables that are antecedents to consumers' perceptions of risk. Perceived risk is an individual's subjective assessment of the probability, other than zero or 1.0, that an undesired outcome will result from choosing a behavioral option. A behavioral option in this research refers to the use of a product or the participation in an activity. In the past, respondents have been asked to make both absolute and relative judgments of perceived risk, via such tasks as rating scales, rank ordering, and estimating the frequency of occurrence of a negative consequence, that consequence being fatality (most typically). Negative consequences in the current research are not restricted to

fatality, given that fatality is an unrealistically extreme negative consequence of many of the stimuli that will be used.

The second stage is to model the determinants of acceptability, i.e., to model the variables that are antecedents to consumers' judgments about the acceptability of behavioral options that entail risk. Acceptability is an individual's cognitive judgment of the overall attractiveness of a behavioral option. It was assumed that acceptability is positively correlated with behavioral intentions, and that behavioral intentions are positively correlated with eventual behavior. The model on the following page (Figure 1) presents the variables that were included in this research, and their relationships to one another.

Only variables which are conceptually consistent with the definition of perceived risk were proposed as determinants of perceived risk. That is, they are included either because they relate to an individual's assessment of the severity of an undesired outcome, or because they relate to an individual's assessment of the probability of that outcome's occurrence, or both. There have been many variables that have been suggested to relate to perceived risk and to acceptability; although, as described in a previous section, the distinction between risk perception and acceptability was not always clear. In this research, only variables which logically relate to either probability of outcome or severity of outcome were included as determinants of perceived risk (including, of course, probability and severity themselves). For example, a variable that has been suggested as a determinant of perceived risk is risk knowledge. However, knowledge should not logically relate to either probability or severity of outcome. Thus, it was excluded from the model of perceived risk, but incorporated (by way a the variable called confidence) in the model of acceptability. Furthermore, only variables which were clearly distinct con-

ceptually were included, both to reduce conceptual redundancy and to control the detrimental impact of the ensuing multicollinearity associated with two variables that mean essentially the same thing. For example, two variables which had been used in previous research, ease of reduction and risk control (Rethans and Albaum 1981), were not seen as conceptually distinct; therefore, one variable called controllability was used. Variables suggested to relate to assessments of severity of outcome include immediacy of outcome, dreadedness of outcome, and reversibility of outcome. The variable suggested to relate exclusively to the perceived probability of outcome is controllability. The variables suggested to relate to both perceived severity and perceived probability include availability of outcome and catastrophic potential of outcome.

The variables that are suggested as determinants of acceptability include perceived beneficiality, confidence, and perceived risk. As such, perceived risk becomes an independent variable in this stage of the model building. Again, other variables have also been suggested to relate to acceptability. In this research, variables were used that had strong empirical or conceptual support for their inclusion, and only those relevant to consumer products were included (for example, voluntariness was judged to be irrelevant in the context of consumer products).

For both perceived risk and acceptability, there are other variables which could also have been included; however, the judgment was made in this research to consider only this particular subset. Each of the regressor variables proposed are defined and discussed in turn below, in correspondence with the model presented in Figure 1.

Regressor Variables and Hypotheses (Perceived Risk)

Controllability:

Controllability is the degree that an individual believes that the probability of a negative consequence resulting from the use of a product or the participation in an activity can be reduced by either personal skill, diligence, or the use of a safeguard (i.e., protective device or equipment such as a bicycle helmet). Consequently, an outcome that can be controlled should be perceived as being less probable. Since an outcome that is perceived as less probable should be perceived as being less risky, an outcome that can be controlled should also be perceived as being less risky.

Controllability is an important variable as it relates to consumer risk from several perspectives. The Consumer Products Safety Commission uses controllability as a guideline to determine what constitutes "reasonable" or "acceptable" risk in their effort to protect the public against unreasonable risk of injury. Similarly, product liability laws, according to a report by an Interagency Task Force of Product Liability (1978), should balance the risks of a product with its utility, that balance in part determined by the user's ability to control danger. Implied by both the Consumer Products Safety Commission and the Interagency Task Force of Product Liability is that the more controllable a product's risks, the less risky and thus more acceptable that product is. Slovic et al. (1980) found through factor analysis that the pattern of interrcorrelations among characteristics of risk could be represented by three underlying dimensions; the one that they called "dread" loaded most highly on the characteristic controllability. (That is, there was a negative relationship between controllability and dread). Vlek and Stallen (1981), using multidimensional scaling, found controllability to be one of two factors that play a prominent role in deter-

mining risk judgments, again with a negative relationship between controllability and risk judgments. Otway and Fishbein (1976) showed that one reason for judging nuclear power as dangerous was the passivity with which the risk had to be lived with; that is, lack of control related positively to risk.

Hypothesis 1: There will be a negative correlation between perceived controllability and perceived risk and probability.

Availability:

Availability is the ease that instances or occurrences of an outcome can be brought to mind. It is a heuristic that people use when they judge an event as likely or frequent if instances of it are easy to imagine or recall (Slovic et al. 1982). As such, availability should be positively correlated with assessments of probability. Availability is affected by frequency of occurrence, and as such is an appropriate cue. Thus, objective probability influences availability, just as availability influences subjective probability. However, availability is also affected by factors unrelated to frequency of occurrence, such as vividness. As such, it can distort risk judgments. Thus, there is likely to be a positive correlation between availability and severity, although again the causal relationship is unclear. In fact, the availability bias has been demonstrated empirically (Slovic et al. 1980). Events which received inordinate media coverage, such as homocide, and events which were described as dramatic or sensational, such as venomous snake bites, tended to be overestimated. In other situations, lack of availability may cause people to underestimate risks, such that what is out of sight is out of mind. Again, Slovic et al. reported that the most underestimated items tended to be unspectacular events, such as diabetes and emphysema. As such, availability may influence an individual's assessment of the probability of an outcome, as well as its severity.

Hypothesis 2: There will be a positive correlation between judgments of availability and perceived risk, probability and severity.

Catastrophic Potential:

Catastrophic potential, sometimes called impact, is an individual's assessment of the potential for a negative consequence to affect large numbers of people, either immediately (as in the case of inhalation of so-called "second hand smoke" from cigarettes, or delayed (as in the case of the spread of disease). Catastrophic potential has consistently been found to be an important determinant of perceptions of risk; Slovic et al. (1980) found it to be one of three underlying dimensions of peoples' perceptions of risk; Vlek and Stallen (1981) found it to be one of two factors playing a prominent role in determining risk judgments. For example, like nuclear power, diagnostic X-rays produce invisible and irreversible contamination which leads to cancer and genetic damage. However, X-rays are not similarly feared. One reason for this difference may be found in the perceived catastrophic potential of nuclear power (Slovic et al. 1980). This construct may influence perceptions of both magnitude of probability and severity of outcome, in that larger numbers affected may increase an individual's assessment of the probability of suffering a negative outcome, and an outcome that affects large numbers of people may be perceived as being of greater severity. Catastrophic potential is somewhat more specifically defined in this research to mean the potential for a negative consequence to affect other people, either directly or indirectly, by an individual's use of a product. In other words, the negative consequence has the potential to affect other people beyond the individual user.

Hypothesis 3: There will be a positive correlation between perceived catastrophic potential and perceived risk, severity, and probability.

Immediacy of Effect:

Immediacy of effect is the individual's perception of the closeness in time of a behavioral option and the negative consequence associated with that option. Time preferences are known to have an effect upon the evaluation and weighing of consequences (Mischel 1974). One of those effects is that individuals prefer immediate or short-term realization of desired benefits, and delayal or long-term occurrence of undesired consequences. In Bechtel and Ribera's (1983) study regressing several risk characteristics against acceptability, immediacy of effect was one of only two variables which attained statistical significance. This characteristic was also very highly loaded upon the factor labeled by Slovic et al. (1980) as "unknown risk" discovered among a set of characteristics. The implications for judgments of risky option acceptability are that undesired consequences with delayed effects may be discounted. This construct is thus related to an individual's assessment of the magnitude of an outcome.

Hypothesis 4: There will be a positive correlation between judgments of immediacy of effect and perceived risk and severity.

Dreadedness:

Dreadedness is an individual's emotional, gut reaction of horror associated with a particular negative consequence of the use of a product or the participation in an activity. It has been suggested (Lowrance 1977) that some risks are regarded with a sort of stoic acceptance, while other risks are more deplorable and are dealt with more on the level of a gut reaction of dread. For example, while seen as unfortunate or even anguishing, the serious injury or death of a child in a bicycle accident might be able to be dealt with reasonably calmly. However, the serious injury or death of a child from flammable clothing, or death from an invisible source of radiation,

might be perceived as more dreadful. As such, dreadedness should be positively related to severity; something that is horrible is also likely to be perceived as severe. Similarly, dreadedness should also be positively correlated with perceived risk. Dreadedness was highly loaded on the factor labeled by Slovic et al. (1980) as "dread" discovered among a set of characteristics. Similarly, in Bechtel and Ribera's (1983) study dreadedness was one of two characteristics which attained statistical significance in a regression of a set of risk characteristics against judgments of risk acceptability.

Hypothesis 5: There will be a positive correlation between perceived dreadedness and perceived risk and severity.

Reversibility of Consequences:

Reversibility is an individual's belief in the potential to undo a negative consequence once it has occurred. Consequences that can be reversed, that is, that an individual does not have to live with forever, should be perceived as being less severe that those that are permanent. For example, consider a possible negative consequence of sexual activity: an unwanted pregnancy. An unwanted pregnancy might seem extremely severe to a person adverse to the idea of abortion, and fairly moderate to another person more accepting of abortion as an option. Reversibility is thus negatively related to an individual's assessment of the severity of an outcome, and negatively related to perceived risk of that option. Reversibility has not been explicitly defined in existing research; it is, however, conceptually similar to the characteristic called "reducability of risks, given the occurrence of a mishap" used by Slovic et al. (1980), which was found to load highly upon the factor they labeled "dread."

Hypothesis 6: There will be a negative correlation between perceived reversibility of consequences and perceived risk and severity.

Regressor Variables and Hypotheses (Acceptability)

Confidence:

Confidence is the degree that an individual is sure of his/her ability to assess the risks of a particular behavioral option. There is evidence that risks with which individuals are familiar will be preferred to those that are novel; well known risks that are well understood may be preferred to unfamiliar ones. Rethans and Albaum (1981) reported "risk knowledge" to be a significant determinant of societal risk acceptability in their stepwise regression analysis. Slovic et al. (1980) found in their factor analysis a factor which they named "familiarity", which was comprised of knowledge and familiarity. An individual's confidence in either their own knowledge, or the knowledge that they believe to be available from experts and/or the scientific community, should increase their judgments of the acceptability of an option that entails risk. For example, an individual may have confidence that they can assess the risks of a particular contraceptive device, but the risk of mercury poisoning from eating tainted swordfish is open to question even by scientists. Similarly, the risk of breast cancer from drinking even moderate amounts of alcohol has only recently been suggested.

While the hypothesis in this research is that confidence is positively related to acceptability, there is also an argument that the relationship could be negative. There is evidence that ambiguity or vagueness is positively related to choice, and

therefore to acceptability, when the known risk is high (Einhorn and Hogarth, 1985). Given the conceptual likeness of confidence as it is defined in this research, and ambiguity as used by Einhorn and Hogarth, it could also be argued that confidence should be negatively related to acceptability, when the risks of an option are known to be high.

Perceived Beneficiality:

Perceived beneficiality is defined as the degree to which an option is perceived to entail advantages, i.e., meets a need, performs a desired function, solves a problem, gives pleasure, or is profitable or important. Intuitively, the acceptability of a risky activity should be based on a weighing of risks against benefits; indeed, this is one of the criteria identified by an Interagency Task Force of Product Liability (1978) to justify product liability laws. From the standpoint of consumer behavior, the concept of beneficiality as it relates to perceived risk is essentially implied. That a consumer uses a potentially hazardous product or engages in a potentially hazardous activity, knowingly and voluntarily, implies that the consumer is aware of at least a subset of the associated benefits. From the standpoint of the behavioral decision sciences, beneficiality has been more explicitly recognized as one of several determinants of alternative acceptability (e.g., Vlek and Stallen 1981). In fact, these researchers argue that their empirical results strongly suggest that judgments of overall acceptability primarily depend on judgments of beneficiality, with judgments of riskiness playing a less important role. Thus, the degree to which a behavioral option is perceived as beneficial should positively influence judgments about that option's acceptability.

Summary

Although research interest in perceived risk in consumer behavior has waned over the last decade, it remains an integral aspect of consumer behavior, marketing management, and public policy. Because of the pervasiveness of risk in marketing, it must be considered as a core component in the development of marketing theory. This chapter has isolated some of the key conceptual and methodological issues that must be confronted when doing research on perceived risk in consumer behavior. While these issues indicate that breakthough research in this domain will not be easy, the establishment of a hierarchical set of research questions helps to map out the needed research program. Moreover, recent developments in risk analysis thought and research methodology offer the promise that the technology for making these breakthrough discoveries may now be available.

Examination of risk perception and acceptability in particular is important in light of Bechtel and Ribera's apt description of this domain as being "at the crossroads of marketing, consumer behavior, and environmental psychology" (1983, page 590). Efforts in better understanding this area are certainly consistent with Lowrance's concluding comments in his work *Of Acceptable Risk*, 1977):

> The effective afterword for this book will be the discussions that ensue in response to it...Reaching for a diverse readership, we have essayed broadly and in a vernacular language; these explorations need to be continued with the precise techniques and specialized languages of several intellectual disciplines.

Chapter 3

Research Design and Methodology

Overview and Review of Research Objectives

This chapter details the research design and methodology that is used to examine the determinants of perceived risk and risky option acceptability. Briefly, the purpose of the research is to build models of risk perception and option acceptability for hazardous products, activities, and technologies using several variables that have been postulated to be important, by way of a multiple linear regression model building approach. Also discussed in this chapter will be the logic and rationale, issues of validity, strengths and weaknesses of the proposed research design and methodology, and the means of data analysis to draw conclusions.

Given the state of existing theory and knowledge, a valid approach at this time is to proceed in a primarily exploratory vein in an effort to better understand the

constructs of perceived and acceptable risk, both their meaning and their determinants. Thus, the primary objective in the proposed research is to build formal models of risk perception and risky option acceptability for products, activities, and technologies that are hazardous to health and safety using a multiple linear regression modeling approach. Implicit in this primary objective is the necessity to conceptually and methodologically delineate the constructs of perceived risk and acceptability, as well as their associated regressor variables. Such modeling is a necessary step in the development of a theory of perceived and acceptable risk, in that it will reveal relationships that can be used for further theory development and testing. Furthermore, it is proposed in this research to take a deeper and more methodologically rigorous approach to multiple linear regression modeling than has been taken previously in this area of research, such that the relationships that are revealed can be accepted with increased confidence.

An important distinction should be made relative to this research as it relates to previous research in a similar vein. Prior research has begun with the assumption that a general model of perceived risk acceptability exists, and by aggregating responses across a wide variety of stimuli, has sought to discover that model. This research does not make that assumption, but rather builds individual models of perceived risk and acceptability for each distinct product, looks for commonalities across those models, and aggregates where appropriate.

Any model is no more than an abstraction of reality, to construct an environment in which a problem can be studied. Several types of models exist: analog, iconic, verbal, and mathematical. An analog model uses objects to represent reality; iconic models are scaled down versions of something in reality; verbal models are created when people use language to represent concepts (i.e., definitional models);

and mathematical models quantify concepts. This research uses verbal models in its defintions, and mathematical models to provide an unambiguous language for testing hypotheses and explicitly stating facts and relationships.

Models can also be classified by purpose (descriptive or decision models) and by technique (verbal, graphical, or mathematical). Descriptive models are designed to communicate, explain, and predict. Decision models are designed to evaluate alternative outcomes associated with different decisions and find the best solution. Verbal models classify variables and relationships in prose. Graphical models provide a visual representation of a verbal model. Mathematical models can be classified as to whether they are linear vs. non-linear, static vs. dynamic, or deterministic vs. stochastic. The multiple linear regression model building approach used in this research refers to mathematical models that are descriptive, linear, static, and deterministic.

Review of the Multiple Linear Regression Model and Its Assumptions

Regression analysis is a statistical technique for investigating and modeling the relationship between variables. Its uses span almost every discipline, and it has been credited with having become perhaps the most widely used statistical technique (Myers 1986; Montgomery and Peck 1982). At the outset, it is necessary to review the general multiple linear regression model and its assumptions.

In general, a response variable may be related to k regressors, $x_1, \ldots, x_k$ so that

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \cdots + \beta_k x_{ki} + E_i$$

$$(i = 1,2, \ldots, n; n \geq k + 1)$$

As such, the x's are variously called independent, regressor, or predictor variables. They are not random and are assumed to be measured with negligible error. The y_i is the response or dependent variable. The β coefficients are unknown constants called regression coefficients, with an important objective of regression analysis being to estimate and draw conclusions about these unknown parameters. The E term refers to statistical error, or a device that accounts for the failure of the model to fit the data precisely. E_i is assumed to be normally and independently distributed, uncorrelated from observation to observation, and with mean zero and constant variance σ^2.

The above model is a linear regression model; regression analysis involves fitting the model, or estimating the regression coefficients, to a set of data, or measurements on the regressor and response variables, using one of several estimation procedures, commonly an ordinary least squares procedure. The outcome of such analysis yields a fitted regression model which is an estimate of the functional relationship describing the data. As such, regression analysis is an iterative procedure, in which data lead to a model and a fit of the model to the data is produced. The quality of the fit is then investigated, leading either to modification of the model or the fit, or to adoption of the model.

The current research begins with an ordinary least squares estimation procedure, with the possibility of more sophisticated estimation procedures being used as necessary and appropriate.

It is necessary to consider specifically the appropriateness of a multiple linear regression approach in the present research. As discussed previously, the area of perceived and acceptable risk exists in the relative absence of any strong theoretical framework. While various factors and relationships among those factors have been proposed and empirically verified, there does not exist a unified theory of "perceived and acceptable risk". Research in these areas has been largely exploratory and empirically driven. As such, the areas of perceived and acceptable risk are among that large class of areas in the social and behavioral sciences where it is unlikely that a perfectly specified model can be built. While any regression model will be an oversimplification of "reality", the intention would be to build a model that would be a reasonable approximation that would work well in the range of data used to build it. As Myers (1986) points out: "When the sophistication of the subject matter field is not sufficient to provide a working theory, a linear and "common sense" empirical model approach can be very informative, particularly when it is used in conjunction with a set of data of reasonable quality (p. 1.7).

Formal Uses and Goals of Regression Analysis

Regression models are used for several purposes, including (1) prediction, (2) variable screening, (3) model specification (system explanation), and (4) parameter estimation. Identification of the particular goal of a piece of research is crucial, since the goal may determine either the estimation procedure or the model adopted. The goals in this research actually span (1), (2) and (3). The initial concern will be to

determine the degree of importance of each variable in explaining the variation in response. Those variables that explain a reasonable amount of variation will thus be candidates for further study; other variables will be eliminated. In addition to simply screening variables, models of perceived and acceptable risk will be postulated. The goal of prediction is relevant as well, in that models will be evaluated on their predictive capability.

A regression model does not imply a cause and effect relationship between variables, despite the fact that a strong empirical relationship may exist between two or more variables. Regression analysis can aid in confirming a cause-effect relationship, but it cannot be the sole basis of such a claim (Montgomery and Peck 1982).

The Data Base

Sample

The random sample was comprised of faculty and classified staff from a large university in the southeast. Housekeeping, physical plant, dining hall, and police staff were excluded from the sample because of a history of non-response from those groups. Random selection of subjects was made by selecting every fifth member of the full-time faculty, and every sixth member of the full-time classified staff, after having identified a random starting point between between 1 and 5 for faculty, and 1 and 6 for staff. Six hundred and eighty nine subjects were solicited to participate,

359 of those were faculty and 330 were classified staff. Subjects were compensated for their effort and time by being entered in a raffle where whey had a chance to win a cash prize of $100, $75, or $50.

Pre-test samples included undergraduate marketing students, doctoral students, and faculty from that same university, and undergraduate economics students from a small liberal arts institution in the southeast. Those samples are described in more detail in a subsequent section detailing pre-test procedures and results. Despite Ferber's well known criticism (1977) of the use of student samples in marketing research because of the inadequacy of generalizing the research results to other populations, such a sample is appropriate in the current research for pre-testing. Most important, the sample selected for a study should be such that the tasks required to be performed have relevance to the subjects (Ferber 1977). The stimuli used, including such things as sexual behavior, sexually transmissable diseases, bicycle safety, and sun exposure are certainly relevant to the average college student. Second, theory testing requires that subjects be relatively homogeneous on nontheoretical variables (Calder, Phillips and Tybout 1981), in order to minimize individual differences that would dilute the power of the test. In this case, students are assumed to be relatively homogeneous on variables that are not of interest in this research. Third, in similar research Bechtel and Ribera (1983) reported correlations of between .90 and .97 of results between students, business professionals and women of the League of Women Voters. Finally, the analyses that were done on pre-test data and final data yielded virtually identical results. For example, values of coefficient alpha did not differ between the pre-test groups and the final sample, leading to the conclusion that the student samples were appropriate.

An adequate sample size is critical; when the sample size is too small, adequate measures of error cannot be computed and there can be no basis for checking model assumptions. Traditional analyses of power are not relevant in the context of multiple regression model-building, due to the interdependent nature of the regressor variables. Based on what is conventional in research of this type, a sample size greater than one hundred is considered appropriate. The sample of 348 in this research (a 51% response rate) was thus ample. Furthermore, there was an ample number to allow for separate analyses of faculty and classified staff.

Response, or Dependent, Variables

Considered in this research are two dependent, or response, variables: the acceptability of an option that entails risk, and the perception of the risk of that option. *Perceived risk* is defined as an individual's subjective feeling that there is some probability that an undesirable outcome will result from choosing a behavioral option. *Acceptability* is defined as an individual's judgment of the relative attractiveness of an option. It is assumed that acceptability is postively correlated with behavioral intentions, and that behavioral intentions are positively correlated with eventual behavior.

Independent, or Regressor, Variables and Hypothesized Relationships

Only variables which are clearly conceptually consistent with the definition of perceived risk are proposed as determinants of perceived risk. That is, they are in-

cluded either because they relate to an individual's assessment of the severity of an undesired outcome, or because they relate to an individual's assessment of the probability of that outcome's occurrence, or both. Variables suggested to relate to assessments of severity of outcome include immediacy of outcome, dreadedness of outcome, and reversibility of outcome. The variable suggested to relate exclusively to the perceived probability of outcome is controllability. The variables suggested to relate to both perceived severity and perceived probability include availability of outcome and catastrophic potential of outcome. Probability of outcome and severity of outcome were, of course, included as regressor variables as well.

The variables that are suggested as determinants of acceptability include perceived beneficiality, confidence, and perceived risk. As such, perceived risk becomes an independent variable in this stage of the model building. To briefly review the model discussed at the end of the previous chapter, what follows are the conceptual definitions for each of the regressor variables, and the direction of the hypothesized relationship to the response variable. The implicit hypothesis in each case is that the variable will be included in the models built.

Controllability: Controllability is the degree that an individual believes that the probability of a negative consequence can be reduced by either personal skill, diligence, or the use of a safeguard.

Hypothesis 1: There will be a negative correlation between perceived controllability and perceived risk and probability.

Availability: Availability is the ease with which instances or occurrences of an outcome can be brought to mind.

Hypothesis 2: There will be a positive correlation between judgments of availability and perceived risk, probability and severity.

Catastrophic Potential: Catastrophic Potential is an individual's assessment of the potential for a negative consequence to affect large numbers of people beyond the individual user, either directly or indirectly, and either immediately or delayed.

Hypothesis 3: There will be a positive correlation between perceived catastrophic potential and perceived risk, severity, and probability.

Immediacy of Effect: Immediacy of Effect is the extent that an individual believes the outcome of a chosen option to occur temporally close to the behavior that caused that outcome.

Hypothesis 4: There will be a positive correlation between judgments of immediacy of effect and perceived risk and severity.

Dreadedness: Dreadedness is an individual's emotional, gut reaction of horror associated with a particular negative consequence.

Hypothesis 5: There will be a positive correlation between perceived dreadedness and perceived risk and severity.

Reversibility of Consequences: Reversibility of Consequences is an individual's belief in the potential to undo a negative consequence once it has occurred.

Hypothesis 6: There will be a negative correlation between perceived reversibility of consequences and perceived risk and severity.

Confidence: Confidence is the degree that an individual is sure of his/her ability to assess the risks of a particular behavioral option.

Hypothesis 7: There will be a positive correlation between confidence and judgments of option acceptability.

Perceived Beneficiality: Beneficiality is the degree to which an option is perceived to entail advantages, i.e., meets a need, performs a desired function, solves a problem, gives pleasure, or is profitable or important.

Hypothesis 8: There will be a positive correlation between perceived beneficiality and judgments of option acceptability. and judged risky option acceptability.

Model Over- and Under-specification

Critical to a regression analysis is model specification; a regression model is over- or underspecified when there are either too many or too few, respectively, regressor variables. Myers (1986) has referred to underspecification, which may result in poor estimates of the regression coefficients and poor predictions, as "Perhaps the most serious limitation in a regression data set" (p. 27). In an underspecified model, the s^2 is biased upward, with the magnitude of the bias depending in large part on the contribution of the coefficients of the omitted variables. On the average, if a model is badly underspecified, one expects s^2 to be inflated. Underspecification may arise because of lack of awareness of all the relevant regressors, or limitation in the data gathering process which prevent them from being measured. Overspecification of the model, on the other hand, inflates the standard error of the predicted values, and dilutes the power of the analysis. As such, a "proper" model may be one that represents a compromise between a biased model and a model with heavy variance. Techniques for assessing the impact of under- and overfitting a model will be discussed in a subsequent section; for now, it is important simply to note the care that must be taken in specifying the regressor variables to include any and all that have have a strong conceptual and/or empirical base, within the very realistic constraints precluding that possibility that are a part of any research effort. Variables

that are measured and found later not to be important can be omitted from the model; however, variables that are not measured cannot be added after the fact.

Range of the Regressor Variables and Selection of Stimuli

It is important to consider the range of the regressor variables in the data, in that the model built and conclusions drawn are data specific, and as such influence the inferences that can be made. The regression model is only valid over the range of regressors in the original data. Thus, stimuli were selected such that high, medium and low levels of each construct would be represented using the shortest possible list of products (in the interest of keeping the task as short as possible, given the large number of constructs being measured).

Stimuli used in past empirical work was used as a guide. What has typically been done is to have respondents rate a large number of stimuli (from 30 to 90) on a collection of variables; data were then aggregated across products and one analysis was done. This research differs from past research in that data were not aggregated across stimuli; rather, each stimulus was considered as unique at the outset, and aggregated with other stimuli as commonalities across models were discovered. The final list of stimuli used included monosodium glutamate, aerosol cans, bicycles, cigarettes, hair dryers, sun-tanning beds, aspirin, and a high cholesterol diet. The process of stimuli selection, both for the final data collection and for pre-test purposes, is described further in the next section detailing pre-test procedures and results.

Operationalization: Measure and Survey Development, Pretest Procedures and Results

Introduction and Overview

This section addresses the issue of developing reliable and valid measures for the constructs developed in the previous chapter and reviewed in the preceding few pages, and focuses on: 1) item generation; 2) selection of stimuli; 3) pretest administration and analyses; and 4) conclusions drawn from the pretest and how the final survey reflects those conclusions.

The underlying assumption throughout the pretesting stage was that the assessment of construct validity and the development of better measures would be two of the significant contributions of this research. With that assumption in mind, the procedure for measure development deliberately followed the framework for developing better measures of marketing constructs proposed by Churchill (1979). That framework suggests an eight step procedure: 1) specify the domain of the construct; 2) generate a sample of items; 3) collect data; 4) purify measure; 5) collect data; 6) assess reliability; 7) assess validity; and 8) develop norms. The following discussion describing measure development is consistent with this procedure.

Churchill's procedure is dependent on the use of multiple-item measures. Given the number of constructs that needed to be measured, single-item scales were considered. However, multi-item scales were preferred in order to increase and assess

reliability, and to be able to make more precise distinctions among individuals than can be obtained with single-item measures.

Procedure for Measure Development

The first step was to review the existing literature in risk perception and acceptability in which the constructs were used. Routinely, single-item semantic differential scales have been used to assess the independent variables and acceptability. Perceived risk has also been measured using rank ordering of stimuli and the assignment of numerical risk values. For the reasons cited above, single-item scales were judged to be inadequate. Furthermore, several existing measures needed to be rewritten in order to make them more congruous with their conceptual definitions in this research. Existing measures served as an initial starting point for subsequent measure development. Those measures, i.e., items, appear in Appendix A. While existing measures served as the starting point for development, scales needed to be constructed for the following constructs: availability, immediacy, dread, catastrophic potential, reversibility, controllability, severity and probability of outcome, perceived risk, confidence, and perceived beneficiality.

The next step was to generate a sample of items for each construct, based on existing measures, key words found in the literature, the dictionary and thesaurus as sources of synonyms and antonyms, and judgment. An initial set of items, ranging from three to five for each construct, of the semantic differential type, was generated. Each item used a slightly different vocabulary and incorporated slightly different subtleties of meaning. These items appear in Appendix B.

At this stage the focus was on assessment of content and construct validity. As a sort of "crude", qualitative assessment of content and construct validity, four people unfamiliar with the research were asked to do a Q-sort procedure. Specifically, they were given the items, each one appearing on a separate sheet of paper, and instructed to sort the items into as many groups as they felt were necessary, such that the items within each group were similar to one another. In addition they were asked to label each of the groups with a word or phrase describing each. Based on the results of this exercise, the item pool was edited and further refined.

The next step was to introduce some variety into the response format of each item. Specifically, some items were rewritten, as appropriate, as Likert agree/disagree scales, and/or as percentage scales. Several iterations of the items were made at this stage, each time trying to be more precise and less ambiguous.

Once a pool of items existed that exhibited reasonable face validity, the items were assembled into a coherent survey, with instructions, examples, and transitions, and a cover letter was drafted. That survey appears in Appendix C.

First Pretest

Seven products were chosen to be used in the first data-collection stage. At this stage in the pretesting, measure development was of paramount importance, and a short list of stimuli representing a variety of products and activities was used. Because subjects would be asked to make evaluations about the negative consequence associated with each stimulus, a negative consequence was provided for them to focus on. Although other negative consequences in addition to the one provided exist,

and could and undoubtedly do enter into judgments of risk and acceptability, it was felt that the provision of one "typical" negative consequence upon which to focus was preferable to letting subjects respond to the variety of negative consequences that might come to mind. Those stimuli (and the associated negative consequences) included sun-tanning beds (skin cancer), bicycles (head injury), homosexual activity (AIDS), heterosexual activity (unwanted pregnancy), downhill skiing (broken leg), cigarette smoking (lung cancer), and high cholesterol diet (heart disease). The survey was pretested in March, 1988 using a sample of 29 students in a required senior level marketing class, who were compensated for their participation with extra-credit points. Students were given the survey on a Friday afternoon and asked to return it by five o'clock the following Monday. In addition to filling out the survey itself, they were asked to keep record of their completion time, and to comment, criticize, or make suggestions on individual questions, format, layout, and the cover letter. Given these extra instructions, their completion times would tend to be inflated over what would be necessary to simply complete the survey; average completion time was 36 minutes. In general, students were very willing to make suggestions, in several cases citing what they had learned in their marketing research classes, and even attaching separate pages with suggestions and comments. Feedback from these respondents was content analyzed, and incorporated into the next iteration of the survey.

The first analysis that was made of the data collected at this stage was inter-item correlations, in that if the items were indeed drawn from the domain of a single construct, responses to those items should be highly intercorrelated. Low inter-item correlations would indicate that some items are not drawn from the appropriate domain and are producing error and unreliability. The next analysis was to assess the

internal consistency of the set of items by calculating the value of coefficient alpha, which indicates how well the sample of items captures the construct. Churchill (1979) recommends that coefficient alpha absolutely be the first measure calculated to assess the quality of an instrument. Coefficient alphas by product, and average coefficient alphas, are presented in Table 3. For early stages of basic research, Nunnally (1967, p. 226) suggests reliabilities of .50 to .60 as adequate, and that increasing the coeffficient beyond .80 is probably wasteful. (It should be noted that in 1978 Nunnally changed that criteria, without explanation, to .70, p. 245). Given the earlier criteria, all constructs other than availability and dread crossed this threshold of acceptability. Furthermore, the value of coefficient alpha is affected by the number of items in the scale (the scale referring to the collection of individual items relating to a particular construct). Therefore, the three or four items per scale used in this survey would tend to yield relatively lower values of coefficient alpha. It was also discovered in this analysis that a lack of variability in certain responses was contributing to extremely low inter-item correlations and values of coefficient alpha. For example, there was almost no variability in the response to the severity and reversibility of the AIDS virus. Nonetheless, it was decided that additional effort be directed towards increasing scale reliability, given Nunnally's revised criteria (1978, p. 245), and the importance of this step on measure development.

In addition, item and scale means for each product were calculated. Specifically, scales were created by adding the values for each individual item together, and dividing by the number of items for that construct. Linear transformations were made such that items with values of 0 - 100 were transformed into scales of 0 to 7 by multiplying the item value by 0.07, making comparisons between items more easily interpreted. The final list of stimuli to be used would require that high, me-

dium, and low levels of each construct be represented. Item and scale means provided an initial starting point for selection of stimuli. Construct scale means for this first pre-test appear in Table 4, although some caution must be used in interpreting scale values for those scales exhibiting low inter-item reliabilities.

Given input from respondents, interitem correlations, and coefficient alphas, several modifications to the survey were made. First, the cover letter was rewritten to be shorter, less formal and less technical; several comments had been made that the letter seemed too academic and even intimidating. Second, the agree/ disagree scale was reversed to be more intuitive (1 signifying disagreement, and 7 signifying agreement). Similarly, several of the semantic differential anchors were reworded and/or reversed as well. Items which produced low correlations, and/or produced a substantial or sudden drop in the value of coefficient alpha, were either rewritten or deleted.

Second Pretest

The next version of the survey, which appears in Appendix D, included several stimuli from the first pre-test (two were eliminated based on comments that they were difficult and/or confusing), and several new ones, for a total of 13 products. New stimuli (and associated negative consequence) included monosodium glutamate (headache), canned tuna (mercury poisoning), Sushi (salmonella poisoning), city drinking water (parasitic infection), aspirin (stomach bleeding/ulcer), hair dryers (electric shock) cosmetics (skin irritation), and blood transfusions (AIDS). Stimuli were selected in an effort to adequately represent high, medium, and low levels of

each construct. Data from the Consumer Products Safety Commission and the NIESS (National Institute of Engineering Safety Standards) provided information on severity of outcome and frequency of injury (most closely aligned with probability of occurrence); decisions on representation of other constructs was based on judgment.

This survey was then pretested on another group of 76 students, this time from two different required senior-level marketing classes. Administration, instructions and compensation for participation were the same for this second data collection, with the exception that respondents were not specifically asked to make comments. Completion time would thus more accurately reflect the time necessary to complete the survey; average completion time was 40 minutes.

Again, coefficient alphas were calculated for each product, and averaged across products. These results appear in Table 5. In summary, at this juncture all of the constructs crossed Nunnally's (1967) threshold of acceptability of .50 - .60. Six of the twelve constructs exhibited average coefficient alphas of .7 or above (ranging from .70 to .88): immediacy, severity and probability of outcome, and acceptability, beneficiality, and perceived risk of the product. Five constructs exhibited average coefficient alphas within the range of .60 to .69: availability, catastrophic potential, reversability, controllability, and confidence. The construct dreadedness had an average coefficient alpha of .55 (up from .40 on the prior pre-test). Alpha coeffecients from the first pre-test were also compared to those of the second as an indicator of test-retest reliability. Those constructs whose items were either unchanged or changed very slightly demonstrated fairly stable alpha coefficients.

Again, scale means for each product were calculated and appear in Table 6. The same caution noted earlier regarding confidence in the meaningfulness of scale

values applies; however, at this point only the dreadedness construct was problemmatic.

At this juncture, several efforts were again made to restructure the items, trying again to appropriately delineate the constructs and eliminate possible distortions. Two debriefing sessions were held during which respondents discussed difficulties with interpreting certain items and difficulties with the response format. Several refinements were made and a new survey was tested on a group of three graduate students (two from education and one from engineering) who were unfamiliar with the research. After having filled out the survey, a small focus group was conducted at which time a detailed item-by- item discussion took place, and several inconsistencies in interpretation were revealed. Based on results of the second pre-test and the focus group discussion, a revised survey was developed, and appears in Appendix E.

Third Pretest

Respondents for the third pre-test included a group of students from a small, private, liberal-arts institution in the Southeast, and several graduate students and faculty in marketing and management at Virginia Tech, for a total of 32 respondents. The former group were compensated with extra credit points for their participation, and the surveys were completed in the presence of the researcher. Graduate students and faculty were asked to fill out the survey "within the next few days".

The stimuli list for this pretest included three stimuli that had been used previously, monosodium glutamate, city drinking water, and cigarettes, (to look at test-

retest reliability), and three new stimuli, phosphate detergents (water pollution), styrofoam (depletion of earth's protective ozone layer), and walkmen (hearing loss), chosen specifically to represent levels of particular constructs which had been found not to have been represented in prior tests. Similar analyses were done on this data set. Standardized coefficient alphas appear in Table 7, where it can be seen that only one construct (confidence) remained somewhat problemmatic at .58, but that relatively low value was influenced by fairly low values on two products. Final fine-tuning of particular items was thus necessary. Once again, several respondents were interviewed as a means of gaining insight into possible sources of misinterpretation or ambiguity.

Scale means for each construct by product appear in Table 8. A final set of products is given in Table 9, along with scale means for each construct. This list of eight products represents the shortest possible list of products (in the interest of keeping the task as short as possible) that adequately represents high, medium, and low levels of each construct. The final stimuli list included one change from this list; aerosol cans replaced syrofoam (the negative consequence remained the same), in that it was felt that subjects would be more aware of the effect of aerosol cans on the earth's ozone layer than they would be of styrofoam's similar effect.

The preceding process succeeded in generating a survey that had reasonable content, or face, validity and reliability. That is, it produced an internally consistent or internally homogeneous set of items for each construct. Given that internal consistency is a necessary condition for construct validity, further procedures to assess construct validity would have been premature without first having established internal consistency. Results from the third pretest supported internal consistency,

and the next analyses were directed towards assessing convergent, discriminant, and nomological validity.

In this research, construct measurement was not done with distinctly different methods; thus, it was impossible to assess convergent validity by looking for evidence that a measure correlated highly with other methods designed to measure the same construct. Measures did, however, take slightly different forms, with each scale using a combination of semantic differential, Likert agree/disagree, and percentage scales (a variant of magnitude scaling). Thus, it is reasonable to use values of coefficient alpha as a sort of proxy for a strict multi-method assessment of convergent validity. As discussed previously, values of coefficient alpha were consistently high (see Tables 3, 5 and 7).

Discriminant validity is the extent to which a measure is unique, and not simply a reflection of some other variable. Thus, scales that correlate too highly may be measuring the same rather than different constructs. As an initial assessment of discriminant validity, correlations between scale items for all six stimuli was calculated; these values appear in Table 10. These correlational tables were examined for consistently high correlations between scales. As would be expected given the current definition of perceived risk, correlations were consistently high between perceived risk and severity of outcome, and perceived risk and probability of outcome. Similarly, the expectation of a high correlation between acceptability and beneficiality was confirmed. More problemmatic, though, was the consistently high correlation found between severity of outcome and dreadedness, leading to the suspicion that the two measures were indeed measuring the same construct. To examine the discriminant validity between the two constructs in greater detail, inter-item correlations were calculated. Inter-item correlations that were higher within

constucts than between constructs would be taken as evidence of discriminant validity. Examination of those values did support discriminant validity between those two measures. Average inter-item correlations are presented in Table 11. The same analysis was done for the variables dread and perceived risk, and they too were found to be distinct constructs.

Nomological validity refers to the degree to which a measure behaves as expected in relation to other measures. Again, scale correlations provide some evidence of nomological validity, specifically, by looking at the direction and magnitude of those correlations. In general, the measures showed themselves to be "well behaved", with correlations consistent with the relationships hypothesized in the model. One exception was the relationship between immediacy and perceived risk. A consistent positive correlation between the two constructs was not found, as expected. However, on examination of the stimuli used in this pre-test, it was found that none of the products whose effect was immediate was very severe or very probable. This probable interaction (i.e., although it was likely on superficial examination, it was not formally tested) between immediacy, severity and probability was causing a lack of nomological validity in this particular stimuli set. This finding underscored the importance of developing a stimuli set that not only represented all levels of each construct, but also represented a wide variety of interactions between them.

Final Survey

The final survey, which reflects the information and knowledge gained in the first three pretests, appears in Appendix F. Consideration was given to using a balanced

incomplete block design such that each subject would receive one of several forms of the survey, each form including only a subset of the total number of questions, in the interest of shortening the task. However, such a design would only have shortened the task by approximately 25%. Given the associated drawbacks, such as the requirement that all forms of the survey be returned in equal proportions, it was decided to have each subject respond to the entire survey. The estimated completion time for the survey was 30 minutes.

Consideration was also given to developing different versions of the survey wherein the order of the questions would be varied, in the interest of controlling for respondent fatigue and its accompanying error in questions in the latter portion of the survey. However, to minimize the complexity of the task by keeping questions of similar response format together, one form was used for all subjects. To be assured that questions in the latter part of the survey were not causing significant error, coefficient alphas were examined to see if they increased when those items were eliminated. They did not, and thus there was no reason to think that the length of the survey was problemmatic.

Data Collection Procedure

On May 9, 1988, an introductory letter describing the purpose of the research and requesting their participation upon receipt of the survey was mailed to all respondents. That letter of introduction appears in Table 12. On May 12 and 13 the survey was mailed to faculty and staff, respectively. Again, a cover letter briefly reminding them about the nature and purpose of the research was included. That

Table 3. Standardized Coefficient Alphas (Pre-test 1)

	Product							
Construct	A	B	C	D	E	F	G	Avg.
Availability	.44	.64	.02	.56	.42	.47	.69	.49
Immediacy	65	.71	.83	.79	.75	.55	.70	.71
Dread	.45	.53	.54	.17	.42	.43	.25	.40
Catastrophic Potential	.41	.52	.66	.77	.64	.84	.70	.65
Controllability	.77	.74	.83	.73	.73	.75	.80	.76
Reversibility	.84	.59	.18	.74	.50	.81	.77	.63
Severity	.60	.60	-.04	.86	.43	.70	.74	.56
Probability	.85	.91	.93	.92	.87	.82	.88	.88
Perceived Risk	.80	.60	.82	.76	.82	.59	.76	.74
Acceptability	.93	.81	.96	.77	.95	.97	.90	.90
Confidence	.33	.51	.69	.67	.54	.31	.50	.51

Product Key

A: Sun-tanning beds
B: Bicycles
C: Homosexual activity
D: Heterosexual activity
E: Downhill skiing
F: Cigarette smoking
G: High cholesterol diet

Table 4. Construct Scale Means by Product (Pre-test 1)

	Product						
Construct	A	B	C	D	E	F	G
Availability	4.15	4.38	2.02	2.67	3.38	2.01	3.02
Immediacy	5.27	1.98	4.36	3.51	2.00	5.74	5.35
Dread	4.45	5.30	1.79	3.66	4.94	2.91	3.66
Catastrophic Potential	1.84	1.89	4.75	3.61	1.99	3.87	2.26
Controllability	3.64	5.07	3.49	5.44	3.93	2.20	3.72
Reversibility	4.40	2.59	6.70	3.26	2.56	5.64	4.80
Severity	5.09	3.89	6.69	4.90	3.90	6.35	5.95
Probability	3.35	2.05	5.52	3.39	2.56	5.41	4.94
Perceived Risk	3.73	2.21	6.47	4.34	3.14	6.23	5.51
Acceptability	4.21	2.23	6.87	1.52	2.64	6.14	4.96
Confidence	3.94	4.27	5.24	5.31	4.02	5.40	5.02

Product Key

A: Sun-tanning beds
B: Bicycles
C: Homosexual activity
D: Heterosexual activity
E: Downhill skiing
F: Cigarette smoking
G: High cholesterol diet

Table 5. Standardized Coefficient Alphas (Pre-test 2)

	Product													
Construct	A	B	C	D	E	F	G	H	I	J	K	L	M	Avg.
Availability	.75	.71	.60	.46	.57	.60	.66	.67	.65	.52	.51	.46	.60	.60
Immediacy	.74	.63	.66	.71	.56	.63	.72	.81	.73	.79	.75	.49	.78	.69
Dread	.44	.64	.63	.45	.43	.62	.63	.64	.60	.63	.52	.56	.30	.55
Catastrophic Potential	.59	.67	.62	.67	.61	.64	.55	.72	.55	.62	.85	.84	.75	.67
Control	.64	.54	.65	.62	.51	.65	.74	.63	.65	.71	.59	.69	.71	.64
Reversibility	.73	.73	.62	.77	.78	.72	.65	.46	.61	.67	.48	.71	.48	.65
Severity	.73	.68	.70	.68	.80	.88	.81	.80	.72	.78	.61	.67	.48	.72
Probability	.85	.87	.76	.81	.86	.80	.81	.86	.74	.76	.82	.73	.88	.81
Perceived Risk	.73	.80	.82	.79	.81	.65	.56	.81	.69	.65	.76	.75	.90	.75
Acceptability	.79	.90	.89	.90	.89	.89	.94	.94	.85	.92	.95	.87	.72	.88
Confidence	.49	.57	.54	.46	.57	.73	.71	.71	.68	.68	.69	.71	.73	.65
Beneficiality	.79	.66	.84	.80	.65	.80	.81	.80	.86	.73	.72	.71	.78	.77

Product Key

A: Monosodium Glutamate
B: Sushi
C: Municipal Drinking Water
D: Canned Tuna
E: Aspirin
F: Hair Dryer
G: Cosmetics
H: Sun-tanning Beds
I: Bicycles
J: Downhill Skis
K: Cigarettes
L: High-cholesterol Diet
M: Blood Transfusions

Table 6. Scale Means for Each Construct by Product (Pre-test 2)

	Product												
Construct	A	B	C	D	E	F	G	H	I	J	K	L	M
Availability	3.32	3.17	3.25	2.60	3.57	3.91	4.14	5.60	4.30	4.93	6.44	5.98	5.80
Immediacy	5.03	4.51	3.99	4.25	3.25	6.62	4.93	2.09	6.30	6.33	1.84	1.89	3.29
Dread	1.82	3.33	3.40	3.41	3.25	3.60	2.25	4.85	3.52	3.42	5.75	5.52	6.35
Catastrophic Potential	2.81	3.30	5.71	4.00	2.84	1.65	2.43	3.04	1.94	2.08	4.82	3.87	3.49
Control	3.18	3.12	2.82	2.74	3.58	5.35	4.40	3.22	4.66	4.04	2.67	3.66	2.81
Reversibility	6.24	4.97	5.25	4.58	3.93	3.84	5.82	1.72	3.65	4.73	1.02	1.73	.59
Severity	2.04	4.23	4.26	4.58	4.50	4.97	2.48	5.98	4.87	4.28	6.67	6.52	6.89
Probability	2.35	2.14	1.91	1.63	2.45	1.57	2.29	4.35	2.52	2.84	5.51	5.27	2.90
Perceived Risk	2.01	2.68	2.29	2.11	2.42	1.87	1.91	4.97	2.86	3.35	6.20	5.94	4.48
Acceptability	3.00	2.34	4.92	4.93	5.13	5.51	4.82	3.16	5.98	5.72	1.87	2.29	2.17
Confidence	3.31	3.09	3.15	2.99	3.87	4.73	3.93	4.56	4.18	4.26	5.60	5.34	4.16
Beneficiality	3.30	2.94	5.87	4.32	5.45	5.33	5.08	3.32	5.60	5.22	2.05	1.96	5.84

Product Key

A: Monosodium Glutamate
B: Sushi
C: Municipal Drinking Water
D: Canned Tuna
E: Aspirin
F: Hair Dryer
G: Cosmetics
H: Sun-tanning Beds
I: Bicycles
J: Downhill Skis
K: Cigarettes
L: High-cholesterol Diet
M: Blood Transfusions

Table 7. Standardized Coefficient Alphas (Pre-test 3)

	Product						
Construct	A	B	C	D	E	F	Avg.
Availability	.74	.80	.63	.60	.82	.89	.75
Immediacy	.62	.61	.52	.70	.74	.64	.64
Dread	.76	.81	.80	.78	.84	.83	.80
Catastrophic Potential	.52	.51	.57	.71	.92	.84	.68
Control	.77	.83	.68	.73	.43	.71	.70
Reversibility	.59	.70	.71	.85	.44	.34	.61
Severity	.88	.75	.74	.86	.82	.86	.82
Probability	.89	.88	.80	.83	.89	.90	.86
Perceived Risk	.80	.87	.86	.85	.70	.84	.82
Acceptability	.89	.94	.88	.90	.92	.92	.91
Confidence	.59	.67	.64	.41	.45	.68	.58
Beneficiality	.81	.71	.84	.91	.76	.83	.82

Product Key

A: Monosodium Glutamate
B: City drinking wateer
C: Styrofoam
D: Phosphate detergent
E: Cigarettes
F: Walkman

Table 8. Scale Means for Each Construct by Product (Pre-test 3)

	Product					
Construct	A	B	C	D	E	F
Availability	3.90	4.07	3.64	4.46	6.48	3.91
Immediacy	5.65	4.78	2.31	3.68	3.30	3.43
Dread	2.21	3.47	3.73	3.78	5.82	3.25
Catastrophic Potential	1.44	4.61	6.25	6.08	4.40	1.77
Control	2.90	3.44	2.11	2.26	2.02	4.94
Reversibility	6.19	5.56	1.78	3.28	1.30	2.69
Severity	2.76	4.85	5.69	5.23	6.68	4.50
Probability	3.09	2.47	3.50	3.43	5.89	2.99
Perceived Risk	2.88	3.31	3.94	3.97	6.44	3.18
Acceptability	2.77	4.20	3.10	2.81	1.87	4.70
Confidence	3.88	3.87	3.76	4.34	6.35	3.83
Beneficiality	3.03	5.72	3.55	3.41	2.24	4.81

Product Key

A: Monosodium Glutamate
B: City Drinking Water
C: Styrofoam
D: Phosphate Detergent
E: Cigarettes
F: Walkman

Table 9. Construct Scale Means for Final Product List

	Product							
Construct	A	B	C	D	E	F	G	H
Availability	3.32* 3.90**	3.64***	4.30	6.44 6.48	3.91	5.98	5.60	3.57
Immediacy	5.03 5.65	2.31	6.30	1.84 3.30	6.62	1.89	2.09	3.25
Dread	1.82 2.21	3.73	3.52	5.75 5.82	3.60	5.52	4.85	3.25
Catastrophic Potential	2.81 1.44	6.25	1.94	4.82 4.40	1.65	3.87	3.04	2.84
Control	3.18 2.90	2.11	4.66	2.67 2.02	5.35	3.66	3.22	3.58
Reversibility	6.24 6.19	1.78	3.65	1.02 1.30	3.84	1.73	1.72	3.93
Severity	2.04 2.76	5.69	4.87	6.67 6.68	4.97	6.52	5.98	4.50
Probability	2.35 3.09	3.50	2.52	5.51 5.89	1.57	5.27	4.35	2.45
Perceived Risk	2.01 2.88	3.94	2.86	6.20 6.44	1.87	5.94	4.97	2.42
Acceptability	3.00 2.77	3.16	5.98	1.87 1.87	5.51	2.29	3.16	5.13
Confidence	3.31 3.88	3.76	4.18	5.60 6.35	4.73	5.34	4.56	3.87
Beneficiality	3.30 3.03	3.55	5.60	2.05 2.24	5.33	1.96	3.32	5.45

Product Key

A: Monosodium Glutamate
B: Styrofoam
C: Bicycles
D: Cigarettes
E: Hair Dryer
F: Phosphate Detergent
G: High-cholesterol Diet
H: Sun-tanning Bed
I: Walkman
J: Aspirin

* top number is scale mean from pre-test 2
** bottom number is scale mean from pre-test 3
*** single number indicates that product was only tested once

Table 10. Scale Correlations - Pretest 3

Monosodium glutamate

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.0											
IMMED	.28	1.00										
DREAD	.13	-.02	1.00									
CATAS	-.08	-.16	.15	1.00								
SEVER	.13	-.19	.77	.34	1.00							
CONTROL	.24	.07	.15	.01	.14	1.00						
REVER	.02	.12	-.53	-.37	-.74	-.06	1.00					
PROB	.35	-.05	.31	.23	.35	.07	-.22	1.00				
RISK	.21	-.21	.51	.39	.68	.16	-.41	.65	1.00			
ACCEP	.35	.17	.03	.08	-.01	.29	-.20	-.27	-.25	1.00		
CONFI	.64	-.07	.19	-.08	.17	.47	-.12	.47	.38	.22	1.00	
BENEF	.26	-.03	.17	.05	.08	.30	-.32	.03	-.11	.74	.31	1.00

City Drinking Water

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	-.01	1.00										
DREAD	.39	.10	1.00									
CATAS	.15	-.32	.18	1.00								
SEVER	.39	-.17	.48	.49	1.00							
CONTROL	.34	.01	.15	-.07	.06	1.00						
REVER	-.23	.23	-.34	-.33	-.38	.11	1.00					
PROB	.31	-.13	.33	.19	.39	.27	-.39	1.00				
RISK	.39	-.02	.63	.30	.48	.13	-.56	.77	1.00			
ACCEP	-.29	.06	-.42	-.21	-.34	-.12	.16	-.58	-.63	1.00		
CONFI	.32	.16	-.24	-.19	-.13	.43	.06	.06	-.01	-.05	1.00	
BENEF	-.06	-.01	-.23	-.27	-.22	.06	.03	-.41	.-46	.65	.09	1.0

Styrofoam

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.10	1.00										
DREAD	.52	.29	1.00									
CATAS	.18	.14	.24	1.00								
SEVER	.56	-.01	.36	.69	1.00							
CONTROL	.12	.28	-.14	-.07	-.03	1.0						
REVER	-.08	.23	-.07	-.44	-.42	.33	1.00					
PROB	.28	-.06	.13	.46	.64	.14	-.53	1.00				
RISK	.48	.03	.25	.50	.64	.22	-.27	.69	1.00			
ACCEP	-.34	.00	-.22	.03	-.20	-.16	.04	-.30	-.42	1.00		
CONFI	.29	.03	-.00	.14	-.04	.43	.14	.16	.32	-.01	1.00	
BENEF	-.02	.05	.15	-.14	-.10	.10	.08	-.14	-.20	.59	.12	1.00

*correlations of .35 are significant at a probability level of .05 (df = 30)

Table 10 (continued)
Scale Correlations - Pretest 3

Phosphate Detergent

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.03	1.00										
DREAD	.44	-.01	1.00									
CATAS	.12	-.42	.30	1.00								
SEVER	.57	-.35	.57	.50	1.00							
CONTROL	-.09	.12	-.31	-.16	-.13	1.00						
REVER	-.18	.19	-.44	-.49	-.53	.40	1.00					
PROB	-.04	.11	.33	.24	.51	.03	-.36	1.00				
RISK	.26	-.09	.51	.39	.59	.04	-.51	.61	1.00			
ACCEP	.02	.12	.13	.03	.00	-.06	-.09	.11	-.15	1.00		
CONFI	-.19	.23	-.40	-.13	-.20	.31	.09	-.09	-.14	-.13	1.00	
BENEF	-.01	.23	.05	-.11	.01	.23	.05	.25	-.07	.69	.14	1.00

Cigarettes

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.18	1.0										
DREAD	.48	.05	1.00									
CATAS	.31	.31	.49	1.00								
SEVER	.31	-.11	.35	.24	1.00							
CONTROL	.09	.06	-.12	.01	-.08	1.00						
REVER	-.27	-.17	-.34	-.26	-.22	.06	1.00					
PROB	.43	.17	.37	.42	.19	.12	-.23	1.00				
RISK	.47	.05	.43	.41	.61	.17	-.10	.70	1.00			
ACCEP	-.58	-.08	-.33	-.36	-.45	-.31	.03	-.35	-.59	1.00		
CONFI	.37	-.13	.29	.19	.48	.04	-.21	.42	.67.	-.39	1.00	
BENEF	-.47	-.11	-.19	-.26	-.37	-.14	.31	-.12	-.36	.70	-.17	1.00

Walkman

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.59	1.00										
DREAD	.60	.22	1.00									
CATAS	.16	-.08	.31	1.00								
SEVER	.51	.24	.66	.07	1.00							
CONTROL	-.27	-.03	-.39	-.39	-.25	1.00						
REVER	-.17	-.23	-.23	.07	-.46	.18	1.00					
PROB	.64	.35	.52	.35	.52	-.30	-.25	1.00				
RISK	.62	.31	.56	.34	.44	-.34	-.20	.86	1.00			
ACCEP	.02	.14	.11	.09	.13	.12	-.11	.10	-.02	1.00		
CONFI	.60	.26	.35	-.02	.18	-.21	.09	.45	.45	.13	1.00	
BENEF	-.04	.05	.14	.00	.26	.15	-.04	.04	-.06	.73	-.01	1.00

*correlations of approximately .40 are significant at a probability level of .05

Table 11. Inter-item Correlations (Dread and Severity) - Pretest 3

	Dread 1	Dread 2	Dread 3	Severity 1	Severity 2	Severity 3
Dread 1	1.0					
Dread 2	.61	1.0				
Dread 3	.55	.59	1.0			
Severity 1	.37	.51	.32	1.0		
Severity 2	.29	.45	.36	.61	1.0	
Severity 3	.35	.43	.43	.61	.60	1.0

Average inter-item correlations:
Within Dread: .58 Within Severity: .61 Between:.39

cover letter appears in Table 13. To return the survey, they had simply to secure it closed so that the return address label was visible and return it through campus mail. No effort was made to disguise sponsorship of the study; on the contrary, both the introductory letter and the cover letter were written by the dissertation chairman, using department letterhead, describing the research as a dissertation being undertaken under his direction.

Surveys received from May 16 through May 27 were included for analysis. Of the six hundred eighty nine surveys mailed, three hundred seventy five (55%) responded within the time frame allowed (two weeks). Of those, three hundred and forty eight were judged to be usable, the others discarded because of large blocks of missing data, or evidence of carelessness or other sources of error (a total of 4%). Thus, the total usable response rate was 51%. Another 60 surveys (9%) were received after the deadline. The total response rate was thus 64%. Table 14 illustrates the rate at which responses were received (85% within the first week).

Summary

This chapter has detailed the research design and methodology to examine the determinants of perceived risk and risky option acceptability. It reviewed the basic approach of multiple linear regression model building; described the data base, including the sample, dependent and independent variables; hypothesized relationships; operationalization, including measure development, survey development, and pre-test procedures and results; and data collection procedures. The next chapter discusses and presents model-building techniques and analyses, and presents results.

Table 12. Letter of Introduction

Dear :[1]

The purpose of this letter is to request your help in the completion of a doctoral dissertation research project that Janet Oglethorpe, a doctoral candidate at Virginia Tech, is completing under my direction.

The overall objective of this research project is to contribute to our knowledge about how people perceive risk in products that they may purchase and use. As is well documented in the media, we are surrounded by products that may present potential risks, large and small, to our health and well being. However, very little knowledge is available concerning how people decide what products present a potential risk, and which products, despite these perceived risks, are nevertheless acceptable to them. What is known is that people, in general, have great difficulty making judgments about product risk and acceptability, and there seems to be considerable misunderstanding. Information about how people perceive product risk and acceptability will be important in the development of public policy, product design, and communications about how to minimize the potential risk associated with certain products.

Within the next few days you will receive a survey giving you an opportunity to express your opinions and attitudes about several potentially risky products. Completing the questionnaire, as promptly as possible after you receive it, willbe very helpful in assuring the accuracy and success of this dissertation research. Your name was selected at random from the list of faculty and staff at Virginia Tech. All information in the survey will be held confidential, and results of the survey will be made available to the University community when they are complete.

Finally, as a participant in this survey you will automatically be entered in a raffle where you will have a chance to win a cash prize of either $100, $75 or $50. We hope that, in addition to your interest in helping in this research project, that the opportunity to win a cash prize will provide you with some additional incentive and compensation for your valuable time.

Thank you for you willingness to help Janet complete this research project.

Sincerely,

Kent B. Monroe
Robert O. Goodykoontz Professor of Marketing
961-7016

[1] Each letter was personally addressed to the respondent

Table 13. Cover Letter

Dear :[1]

A few days ago I sent you a letter describing a research project dealing with the perceived risks of potentially hazardous consumer products. The project is being conducted by Janet Oglethorpe, a doctoral candidate in the Department of Marketing, under my direction. Your help, by filling out the attached questionnaire, will be of great value in assuring the accuracy and success of this research.

In exchange for your willingness to give some of your valuable time to help Janet complete this research project, you will be entered in a raffle where you will have a chance to win a cash prize of either $100, $75, or $50. We are expecting approximately 125 people to participate in this project, and the drawing will be held during the first week of next month.

Many of the questions on this survey will seem redundant. Please be patient with this repetition, as it is necessary in order to get accurate results. We have found that it takes approximately 30 minutes to complete the survey. Please answer each question frankly, knowing that there are no "right" or "wrong" answers; your honest and thoughtful opinion is what matters.

To return the survey, simply fold it so that the return address is showing, staple or tape it closed, and return it through campus mail. Thank you again for your willingness to participate.

Sincerely,

Kent B. Monroe
Robert O. Goodykoontz Professor of Marketing
961-7016

[1]Each letter was personally addressed to the respondent

Table 14. Receipt of Responses

Date	Responses	Cumulative Frequency
May 16, 1988	1 - 116	30.9%
May 17, 1988	117-201	53.6%
May 18, 1988	202-254	67.7%
May 19, 1988	255-285	76.0%
May 20, 1988	286-315	84.0%
May 23, 1988	316-331	88.2%
May 24, 2988	332-349	93.1%
May 25, 1988	350-360	96.0%
May 26, 1988	361-369	98.4%
May 27, 1988	370-375	100.0%
post May 27, 1988	376-436	

Chapter 4

Results and Analyses

Overview

This chapter describes the analytic procedures and the findings of this study. The analyses are done using the data base described in the previous chapter. Specifically, information from the survey described in Chapter III was coded into data files appropriate for use in either SAS or SPSSX statistical computer packages. A respondent profile is described, results of tests to assess for non-response bias are presented, and assessment of construct validity is made. Criteria used to assess multiple linear regression model building are described, and final models are identified and supported.

Respondent Profile

To provide a demographic profile of respondents, information was collected on various individual difference variables, specifically, age, sex, education, income, and occupation. As shown in Table 15, their ages ranged from 22 to 83 years, with a mean age of 40.9 (standard deviation of 9.6). Also, 46.2% of total respondents were women, 53.8% were men; 69.4% held a bachelors degree or higher; 54.9% held a masters degree or higher; and 39.5% held a doctoral degree or higher. Faculty comprised 46.8% of the respondents; classified staff, which excluded housekkeeping, physical plant, dining hall, and police staff, comprised the remaining 53.2%. Table 15 also presents the income profile, the most frequently occurring total family income category being between $40,000 and $49,999.

A separate profile was also done of the two major respondent categories: faculty and classified staff. Table 16 presents a profile of age, sex, education and income for faculty; Table 17 presents the same profile for classified staff. The profiles of the two major respondent categories are demographically quite different, although not in unexpected ways. Specifically, women make up the larger part of classified staff (65.2% vs. 24.7%); the educational profile shows 81.6% of the faculty holding at least a Ph.D. or professional degree, and the distribution of income between the two groups differs accordingly.

Assessment of Nonresponse Bias

One concern associated with mail surveys is their typically low response rate, and the concommitant possibility that nonrespondents may have responded differently enough to have altered the final results. This is of particular concern when the percentage of nonrespondents is high relative to the percentage of respondents. Given the high usable response rate in this research (55%), problems of nonresponse bias are less likely to be a major concern. However, it should not be assumed that nonrespondents do not differ from respondents.

To assess this possibility, a follow-up survey was sent to a sample of the nonrespondents. This survey was comprised of a subset of the questionnaire as a whole, introduced by a cover letter explaining its purpose. The cover letter and survey are found in Appendix G. The follow-up survey contained six questions about four products, which could be completed in approximately five minutes. Items included immediacy, perceived risk, severity, probability, beneficiality and acceptability. Products used were monosodium glutamate, bicycles, aerosol cans and cigarettes. In this way, comparisons could be made with 24 known values of the nonrespondent population. If these values did not differ between the two groups, it would be assumed that the other values would not differ either. Thirty-eight follow-up surveys were mailed during the first week of June, 1988, 20 to faculty, and 18 to staff. Of those 38, 18 were returned, 12 from faculty and 6 from staff, for a response rate of 47%.

The t′ (approximate t) test was used to test for the difference between means. This test is appropriate when the sample sizes of the two groups differ drastically.

For all 24 questions, the null hypothesis of no differences in group means could not be rejected (at a probability level of .05). Therefore, it can be concluded that no statistically significant differences exist on these known values between respondents and nonrespondents, and it will be assumed that other values would be similarly the same.

Assessment of Measurement Instrument and Construct Validity

The procedure for developing measures for the constructs used in this study followed that outlined by Churchill (1979). That procedure is described in detail in the previous chapter. Specifically, the steps of that procedure involve specifying the domain of the construct, generation of a sample of items, data collection, purification of the measure, data collection, assessment of reliability, assessment of validity, and the development of norms. Before subsequent analyses using the measures are carried out, it is necessary to repeat the last three steps of that procedure to verify the quality of the measures. Thus, the first analyses are to (1) assess the reliabilities of the measures using coefficient alpha, which is the basic statistic for determining the reliability of a measure based on internal consistency, (2) assess construct validity by examining both discriminant and nomological validity, and (3) examine the actual meaning of the scale values.

Table 15. Respondent Profile: Age, Sex, Education, Occupation, Income

Age	Frequency	Cumulative Frequency	Cumulative Percent
missing	7		
22-25	5	5	1.5
26-30	38	43	12.6
31-35	72	115	33.7
36-40	79	194	56.9
41-45	47	241	70.7
46-50	41	280	82.1
51-55	30	310	90.9
56-60	21	331	97.1
61-65	8	339	99.4
over 65	2	341	100.0

Mean Age: 40.85
Standard Deviation: 9.55

Sex	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	2			
female	160	46.2	160	46.2
male	186	53.8	346	100.0

Education	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	3			
high school	80	23.2	80	23.2
associate deg.	26	7.5	106	30.7
bachelors deg.	50	14.5	156	45.2
masters deg.	53	15.4	209	60.6
Ph.D./Prof.	113	32.8	322	93.3
post-doctoral	23	6.7	345	100.0

Occupation	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Faculty	163	46.8	163	46.8
Staff	185	53.2	348	100.0

Income	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	29			
10,000-19,999	26	8.2	26	8.2
20,000-29,999	56	17.6	82	25.7
30,000-39,999	45	14.1	127	39.8
40,000-49,999	76	23.8	203	63.6
50,000-59,999	42	13.2	245	76.8
60,000-69,999	21	6.6	266	83.4
above 70,000	53	16.6	319	100.0

Table 16. Faculty Profile: Age, Sex, Education, Income

Age	Frequency	Cumulative Frequency	Cumulative Percent
missing	3		
27 - 30	6	6	3.8
31 - 35	34	40	25.0
36 - 40	34	74	46.3
41 - 45	23	97	60.6
46 - 50	27	124	77.5
51 - 55	13	137	85.6
56 - 59	17	154	96.3
60 - 65	4	158	98.8
above 65	2	160	100.0

mean age: 43.45
standard deviation: 9.577

Sex	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	1			
female	40	24.7	40	24.7
male	122	75.3	162	100.0

Education	Frequency	Percent	Cumulative Frequency	Cumulative Percent
high school	3	1.8	3	1.8
associate	2	1.2	5	3.1
bachelors	5	3.1	10	6.1
masters	20	12.3	30	18.4
Ph.D. or prof	111	68.1	141	86.5
post doc.	22	13.5	163	100.0

Income	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	14			
10,000-19,999	1	0.7	1	0.7
20,000-29,999	14	9.4	15	10.1
30,000-39,999	11	7.4	26	17.4
40,000-49,999	34	22.8	60	40.3
50,000-59,999	26	17.4	86	57.7
60,000-69,999	16	10.7	102	68.5
above 70,000	47	31.5	149	100.0

Table 17. Classified Staff Profile: Age, Sex, Education, Income

Age	Frequency	Cumulative Frequency	Cumulative Percent
missing	4		
22 - 25	5	5	2.8
26 - 30	32	37	20.4
31 - 35	38	75	41.4
36 - 40	45	120	66.3
41 - 45	24	144	79.6
46 - 50	12	156	86.2
51 - 55	17	173	95.6
56 - 60	4	177	97.8
61 - 65	4	181	100.0

mean age: 38.56
standard deviation: 8.95

Sex	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	1			
female	120	65.2	120	65.2
male	64	34.8	184	100.0

Education	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	3			
high school	77	42.3	77	42.3
associate	24	13.2	101	55.5
bachelors	45	24.7	146	80.2
masters	33	18.1	179	98.4
Ph.D./Prof.	2	1.1	181	99.5
Post-doc	1	0.5	182	100.0

Income	Frequency	Percent	Cumulative Frequency	Cumulative Percent
missing	15			
10,000-19,999	25	14.7	25	14.7
20,000-29,999	42	24.7	67	39.4
30,000-39,999	34	20.0	101	59.4
40,000-49,999	42	24.7	143	84.1
50,000-59,999	16	9.4	159	93.5
60,000-69,999	5	2.9	164	96.5
above 70,000	6	3.5	170	100.0

Internal Consistency of Items

The internal consistency of the set of items was assessed by calculating the values of coefficient alpha, which indicates how well the sample of items captures each construct. Churchill (1979) recommends that coefficient alpha absolutely be the first measure calculated to assess the quality of the instrument. Although values of coefficient alpha were calculated on pre-test instruments, and there was no reason to believe that they would differ in the final data analysis, they are examined once again to be certain that the pre-test sample did not differ from the final sample with regard to internal consistency. For early stages of basic research, Nunnally (1967, 1978) suggests that alpha coefficients of .50 - .60, and .70, respectively, are adequate. Table 18 presents standardized coefficient alphas for each construct by product, as well as average standardized coefficient alphas. Eleven of the twelve constructs had average standardized alphas above 0.70 (immediacy was .66); only one of the individual alphas fell below 0.60 (immediacy of lung cancer from cigarettes: .55). Severity and beneficiality had alphas of .79, and probability, perceived risk and acceptability had values above .80. Internal consistency was thus judged as acceptable for basic research of this type.

Discriminant Validity

Discriminant validity is the extent to which a measure is unique, and not simply a reflection of some other variable. Thus, items that correlate too highly may be measuring the same rather than different constructs. There were several constructs

for which a consistently high correlation was seen between the items measuring them. These included dreadedness and severity, severity and perceived risk, probability and perceived risk, and acceptability and beneficiality. None of these correlations are surprising given the conceptual definitions of the constructs, and the proposed relationships among them. Nonetheless, to examine the discriminant validity between the constructs, inter- item correlations were calculated. Inter-item correlations that were higher within constructs than between them would be taken as evidence of discriminant validity. Average inter-item correlations are presented in Table 19. Using a general test for differences between correlations (Hayes & Winkler 1970), all of the four pairs of correlations were found to be significantly different from one another at a probability level of .05. The constructs were thus concluded to exhibit discriminant validity.

Formation of Scales

Once internal consistency and discriminant validity of items was established, the items were combined into scales. Then, the combined scales were analyzed to determine whether the constructs correlated consistently and as predicted with other independent and dependent variables. Scales were formed by adding the individual values of the three items for each construct together, and dividing by three. Linear transformations were made such that items with values of 0 - 100 were transformed into scales of 0 to 7, making comparisons between items more easily interpreted. The transformation was done by multiplying the value by 0.07. For each construct, low values on the scale correspond to low values of the construct, and vice versa.

Table 18. Standardized Coefficient Alphas

	Product								
Construct	A	B	C	D	E	F	G	H	Average
Availability	.74	.67	.74	.76	.75	.72	.64	.72	.72
Immediacy	.79	.76	.62	.67	.64	.60	.55	.65	.66
Dread	.77	.71	.65	.75	.66	.69	.75	.75	.72
Catastrophic Potential	.59	.69	.79	.80	.71	.72	.81	.73	.73
Controllability	.81	.80	.64	.78	.70	.78	.68	.70	.74
Reversibility	.76	.75	.75	.77	.82	.70	.65	.67	.73
Severity	.81	.78	.80	.85	.82	.79	.72	.78	.79
Probability	.86	.88	.80	.91	.77	.83	.84	.87	.85
Perceived Risk	.85	.86	.80	.85	.76	.84	.79	.85	.83
Acceptability	.82	.90	.89	.87	.89	.86	.92	.83	.87
Confidence	.80	.80	.67	.73	.73	.73	.65	.66	.72
Beneficiality	.78	.79	.79	.89	.85	.81	.73	.68	.79

Product Key

A: Monosodium Glutamate
B: Sun-tanning Bed
C: Bicycle
D: Aerosol Cans
E: Hair Dryer
F: Aspirin
G: Cigarettes
H: High-cholesterol Diet

Table 19. Inter-item Correlations: Dread, Severity, Risk, Probability, Acceptabiliy, Beneficiality

	Dread 1	Dread 2	Dread 3	Severity 1	Severity 2	Severity 3
Dread 1	1.00					
Dread 2	.53	1.00				
Dread 3	.48	.48	1.00			
Severity 1	.33	.23	.23	1.00		
Severity 2	.48	.43	.46	.56	1.00	
Severity 3	.23	.20	.19	.54	.58	1.00

	Risk 1	Risk 2	Risk 3	Severity 1	Severity 2	Severity 3
Risk 1	1.00					
Risk 2	.75	1.00				
Risk 3	.66	.66	1.00			
Severity 1	.34	.37	.30	1.00		
Severity 2	.45	.43	.35	.56	1.00	
Severity 3	.35	.42	.31	.54	.58	1.00

	Risk 1	Risk 2	Risk 3	Probability 1	Probability 2	Probability 3
Risk 1	1.00					
Risk 2	.75	1.00				
Risk 3	.66	.66	1.00			
Probability 1	.53	.64	.63	1.00		
Probability 2	.62	.59	.78	.64	1.00	
Probability 3	.59	.59	.78	.66	.88	1.00

	Accep 1	Accep 2	Accep 3	Benefit 1	Benefit 2	Benefit 3
Acceptability 1	1.00					
Acceptability 2	.75	1.00				
Acceptability 3	.66	.76	1.00			
Benefit 1	.46	.52	.59	1.00		
Benefit 2	.35	.33	.45	.51	1.00	
Benefit 3	.45	.43	.50	.57	.57	1.00

Average inter-item correlations:

Within Acceptabilty: .72	Within Benefit: .55*	Between: .45*.
Within Risk: .70**	Within Probability:.73	Between: .64**.
Within Dread: .50	Within Severity: .56	Between: .30
Within Risk: .70	Within Severity: .56	Between: .37

* Chi-square (1) = 2.989; $p < .05$

** Chi-square (1) = 2.008; $p < .05$

For example, the higher the value on the immediacy scale, the more immediate that consequence was judged to be, and so on for each construct.

Nomological Validity

Nomological validity refers to the degree to which a measure behaves as expected in relation to other measures. Correlations between measures of constructs within the theoretical network provides evidence of nomological validity, specifically by looking at the direction and magnitude of those correlations. Table 20 presents construct correlations for each product. However, it is difficult to synthesize and integrate the information presented in eight different correlation matrices. Therefore, the last correlation matrix of Table 20 represents the aggregation across products. Although it is not assumed that all products can be aggregated into one regression analysis, that is, that each independent variable is of equal importance in a model building context, it can be assumed that the general direction of correlations would be consistent across products. Therefore, the following discussion of nomological validity is done with respect to the last correlation matrix of Table 20.

First, consider the expected direction of correlations between probability and catastrophic potential (+), controllability (-), and availability (+). All correlations were significant and in the direction expected.

Second, consider the direction of correlations between severity and catastrophic potential (+), availability (+), immediacy (+), dread (+), and reversibility (-), All of these correlations were significant and in the direction expected. Thus, with the

exception of confidence, where a positive relationship with acceptability was expected, but no relationship was found, all correlations were in the direction expected.

Third, consider the correlations between the six regressor variables that are proposed as determinants of perceived risk: availability, dreadedness, catastrophic potential, immediacy, reversibility, and controllability (the first four should be positive, the latter two negative). All the directions of correlation were as expected, and all were significant at a probability level of .0001.

Fourth, consider the direction of correlations between perceived risk and probability of outcome (+) and severity of outcome (+); both were significant and in the direction expected.

Finally, consider the expected direction of correlations between acceptability, and perceived risk (-), beneficiality (+), and confidence (+). All correlations were significant and in the direction expected, with the exception of confidence, with a correlation of -.10. Nomological validity is thus supported in this study.

Range of Regressor and Dependent Variables

Stimuli were selected such that high, medium and low levels of each construct would be represented, in the event that all the products could be aggregated into one model. Table 21 presents the scale means and standard deviations for each construct by product. The goal of adequately representing each construct was more successful in some cases than in others. Specifically, those constructs which achieved this goal included immediacy, dread, control, reversibility, probability, perceived risk, accept-

Table 20. Scale Correlations

Monosodium glutamate *

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.22	1.00										
DREAD	.33	-.04	1.00									
CATAS	.08	-.09	.36	1.00								
SEVER	.31	-.11	.65	.30	1.00							
CONTROL	-.17	-.21	-.07	.02	-.05	1.00						
REVER	-.11	.27	-.57	-.38	-.56	-.06	1.00					
PROB	.40	.07	.51	.30	.49	-.09	-.35	1.00				
RISK	.33	-.04	.61	.34	.72	-.08	-.52	.68	1.00			
ACCEP	-.29	-.04	-.25	-.16	-.25	.10	.14	-.34	-.42	1.00		
CONFI	.23	.01	-.05	-.06	.04	.21	.03	.05	.05	-.03	1.00	
BENEF	-.17	-.11	-.09	-.02	-.09	.18	.02	-.19	-.24	.56	-.01	1.00

Sun-Tanning Bed

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.01	1.00										
DREAD	.32	.04	1.00									
CATAS	.05	.04	.19	1.00								
SEVER	.42	-.01	.51	.13	1.00							
CONTROL	-.14	.05	-.16	-.06	-.14	1.00						
REVER	-.18	.13	-.26	.02	-.45	.25	1.00					
PROB	.44	.11	.41	.10	.46	-.22	-.52	1.00				
RISK	.53	.12	.41	.10	.59	-.25	-.48	.80	1.00			
ACCEP	-.31	-.03	-.11	-.05	-.20	.18	.15	-.27	-.41	1.00		
CONFI	.21	.00	-.03	-.06	.16	.11	-.07	.20	.16	.00	1.00	
BENEF	-.18	.03	.02	.02	-.10	.12	.17	-.13	-.22	.61	.03	1.00

Bicycle

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.22	1.00										
DREAD	.40	.16	1.00									
CATAS	.17	-.01	.28	1.00								
SEVER	.41	.20	.53	.22	1.00							
CONTROL	.01	.13	-.12	-.16	-.02	1.00						
REVER	-.20	-.06	-.32	-.23	-.49	.12	1.00					
PROB	.19	-.12	.24	.28	.16	-.29	-.29	1.00				
RISK	.35	-.02	.40	.35	.39	-.29	-.40	.67	1.00			
ACCEP	.04	.15	-.14	-.09	-.01	.28	.09	-.34	-.39	1.00		
CONFI	.17	.06	-.02	.04	.03	.33	.02	.00	.00	.07	1.00	
BENEF	.08	.14	-.09	-.06	.04	.40	.09	-.34	-.31	.62	.13	1.00

* correlations of approximately .15 are significant at a probability level of .05 (df = 346)

Table 20 (continued)
Scale Correlations

Aerosol Cans

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.22	1.00										
DREAD	.52	.11	1.00									
CATAS	.29	-.28	.33	1.00								
SEVER	.53	-.05	.56	.51	1.00							
CONTROL	-.14	.42	-.23	-.39	-.27	1.00						
REVER	-.28	.14	-.38	-.54	-.56	.52	1.00					
PROB	.56	.10	.51	.44	.63	-.37	-.63	1.00				
RISK	.64	.18	.59	.39	.69	-.27	-.53	.84	1.00			
ACCEP	-.39	-.06	-.35	-.23	-.34	.34	.31	-.46	-.49	1.00		
CONFI	.45	.16	.25	.14	.32	-.03	-.22	.45	.42	-.17	1.00	
BENEF	-.30	-.11	-.23	-.14	-.19	.26	.24	-.33	-.35	.75	-.14	1.00

Hair Dryer

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.21	1.00										
DREAD	.40	.12	1.00									
CATAS	.12	-.08	.23	1.00								
SEVER	.43	.24	.56	.15	1.00							
CONTROL	.12	.12	.04	-.08	.18	1.00						
REVER	-.22	-.06	-.39	-.11	-.56	-.02	1.00					
PROB	.07	-.08	.30	.28	.18	-.19	-.28	1.00				
RISK	.27	-.02	.40	.29	.35	-.10	-.37	.65	1.00			
ACCEP	-.09	.12	-.03	-.16	.08	.23	-.07	-.11	-.13	1.00		
CONFI	.22	.07	.12	-.08	.21	.41	-.22	.04	.06	.14	1.00	
BENEF	-.01	.13	.05	-.06	.15	.28	-.06	-.07	-.07	.70	.17	1.00

Aspirin

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.12	1.00										
DREAD	.38	.02	1.00									
CATAS	.14	.00	.35	1.00								
SEVER	.44	-.09	.57	.24	1.00							
CONTROL	-.02	-.06	-.04	.02	-.04	1.00						
REVER	-.16	.16	-.36	-.13	-.43	.20	1.00					
PROB	.38	.02	.43	.18	.42	-.19	-.45	1.00				
RISK	.42	.07	.53	.25	.58	-.08	-.50	.74	1.00			
ACCEP	-.18	.03	-.27	-.12	-.24	.22	.29	-.35	-.38	1.00		
CONFI	.26	.11	.01	.00	.16	.26	.03	.09	.11	.13	1.00	
BENEF	-.07	.03	-.20	-.08	-.10	.22	.29	-.29	-.32	.67	.21	1.00

* correlations of approximately .15 are significant at a probability level of .05

Table 20 (continued)
Scale Correlations

Cigarettes

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	-.01	1.00										
DREAD	.31	.07	1.00									
CATAS	.30	.09	.22	1.00								
SEVER	.44	-.01	.44	.23	1.00							
CONTROL	-.14	.05	-.05	-.16	-.15	1.00						
REVER	-.29	-.09	-.30	-.20	-.40	.26	1.00					
PROB	.50	.13	.35	.39	.46	-.16	-.43	1.00				
RISK	.56	.14	.37	.34	.50	-.18	-.46	.72	1.00			
ACCEP	-.32	-.01	-.17	-.25	-.18	.26	.25	-.37	-.40	1.00		
CONFID	.22	.02	.14	.15	.27	-.05	-.18	.31	.21	-.06	1.00	
BENEF	-.35	.01	-.12	-.24	-.16	.27	.31	-.32	-.34	.59	-.14	1.00

High-cholesterol Diet

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	-.05	1.00										
DREAD	.38	.05	1.00									
CATAS	.16	.02	.20	1.00								
SEVER	.57	-.09	.49	.14	1.00							
CONTROL	-.17	.13	-.15	-.05	-.22	1.00						
REVER	-.28	.04	-.30	-.11	-.43	.38	1.00					
PROB	.60	-.01	.45	.19	.11	-.21	-.43	1.00				
RISK	.62	.03	.47	.15	.67	-.25	-.40	.76	1.00			
ACCEP	-.41	-.12	-.21	-.06	-.23	.17	.27	-.39	-.42	1.00		
CONFID	.46	-.06	.26	.07	.50	-.02	-.24	.55	.47	-.15	1.00	
BENEF	-.40	-.03	-.20	-.02	-.25	.26	.25	-.40	-.42	.64	-.20	1.00

Aggregated Scale Correlations **

	AVA	IMM	DRE	CAT	SEV	CONT	REV	PROB	RISK	ACC	CONF	BEN
AVAIL	1.00											
IMMED	.21	1.00										
DREAD	.56	.30	1.00									
CATAS	.22	.36	.39	1.00								
SEVER	.58	.31	.69	.42	1.00							
CONTROL	-.22	-.38	-.26	.41	-.20	1.00						
REVER	-.29	-.27	-.42	-.37	-.52	.27	1.00					
PROB	.55	.49	.61	.51	.61	-.52	-.47	1.00				
RISK	.62	.46	.67	.47	.71	-.46	-.50	.88	1.00			
ACCEP	-.39	-.33	-.35	-.28	-.28	.47	.26	-.57	-.58	1.00		
CONFI	.40	.14	.30	.14	.36	.00	-.18	.35	.37	-.10	1.00	
BENEF	-.35	-.36	-.31	-.29	-.25	.52	.28	-.57	-.56	.80	-.10	1.00

* correlations of approximately .15 are significant at a probability level of .05
** all hypothosized correlations were significant at a prob.level of .0001; df = 2768 (except confid and control)

ability, beneficiality, and severity. Catastrophic potential lacked mid-range values, and both availability and confidence lacked low values. Nevertheless, the range was judged as adequate to perform subsequent analyses.

Interpretation of Correlations

While correlations were discussed in a general sense in the previous discussion of nomological validity, they are discussed in greater detail below. Each variable in this research has been hypothesized to be significantly correlated, in a specific direction, to one or more other variables. First, the correlations for data aggregated across products are discussed, followed by the correlations for individual products.

Aggregated Across Products: With the data aggregated across products, all hypothesized correlations with the exception of one were significant and in the hypothesized direction. Availability was positively correlated with probabilitiy, severity, and perceived risk; immediacy was positively correlated with severity and perceived risk; dreadedness was positively correlated with severity and perceived risk; controllability was negatively correlated with probability and perceived risk; reversibility was negatively correlated with severity and perceived risk; catastrophic potential was positively correlated with probability, severity, and perceived risk; perceived risk was negatively correlated with acceptability; and beneficiality was positively correlated with acceptability. The only relationship which was not in the hypothesized direction was confidence and acceptability. The correlation coefficient (.11) was significant. Given the very large sample that is used when data are aggre-

Table 21. Scale Means and Standard Deviations for Each Construct by Product

	Product							
Construct	A	B	C	D	E	F	G	H
Availability	3.82	5.44	4.57	4.15	3.92	3.85	6.45	5.78
	1.70	1.23	1.64	1.64	1.73	1.42	0.87	1.18
Immediacy	5.20	2.54	6.10	2.29	6.11	3.89	2.50	2.71
	1.26	1.36	1.09	1.32	1.15	1.09	1.28	1.31
Dread	1.68	3.53	2.94	3.26	2.58	2.47	5.24	4.48
	0.95	1.45	1.43	1.52	1.35	1.13	1.60	1.57
Catastrophic Potential	1.39	1.76	2.14	6.33	1.59	1.55	5.35	2.26
	0.66	1.04	1.21	1.12	0.83	0.81	1.56	1.42
Control	2.81	3.50	5.29	2.06	5.48	4.24	1.79	2.87
	1.91	1.72	0.94	1.72	1.21	1.51	1.70	1.69
Reversibility	6.04	3.06	4.16	2.25	4.32	4.82	1.59	2.76
	1.12	1.45	1.42	1.53	1.82	1.17	1.15	1.37
Severity	2.64	5.52	4.91	5.46	4.54	3.97	6.69	6.23
	1.19	1.14	1.49	1.36	1.68	1.23	0.55	0.84
Probability	2.55	4.14	2.12	4.55	1.62	2.55	5.88	5.27
	1.41	1.40	1.12	1.65	0.92	1.17	1.01	1.20
Perceived Risk	2.55	4.86	2.82	4.47	2.14	2.77	6.52	5.82
	1.30	1.40	1.23	1.62	1.05	1.16	0.71	1.09
Acceptability	3.09	2.22	5.57	3.36	4.98	5.11	1.82	2.94
	1.45	1.52	1.47	1.61	1.81	1.48	1.65	1.52
Confidence	4.26	4.93	5.02	4.82	4.95	5.18	6.41	6.13
	1.75	1.51	1.38	1.49	1.51	1.29	0.75	0.90
Beneficiality	2.85	2.54	5.88	3.18	4.94	5.60	1.73	2.58
	1.32	1.44	1.08	1.68	1.60	1.13	1.39	1.37

Product Key
A: Monosodium Glutamate
B: Sun-tanning Bed
C: Bicycle
D: Aerosol Cans
E: Hair Dryer
F: Aspirin
G: Cigarettes
H: High-cholesterol Diet

*Standard deviation listed below each mean; values range from 0 to 7

gated across products (N = 2768), it's significance is not surprising; it was, however, much smaller in magnitude than all of the other correlation coefficients. Figure 4 shows the magnitude of the correlations across products.

Correlations for individual products: The correlations involving availability were significant and in the hypothesized direction for each individual product. For all products, the hypothesis relating controllability to probability was supported, although it was weak for monosodium glutamate. Correlations between catastrophic potential and perceived risk, probability, and severity were positive, as hypothesized, for all products, but insignificant for hair dryers, aspirin, sun-tanning beds, and high-cholesterol diet. For all products, the correlations were significant and in the direction hypothesized between reversibility and both perceived risk and severity, and dreadedness and both perceived risk and severity. For only one product (aerosol cans) was there a significant correlation in the hypothesized direction between immediacy and perceived risk. All other correlations involving immediacy were insignificant. For only two products (bicycles and hair dryers) was there a significant correlation in the hypothesized direction between immediacy and severity.

For all products, the positive correlation betwen beneficiality and acceptability was significant, and the negative correlation between perceived risk and acceptability was significant. The positive relationship hypothesized between confidence and acceptability was found for only three products, and those correlations were weak to non-existent.

Correlations that were not hypothesized: In addition to examining the correlations between the variables that were hypothesized to be related to one another, examination of the correlation matrix revealed that there were several additional pairs of variables relating to perceived risk that were consistently significantly corre-

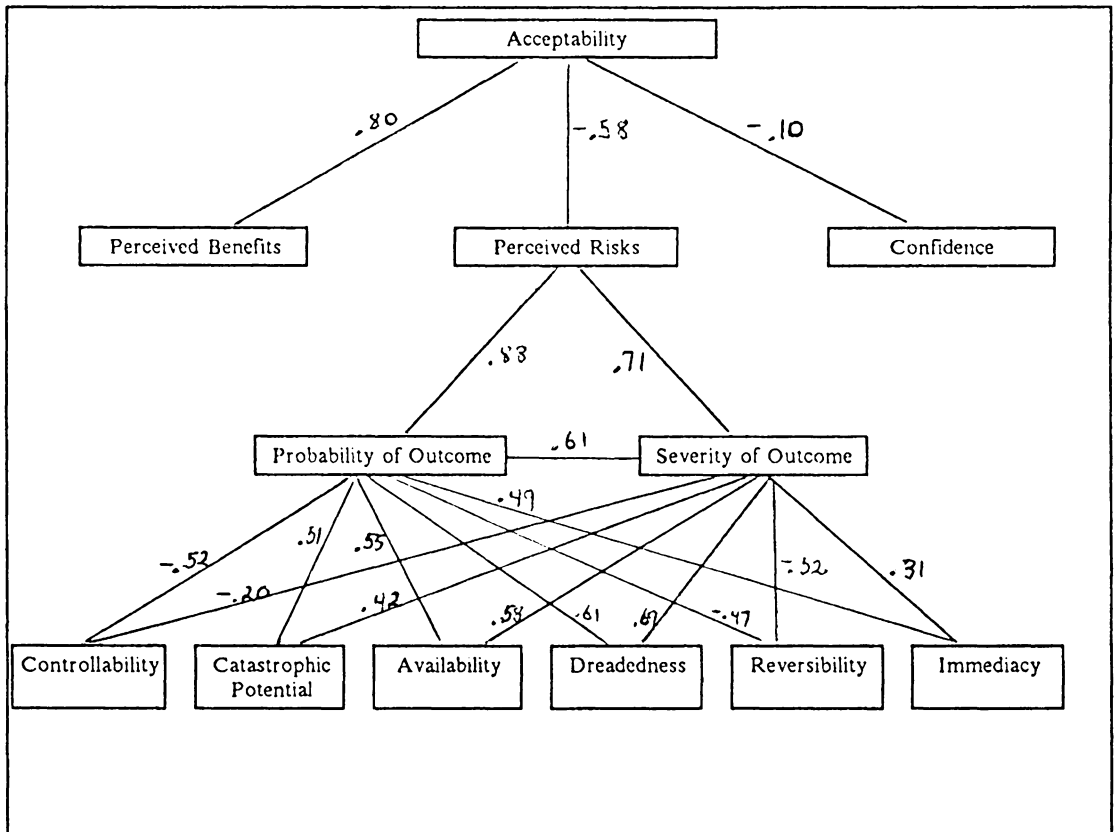

Figure 4. Magnitude of Correlations Across Products

lated with one another. Therefore, all pairs of variables relating to perceived risk were examined.

For every individual product, as well as across products, there was a significant negative correlation between reversibility and probability, a significant positive correlation between dreadedness and probability, and a significant positive correlation between probability and severity. The correlation between immediacy and probability was non-significant for any individual product, but significantly positive across products. Finally, for four products (sun-beds, aerosol cans, cigarettes, and diet) there was a significant negative correlation between controllability and severity. Figure 4 also gives the correlations between variables relating to perceived risk for those pairs of variables that were not hypothesized as being related.

Essentially, those variables which were hypothesized as being related to either probability or severity, but not both, were indeed found to be related to both. In every case, the direction of correlation was the same between any individual regressor variable and either probability or severity; that is, if a variable was positively correlated with probability, it was also positively correlated with severity, and vice versa. In other words, the relationship between any of the six regressor variables and either probability or severity was the same. These results indicate that the pattern of relationships illustrated in Figure 1 may not tell the full story; that is, all the regressor variables may be determinants of both probability and severity, and there may be no variable that relates exclusively to one or the other.

Summary: In summary, variables were related to one another in the manner hypothesized, with the exception of immediacy and confidence. Regarding immediacy, it may simply not hold true that because people, in general, prefer immediate gratification that they also prefer delay of negative consequences. More

importantly, they do not necessarily have that choice. If, for example, they had the choice of suffering the head injury from a bicycle accident immediately or in the future, they might well choose the future. Obviously, consumers do not have those preferences. Furthermore, the variable may not have a great deal of relevance, in that consumer products rarely present an immediate and strong danger.

Similarly, there is little support for confidence as a determinant of acceptability. Apparently in this research, respondents did not evaluate the acceptability of an option with regard to whether they could obtain information about the risks of that option. In general, though, confidence was high for all products, the lowest value being 4.26 on a 7-point scale. Perhaps this lack of variability contributed to the results.

Regarding correlations that were not hypothesized, in general, the same direction of correlation was found whether one of the six additional regressor variables was paired with either probability or severity. This result is not surprising given the fairly consistent strong positive correlation found between probability and severity. However, even in those cases where the correlation between probability and severity was weak, e.g., high cholesterol diet, the same direction of correlation was found whether a variable was paired with either probability or severity. Apparently, probability and severity are related strongly enough to one another in this research that the correlations are similar regardless of whether a variable is paired with one or the other. This may reflect the particular product set used in this research.

Criteria for Model Selection

Introduction

Variables were included in this research based on existing theoretical and empirical support; as such, each regressor variable is expected to be influential and appear as part of a final model. In fact, however, the regressor variables should be considered *candidates* for inclusion in a final model, the final model likely being a subset of the available regressors. Identifying that subset of variables, and their functional form, presents a dilemma on several levels. First, the decision may be "complicated by ... the scientist's prior views and prejudices regarding the importance of individual variables (Myers 1986, p. 4.1). This important problem supports the notion of this research as exploratory, without explicitly hypothesized relationships (other than direction of correlation.) A second dilemma involves two conflicting objectives: maximization of the "information content" of the model by including as many regressors as possible, and minimization of the variance of the predicted response variable by including as few regressors as possible. A third dilemma involves identifying the purpose of the model; different models serve different purposes, thus the purpose must be defined at the outset.

As discussed previously, the purpose of the cuurrent research is both variable screening, and model specification, with prediction in a tertiary role. Variable screening is a means of learning the degree of importance of each variable in explaining the variability in the response. Variables that are found to explain a reasonable amount of variation are retained, and those that explain a negligible portion

are eliminated. Model specification involves selecting among a set of candidate models which may be in fairly close competition with one another, some superior on one criteria, and some superior on a different criteria. One of those criteria is a model's predictive capability, and thus prediction as a tertiary goal. Thus, it will be important to consider several criteria for choosing a model among what may be a large set of candidate models. The criteria for comparing candidate models are many and varied. Each are reviewed briefly in turn below, beginning with the coefficient of determination. More detailed explanation of their use in the current research is given in subsequent sections as necessary.

Coefficient of Determination

R^2, or the "coefficient of determination", is an overall measure of the adequacy of a regression model in fitting the data. While this criteria is the one most commonly reported in the literature on perceived and acceptable risk, its use as a sole criterion is inadequate. First, the statistic is a measure only of the model's capacity to fit the present data, and says nothing about how well the model is predicting the response. Second, the insertion of any new regressor into a model cannot bring about a decrease in R^2. The insertion of new regressors, however, can induce both an increase in the error variance (discussed below), and multicollinearity (also discussed below). Thus, model selection based solely on R^2 can be misleading. Therefore, we need to look for other criteria such as the estimate of error variance.

Estimate of Error Variance

The "residual mean square", s^2 , is more informative than the coefficient of determination, and is particularly appropriate when the goal of the analysis is to learn something about the complex system from which the data are taken. The coefficient of determination can only increase as regressor variables are added to the model; therefore, a high R^2 can be deceptive. The residual mean square indicates whether the amount of residual sum of squares reduced by adopting a larger model was worth the loss in residual degrees of freedom. Thus, it is more reasonable to choose the model with the smallest value of s^2 than the one with the highest value of R^2. In addition, is is useful to consider cross-validation.

Cross Validation

Cross validation is used when the goal is to select from a set of candidate models the one which will best predict response. The first method of cross-validation is data splitting, where the data are partitioned into two subsamples, one for fitting and one for validation. While useful, it is not always practical or efficient. The second method, the PRESS (prediction error sum of squares) statistic, is a more efficient form of validation that is conceptually based on data splitting. With the PRESS procedure, the fitting sample for each validation is n-1. Specifically, the first observation in a data set is "set aside" from the sample, and the remaining n-1 observations are used to estimate the coefficients for a particular candidate model. The first observation is then replaced and the second observation withheld with coeffi-

cients estimated again. Each observation is removed one at a time and thus the candidate model is fit n times. The deleted response is estimated each time, resulting in n prediction errors or PRESS residuals. Thus, each candidate model has an associated PRESS statistic, the smallest being a candidate for the "best" model.

Conceptual Predictive Criteria

The criterion discussed thus far have been empirically based; it is important to consider conceptually based criteria as well. As mentioned in a previous section, there is a price to be paid for including either too many or too few regressor variables in the model. "A model that is too simple may suffer from biased coefficients and biased prediction, while an overly complicated model can result in large variances, both in the coefficients and in the prediction" (Myers 1986, p. 4.13). More specifically, the bias in s^2 in an underspecified model can be written in terms of the sum of the squared biases in the prediction at the data points. The impact of an underspecified model is fixed bias in several important quantities: prediction at the data points, the regression coefficients, and the estimate of error variance. When one underfits, the variation accounted for by the ignored variables is deposited in the residual sum of squares and hence inflates the residual mean square. This inflation may be viewed as reflecting bias in prediction at the data points. On the other hand, fitting model terms that contribute little or nothing, i.e., overfitting, produces results involving variances that are larger than those for the simpler model. This inflated variance is reflected in both the predicted values and the regression coefficients. *Mallows' Cp statistic mathematically* expresses "variance" + "bias" and can be ex-

tremely useful as a criterion for discriminating between models. It allows the researcher to select a model that is a compromise between a biased model and a model with heavy variance. Finally, there are several sequential variable selection criteria.

Sequential Variable Selection Criteria

The several sequential variable selection criteria, which are based on systemmatic procedures based on sequential F-tests, need to be considered with two caveats. First, the procedures are designed such that only a relatively small number of subset regressions are actually tested. Second, the procedures make no assessment of multicollinearity (linear dependencies among the regressor variables). Nonetheless, they are efficient, and are conventionally used in regression analyses in the area of perceived and acceptable risk. Problems associated with their use were discussed in Chapter II. Each of five variable selection criteria are discussed below.

Forward selection begins with an initial model containing only a constant term, and then allows entry of the variable which produces the largest R^2 of any of the regressors. The second regressor is chosen which produces the largest increase in R^2 in the presence of the first regressor, and so on until the candidate regressor for entry does not exceed a preselected F-value for entry. *Stepwise regression* proceeds similarly, except that at each stage a variable may exit as well as enter in accordance with a preselected F-value for exit. Therefore, a variable must continue to perform in the model or be eliminated. *Backward elimination* begins with all regressors in the model and eliminates one at a time, the elimination criteria being the smallest de-

crease in R^2 , until no regressors in the model can be eliminated on the basis of the preselected F-value for exit.

The *MAXR* procedure has the advantage over the preceding ones in that it allows for more replacements of regressors and, as such, requires more regressions to be performed than in the other methods. MAXR begins as in forward selection or stepwise, in that the regressor that produces the largest increase in R^2 is the first one allowed to enter. This procedure continues until there is a set of k models, one each for values of the number of regressors. The feature that distinguishes MAXR from the other is that at each stage it allows for replacement of a model regressor with a regressor that has not entered if the replacement produces a larger R^2. The regressor that has been replaced is relegated to the pool of "waiting" regressors, all of which will eventually enter. This "switching" continues until no one-on-one replacements will increase R^2.

All possible regressions yields the most information, but requires the fit of all regression equations involving one candidate regressor, two candidate regressors, and so on. This would clearly not be possible without the availability of high-speed computers, and in many cases it is not practical to consider <u>all</u> possible models. A more reasonable approach is to reduce the number of candidate models to a manageable set for further scrutiny. In order to reduce that large number of candidate models in this research to a manageable size, models were rank ordered according to Mallow's Cp statistic; only those with a reasonable value of Cp were studied further. A reasonable norm by which to judge the Cp value of a model is Cp = p, (the number of parameters), which would suggest that the model contains no estimated bias.

Detecting and Combatting Multicollinearity

Multicollinearity refers to near linear dependencies among the regressor variables; such dependencies obscure efforts to discover the individual role of each variable. This section will discuss the sources of, the means by which to diagnose, and the techniques available to combat multicollinearity.

Sources of Multicollinearity

There are four primary sources of multicollinearity: the data collection method used, constraints on the model or in the population, model specification, and an over-defined model (Montgomery and Peck 1982). The data collection method can lead to multicollinearity problems when only a subspace of the region of the regressors defined is sampled. For example, consider the measurement of the number of cases and the distance that soft drinks are being delivered. If sampling is done such that a small number of cases generally also have a short distance, while observations with a large number of cases usually also have a long distance, cases and distance will be positively correlated due to the sample used. If this positive correlation is strong enough, a multicollinearity problem will occur. As such, this source is not inherent in the model or the population being sampled. Constraints on the model or in the population being sampled occurs, for example, when data for two regressors lie approximately along a straight line. An illustration of this might be family income and house size. In this case, a physical constraint in the population has caused multicollinearity, and the phenomenon will exist regardless of the sampl-

ing method. The third source of multicollinearity is an over-defined model (one having more regressor variables than observations). This occurs in research where there may be only a small number of subjects available, and information is collected for a large number of regressors on each subject. The final source of multicollinearity is the choice of the model. For example, if the range of levels of x is small, adding an x^2 term can result in significant multicollinearity. In this research, only the first two sources were potentially problemmatic. There are several diagnostics available to uncover multicollinearity; these are discussed below.

Multicollinearity Diagnostics

Several diagnostics are available to determine the existence and extent of multicollinearity in a data set. The first and most obvious of these is examination of the off-diagonal elements of the *correlation matrix*. If two regressors are nearly linearly dependent, the correlation between them will be close to 1. However, there are no definite guidelines on the simple correlations and, more importantly, multicollinearity often involves associations among more than two regressor variables which will not be exhibited by simple correlations, which only show what one-on-one associations exist.

A second diagnostic tool are *variance inflation factors (VIF's)*, which represent the inflation that each regression coefficient experiences above the ideal, the ideal being a correlation matrix which is an identity matrix. The VIF for the ith regression coefficient can be written: $VIF = \frac{1}{1 - R_i^2}$, where R_i^2 is the coefficient of multiple determination of the regression produced by regressing the variable x_i against the other

regressor variables. If this value is large, i.e., near unity, the VIF will be quite large. This will occur if the ith regressor variable has a strong linear association with the remaining regressors. The VIF for each term in the model measures the combined effect of the dependencies among the regressors on the variance of that term. One or more large VIF's indicate severe multicollinearity, large loosely defined as 5 to 10 (Montgomery and Peck 1982; Myers 1986).

The *eigensystem* (values and vectors) of the correlation matrix provides a third diagnostic tool. If there are one or more near linear dependencies in the data, then one or more of the eigenvalues will be small, the strength of the linear dependency indicated by the nearness to zero of the smallest eigenvalue. The number of eigenvalues near zero indicate the number of collinearities detected among the regressor variables. Multicollinearity is often measured by the ratio of the largest to the smallest eigenvalue, which is called the condition number of the correlation matrix. A large condition number, large loosely defined as 1000 (Myers 1986), indicates serious multicollinearity. (The output of a SAS analysis gives the square root of the condition number, and the associated cutoff is thus approximately 30.)

Finally, there are several more intuitive, or common sense approaches that relate to the "behavior" of the regression coefficients that should augment the more technical approaches. Specifically, if the regression coefficients are highly unstable, that is, change dramatically with the addition and removal of a regressor, if the deletion of one or more data points results in large changes in the coefficients, and if the signs or magnitudes of the regression coefficients in the model are contrary to prior expectation, then multicollinearity is indicated.

Once multicollinearity has been diagnosed, it is useful to determine what proportion of the variance of each coefficient is attributed to each dependency. This is

the role of variance decomposition proportions. "A small eigenvalue ... accompanied by a subset of regressors (at least two) with high variance proportions represents a dependency involving the regressors in that subset, and the dependency is damaging to the precision of estimation of the coefficients in the subset" (Myers 1986, p.7.8).

Methods for Dealing with Multicollinearity

In the event of multicollinearity, which is a distinct possibility given the correlation matrices seen in the pre-test stages of this research and in previous research, there are two categories of combatting techniques to use, one involving alternatives to a least squares approach, and the other using methods without resorting to such alternatives. Ridge regression and principal components regression are two such alternatives to least squares. Preferable methods are (1) eliminating one or more regressors, (2) transformations on the regressor variables, and (3) the collection of additional data in a manner designed to break up the multicollinearity (where possible and appropriate). In this research, it is the first of these three methods which would be appropriate.

The criteria for model selection discussed above are important in subsequent analyses. The progression of those analyses is discussed in the next section.

Justification for Progression of Analyses

This research is exploratory in its objective of building models of perceived risk and acceptability. Nonetheless, existing theoretical and empirical work guided the

selection of variables to be considered, as well as the postulation of relationships between those variables, as illustrated by Figure 1. Therefore, variables were allowed to enter a model of either perceived risk or acceptability based on existing theoretical and empirical work, but they were not required to be in those models. If a variable did not did contribute to a model in terms of the various performance criteria discussed above, it was not included in the model.

Figure 1 can actually be viewed as two separate stages, the first dealing with perceived risk of an option, and the second dealing with the acceptability of that option. The justification for the progression of analyses for the first stage will be discussed initially, followed by a discussion of the progression of analyses for the second stage. Finally, the specific steps of the general procedure followed for the analyses are described.

Stage One: Perceived Risk

The first stage in the current research was to build models of perceived risk (one for each product), using the techniques and criteria discussed above. It would be expected that absolute convergence among those criteria would probably not occur. Furthermore, it would be unlikely that any one model would stand out as the "best" across all products. Therefore, analyses at this stage were done with the goal of finding a subset of models, for each individual product, that performed well consistently according to a variety of criteria. To the extent that commonalities across products could be discovered among those models, they might be combined into a "unified" model for all products. In other words, if the same model was a consistently good performer according to the various criteria, even if that model was not the best in every case, it would be reasonable to call that model a unified model of perceived risk across all eight products. The goal was thus to search for a unifying

model of perceived risk that would perform reasonably well across a variety of criteria for a variety of products. Short of that, the goal would be to identify a model that would perform well across a variety of criteria for respective individual products.

In order to investigate further the possibility that a model of perceived risk, that performed well according to the criteria discussed previously, existed for all products, the data were aggregated and analyzed across products.

According to Figure 1, the variables that should be allowed to enter models of perceived risk include probability and severity, and six additional variables that relate to probability and severity. The first step in each analysis by product would be to look at the role of probability and severity alone, and to evaluate those models according to the performance criteria discussed above. Given the conceptual definition of perceived risk and prior research, it would be expected that these two variables alone should account for a large proportion of the variance of perceived risk. However, given prior research indicating the other six regressors to be important as well, it would be expected that the models containing only probability and severity would be underspecified and thus be systematically biased (as evidenced by Mallow's Cp statistic) and lacking in their predictive capacity (as evidenced by the PRESS statistic).

The second step would be to look at the role of the additional six regressor variables together, excluding probability and severity and, again, evaluate those models according to the same criteria. If probability and severity are completely subsumed, or captured, by those six additional regressor variables, then models including the six additional variables should perform at least as well as those containing only probability and severity according to all criteria.

The third step would be to look at the eight variables in concert. If the six regressor variables are determinants of perceived risk through and solely through probability and severity, as would be implied in Figure 1, then in no case would any of those six variables be significant in a model that included probability and severity. In other words, the presence of any of those six variables as significant in a model containing probability and severity would indicate that the particular variable was acting as a determinant of perceived risk directly, adding a unique contribution in addition to probability and severity. Although Figure 1 does not directly relate any of those six regressor variables to perceived risk, this possibility should be considered, given the exploratory nature of this research.

The next question then would be: do the six regressor variables act through probability and severity at all, or do they strictly have a direct and unique impact apart from their relationship with probability and severity? One way to consider this question in a general sense is by looking at the linear dependencies among the regressor variables in the full model, that is, the model containing probability, severity, and the additional six regressor variables. If these eight variables are not totally orthogonal to one another, that is, have a correlation matrix that is an identity matrix, then it may be viewed that the impact of any one variable occurs through it's relation to one or more of the others. To examine this relationship with specific respect to probability and severity and the other six regressors, it is possible to compare the R-square of the model of perceived risk regressed against the six independent variables with the R-square of the model of perceived risk against the six independent variables given probability and severity (that is, a conditional correlation with the effects of probability and severity partialled out of the regression). If the R-square of the former model is significantly greater than the R-square of the

latter, it would support the argument that the six regressor variables are impacting perceived risk through probability and severity.

The final step would be to examine both probability and severity as dependent variables; that is,to build models of both probability and severity using the other regressor variables. In that the correlation matrix indicated that all five regressor variables (with the exception of immediacy) were consistently significantly correlated with both probability and severity, all five were used in building models of both probability and severity.

Stage Two: Acceptability

Referring again to Figure 1, the second stage was to build models of acceptability; in this stage variables allowed to enter models included perceived risk, beneficiality, and confidence.

General Procedure Followed for Stages 1 and 2

The choice of which criterion to consider first, of those discussed above, is to some extent arbitrary, given that all criteria should ultimately be considered. In the current research, the general procedure followed in both stages involved first running the "all possible regressions" procedure, rank ordered according to Mallow's Cp statistic. This procedure allows selection of the best one variable model, two variable model, and so on acccording to the Cp criteria, and also gives the coefficient of determination for each model. Again, an underspecified model, one that is too simple, may suffer from biased coefficients and biased prediction, while an overly complicated model can result in large variances, both in the coefficients and in the prediction. The Cp statistic allows a model to be chosen that represents a proper balance; a reasonable norm by which to judge the Cp value of a model is Cp = p (the number of parameters), which would suggest that the model contains no estimated bias. The

typical outcome of such an analysis is several models that could be considered candidates for a final model.

In order to narrow down that set of candidate models, the second step was to run the "all possible regressions" procedure, this time rank ordered according to the PRESS statistic, to look for convergence between this criteria and Cp. The PRESS statistic is a cross-validation procedure that allows assessment of how well the model is predicting the response variable, without the response variable being used simultaneously for both fit and model assessment. Each model has an associated PRESS statistic and, while there are no absolute rules of thumb to guide model selection, the goal is to choose a model with a small PRESS statistic relative to other models. At this point, each product would have a small set of candidate models. Examination of all of these models would follow in order to see if there was a recurrent model across all products, or even several products. In the event that no recurrent model existed, one "best" model would be selected for each product for further analysis.

The third step would be to run a full regression analysis on each "best" model, or models, that performed well according to both Cp and PRESS. The goal at this step would be assess the significance of each regressor, assess the model with regard to R-square and mean square error, assess the extent and impact of multicollinearity in the model, and detect outliers and highly influential observations. While the sign of the parameter estimate will be noted with respect to whether it was in the hypothesized direction, it should be remembered that sign is very sensitive to any multicollinearity in the data set in a multiple regression context. A coefficient estimate represents the contribution of a variable in the presence of other variables. The sign of a coefficient in a "full" model (that is, a two or more variable model) may be different than the sign indicated by a correlation analysis. In other words, coef-

ficient signs in a multiple regression context, in the absence of orthogonal constructs, really do not define the relationship between an individual regressor and a response variable. Therefore, coefficients that are not in the direction hypothesized are of no particular cause for alarm, and those that are are of no particular cause for celebration. The point of this discussion is to emphasize that coefficient estimates cannot be considered as 'units of change' or given some such similar substantive interpretation.

This general procedure is used for each of the two stages of the research; discussion of the first stage follows.

Variable Screening and Model Specification: Perceived Risk

Role of Probability and Severity

Probability and severity are, by definition and based on prior research, the constructs that should drive an individual's perception of risk. Thus, the first logical analysis would be to see how well those two variables perform as predictors of perceived risk according to the criteria outlined above. The first analysis was to look at the Cp statistic for the two-variable models across products that included probability and severity. Consistently over all eight products, the probability/severity models were far superior to models containing either variable alone based on both

Cp and R-square, but had Cp statistics that were much larger than would be considered ideal. Specifically, it ranged from 15.76 to 50.73. On the other hand, that model did have a fairly large R-square, ranging from .53 to .74. By simply judging R-square, that two-variable, definitionally based, model performed fairly well. However, it's consistently large Cp value indicated that the model did not represent a good balance between the bias of underfitting and the variance of overfitting. Thus, the bias from under-fitting those two-variable models made them flawed as models of perceived risk. PRESS statistics for this two-variable model were simmilarly high, indicating a lack of predictive capacity. The next stage was to consider the role of the additional six regressor variables.

Role of Additional Six Regressor Variables

To examine the role of the additonal six regressor variables, in the absence of probability and severity, the model selection procedure described above was performed using perceived risk as the dependent variable with six independent variables: availability, catastrophic potential, controllability, dreadedness, reversibility, and immediacy. The results of that procedure are summarized in Table 22. Only models with a Cp statistic less than or equal to 7.0 were included (again, a reasonable value by which to evaluate the Cp of a model is Cp = p (the number of parameters). To gain an appreciation of the range of this statistic, it can be noted that the Cp statistic went as high as 400. At this point the goal was to look at the candidate models for each product according to this criteria, and look for an even smaller subset of models that appeared consistently across products.

As can be seen in Table 22, three models appeared consistently. For every product, the same five variable model was a good performer: availability, catastrophic potential, controllability, reversibility, and dreadedness (designated Model 3 in Table 22). Two four variable models, each a subset of the five variable model, were also good performers, but not for each product. Specifically, the five variable model exluding either controllability or catastrophic potential appeared each time (designated as Model 1 and Model 2, respectively, in Table 22).

The next step was to look at the Cp statistic for each of those three models for each product, to see if the Cp values were acceptable for all three. Those results are presented in Table 23. Again, Model 3 is a consistently good performer across all eight products, the Cp statistic ranging from 5.0 to 6.5. Model 1, which excludes controllability from the five variable Model 3, does well with two exceptions; specifically for Products B (sun-tanning beds) and C (bicycles), with a Cp value of 13.1 and 26.0, respectively. Model 2, which excludes catastrophic potential from the five variable Model 3, does well with the exception of Products A (monosodium glutamate), C (bicycles), E (hair dryers), and G (cigarettes), with Cp values of 16.2, 20.8, 23.0, and 14.0 respectively. Nonetheless, considering the range of the Cp statistic into the hundreds, none of these models is an alarmingly poor performer for any one product. The evidence at this point, however, is clearly in favor of Model 3.

The next analysis was to rank order all possible models according to the PRESS statistic, in order to see if this criteria favored the same models as did the Cp statistic. Results of this analysis are summarized in Table 24, which lists the top several models according to PRESS. Again, to appreciate the range of this statistic, 63 models were evaluated and values of PRESS went as high as the 600's. Table 24 also

presents the values for Cp, mean square error (MSE) and R-square, to begin to compare candidate models in even more detail.

Results in Table 24 confirm the models selected previously. Again, Model 3, the five variable model, is a good performer for each product. Additionally, Model 3, in every case but one, has the lowest mean square error.

Given the consistent good performance of Model 3, the next analysis was to run a full regression analysis using that model, to look at the significance of each variable, as well as to examine the extent and impact of multicollinearity.

Of primary interest at the stage would be (1) determining the significance of the regressor variables, and (2) assessing the extent and impact of multicollinearity. Model performance as far as R-square and mean square error would also be assessed. Given that the five variable model was not the best performer in each case, albeit close to the best, it would not be expected that all five variables would be significant for each and every product. Rather, it would be hoped that all five variables would be significant, or nearly so, across most of the eight products, and that four of the variables would be significant across all of the eight products. These results would be consistent with what was learned by evaluating Cp and PRESS values. Furthermore, it would be hoped that multicollinearity would not exist to the extent that would be unduly damaging to the regression results.

Using a significance level of .05 for the regressor variables and a condition number of 30 to indicate multicollinearity, the results were acceptable. To summarize, all of the variables were significant for two of the eight products (bicycles and hair dryers); four of the five variables were significant for five products (all but catastrophic potential for sun-tanning beds and high cholesterol diet, and all but controllability for MSG, aerosol cans, and cigarettes); and three of the five variables

Table 22. Candidate Models for Perceived Risk - Cp Statistic (Regressor Variables: Immediacy, Availability, Dreadedness, Catastrophic Potential, Controllability, Reversibility)

Model	Cp *
Product A (Monosodium Glutamate)	
Avail/Catas/Rever/Dread[1]	3.47
Immed/Avail/Catas/Rever/Dread	5.43
Avail/Catas/Contro/Rever/Dread[3]	5.01
Product B (Sun-tanning Beds)	
Avail/Contr/Rever/Dread[2]	4.01
Immed/Avail/Contr/Rever/Dread	5.74
Avail/Catas/Contr/Rever/Dread[3]	5.32
Product C (Bicycles)	
Avail/Catas/Contr/Rever/Dread[3]	.48
Product D (Aerosol Cans)	
Avail/Catas/Rever/Dread[1]	4.89
Immed/Avail/Catas/Rever/Dread	6.06
Avail/Catas/Contr/Rever/Dread[3]	5.77
Product E (Hair Dryer)	
Avail/Catas/Contr/Rever/Dread[3]	5.57
Product F (Aspirin)	
Avail/Rever/Dread	4.49
Avail/Contr/Rever/Dread[2]	6.40
Immed/Avail/Rever/Dread	4.80
Avail/Catas/Rever/Dread[1]	4.64
Immed/Avail/Contr/Rever/Dread	6.75
Avail/Catas/Contr/Rever/Dread[3]	6.51
Immed/Avail/Catas/Rever/Dread	5.08
Product G (Cigarettes)	
Avail/Catas/Rever/Dread[1]	6.09
Avail/Catas/Contr/Rever/Dread[3]	5.53
Product H (High-cholesterol Diet)	
Avail/Contr/Rever/Dread[2]	3.41
Avail/Catas/Contr/Rever/Dread[3]	5.38
Immed/Avail/Contr/Rever/Dread	5.04

* full model would have a Cp of 7.0; thus only models with a Cp of 7.0 or below were included at this stage

Table 23. Cp Statistic for Three "Best" Models

Product	Model 1	Model 2	Model 3	"Best"
MSG	3.5	16.2	5.0	Model 1 (3.5)
Sun-Bed	13.1	4.0	5.3	Model 2 (4.0)
Bicycle	26.0	20.8	5.5	Model 3 (5.5)
Aerosol Can	4.9	9.6	5.8	Model 1 (4.4)
Hair Dryer	8.3	23.0	5.6	Model 3 (5.6)
Aspirin	4.6	6.4	6.5	Model 1 (4.6)
Cigarettes	6.1	14.0	5.5	Model 3 (5.5)
Cholesterol	8.0	3.4	5.0	Model 2 (3.4)

Model 1: Avail Catas Rever Dread
Model 2: Avail Control Rever Dread
Model 3: Avail Catas Control Rever Dread

Table 24. Candidate Models for Perceived Risk - Press Statistic

Regressor Variables: Avail Immed Dread Catas Control Rever

	Model	Press	Cp	MSE	Rsquare
MSG	Avail/Dread/Catas/Rever[1]	359.552	3.652	1.01	.41
	Avail/Dread/Catas/Control/Rever[3]	361.678	5.495	1.01	.41
	Avail/Immed/Dread/Catas/Rever	361.946	5.090	1.01	.41
	Avail/Dread/Catas	368.691	15.346	1.05	.38
Sun-bed	Avail/Dread/Control/Rever[2]	480.181	3.942	1.36	.36
	Avail/Immed/Dread/Control/Rever	481.837	5.541	1.36	.36
	Avail/Dread/Catas/Control/Rever[3]	482.432	5.454	1.36	.36
	Avail/Dread/Control	491.545	12.520	1.39	.34
Bicycle	Avail/Dread/Catas/Control/Rever[3]	384.526	6.401	1.09	.31
	Avail/Immed/Dread/Catas/Control	389.729	11.306	1.10	.30
	Avail/Dread/Catas/Control	389.848	11.482	1.10	.30
	Avail/Catas/Control/Rever	399.710	20.201	1.13	.28
Aerosol	Avail/Dread/Catas/Rever[1]	497.698	5.666	1.40	.50
	Avail/Dread/Catas/Control/Rever[3]	498.288	5.152	1.40	.50
	Avail/Immed/Dread/Catas/Rever	500.745	7.480	1.41	.50
	Avail/Dread/Control/Rever[2]	504.015	12.262	1.43	.49
Hair dryer	Avail/Dread/Catas/Control/Rever[3]	289.074	5.483	.82	.30
	Avail/Dread/Catas/Rever[1]	291.407	8.594	.83	.28
	Dread/Catas/Control/Rever	292.050	9.395	.83	.28
	Avail/Immed/Dread/Catas/Rever	292.768	10.336	.83	.29
Aspirin	Avail/Dread/Catas/Rever[1]	329.705	3.845	.93	.34
	Avail/Dread/Catas/Control/Rever[3]	331.450	5.020	.93	.35
	Avail/Dread/Rever	332.675	7.000	.94	.33
	Avail/Immed/Dread/Catas/Rever	333.203	5.818	.94	.34
	Avail/Dread/Control/Rever[2]	334.638	8.710	.95	.33
Cigarettes	Avail/Immed/Dread/Catas	279.526	5.53	.77	.23
	Avail/Dread/Catas	279.959	5.60	.77	.23
	Avail/Immed/Dread/Catas/Control	280.118	6.68	.77	.24
	Avail/Dread/Catas/Control	280.519	6.67	.77	.23
	Avail/Immed/Dread/Catas/Rever	283.697	5.58	.76	.24
	Avail/Dread/Catas/Rever[1]	283.739	5.39	.77	.23
	Avail/Dread/Catas/Control/Rever[3]	284.904	6.76	.77	.24
	Avail/Immed/Catas	287.149	15.48	.79	.21
Chol.Diet	Avail/Dread/Control/Rever[2]	377.098	3.40	1.06	.33
	Avail/Dread/Rever	378.541	4.44	1.07	.33
	Avail/Immed/Dread/Control/Rever	379.405	5.39	1.07	.33
	Avail/Dread/Catas/Control/Rever[3]	379.867	5.0	1.07	.34
	Avail/Immed/Dread/Rever	380.817	6.41	1.07	.33
	Avail/Dread/Catas/Rever[1]	381.827	6.04	1.08	.31
	Avail/Immed/Dread/Catas/Rever	383.448	8.03	1.08	.31

[1]Model 1
[2]Model 2
[3]Model 3

(all but catastrophic potential and controllability) for the eighth (aspirin). In no case was the condition number greater than 30; in fact, in most instances it was well below 30. (Again, the condition number is the ratio of the largest to the smallest eigenvalue of the correlation matrix, a value over 30 indicating serious multicollinearity.) Furthermore, the largest condition number was always associated with the intercept, indicating that a variable might be a near-constant term, but that there were no linear dependencies among the regressor variables. R-square ranged from .29 to .55, and mean square error ranged from 0.55 to 1.11.

Role of Eight Variables in Concert

While the five variable model is a good performer according to important criteria, specifically, PRESS, Cp, MSE relative to models using the initial six regressor variables, and multicollinearity, it is very unimpressive when compared to the R-square for the definitional model, including probability and severity, alone. In order to explain a greater portion of the variance of the response variable, it would be necessary to bring in the two variables that conceptually define perceived risk: probability and severity. Despite the conceptual rationale for introducing probability and severity into the analysis with the other six regressors, there are two methodological concerns in bringing these two variables into the model. First, the fairly high correlations between these variables and several of the regressor variables make it possible that including them in the model would introduce undue multicollinearity into the model. Second, the PRESS statistic tends to favor the most parsimonious model possible. Therefore, introducing two more variables into the

model might increase the PRESS statistic, and thus make it unlikely that this criteria would agree with other criteria such as Cp.

Because of these concerns it is important to keep in mind the relationships among these criteria. For example, a high value of Cp is indicative of a high amount of variance in the coefficients and the prediction. However, the "magnitude of variance inflicted by the addition of marginal variables depends to a great extent on the multicollinearity induced by the 'questionable' regressors" (Myers, p.) Thus, a Cp that is higher than optimal is relatively harmless given regressors that are not collinear. Furthermore, given the goals of this research as primarily variable screening and model specification, the use of stringent criteria with regard to PRESS, which deals with the tertiary goal of prediction, may be unwarranted. It is therefore necessary to consider all criteria in concert, anticipating the lack of absolute convergence or consistency among criteria, and/or across products.

Thus, the next analysis was to assess the full, eight variable model. Again, the "all possible regression" procedure was run using Cp as a rank-ordering criteria, with only models with a Cp statistic of 9.0 or less (the number of parameters in the full model) considered. The results of this procedure are summarized in Table 25. While every product yielded at least one model that performed well according to Cp, notably absent is any commonality across products. On the contrary, eight products yielded eight "best" models. Clearly there were elements in common, but the configuration of variables was distinct in each case, indicating that subtle differences in risk perception occcured depending on the nature of the product. Most obvious, but not surprising, was the appearance of both probability and severity in each case. Availability and dreadedness appeared in seven out of eight "best" models,

controllability and reversibility in five of the eight, and immediacy and catastrophic potential in three of the eight.

As before, the next analysis was to run the same procedure using the PRESS statistic as a rank-ordering criterion. The results of this analysis are summarized in Table 26. Again, there is no consistent model that appears across the eight products; in fact, the eight "best" models are unique. Again, certain commonalities were found: probability and severity were present in all of the eight best models, availability in six of the eight, catastrophic potential and reversibility in four, dread in three, and immediacy and controllability in two. The next step was thus to combine the two criteria and look for convergence between them. This would indicate that, in the absence of one "unifying" model, individual models were performing well on these two criteria. By combining these two criteria, one "best" model could be chosen for each product; those models could then be analyzed further.

The two criteria were fairly consistent. Exact convergence was found for three of the eight products (monosodium glutamate, sun-tanning beds, and hair dryers). For bicycles the best PRESS model was the second best Cp model. For aerosol cans the second best Cp was the third best PRESS. For aspirin and cigarettes the best model represented the best Cp model, which was not calculated by the PRESS subroutine. Finally, the model for high-cholesterol diet was the fourth best Cp and the third best PRESS.

The next stage in the analysis was to perform a regression analysis on the best model for each product, again, to test the direction and significance of the variables, and assess multicollinearity, R-square and MSE.

Table 25. Candidate Models for Perceived Risk - Cp Statistic Regressor Variables: All

Product	Model	Cp
MSG	Catas/Rever/Dread/Prob/Sever	4.12
	Catas/Dread/Prob/Sever	4.52
	Immed/Catas/Rever/Dread/Prob/Sever	5.31
	Immed/Catas/Dread/Prob/Sever	5.84
	Catas/Contro/Rever/Dread/Prob/Sever	5.98
Sun-bed	Avail/Control/Prob/Sever	2.00
	Immed/Avail/Control/Prob/Sever	3.40
	Avail/Control/Rever/Prob/Sever	3.64
	Avail/Control/Dread/Prob/Sever	3.94
	Avail/Catas/Control/Prob/Sever	3.92
Bicycle	Avail/Catas/Control/Dread/Prob/Sever	6.65
	Avail/Catas/Control/Prob/Sever	7.36
	Avail/Catas/Control/Rever/Dread/Prob/Sever	7.37
	Avail/Catas/Control/Rever/Prob/Sever	7.90
Aerosol	Immed/Avail/Control/Dread/Prob/Sever	6.11
	Avail/Control/Dread/Prob/Sever	7.19
	Immed/Avail/Catas/Control/Dread/Prob/Sever	7.42
	Immed/Avail/Dread/Prob/Sever	7.52
	Avail/Catas/Control/Dread/Prob/Sever	7.76
	Avail/Dread/Prob/Sever	8.76
Hair Dryer	Avail/Catas/Rever/Prob/Sever	5.11
	Avail/Catas/Rever/Dread/Prob/Sever	5.34
	Avail/Catas/Rever/Dread/Prob	6.36
	Avail/Catas/Control/Rever/Prob/Sever	6.81
	Avail/Catas/Control/Rever/Dread/Prob/Sever	7.05
Aspirin	Avail/Control/Rever/Dread/Prob/Sever	7.08
	Control/Rever/Dread/Prob/Sever	7.43
	Immed/Control/Rever/Dread/Prob/Sever	7.65
	Immed/Avail/Control/Rever/Dread/Prob/Sever	7.84
Cigarettes	Avail/Rever/Prob/Sever	5.43
	Avail/Rever/Dread/Prob/Sever	6.08
	Avail/Control/Rever/Prob/Sever	6.18
	Avail/Catas/Rever/Prob/Sever	6.35
	Immed/Avail/Rever/Prob/Sever	6.48
	Avail/Control/Rever/Dread/Prob/Sever	6.70
	Immed/Avail/Control/Rever/Dread/Prob/Sever	7.77
Cholesterol	Immed/Avail/Control/Dread/Prob/Sever	6.32
	Avail/Control/Dread/Prob/Sever	7.08
	Immed/Avail/Control/Rever/Dread/Prob/Sever	7.13
	Avail/Control/Prob/Sever	8.41
	Avail/Rever/Dread/Prob/Sever	8.51

Table 26. Candidate Models for Perceived Risk - PRESS Statistic Regressor Variables: All

Product	Model	PRESS
MSG	Catas/Rever/Dread/Prob/Sever	216.906
	Catas/Rever/Prob/Sever	216.960
	Rever/Dread/Prob/Sever	217.016
	Rever/Prob/Sever	217.792
Sun-bed	Avail/Control/Prob/Sever	247.392
	Avail/Control/Rever/Prob/Sever	247.901
	Immed/Avail/Control/Prob/Sever	248.519
Bicycle	Avail/Catas/Control/Prob/Sever	247.528
Aerosol	Avail/Dread/Prob/Sever	288.504
	Avail/Prob/Sever	289.650
	Avail/Control/Dread/Prob/Sever	289.738
	Immed/Avail/Dread/Prob/Sever	289.839
Hair Dryer	Avail/Catas/Rever/Prob/Sever	196.830
	Avail/Catas/Rever/Dread/Prob/Sever	197.738
Aspirin	Immed/Rever/Dread/Prob/Sever	176.082
	Catas/Rever/Dread/Prob/Sever	177.874
	Control/Rever/Dread/Prob/Sever	178.013
Cigarettes	Immed/Avail/Catas/Prob/Sever	238.720
	Immed/Catas/Prob/Sever	239.078
	Avail/Catas/Prob/Sever	239.106
Cholesterol	Avail/Rever/Prob/Sever	290.167
	Avail/Dread/Rever/Prob/Sever	291.350
	Avail/Control/Prob/Sever	291.922
	Immed/Avail/Rever/Prob/Sever	291.645
	Avail/Control/Dread/Prob/Sever	292.322

Performance of Eight Best Individual Models

Each of the eight individual models are discussed briefly in turn. This information appears in summary form in Table 28, which includes the variables in the model, their associated probability levels and parameter estimates, R-square, MSE, the largest condition number and the largest variance inflation factor. Table 29 simply highlights whether a variable appeared in a particular model, to better illustrate the role of each individual variable. It should be noticed that each product has a unique best model, but that there would be no a priori reason to predict the best model for a particular product. For example, one might expect to see catastrophic potential in a model for aerosol cans, which is the only product in the set that clearly was perceived as effecting a large number of people in addition to the individual user. Similarly, one might expect dreadedness to be in the model for cigarettes, given that lung cancer was consistently judged as a dreadful outcome. In this multivariate context it is impossible to predict how a set of interrelated variables will interact. The fact that multicollinearity does exist in this data set, despite the fact that it is not present to the extent that the regression results are unduly damaged, makes a priori hypotheses about what particular variable will be significant for a particular product, in the presence of other variables, almost meaningless.

Monosodium glutamate: The model for monosodium glutamate included catastrophic potential, reversibility, dread, probability, and severity. The latter three were significant at or below a probability level of .03; catastrophic potential was at .08 and reversibility was at .10. The largest condition number was 2.68 (well below the cutoff of 30); the largest variance inflation factor (VIF) was 1.98 (well below the

cutoff of 5-10); R-square was .68, and MSE was 0.74. Parameter estimates were all in the direction hypothesized.

Sun-tanning beds: This model contained availability, controllability, probability, and severity. All variables were significant at or below a probability level of .04. The largest condition number was 1.97; the largest VIF was 1.38; R-square was .74, and MSE was 0.72. Parameter estimates were all in the hypothesized direction.

Bicycle: The model for bicycles included availability, catastrophic potential, controllability, probability, and severity. All variables were significant at or below a probability level of 0.003. The largest condition number was 1.76; the largest VIF was 1.22; R-square was .58; and MSE was .81. All parameter estimates were in the hypothesized direction.

Hair Dryer: This model included availability, catastrophic potential, reversibility, probability and severity. All variables were significant at or below a probability level of 0.01. The largest condition number was 1.92; the largest VIF was 1.41; R-square was 0.52, and MSE was .73. Parameter estimates were all in the hypothesized direction.

Aerosol cans: The best model for this product included immediacy, availability, controllability, dread, probability, and severity. All variables were significant at or below a probability level of .0003, with the exception of immediacy and controllability, which were at a level of .07. The largest condition number was 2.89; the largest VIF was 2.10; R-square was .78; and MSE was 0.77. Parameter estimates, with the exception of immediacy and controllability, were in the direction hypothesized.

Aspirin: The best model included availability, controllability, reversibility, dread, probability, and severity. With the exception of availability (.17), all variables

were significant at or below a probability level of 0.02. No condition number exceeded 2.44; no VIF exceeded 1.71; R-square was .68; and MSE was .66. With the exception of controllability, all parameter estimates were in the hypothesized direction.

Cigarettes: The best model for cigarettes included availability, reversibility, probability and severity, with all of those variables significant at or below a probability level of 0.002. The largest condition number was 1.98; the largest VIF was 1.47; R-square was .63, and MSE was .44. All parameter estimates were in the direction hypothesized.

High cholesterol diet: The best model in this case included availability, controllability, dread, probability, and severity. Controllability and dread achieved a probability level of .06; all others were at or below .0002. The largest condition number was 2.59; the largest VIF was 1.90; R-square was .69, and MSE was 0.62. All parameter estimates were in the direction hypothesized.

Performance of Full Eight Variable Model

At this point, the evidence is clearly against finding one unifying model of perceived risk. It does appear, however, that a subset of the full eight-variable model works well in every case. To determine the value of the full-eight variable model as a unified model of perceived risk, the most important criterion to assess would be multicollinearity. If the regressor variables are not severely collinear, the inclusion of all of them would be, even if not all were significant for a particular product, at least not unduly damaging to the coefficients or the prediction.

The full eight variable model was thus analyzed to diagnose any multicollinearity, even though severe multicollinearity was not suspected given the results of individual models. As expected, severe multicollinearity was not evident from either eigenvalues, variance inflation factors, condition numbers, or variance proportions. No collinearity diagnostic showed any evidence of any serious linear dependencies among the regressor variables. (The largest condition number was 3.30). It should be noted that multicollinearity was indeed present, but not to the extent that would be unduly damaging to the regression results.

Data Aggregated Across Products

In order to investigate the possibility that differences among products were not actually meaningful, that is, that differences between the various criteria used were so subtle that possibly one unifed model did exist, the data were aggregated and analyzed across products. The first analysis was to run 'all possible regressions', rank ordered according to the Cp statistic, using all of the regressor variables (other than probability and severity). The lowest value of Cp in this analysis, other than the full model where Cp is equal to the number of parameters), was 51.74, with an R-square of .67, for the model containing availability, immediacy, controllability, reversibility and dreadedness. The Cp value is so high as to suggest that the model is either extremely biased or suffers from extreme variance. The next step was to repeat the analysis, this time including probability and severity. In this case, the best model, including availability, immediacy, controllability, reversibility, dreadedness, probability and severity, had a Cp statistic of 17.49 and an R-square of .85.

Thus, while an aggregated model explains more of the variance in perceived risk, an aggregated model performs much worse according to Cp than does a product-specific model. To consider this comparison between a unified model and a product-specific model further, one can examine the Cp value for aggregated data for each "best" individual model. In other words, how well does an individual model perform for data that are aggregated? The Cp values for each product-specific model, when data were aggregated, were: MSG (136.69), sun-tanning beds (92.58), bicycles (90.27), aerosol cans (32.66), hair dryers (89.52), aspirin (29.52), cigarettes (89.74), and high-cholesterol diet (44.94). In every case, the best model for an individual product was extremely poor when the data were aggregated. In addition, it is useful to look at the Cp statistic for the best aggregated model across each product. In other words, how well does the best aggregated model do for any particular product? Those values were: monosodium glutamate (11.04), sun-tanning beds (7.01), bicycles (13.95), aerosol cans (7.75), hair dryers (12.28), aspirin (7.84), cigarettes (7.76), and high-cholesterol diet (7.13). While these values of Cp are not terribly high, when they are compared to those values for each individual product given in Table 25, it can be seen that individual models perform much better.

A regression analysis of the full model with data aggregated was also done to test for significance of the regressor variables and the extent of multicollinearity. All eight variables were significant at a probability level of .001; R-square was .85; MSE was .76, and the largest condition number was 3.78. While there is not a subset model with an acceptable value of the Cp statistic when data are aggregated across products, every variable in the full model is significant, and collinearity is not present to an extent that would be damaging to the regression results.

Intermediate Role of Probability and Severity

As discussed earlier, Figure I, as drawn, implies that the six regressor variables, immediacy, dreadedness, controllability, availability, reversibility, and catastrophic potential, are determinants of perceived risk through their determination of probability and severity. In other words, they impact on risk through and solely through, probability and severity.

Given that models were constructed, that had good performance criteria in explaining and predicting perceived risk, and that showed some of those six variables as being significant in the presence of probability and severity, it is clear that the six regressor variables do not determine perceived risk solely through probability and severity. Rather, they add a unique contribution to models of perceived risk in addition to probability and severity.

The next question becomes: do the six regressor variables act through probability and severity at all, or do they strictly have a direct and unique impact apart from their relationship with probability and severity? As discussed before, one way to consider this question is by looking at the linear dependencies among the regressor variables in the full model, that is, the model containing probability, severity, and the additional six regressor variables. Multicolinearity among these variables indicates that any one variable acts, to some degree, through it's relation to one or more of the others. The results of this research show that, while collinearity among the regressor variables is not unduly damaging to the regression, neither are the variables totally orthogonal to one another. The presence of multicollinearity, even to the extent that it exists in this data set, indicates that the six regressor variables may be viewed as acting, at least somewhat, through probability and severity.

To examine this relationship more specifically, it is possible to compare the R-square of the model of perceived risk regressed against the six independent variables with the R-square of the model of perceived risk against the six independent variables given probability and severity (that is, a conditional correlation partialling out the effect of probability and severity). If the R-square of the former model is significantly greater than the R-square of the latter, it would support the argument that the six regressor variables relate to perceived risk through probability and severity. This analysis was done; the results are presented in Table 27. For each product, the R-square of the former model is much larger than the R-square for the latter model. To illustrate, the product for which the two were most similar was hair dryers, with an R-square for the six variable model of .2946, and an R-square for the six variable model given probability and severity of .0641. These results indicate that much of the relationship of the six variables to perceived risk is through probability and severity, although the analysis does not specify exactly how much.

The next analysis was to look at probability and severity as dependent variables, to assess the regressor variables as determinants of probability and severity.

Probability and Severity as Dependent Variables

Probability: The first analysis was to run all possible regressions rank ordered according to the Cp statistic. Contrary to what was found when perceived risk was the dependent variable, there was a great deal of consistency across products. For four products (sun-beds, bicycles, aerosol cans, and cigarettes), the full model was best, with a Cp statistic equal to 6.0. For all other products, a subset model was

Table 27. Mediating Role of Probability and Severity

Product	R-square (6)	R-square (6/Prob & Sever)
MSG	.4449	.0331
Sun-beds	.3906	.0668
Bicycle	.3236	.0595
Aerosol Can	.5522	.1124
Hair Dryer	.2946	.0641
Aspirin	.4031	.0737
Cigarettes	.4102	.0906
Diet	.4102	.0491

better according to Cp, but the improvement of the subset over the full was slight. Specifically, the best subset model's Cp was 4.4, as opposed to 6.0 for the full model. In two of those four cases (MSG and high cholesterol diet), the best subset model included the variables availability, reversibility, dreadedness and catastrophic potential. For hair dryers, the best subset model was controllability, reversibility, dreadedness and catastrophic potential; for aspirin the best subset model included availability, controllability, reversibility and dreadedness. Furthermore, even when a subset model was better than the full model, the full model was always the second best.

Given the consistency of the full model as either best or a close second best, a regression analysis was done for each product using the full model. As would be expected from the Cp statistic, not every variable was significant for every product. However, given the lack of serious multicollinearity among the regressor variables, it is not harmful to the regression analysis to include all five variables in a unified model of probability. Values of R-square ranged from .20 to .53, and values of MSE ranged from .81 to 1.18.

This analysis showed that, contrary to the pattern of relationships illustrated in Figure 1, that is, with only three variables (controllability, catastrophic potential, and availability) as determinants of probability, indeed five regressor variables, including as well dreadedness and reversibility, are significant determinants of probability. This result is not surprising in light of the results presented and discussed earlier of correlational results which were not hypothesized. Specifically, correlations between probability and both reversibility and dreadedness were found to be significant across products, although no correlation was hypothesized. The results of probability as a dependent variable confirm the relationship between all probability and the five

regressor variables that was indicated previously in the correlational analysis. Thus, although no conceptual or theoretical relationship was presented or discussed between probability and both reversibility and dreadedness, there is consistent support for relationships.

Severity: Again, the first analysis was to examine all possible regressions rank ordered according to the Cp statistic. As with probability, there was a great deal of consistency across products. Specifically, for five products (MSG, sun-beds, bicycles, aerosol cans, and aspirin) the best model was a four-variable model containing availability, reversibility, dreadedness, and catastrophic potential. In all these five cases, the full model was the second best, with the difference between the best and the second best being, at most, 4.10 and 6.0. For two products, hair dryers and cigarettes, the full five-variable model was best. For the eighth product, high-cholesterol diet, the best model was the four-variable subset model of availability, controllability, reversibility and dreadedness, with a Cp value of 4.01. Again, the second best model for this product was the full model.

Next, a regression analysis was done for all eight products using all five variables. Again, not every variable was significant for each product (as would have been expected given the Cp statistics), but including all of them is not damaging from the standpoint of multicollinearity. Values of R-square ranged from .30 to .49, and values of MSE ranged from .46 to 1.26.

Once again, the results were inconsistent with the pattern of relationships illustrated in Figure 1. Specifically, Figure 1 shows all the regressor variables other than controllability to be determinants of severity. The results of this analysis show controllability to be a significant determinant of severity as well. As was the case with probability, these results were neither inconsistent with nor surprising given the

results of the correlational analysis. Specifically, controllability was found to be significantly correlated with severity across products, even though no such correlation was hypothesized, and no conceptual or theoretical rationale for such a relationship was presented or discussed.

The Multiplicative Effect of Probability and Severity

Empirical work has supported an additive combination rule, or "cognitive algebra" between probability and severity (Bettman 1973; Peter and Ryan 1976); however, other empirical work has assumed a multiplicative model. Therefore, the possibility that the two terms interact in a multiplicative manner was explored. A regression analysis was run for each product using the best model and including in addition an interaction term that was the product of probability and severity. The objective was to assess the significance of this term, and to assess the significance of the other variables in the presence of this term. Additionally, the models were evaluated with respect to R-square and multicollinearity.

For five products, the interaction term was significant. Those products (and their associated probability levels) are: MSG (.005), bicycles (.03), hair dryers (.01), aspirin (.0004), and cigarettes (.0005). For the remaining three products, sun-beds, aerosol cans, and high cholesterol diet, probability levels for the interaction term were .32, .10, and .90 respectively. An associated finding of this analysis was that for three of the products for which the interaction term was significant (bicycles, hair dryers and aspirin), and for one where it was not (aerosol cans), severity was no longer significant in the presence of the interaction term. No other variables which

were significant in the original model became insignificant in the presence of the interaction term, and none of the parameter estimates changed direction. R-square increased by no more than .01 for any model by including the interaction term. Multicollinearity, as would be expected, increased considerably, with the highest condition number for any model reaching 27.8. While this is still below the cutoff (30) at which multicollinearity is considered to be damaging enough to require an alternate estimation procedure, or for the regression results to be discounted, it is nevertheless approaching that point.

The results of this analysis indicate that consumers, in some cases, make evaluations of risk that are a function of their combined evaluations of probability and severity. Although probability and severity are isolated as separate constructs in defining perceived risk in this research, these results indicate that they are not altogether isolated in consumers' minds across products. Rather, they combine in a multiplicative fashion and act as a kind of "joint" determinant of perceived risk.

This raises the question of why the interaction term was significant for some products and not for others. Those products for which the interaction term was found to be significant (MSG, bicycles, hair dryers, aspirin, and cigarettes) did not reveal any consistent pattern of values of probability and severity. For example, both values were not consistently similar, nor consistently different, nor consistently high, nor consistently low. Values of probability were more similar to values of perceived risk than were values of severity, but that was true across all products, not only for those five products for which the interaction term was significant.

Similarly, the question is raised of why for some products (bicycles, hair dryers, aspirin, and aerosol cans) severity was no longer significant in the presence of the interaction term, and for some products it remained significant in the presence of the

interaction term. Again, no consistent pattern of mean values for each variable was found which would lend insight into that result. It does appear that, for at least some products, severity is a significant determinant of perceived risk only as it combines in a multiplicative fashion with probability.

Summary: Perceived Risk (Stage One)

To summarize, the results presented above related to variable screening and model specification for perceived risk are:

1. The model including the constructs probability and severity, which define perceived risk, performs reasonably well across products in explaining the variance of the dependent variable, as measured by R-square. However, it does not represent a good balance between the bias of underfitting a model and the variance of overfitting a model, as evidenced by a consistently large value of Mallow's Cp statistic.
2. The model including the constructs availability, catastrophic potential, controllability, dreadedness and reversibility performs reasonably well across products when evaluated by Mallow's Cp statistic and the PRESS statistic. However, it does not perform well in explaining the variance of the dependent variable, as measured by R-square. Minimal multicollinearity is seen among those five regressor variables. The construct immediacy did not appear as playing a significant role for any of the eight products.
3. It is possible to identify a unique "best" model for each individual product, that is a subset of the eight variables discussed in (1) and (2), that performs well

according to R-square, Cp, PRESS, and that has minimal collinearity among the regressor variables, and where each variable plays a significant role in explaining the variability in the response variable.

4. The full eight-variable model performs reasonably well as a "unified" model of perceived risk across all eight products. Not every variable plays a significant role for each product, but the collinearity among the variables is so low that inclusion of "extra" variables is not unduly damaging to the coefficients or to the prediction. The construct immediacy, which is never seen in a "best" model, does approach significance (when measured at a level of .05) in several cases.

5. The best model when both probability and severity are analyzed as dependent variables includes the five variable model including availability, controllability, dreadedness, reversibility, and catastrophic potential.

6. For half of the products, including a term in the model that is the product of probability and severity causes the variable severity to become insignificant.

Variable Screening and Model Specification: Acceptability

The second stage in the current research was to develop a model of acceptability for products that entail risk, again using the techniques and criteria described above. The variables that would be used for possible inclusion were perceived risk, beneficiality, and confidence.

The first step involved running the "all possible regressions" procedure, rank ordered according to Mallow's Cp statistic. In contrast to what was found for perceived risk, the pattern for acceptability was very consistent across products. With the two exceptions of cigarettes and high-cholesterol diet, the Cp statistic clearly indicated that perceived risk and benefit were the only two variables that belonged in the model. Specifically, those were the only two products for which the value of Cp was greater for the two variable model including risk and benefit than it was for the full model (where the value of Cp is equal to the number of parameters). This would indicate that confidence might be playing a significant role in perceptions of acceptability for these particular products, in that the model appears to be biased in the absence of confidence.

The PRESS statistic clearly confirmed the superiority of the two-variable model for six of the products. For the two products where Cp indicated that confidence might also be playing a role, the PRESS statistic still favored the two-variable model, but the difference in values of PRESS for the two and the three-variable models were not great (specifically, 632.519 vs. 636.206 for cigarettes, and 487.824 vs. 489.733 for high-cholesterol diet).

The third procedure was to run a full regression analysis on the best model for each product to assess the significance of each regressor, assess the model with regard to R-square and mean square error, and assess the extent and impact of multicollinearity in the model. Results of this procedure can be summarized very easily, given the consistency across products. (See Table 28 for a tabular summary of the models.)

For those six products where the two variable model was clearly the best, with only one exception, both perceived risk and benefit were significant at a probability

level of 0.0001; for hair dryers perceived risk was significant at a level of 0.04. The largest condition number for any of those six products was 1.39; the largest variance inflation factor (VIF) was 1.21. R-square ranged from 0.40 to 0.62; MSE ranged from 1.00 to 1.29. In every case parameter estimates were in the hypothesized direction.

For cigarettes, when confidence was included in the model, both risk and benefit had probability levels below 0.0001; confidence had a probability level of 0.095. R-square was .40, MSE was 1.26, no condition number was greater than 1.51, and no variance inflation factor wa greater than 1.17. Parameter estimates for all three variables were in the hypothesized direction.

For high-cholesterol diet, when confidence was included in the model, both risk and benefit were significant at a probability level at or below 0.001; confidence had a probability level of 0.045. R-square was .45, MSE was 1.32, no condition number was greater than 1.98, and no VIF was greater than 1.53. Parameter estimates for all three variables were in the hypothesized direction.

When the data were aggregated across products, the Cp statistic indicated that all three variables belong in the model. A regression analysis showed all three variables to be significant, with an R-square of .67, and with all parameter estimates in the hypothesized direction.

To summarize the variable screening and model specification for acceptability (stage two):

1. With the exception of cigarettes and high cholesterol diet, the two-variable model including perceived risk and beneficiality had the best performance with respect to Cp, PRESS, and MSE.

2. The model including perceived risk, beneficiality, and confidence was best for cigarettes and high-cholesterol diet, with respect to Cp, and second best with respect to PRESS. Confidence approached significance for cigarettes, (.095) and was significant for high-cholesterol diet (.045).

3. R-square was relatively low for all products, ranging from .40 to .62.

4. Multicollinearity among the regressor variables, to an extent that would seriously damage the regression results, was not found. 5. When data were aggregated across products, the best model contained perceived risk, beneficiality, and confidence.

Models of Perceived Risk and Acceptability: Faculty vs. Staff

Overview

The sample used in this study was comprised of faculty and classified staff. The concommitant demographic differences between those two groups, for example, education, income and sex, make it distinctly possible that models of perceived risk and acceptability would differ between those two groups. Therefore, the model selection procedure was repeated using those two sub-populations. Although the same procedure was followed as that described previously, for these sub-populations only the final model is discussed. As before, there was high convergence between Cp and

PRESS, and a model with good performance criteria was found for each of the eight products, for each of the two sub- populations. Although there was a good deal of overlap and consistency, the best models for each sub-group did differ both from each other, and from models for the population as a whole. A summary of each model, including variables and associated significance levels, R-square, MSE, condition numbers and variance inflation factors, is presented in Table 27.

The best models for each sub-group are discussed, by product, below. Over the sixteen models, the largest variance inflation factor was 2.45 (well below the cutoff of 5-10), and the largest condition number was 3.14 (well below the cutoff of 30). Because collinearity was clearly not a problem, diagnostics are not discussed for each model. Finally, and again in light of the caveat expressed previously about the importance of coefficients exhibiting the "appropriate" sign, all parameter estimates were in the hypothesized direction, with the following exceptions: catastrophic potential of hair dryers (staff), immediacy of monosodium glutamate and sun-tanning beds (faculty), controllability of aspirin (faculty), and catastrophic potential of high-cholesterol diet (faculty).

Perceived Risk: Faculty and Staff

What follows is a summary of the differences between faculty and staff for the models for each individual product. No systemmatic differences between those two groups were found. For example, neither group tended to place more or less importance on any one variable than another. Neither did either group tend to have more parsimonious models than the other. Results for each product appeared to be

idiosyncratic, making meaningful interpretations for differences between the two groups extremely difficult. The product for which faculty and staff had the most similar models was cigarettes. Perhaps this is because the health risks associated with cigarettes are so widely publicized that they are fairly consistently understood and interpreted; (one respondent remarked that she had information about the risks of cigarettes "ad nauseaum".) Consistent with this line of reasoning is the fact that models for aerosol cans, for which faculty might be expected to have a different level of understanding than staff, were fairly different between the two groups (although the groups still had several variables in common). Again, however, the differences were not ones that are intuitively clear. For example, one might expect faculty to have a better understanding of the catastrophic potential of depletion of the ozone layer than staff, but it was staff for whom this variable was important. What follows is a simple presentation of what the differences between the two groups were; little in the way of explanation for those differences can be found in this research.

Monosodium glutamate: The best models for both faculty and staff included probability, severity, and catastrophic potential. The additional variables immediacy and dread were in faculty's model (although, as usual, immediacy played a minor role), and reversibility was also included in the model for staff.

Sun-tanning Beds: Models for both faculty and staff were very similar, with both groups having models including availability, controllability, probability and severity. Faculty's model also included immediacy, and staff's model also included reversibility. It is conceivable again, that differences in level of sophistication of knowledge of skin cancer could account for the difference with respect to reversibility. There are two types of skin cancer, the far more common one being "curable", in that the cancers can be removed, and the far less common one usually

being fatal. This explanation may be reasonable, but only if we assume that faculty's knowledge of skin cancer is indeed the more sophisticated, with staff assuming a higher fatality rate associated with skin cancer.

Bicycle: Variables in common for the two groups for bicycles included probability, severity and controllability. Catastrophic potential was also in the faculty model, and availability and dreadedness were also in the staff model.

Aerosol cans: For faculty, variables included simply availability, probability, and severity, this being one of the most parsimonious models across products. The same three variables were in the staff model, with the addition of catastrophic potential and dreadedness. As discussed above, the difference with respect to catastrophic potential was counter to what might have been predicted.

Hair dryer: For faculty, variables included dread, availability, reversibility, and probability. This was the only case for which severity was not included. Staff had a "large" model, including three of the same variables as faculty (availability, reversibility, and probability) and an additional three (catastrophic potential, controllability, and severity). It is likely in this case that the risks associated with hair dryers is similarly understood by both faculty and staff, in that it is not a technical or otherwise difficult to understand risk. Nonetheless, the groups differed substantially.

Aspirin: Dreadedness, probability and severity were included in models for both faculty and staff; the model for faculty also included controllability and the model for staff also included availability. It may be that faculty are more aware of alternatives to aspirin that do not have the associated ill effects of stomach bleeding and ulcers, if in fact faculty considered the use of an alternative to aspirin a means of controlling the risk of aspirin.

Cigarettes: As discussed above, models for cigarettes were quite similar for the two groups, with the faculty model including availability, reversibility, probability and severity, and the staff model including the same variables with the exception of reversibility. The fact that they are similar may have something to do with the fact that the risks of cigarette smoking are widely publicized and discussed in the media, and the two groups may have very similar understandings of those risks.

High-cholesterol diet: Once again, both groups' models included availability, probability, and severity. Catastrophic potential was in the model for faculty, and dreadedness and controllability were in the model for staff.

Acceptability: Faculty and Staff

The model selection procedure was repeated for each of the two sub-groups for acceptability as well. Once again, only the final model for each population is discussed. A summary of each model, including variables and associated probability levels, R-square, MSE, condition numbers and variance inflation factors, is presented in Table 30.

Results were virtually unchanged for both groups for three products: monosodium glutamate, sun-tanning beds, and bicycles. Results were also unchanged for faculty with regard to aerosol cans, and for staff with regard to hair dryers. In these cases the best model clearly included only perceived risk and beneficiality once again, with R-square values ranging from .39 to .66, MSE ranging from .93 to 1.22, and all collinearity diagnostics well below criterion values.

Table 28. Summary of Best Models of Perceived Risk

Monosodium Glutamate (Product A)

Population:	Variables:	Catas	Rever	Dread	Prob	Sever
	P-value:	.0773	.1013	.0323	.0001	.0001
	Parameter Est.	.12	-.10	.13	.36	.46
	R-square: .68			MSE: .74		
	Largest condition #: 2.6			Largest VIF: 1.98		
Faculty	Variables:	Immed	Dread	Catas	Prob	Sever
	P-value:	.1201	.0070	.1521	.0001	.0001
	Parameter Est.	.12	.24	.18	.35	.43
	R-square: .68			MSE: .72		
	Largest condition #: 2.64			Largest VIF: 1.84		
Staff	Variables:	Catas	Rever	Prob	Sever	
	P-value:	.1622	.0154	.0001	.0001	
	Parameter Est.	.11	-.22	.38	.49	
	R-square: .67			MSE: .76		
	Largest condition #: 2.19			Largest VIF: 1.59		

Sun-tanning beds (Product B)

Population	Variables:	Avail	Control	Prob	Sever	
	P-value:	.0001	.0352	.0001	.0001	
	Parameter Est.	.17	-.05	.64	.27	
	R-square: .74			MSE: .72		
	Largest condition #: 1.97			Largest VIF: 1.38		
Faculty	Variables	Immed	Avail	Control	Prob	Sever
	P-value:	.0721	.0001	.0641	.0001	.0001
	Parameter Est.	.15	.21	-.06	.59	.30
	R-square: .76			MSE: .72		
	Largest condition #: 2.00			Largest VIF: 1.28		
Staff	Variables:	Avail	Control	Rever	Prob	Sever
	P-value:	.0023	.1906	.1804	.0001	.0023
	Parameter Est.	.16	-.04	-.10	.66	.20
	R-square: .72			MSE: .70		
	Largest condition Number: 2.11			Largest VIF: 1.55		

Table 28 (continued)
Summary of Best Models of Perceived Risk

Bicycle (Product C)

Population	Variables:	Avail	Catas	Control	Prob	Sever
	P-value:	0010	.0030	.0033	.0001	.0001
	Parameter Est:	10	.12	-.15	.61	.18
	R-square: .58			MSE: .81		
	Largest condition #: 1.76			Largest VIF: 1.22		
Faculty	Variables	Catas	Control	Prob	Sever	
	P-value:	.0025	.1420	.0001	.0001	
	Parameter Est:	18	-.11	.67	.23	
	R-square: .58			MSE: .85		
	Largest condition Number: 1.45			Largest VIF: 1.05		
Staff	Variables:	Avail	Dread	Control	Prob	Sever
	P-value:	.0017	.0161	.0024	.0001	.0793
	Parameter Est:	13	.12	-.20	.55	.08
	R-square: .61			MSE: .74		
	Largest condition Number: 2.24			Largest VIF: 1.54		

Aerosol Cans (Product D)

Population	Variables:	Immed	Avail	Control	Dread	Prob	Sever
	P-value:	.0782	.0001	.0696	.0003	.0001	.0001
	Parameter Est:	.09	.14	.05	.13	.60	.20
	R-square: .78			MSE: .77			
	Largest condition #: 2.89			Largest VIF: 2.10			
Faculty	Variables	Avail	Prob	Sever			
	P-value:	.0018	.0001	.0490			
	Parameter Est:	15	.69	.12			
	R-square: .77			MSE: .81			
	Largest condition #: 2.53			Largest VIF: 2.05			
Staff	Variables:	Avail	Dread	Catas	Prob	Sever	
	P-value:	.0007	.0193	.0544	.0001	.0001	
	Parameter Est:	16	.12	-.11	.48	.36	
	R-square: .78			MSE: .73			
	Largest condition #: 3.14			Largest VIF: 2.45			

Table 28 (continued)
Summary of Best Models of Perceived Risk

Hair Dryer (Product E)

Population	Variables:	Avail	Catas	Rever	Prob	Sever
	P-value:	.0004	.0136	.0001	.0001	.0098
	Parameter Est.	.09	.13	-.17	.64	.07
	R-square: .52			MSE: .73		
	Largest condition #: 1.92			Largest VIF: 1.41		
Faculty	Variables	Avail	Rever	Dread	Prob	
	P-value:	.0036	.0005	.1938	.0001	
	Parameter Est.	.10	-.20	.06	.79	
	R-square: .64			MSE: .67		
	Largest condition #: 1.69			Largest VIF: 1.27		
Staff	Variables:	Avail	Catas	Control	Rever	Prob	Sever
	P-value:	.0272	.0100	.0228	.0155	.0001	.0001
	Parameter Est.	.09	.18	-.12	-.14	.42	.14
	R-square: .47			MSE: .76			
	Largest condition #: 2.01			Largest VIF: 1.51			

Aspirin (Product F)

Population	Variables:	Avail	Control	Rever	Dread	Prob	Sever
	P-value:	.1686	.0236	.0007	.0022	.0001	.0001
	Parameter Est.	.04	.06	-.18	.13	.57	.20
	R-square: .68			MSE: .66			
	Largest condition #: 2.44			Largest VIF: 1.71			
Faculty	Variables	Dread	Control	Rever	Prob	Sever	
	P-value:	.0140	.0323	.0010	.0001	.0001	
	Parameter Est.	.14	.07	-.25	.56	.24	
	R-square: .75			MSE: .62			
	Largest condition #: 2.38			Largest VIF: 1.72			
Staff	Variables:	Avail	Dread	Prob	Sever		
	P-value:	.0387	.0347	.0001	.0071		
	Parameter Est.	.09	.13	.58	.16		
	R-square: .59			MSE: .72			
	Largest condition #: 2.21			Largest VIF: 1.58			

Table 28 (continued)
Summary of Best Models of Perceived Risk

Cigarettes (Product G)

Population	Variables:	Avail	Rever	Prob	Sever
	P-value:	.0001	.0022	.0001	.0001
	Parameter Est.	19	-.11	.38	.24
	R-square: .63			MSE: .44	
	Largest condition #: 1.98			Largest VIF: 1.47	
Faculty	Variables:	Avail	Rever	Prob	Sever
	P-value:	.0004	.0018	.0001	.0374
	Parameter Est.	21	-.19	.41	.17
	R-square: .65			MSE: .49	
	Largest condition #: 2.20			Largest VIF: 1.56	
Staff	Variables:	Avail	Prob	Sever	
	P-value:	.0003	.0001	.0001	
	Parameter Est.	17	.31	.32	
	R-square: .60			MSE: .37	
	Largest condition #: 1.84			Largest VIF: 1.39	

High-cholesterol diet (Product H)

Population	Variables:	Avail	Control	Dread	Prob	Sever
	P-value:	.0002	.0644	.0614	.0001	.0001
	Parameter Est.	14	-.04	.05	.45	.35
	R-square: .69			MSE: .62		
	Largest condition #: 2.59			Largest VIF: 1.90		
Faculty	Variables	Avail	Catas	Prob	Sever	
	P-value:	.0177	.2425	.0001	.0001	
	Parameter Est.	13	-.04	.54	.34	
	R-square: .73			MSE: .61		
	Largest condition #: 2.56			Largest VIF: .77		
Staff	Variables:	Avail	Dread	Control	Prob	Sever
	P-value:	.0007	.0935	.0312	.0001	.0001
	Parameter Est.	19	.06	-.06	.31	.36
	R-square: .61			MSE: .64		
	Largest condition #: 2.51			Largest VIF: 1.84		

Table 29. Role of Each Variable in Models of Perceived Risk

	Avail	Immed	Dread	Catas	Control	Rever	Prob	Sever
MSG								
Population:			x	x		x	x	x
Faculty:		x	x	x			x	x
Staff:				x		x	x	x
Sun-beds								
Population:	x				x		x	x
Faculty:	x	x			x		x	x
Staff:	x				x	x	x	x
Bicycle								
Population:	x			x	x		x	x
Faculty:				x	x		x	x
Staff:	x		x		x		x	x
Aerosol Cans								
Population:	x	x	x		x		x	x
Faculty:	x						x	x
Staff:	x		x	x			x	x
Hair Dryer								
Population:	x			x		x	x	x
Faculty:	x		x			x	x	
Staff:	x			x	x	x	x	x
Aspirin								
Population:	x		x		x	x	x	x
Faculty:			x		x	x	x	x
Staff:	x		x				x	x
Cigarettes								
Population:	x					x	x	x
Faculty:	x					x	x	x
Staff:	x						x	x
High-cholesterol Diet								
Population:	x		x		x		x	x
Faculty:	x			x			x	x
Staff:	x		x		x		x	x

For the remaining cases, the Cp criterion indicated that confidence might be playing a significant role as well. For those cases, regression analyses were done including confidence to more closely examine its role.

For faculty's assessment of hair dryers, perceived risk actually dropped out of the model, leaving only beneficiality and confidence. For staff's assessment of aerosol cans, confidence joined perceived risk and beneficiality, but not in a major role.

For aspirin, the three-variable model was best for faculty. In contrast, for staff the model including only beneficiality was clearly the best.

For cigarettes, the perceived risk/beneficiality model was best for faculty. In contrast, for staff the model also included confidence.

Finally, for high-cholesterol diet, the perceived risk/beneficiality model was best for faculty. For staff however, the addition of confidence improved the model.

In every case, collinearity diagnostics were well below criterion values, and parameter estimates were in the hypothesized direction.

Residual Analysis

Residuals are defined as the difference between an observation and its corresponding fitted value or, simply, the deviation between the *data* and the *fit*. Since the residuals are actually the observed values of the errors, any departures from the underlying assumptions on the errors should show up in the residuals. Thus, a primary motivation behind the analysis of residuals is to assess the validity of the assumptions upon which the basic regression model is based. Violations in these

Table 30. Summary of Best Models of Acceptability

Monosodium Glutamate (Product A)

Population:	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.33	.53	
	R-square: .40			MSE: 1.13
	Largest condition #: 1.28			Largest VIF: 1.06
Faculty	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.34	.55	
	R-square: .41			MSE: 1.11
	Largest condition #: 2.11			Largest VIF: 1.64
Staff	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.31	.53	
	R-square: .39			MSE: 1.15
	Largest condition #: 1.34			Largest VIF: 1.08

Sun-tanning beds (Product B)

Population	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.31	.59	
	R-square: .45			MSE: 1.14
	Largest condition #: 1.26			Largest VIF: 1.05
Faculty	Variables	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.27	.44	
	R-square: .39			MSE: .94
	Largest condition #: 1.34			Largest VIF: 1.13
Staff	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est.:	.45	.59	
	R-square: .50			MSE: 1.21
	Largest condition Number: 1.44			Largest VIF: 1.14

Table 29 (continued)
Summary of Best Models of Acceptability

Bicycle (Product C)

Population	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est:	.25	.75	
	R-square: .43			MSE: 1.10
	Largest condition #: 1.38			Largest VIF: 1.11
Faculty	Variables	Risk	Benefit	
	P-value:	.0018	.0001	
	Parameter Est:	.22	.81	
	R-square: .43			MSE: 1.03
	Largest condition Number: 1.42			Largest VIF: 1.13
Staff	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est:	.31	.68	
	R-square: .42			MSE: 1.17
	Largest condition Number: 1.39			Largest VIF:1.11

Aerosol Cans (Product D)

Population	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est:	.28	.62	
	R-square: .61			MSE: 1.00
	Largest condition #: 1.44			Largest VIF: 1.14
Faculty	Variables	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est:	.31	.58	
	R-square: .66			MSE: .95
	Largest condition #: 1.60			Largest VIF: 1.24
Staff	Variables:	Risk	Benefit	Confidence
	P-value:	.0001	.0001	.1461
	Parameter Est:	.29	.62	.09
	R-square: .59			MSE: 1.03
	Largest condition #: 1.77			Largest VIF: 1.35

Table 29 (continued)
Summary of Best Models of Acceptability

Hair Dryer (Product E)

Population	Variables:	Risk	Benefit	
	P-value:	.0443	.0001	
	Parameter Est:	.14	.77	
	R-square: .49			MSE: 1.29
	Largest condition #: 1.07			Largest VIF: 1.00
Faculty	Variables	Benefit	Confidence	
	P-value:	.0001	.1576	
	Parameter Est.	.77	.10	
	R-square: .47			MSE: 1.34
	Largest condition #: 1.18			Largest VIF: 1.03
Staff	Variables:	Risk	Benefit	
	P-value:	.0396	.0001	
	Parameter Est:	.19	.74	
	R-square: .49			MSE: 1.23
	Largest condition #: 1.00			Largest VIF: 1.00

Aspirin (Product F)

Population	Variables:	Risk	Benefit	
	P-value:	.0001	.0001	
	Parameter Est:	.24	.80	
	R-square: .48			MSE: 1.07
	Largest condition #: 1.40			Largest VIF: 1.11
Faculty	Variables	Risk	Benefit	Confidence
	P-value:	.0001	.0001	.0096
	Parameter Est:	.43	.75	.15
	R-square: .60			MSE: .91
	Largest condition #: 1.51			Largest VIF: 1.16
Staff	Variables	Benefit		
	P-value:	.0001		
	Parameter Est.	.81		
	R-square: .42			MSE: 1.17
	Largest condition #:			Largest VIF:

Table 29 (continued)
Summary of Best Models of Acceptability

Cigarettes (Product G)

Population	Variables:	Risk	Benefit	Confidence
	P-value:	.0001	.0001	.0945
	Parameter Est:	.55	.61	.16
	R-square: .40			MSE: 1.26
	Largest condition #: 1.51			Largest VIF: 1.17
Faculty	Variables:	Risk	Benefit	
	P-value:	.0023	.0001	
	Parameter Est:	.37	.42	
	R-square: .31			MSE: 1.16
	Largest condition #: 1.52			Largest VIF: 1.19
Staff	Variables:	Risk	Benefit	Confidence
	P-value:	.0001	.0001	.0167
	Parameter Est:	1.04	.73	.33
	R-square: .54			MSE: 1.24
	Largest condition #: 1.49			Largest VIF: 1.16

High-cholesterol diet (Product H)

Population	Variables:	Risk	Benefit	Confidence
	P-value:	.0001	.0001	.0448
	Parameter Est:	.34	.62	.16
	R-square: .45			MSE: 1.31
	Largest condition #: 1.98			Largest VIF: 1.53
Faculty	Variables	Risk	Benefit	
	P-value:	.0004	.0001	
	Parameter Est:	.31	.60	
	R-square: .49			MSE: 1.13
	Largest condition #: 2.10			Largest VIF: 1.64
Staff	Variables:	Risk	Benefit	Confidence
	P-value:	.0009	.0001	.0713
	Parameter Est:	.34	.62	.22
	R-square: .42			MSE: 1.15
	Largest condition #: 1.81			Largest VIF: 1.38

assumptions may indicate an unstable model which would change, possibly considerably, were a different sample used. Specifically, residual analysis yields information on model underspecification, departure from the assumption of homogeneous variance, the existence of suspect data points, departure from normality in the model errors, and highly influential data points (Myers 1986).

Detection and Treatment of Outliers

An outlier is an extreme observation, its atypicality from the rest of the data making it suspect. Some such points are "bad" values, the result of unusual but explainable events such as faulty measurement or incorrect recording of the data. Such values will either be corrected (where possible) or deleted from the data set. However, there should be strong non-statistical evidence that the outlier is a "bad" value before it is deleted, because an outlier may be a perfectly plausible and informative observation.

Three possibilities exist in the case of suspicious data points: (1) there is a breakdown in the model at that point producing a location shift, (2) there is a breakdown in the model at that point and the variance of the error at that location exceeds the error variance at the other data locations, and (3) the large disturbance is produced by chance. In any case, the model breakdown is manifested in a residual that is expected to be large in magnitude for a data point at that specific location. One statistical diagnostic that can be used to assess such model breakdowns is the studentized residual to determine if the residual is further from zero than would be expected under ideal conditions. A second diagnostic is the R-student statistic,

which has two advantages over the studentized residual. First, it uses a root residual mean square that is calculated without utilizing the ith observation. In that model misspecification can result in an upwardly biased s^2 ,it is appropriate to use an alternative estimator for sigma. The difference between the two diagnostics will depend on the influence exerted on the results by the ith observation. The second advantage of the R- student statistic is that, because it follows a t-distribution, it allows a formal mechanism for detection of outliers and increases in error variance at the ith data point through hypothesis testing. As a very rough guide, an R-student of plus or minus 2 will signal that a model breakdown or an increase in error variance at the ith point is indicated.

R-student statistics were examined using the best model for each product for perceived risk and acceptability. In a data set this size, one would expect to find approximately 14 observations with an R-student of plus or minus 2. The number of R-students at or above this cutoff ranged from 9 to 17 per product. Given that the number detected was that which would be expected in a sample this size, there was no need to further analyze any individual point at this juncture.

Residual plots

There are two residual plots that can be used to detect outliers. The first analysis would be to plot the *ordinary residuals against the fitted* values to look for either model underspecification or a deviation from the homogeneous variance assumption. A random pattern of points around zero with no detectable trend would depict the ideal situation. The second analysis would be to plot the *studentized res-*

iduals (i.e., standardized residuals) against the fitted values, the advantage of this analysis over the first being that standardization eliminates the effect of the location of the data point in the regressor space. For example, a data point that is remote from the data center will have a small residual, thus masking any model inadequacy. Again, a random pattern of points around zero with no detectable trend would depict the ideal situation. Given the number of plots that would be necessary to examine in this research (one for each variable, for each product, for each sample), and the difficulty of interpreting plots of a data set this size, only a subset of plots were done. To illustrate a "worst case" scenario, a residual plot was done for one product where the two sub-populations differed from both each other and from the population as a whole (sun-tanning beds). The variable availability was chosen because it appears among all three groups. The pattern of points was close enough to the ideal that no problem of homogeneity of variance was diagnosed.

Partial Regression Leverage Plots

In order to illustrate the true role of each of the regressor variables, plots can be made of an adjusted y against an adjusted x_j, where adjusting means that the linear dependency of x with the other x's has been removed. Thus, there would be one plot for each regressor variable. Information available from such plots include (1) a pictorial display of the relative strength of a variable, with strong explanatory regressors resulting in plots with points approximating a straight line, (2) indications of necessary transformations on a regressor, and (3) the uncovering of points that have a disproportionate amount of influence on the regression results.

Again, because of the large number of plots that would be involved, and the difficulty in interpreting plots using a data set of this size, only a subset of the possible plots were made, again for the products sun-tanning beds and cigarettes, because they represented products for which the three populations were different and similar, respectively. These plots did not illustrate either the need to transform a regressor, or any points that had a disproportionate amount of influence on the regression results.

Influence Diagnostics

Identification of Highly Influential Observations

Those points set aside as "suspect" through analysis of residuals need to be further analyzed in order to assess their amount of "influence" on the regression results such as predicted values, estimated coefficients, and performance criteria. Again, there are several diagnostics that can be used to determine highly influential observations.

First, an R-student statistic (discussed in the previous section) signals an unusually large error in fit; however it assesses neither the extent of the influence nor what statistics are being influenced. The HAT diagonals provide a measure of standardized distance that a point is from the centroid of the data, and as such is a measure of leverage, pinpointing points that are extreme in the x direction. A point with a large HAT diagonal does not necessarily exert undue influence on the re-

gression coefficients if it follows the trend in the model set by the other data points. Thus, the first diagnostic that was used was examination of the HAT diagonals; data points with large HAT diagonals and relatively large residuals were considered highly influential. A large HAT diagonal is loosely defined as greater than 2p/n (Myers 1986). In this research, a large HAT diagonal was defined as greater than 0.05.

Influence is thus a combination of leverage (as measured by the HAT diagonal) and the nature of the fit of the model to the point in question (as measured by the residual). There are a group of statistics based on removing a data point from the rest of the data that can be used to determine the extent of influence. The first of these is DFFITS, which measures the influence an observation has on a predicted value. The value of (DFFITS)i is the number of estimated standard errors that the fitted value changes if the ith point is removed from the data set. The next relates to the influence on the regression coefficients: DFBETAS, which gives the number of standard errors that the coefficient changes if the ith observation were removed. While there are available cutoffs for each of these statistics, these cutoffs are merely signals of high influence, and should not be taken as proof that the results would be significantly different with the removal of a particular point. In general, a value of 2.0 for either DFFITS or DFBETAS is extremely rare in a data set of the size used in the current study, and observations of that degree of infuence should be further analyzed.

Handling High Influence Points

Highly influential points should typically be re-evaluated to see if deletion is warranted (as in the case of an invalid data gathering procedure). If its elimination is unwarranted, its information value should be analyzed.

In this research, there were several points for each product that had high values of R-student, however, no more than would be expected in a data set of this size. There was, however, one observation for Product G (cigarettes), whose unusually high R-student (-5.71), in tandem with a high HAT diagonal (.06), resulted in a high value of DFFITS (-1.48). Although the common cutoff for DFFITS is 2.0, the value for this particular point was different enough from the rest of the values of DFFITS to warrant further attention.

This particular observation was first inspected to see if there was any reason to delete it, for example, if the survey was obviously carelessly filled out. Although it was in no way "suspicious", the model selection procedure was repeated with the observation omitted to assess it's actual influence. The Cp ranking indicated that an additional variable (catastrophic potential) might be playing a significant role. Thus, the regression analysis was also repeated. This analysis indicated that the deletion of that one observation was enough to bring that variable into the model at a probability level of .0687 (for the analysis of faculty, from which group the observation came). For the population as a whole, that variable entered the model at a probability level of .1630. The conclusion at this point can only be that catastrophic potential may possibly be playing a more important role in explaining the perceived risk of cigarettes than what was discovered through the foregoing analysis.

In no other case was the influence of a single point large enough to alter either the sign of a coefficient or its role in the model; therefore, there was no need to either delete them or further analyze them.

Summary

In summary, this chapter presented the analytic procedures and findings of the study. A respondent profile was described, detailing various demographic data about the two major groups of respondents: faculty and classified staff. The two groups were of approximately equal size, and differed in ways that would be expected, specifically on education and the demographic differences that typically accompany education (sex and income). Assessment of the measurement instrument showed that the items were internally consistent, and conformed to criteria for discriminant and nomological validity. Scale values for each construct by product were presented, illustrating that each construct was represented over a range of low to high values.

Criteria for variable screening and model selection were discussed, and models were selected for each of the eight products for perceived risk and for acceptability. It was possible to construct a model with good performance criteria for each of the eight products, and although there was considerable overlap, each of the eight models differed from one another. The procedure was followed for the population as a whole, as well as for the two sub-populations (faculty and classified staff); the two sub-populations differed from one another but, again, there was considerable overlap between the two groups.

Chapter 5

Conclusions and Directions for Future Research

Overview

This chapter provides an overview of the study and then discusses the findings and conclusions that can be drawn. Next, theoretical, methodological, and substantive implications are discussed. Then, the limitations and boundaries of the study are identified. Finally, suggestions for future research are made.

Study Overview

Objectives

This research sought to better understand the antecedents of consumers' perceptions of risk (health and safety risks specifically), and the relationship between the perceived risk of an option, and judgments about the acceptability of that option. The specific objective of the proposed research was to build a model of risk perception and risky option acceptability for hazardous products and activities (i.e., that present downside risks to a consumer's health and safety), using several variables that have been postulated to be important, using a multiple linear regression model building approach. One goal was to integrate the study of perceived risk in consumer behavior with various concepts and models of risk perception and risk acceptability from the behavioral decision sciences, an integration suggested previously by Jacoby (1981). Emphasis was placed on conceptual and methodological issues that confront researchers from either domain that need to be resolved if risk is to occupy a central place in marketing theory.

The general framework illustrating how several proposed variables are suggested to relate to risk perception and alternative evaluation in the current research appears in Figure 1 in Chapter 1. As discussed in Chapter III, the framework suggests a number of variables that influence risk perception, in addition to perceived probability and severity of outcome, which constitute the conceptual definition of risk: availability, controllability, immediacy of effect, reversibility, dreadedness of outcome, and catastrophic potential of outcome. Variables suggested to influence

the acceptability of risky options include perceived benefits, perceived risks, and confidence.

Hypotheses

The context of this research as model building is, to a large extent, exploratory and, thus, without explicit hypotheses. The very inclusion of certain variables for measurement and testing, however, implies that those variables are hypothesized as being significant determinants of perceived risk and acceptability. Implicit as well is the hypothesized direction of the correlational relationship between those variables and those two constructs.

Two of the variables included in the study of the determinants of perceived risk comprise the conceptual definition of perceived risk used in this research: probability of a negative outcome, and severity of a negative outcome. Specifically, both were hypothesized to be positively correlated with perceptions of risk.

Six additional variables were also examined as determinants of perceived risk. Given the definition of risk used in this research, these variables relate to either or both of the constructs probability and severity, and implicitly were also hypothesized to be significant determinants of risk perception. The variable examined that relates to probability exclusively was controllability. Specifically, a negative relationship was hypothesized between the perceived risk of a product and the controllability of the negative outcome associated with that product. Variables which relate to severity exclusively include reversibility, dreadedness, and immediacy. Specifically, judgments of negative consequences as immediate, dreaded, and irreversible were

hypothesized to be positively correlated with perceptions of risk. Finally, two variables that relate to both probability and severity included availability and catastrophic potential. Specifically, there should be a positive relationship between the perceived risk of a product and the availability and catastrophic potential of the negative outcome associated with that product.

In summary, there were eight variables examined as possible determinants of risk perception, including (with hypothesized direction of relationship): probability of outcome (+), severity of outcome (+), dreadedness of outcome (+), reversibility of outcome (-), immediacy of outcome (+), availability of outcome (+), controllability of outcome (-), and catastrophic potential of outcome (+).

Variables examined as determinants of acceptability included perceived risk (-), beneficiality (+), and confidence (+).

Operationalization and Measure Development

The procedure for measure development followed the framework for developing better measures of marketing constructs proposed by Churchill (1979). That framework involves: 1) specification of the domain of the construct; 2) generation of a sample of items; 3) data collection; 4) measure purification; 5) data collection; 6) assessment of reliability; 7) assessment of validity; and 8) development of norms. Multiple-item measures were developed over a series of three pre-tests, using at various stages as subjects undergraduate students, and faculty and graduate students both inside and outside of marketing.

In addition to the goal of measure development during this series of pre-tests, another goal was to identify a set of products that could be used as stimuli. The objective was to find a set of products that would represent high, medium and low levels of each construct. Products were presented to subjects along with an associated negative consequence. The final set of eight products (along with the associated negative consequence) were: monosodium glutamate (headache), sun-tanning beds (skin cancer), bicycles (head injury), aerosol cans (depletion of earth's protective ozone layer), hair dryers (electric shock), aspirin (stomach bleeding/ulcer), cigarettes (lung cancer), and high-cholesterol diet (heart disease).

Sample and Data Collection

On May 9, 1988, an introductory letter describing the purpose of the research and requesting participation was mailed to a random sample of faculty and classified staff from Virginia Tech. On May 12 and 13 the survey was mailed to faculty and staff, respectively. Of the 689 subjects solicited to participate, 359 were faculty and 330 were classified staff. Subjects were compensated for their participation by being entered in a raffle for cash prizes. Response was very good, with a total response rate of 64%, with the percentage of usable responses being 51%. Another 9% were received after the two week deadline; 4% were incomplete or otherwise unusable. A short follow-up survey to assess the extent of non-response bias was also done.

Data Analyses

The areas of perceived risk and acceptability are among a large class of areas in the social and behavioral sciences where it is unlikely that a perfectly specified model can be built. The intention was to use regression analysis, which is a statistical technique for investigating and modeling the relationship between variables, to build models that would reasonably approximate "reality" and that would work well in the range of data used to build them. Rather than assume that one unified model existed that would perform well across all products, individual models for each product were constructed to look for patterns and commonalities. Variable screening and model specification was done using the REGRESSION and RSQUARE procedures of SAS. Pre-test and measure quality analyses were assessed using the RELIABILITY and CORRELATION procedures of SPSSX. Data were analyzed for both the entire population of faculty and staff, and for each of those two subpopulations separately.

Findings

Findings of the research will be discussed in two sections: 1) with respect to variable screening and model specification, and 2) with respect to the role of each variable.

<u>1) Variable Screening and Model Specification</u>

Dependent Variable: Perceived Risk (Entire Population of Respondents): To summarize the results presented in Chapter IV related to variable screening and model specification for perceived risk for the population as a whole:

1. The model of perceived risk as a function of probability and severity, the constructs used to define perceived risk, performs reasonably well across products in explaining the variance of the dependent variable, as measured by R-square (which ranged from .53 to .74). However, it does not represent a good balance between the bias of underfitting a model and the variance of overfitting a model, as evidenced by a consistently large value of Mallow's Cp statistic. This research indicates that while the definition of perceived risk as a function of probability and severity remains an accurate and a useful one, that a comprehensive model of perceived risk needs to incorporate variables other variables as well.
2. Perceived risk as a function of availability, catastrophic potential, controllability, dreadedness and reversibility performs reasonably well across products when evaluated by Mallow's Cp statistic and the PRESS statistic. However, it does not perform as well in explaining the variance of perceived risk, as measured by R-square (which ranged from .24 to .50). Therefore, this research indicates that while these five variables are important in a comprehensive model of perceived risk, they are not sufficient and cannot be viewed as replacing probability and severity. Minimal multicollinearity is seen among those five regressor variables, meaning that while each variable might not be important for any individual product, including all of them together would not yield regression results that are unduly damaged. Model selection criteria used indicate that immediacy did not appear to be a significant determinant for any of the eight products in the presence of the other five variables. Possible reasons for this were discussed previously.
3. It is possible to identify a unique "best" model for each individual product, that is a subset of the eight variables discussed in (1) and (2), that explains a rea-

sonable amount of variability in perceived risk, has little bias and variance, predicts fairly well, has minimal collinearity among the regressor variables, and where each variable plays a significant role in explaining the variability in the response variable. Given the multiple criteria that were used in model selection, one can be confident that each model is the best possible (given the variables considered).

4. The full eight-variable model performs reasonably well as a "unified" model of perceived risk across all eight products. Not every variable plays a significant role for each product, but the collinearity among the variables is so low that inclusion of "extra" variables is not unduly damaging to the coefficients or to the prediction. Thus, if one wanted to know the model for some product other than the eight examined here, the full model could be used, and the worst that could happen is that more variables than are really necessary are included. In such a case, one or more variables might not turn out to be significant, but damaging multicollinearity among the variables would be highly unlikely.

5. For both probability and severity as dependent variables, the best model is a five variable model including availability, controllability, reversibility, dreadedness and catastrophic potential. This research indicates a very close relationship between probability and severity, in that the same five variables appear as determinants of both constructs. Although no conceptual or theoretical relationship was suggested in the review of literature between probability and both reversibility and dreadedness, nor between severity and controllability, an empirical relationship was found between these variables. It is suggested that probability and severity are so closely related both to one another that it is very difficult to isolate the two constructs from one another. This very close re-

lationship is supported in the next summary point, relating to the multiplicative effect of probability and severity.

6. Analysis of the effect of a multiplicative term (the product of probability and severity) indicates that consumers, in some cases, make evaluations of risk that are a function of their combined evaluations of probability and severity. That is, probability and severity combine in a multiplicative fashion and act as a kind of "joint" determinant of perceived risk. Furthermore, in some cases, the multiplicative effect of probability and severity eliminates the effect of severity alone. Thus, while probability and severity are conceptually distinct contructs, consumers do not necessarily deal with them as isolated, distinct constructs to be evaluated independently. Thus, events or information which impact a consumer's assessment of the probability of an outcome, may also impact that consumer's assessment of it's severity, and vice versa.

Dependent Variable: Acceptability (Entire Population): To summarize the variable screening and model specification for acceptability for the population as a whole:

1. With the exception of cigarettes and high cholesterol diet, the two-variable model including perceived risk and perceived beneficiality had the best performance with respect to bias, variance, prediction and error. Perceived beneficiality was the best single-variable model in every case, as measured by both Cp (bias and variance) and percent of variability explained. Thus, beneficiality is a more important determinant of acceptability than is perceived risk. In the risk/benefit tradeoff, this research indicates that benefits outweigh risks.
2. The model including perceived risk, beneficiality, and confidence was best for cigarettes and high-cholesterol diet, with respect to Cp (the balance between bias

and variance) and second best with respect to PRESS (prediction of response). Confidence approached significance for cigarettes, (.095) and was significant for high-cholesterol diet (.045). While confidence received limited empirical support as a determinant of acceptability in this research, it should not be abandoned at this point.

3. R-square was lower than that found for perceived risk for all products, ranging from .40 to .62. Nonetheless, this proportion of variance explained is very respectable for work in the social and behavioral sciences. With respect to what is a reasonable expectation in the social and behavioral sciences regarding variance explained, although the following quotation relates specifically to experimentation, it is appropriate here as well: "The experiment is modest, seeking only to elucidate whether a particular cause has an effect. It is not aimed at a comprehensive evaluation of all causal forces that determine a particular outcome; nor is it usuallly aimed at establishing sufficient causes and their necessary counterparts" (Cook & Campbell, 1979, p. 32). Most behaviors are multiply determined. That is, most behaviors, however measured, are due to more than one causal agent. Researchers usually admit that the behavior under consideration is influenced by several factors concurrently. In many instances, researchers consider only those factors of interest to them and recognize that many other factors, including time, money, methodological issues, etc., influence research outcomes. Thus, the error term in the analysis is thought to include both random and systemmatic error.

In fact, it can also be argued that some portion of variance associated with behavior is unpredictable: "A good rule of thumb is that one is fooling oneself if more than 50% of the variance is predicted" (Kenney, 1979, p. 9). Further-

more, global measures of explained variance, such as R-square, may partly reflect on the number of variables investigated, the reliability of the measures, the heterogeneity of the populations sampled, the possibility that the constructs do not apply to all segments of the sample, the levels of the treatment factors, the design used, and the state of the theory involved (i.e., its level of development, level of generalization and sophistication of the constructs in the theory). In this research, measures were found to be acceptable for basic research of this type; nonetheless they are not perfect, and as such R-square is likely to be attenuated. Similarly, samples used were not homogeneous, causing further attenuation.

4. Multicollinearity among the regressor variables, to an extent that would be damaging to the regression results, was not found.

Dependent Variables: Perceived Risk and Acceptability (Faculty vs. Classified Staff): To summarize findings for the two populations analyzed separately:

1. For perceived risk, the "best" model for all eight products differed between faculty and staff, but typically by only one or two variables. Similarly, the best model for both faculty and staff differed from the best model for the entire population by one or two variables. No systemmatic differences were found. The product that produced the most consistent results across the three analyses was cigarettes.
2. For acceptability, differences between faculty and staff were again very subtle. Again, the two variable model including perceived risk and benefit was most often the best model. Confidence entered the model for staff for three products (aerosol cans, cigarettes, and high-cholesterol diet); for faculty for aspirin and, to a lesser degree, hair dryers. Perceived risk played no importance at all for faculty regarding hair dryers, nor for staff regarding aspirin.

2) The Role of Each Variable

What follows is a discussion of the role played in this research by each independent variable in turn. First, the degree to which correlational hypotheses were supported will be discussed. Second, the variable's contribution to each model will be discussed. There were 24 different models identified; one for each product for three populations: faculty, classified staff, and the population as a whole. If the variable appeared in the "best" model according to the variable selection criteria used, it is included in the model for a product, even if it's probability level is high (i.e., above the level of .05).

Probability and Severity: Given the conceptual definition used in this research, both probability and severity of outcome were hypothesized as being positively related to perceptions of risk. In all cases for both constructs this hypothesis was supported. Probability appeared in all of the 24 models evaluated, and severity in all but one (hair dryers for faculty). These two variables are clearly the most important determinants of perceived risk.

Availability: Negative outcomes that are easily brought to mind were hypothesized as impacting perceptions of risk by both increasing the vividness, and therefore the perception of severity of an outcome, and by causing people to overestimate that outcome's probability. As hypothesized, for every product, there was a strong positive correlation between availability and perceived risk, probability, and severity. Out of 24 models that were evaluated, availability appeared in 19. It appeared for all three groups for five of the eight products (sun-beds, aerosol cans, hair dryers, cigarettes, and high-cholesterol diet), for two of the three groups (population and staff) for two products (bicycles and aspirin), and not at all for monosodium

glutamate. Availability thus appears to be the most important of the six additional variables studied in this research as a determinant of perceived risk.

Controllability: The extent to which a product's negative outcome is perceived as being under the user's control is hypothesized as being negatively related to both the probability of that outcome's occurrence, and the perceived risk of that product, in that the user can influence the probability of that outcome's occurrence. For all products, the hypothesis relating perceived risk to controllability was supported, although the correlation was weak for monosodium glutamate, hair dryers, aspirin and cigarettes. The hypothesis relating probability to controllability was supported for all products. Of the 24 models evaluated, controllability appeared in 13. It appeared in all three groups for sun-tanning beds and bicycles (although it's role was weak in two of those six models), and for none of the three groups for monosodium glutamate and cigarettes. This research indicates that controllability is also an important variable in a comprehensive model of perceived risk.

Catastrophic potential: The perception that a product's negative outcome has an impact beyond solely the user is hypothesized as being positively related to the perception of that product's risk, both because the perceived probability that an individual will be affected will increase (i.e., an individual can be affected by either their own or someone else's use of the product), and because an outcome that affects many people is more severe. The hypothesis relating catastrophic potential to perceived risk was supported for all products, although the correlations were weak for hair dryers, aspirin, sun-tanning beds and high-cholesterol diet. Relative to probability and severity, all correlations were positive, although they also were weak for the same products. Of the 24 models evaluated, catastrophic potential appeared in 9. Although it appeared for all three groups for monosodium glutamate, it's role

was weak. It appeared for none of the three groups for sun-tanning beds, aspirin, and cigarettes.

Overall, this variable is the second least consistent and important of the variables considered as determinants of perceived risk (second to immediacy). It is possible that respondents are less accustomed to thinking in terms of how their actions affect others with regard to risk than they are with how they personally are affected. In fact, products which have an impact beyond the individual user are fairly few and far between; thus, it would not be surprising for consumers to place less importance on the broader impact of their actions. Also, although the reliability of this construct was acceptable in final survey, it was the most difficult of the constructs to operationalize and measure. It is possible that this question was not well-understood or uniformly interpreted. Although this variable was the least consistent, it's is nonetheless valuable in a comprehensive model of perceived risk.

Reversibility: The perception that the negative outcome associated with a product is not a permanent condition was hypothesized as being negatively related to the perceived risk of that product, in that permanance would be negatively related to severity. For all products, the correlation was significant and in the direction hypothesized between reversibility and both perceived risk and severity. Of the 24 models evaluated, reversibility appeared in 10. It appeared for all three groups only for hair dryers, and for none of the three groups for bicycles, aerosol cans, or high-cholesterol diet.

Dreadedness: The perception of a negative outcome associated with a product as one of horror or dread, that is, as a strong emotional reaction, was hypothesized as being positively related to the perceived risk of that product, in that it would be negatively related to the outcome's severity. For all products, both hypotheses were supported.

Of the 24 models evaluated, dreadedness appeared in 11. It appeared for all groups only for aspirin, and for none of the groups for sun-tanning beds and cigarettes. One finding of this research that is interesting, although it has been taken for granted throughout discussions, is that dreadedness is indeed a separate and distinct from severity, and it's measurement appears to have captured an emotion.

Immediacy: A positive relationship was hypothesized between the immediacy with which a negative outcome associated with a product occurred, and the perceived risk of that product, in that immediacy would be related to severity. For all eight products, the correlation between immediacy and perceived risk was very weak, and in the hypothesized direction for only five of the eight products. The correlation between severity and immediacy was similarly weak for all products. Of the 24 models evaluated, immediacy appeared in 3, and was significant in those cases at a probability level of .07 to .12. These results may well have something to do with the nature of the product set selected, and the nature of consumer products in general. In this research, an significant positive correlation existed between immediacy and severity. Virtually every immediate outcome was perceived as being low to moderately severe. In fact, most consumer products that present an immediate and strong danger have been regulated out of existence (e.g., consider the case of all-terrain vehicles). In contrast, there are products, known to be lethal over a period of years of use, which are readily and widely available (e.g., cigarettes). As mentioned previously, all things being equal, consumers probably would prefer to delay a negative consequence, as they tend to prefer immediate gratification. However, that choice is unrealistic. Given that lack of choice, consumers may simply not consider the immediacy of a negative outcome in their determinations of risk.

Beneficiality: A positive relationship was hypothesized between the perceived beneficiality of a product and the acceptability of that product. For every product, that hypothesis was supported. Of the 24 models evaluated, beneficiality appeared in all of them. Beneficiality was the best single-variable model in every case, as measured by both Cp and R-square, indicating that judgments of beneficiality outweigh judgements of risk in determining product acceptability.

Perceived Risk: A negative relationship was hypothesized between the perceived risk of a product and the acceptability of that product. For every product, that hypothesis was supported. Of the 24 models evaluated, perceived risk appeared in 22 of them (all but hair dryers for faculty, and aspirin for staff). Thus, consumers do evaluate the risk inherent in a product, in addition to its benefits.

Confidence: A positive relationship was hypothesized between a consumer's confidence that information about the risks of a product could be obtained if desired and the acceptability of that product. In general, that hypothesis was not well supported. The correlations were positive for only three of the eight products, and those correlations were weak to non-existent. Furthermore, for the 24 models evaluated, confidence appeared in only 7. In only two of those models was it significant at a probability level of .05 or less (aspirin for faculty and cigarettes for staff). Although the support for its inclusion in a comprehensive model of acceptability is relatively weak, it is sufficiently strong to indicate that it should not be excluded altogether.

Implications of the Research

Theoretical

The concept of perceived risk in consumer decision making has become well accepted and appears in nearly every consumer behavior textbook. The essence of the concept is that various risks to consumers exist, that consumers do perceive them, and that their perceptions influence their decision making and behavior. What has not been well understood are the determinants of perceived risk and acceptability of risky options. While numerous variables have been suggested to be important in the determination of consumers' subjective judgments of risk and acceptability, and while certain relationships between those variables and judgments have been hypothesized and empirically tested, conceptual and methodological limitations have obscured a clear understanding of what is driving consumers' judgments of products as relative to their risk and acceptability. Existing empirical results are meager and equivocal, with different studies indicating not only different variables as being important, but even conflicting directions of relationships. There has also not been a clear distinction made between personal and social acceptability, and between the acceptability of a product and the acceptability of it's risk. Given such problems and inconsistencies, ambiguous results are not surprising. Therefore, the research contributes to the existing body of theoretical knowledge by assessing the reliability, discriminant validity and nomological validity of the constructs of risk perception, acceptability, and their determinants. It also makes a clear distinction that consumers judge the risk of a product, and the acceptability of a product that entails

risk; it did not test the possibility that consumers evaluate the acceptability of a risk per se. It is very different to ask consumers to evaluate the acceptability of, for example, a bicycle, than to evaluate a 5% chance of suffering a head injury, the latter evaluation being what would be implied by "risk acceptability". The models that have been built of risk perception and acceptability for hazardous products and activities have revealed relationships that can be used for further theory development and further testing. Such modeling is a necessary step in the development of a theory of perceived and acceptable risk, relational research being a logical step in theory construction.

The proposed research is distinct from and extends prior research in the area in four important ways. First, it extends work in consumer behavior by examining the psychological determinants of perceptions of risk and acceptability, with prior research having been more concerned with behavioral responses to perceived risk. For example, much of the work in consumer behavior relates to risk reduction strategies; however, risk reduction assumes the perception of risk. This research builds a more solid foundation upon which to study risk reduction. It also isolates the determinants of a particular type of risk, and enriches the area of research related to this typology. Second, it is based on a classical decision theory model, but makes no assumptions of well-specified outcomes and probabilities; rather, it focuses on qualitative, or subjectively determined, factors that influence perceptions of risk and acceptability, rather than quantitative factors. This research supports the idea that there is more to understanding consumer's perceptions of risk than just the probability and the outcome. While probability and outcome remain the most important driving factors, and are adequate in explaining the variance in perceptions of risk, this overly simple model of risk is underspecified, biased, and a poor predictor; ad-

ditional variables clearly are important in reducing that bias and improving the predictive capacity of the model. This research indicates that availability, controllability, catastrophic potential, dreadedness and reversibility should all be considered as antecedents of perceived risk, not only through their relationship to probability and severity, but in addition to the important roles of probability and severity.

This research also indicates that perceived beneficiality plays the most important role in determining acceptability, with perceived risk also very important, and confidence playing a relatively minor role. While confidence rarely was significant, it's role should not be abandoned at this time. The confidence that consumers have in their ability to assess product risks remains an important substantive issue, and this research indicates that it plays an important, if tertiary role, in determinations of acceptability. The direction of the relationship between confidence and acceptability remains unresolved by this research. While confidence was hypothesized to be positively related to acceptability, the relationship may not be linear; the possibility of an interaction, with confidence positively related to acceptability for products whose risks are perceived to be low, and negatively related for products whose risks are perceived to be high, might be explored in future research.

The model reflecting the findings of this research is depicted in Figure 5. Figure 5 is drawn to reflect the relative importance of each variable, with variables rank ordered by vertical position. Rank order was determined by the number of times a variable appeared in a model. Thus, beneficiality is ranked first, perceived risk second, and confidence third with respect to acceptability. With respect to perceived risk, availability is ranked first, controllability second, dreadedness third, reversibility fourth, and catastrophic potential fifth. Immediacy was not included in the model

at all given the limited empirical support for its importance. While the variables are rank ordered by vertical position, the positioning should not be interpreted proportionately. That is, there is not an equal difference in importance between availability and controllability, and controllability and dreadedness, and so on. In fact, dreadedness, reversibility, and controllability were very similar in terms of relative importance.

Figure 5 also depicts both direct relationships between each of the variables availability, controllability, dreadedness, reversibility, and catastrophic potential and perceived risk, and indirect relationships by way of probability and severity.

This direct relationship raises the question of whether the definition of perceived risk needs to be revised to incorporate these other variables. In that probability and severity predominate in all models, and that the additional variables all relate in a consistent way to probability and severity, and that much of their relationship is through probability and severity, the contention here is that the definition should remain the same, but that a comprehensive model of risk should include these additional variables. The findings of this research are consistent with existing empirical work which looked for patterns of intercorrelations (Fischoff 1978; Slovic et al. 1980a) among risk characteristics, in that many of the same variables were found to be important. This research indicates, however, that it is useful and legitimate to consider seven unique variables when considering perceived risk, rather than trying to reduce that number to a smaller number of factors.

Third, it extends the behavioral decision science's work on societal risk assessment, by changing the focus to the individual decision maker. As such, this research has more relevance for consumer products that are widely available and easily obtained. While judgments of personal and social acceptability may differ, it is more

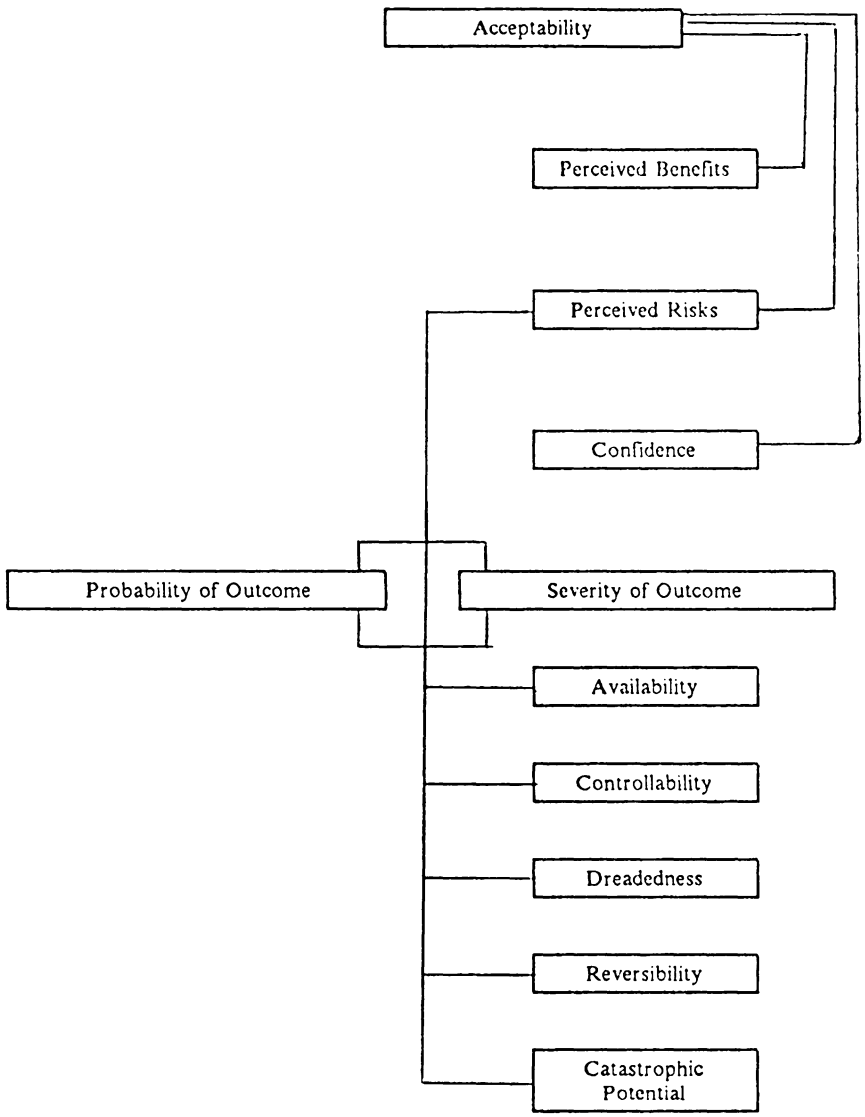

Figure 5. Revised Model of Perceived Risk and Option Acceptability

reasonable to assume that people who judges a product as acceptable to them personally will also judge that product as acceptable to society (meaning that the product need not be further regulated), than it is to assume that a product judged as acceptable to society with be acceptable to individuals. For example, a person may well believe that people should be allowed to use sun-tanning beds if they wish, but still consider that alternative unacceptable to them personally. It is unlikely, however, that a person who finds sun-beds an attractive option would want their use regulated or prohibited. Again then, this research relating to personal acceptability provides a more developed and solid foundation upon which to study societal acceptability.

Fourth, this research makes a clear distinction between the perception of risk in a product, and the evaluation of that product's overall acceptability. They are treated as two conceptually and methodologically distinct constructs, without the confusing merging of the two into one construct called "risk acceptability". Because it makes this distinction, the conceptual linkage between variables related to both risk and acceptability is more clear. Each of the variables related to risk, for example, relate to risk because of a clear linkage between either probability or severity, or both. Furthermore, it is clear that a consumer evaluates more than simply risk in product, as evidenced by the consistently important role played by beneficiality. This particular finding supports empirical results reported by Vlek and Stallen (1981) which indicate the importance of perceived benefits in judgments of acceptability. Research in consumer behavior directed toward understanding responses to perceived risk would benefit from the introduction of beneficiality into the conceptualization.

Methodological

The modeling proposed involves the use of a multiple linear regression model building approach. While this approach has appeared in existing literature, as discussed in Chapter II, there are numerous problems and shortcomings associated with its use. This research used a multitude of techniques, both conceptual and empirical, for selecting the best model from a number of candidate models. One major contribution is it's use of two model selection criteria that are rarely considered: Mallow's Cp statistic and the PRESS statistic. Had the coefficient of determination been the driving force in this analysis, only two variables would have been significant relative to consumers' perceptions of risk: probability and severity. However, the Cp statistic indicated that such a model of perceived risk would have been severely underspecified, and the PRESS statistic indicated that the model would have been poor in predicting the response.

Another methodological distinction in this research was the analysis of individual products, rather than the aggregation of products under the assumption that a unified model of risk and acceptability exists across all products. Eight different products yielded eight unique, albeit overlapping, "best" models. In light of the results, it is clear that in trying to find one unified model for all products, the role of individual variables for individual products would have been obsured. However, it is useful to know that, the "full model", that is, of risk as a function of probability, severity, availability, controllability, catastrophic potential, dreadedness and reversibility, although not optimal for any individual product, is not damaged by collinearity. Immediacy is not recommended in the full model, in that it so rarely and inconsistently important.

Finally, the response and regressor variables have been assumed in past research to be construct valid, and have been measured using single-item indicators. This research assessed the reliability and construct validity of both the dependent and independent variables, and as part of the regression analysis used a host of diagnostics to look for multicollinearity among the regressor variables. It also used techniques of residual analysis and influence diagnostics to assess the degree to which specific data points may be infuencing final results. Given these methodological contributions, more confidence can be placed in these results than in previous work in a similar vein in the domain.

Substantive

There are strategic, legal, and public policy implications for manufacturers and marketers to better understand how the risks of their products are perceived or misperceived, and accepted or not accepted by consumers. Each are discussed below in turn.

Strategic: Two clear strategic areas in which perceived risk is implicated are communication and product design. In understanding what determines consumers' perceptions of risk, marketers will better know what information to communicate such that consumers can make better informed assessments. Specifically, they need to address all of the variables that have been found in this research to belong in a comprehensive model of perceived risk. It has been recognized for some time that information about risk is particularly prone to misinterpretation. Knowing that there is a richer and more complete way to communicate to consumers about prod-

uct risks, beyond information about probability and severity, opens new avenues for marketing managers. Knowing the specific variables that determine a consumer's judgment of a product as risky can help marketers communicate information about their products in such a way that consumers' perceptions are more consistent with objective estimates of risk. The strategic area of communication is particularly enriched by this contribution.

One example of how communication strategy is enriched is the importance of communicating to consumers whether and how a risk can be controlled, either through diligence, skill, or the use of a safeguard. Manufacturers of sunscreens already stress the controllability of skin cancer; manufacturers of sunglasses, particularly given the recent media attention to retinal damage and cataract formation, might stress controllability in their advertising messages as well. Manufacturers who market products which are designed to control risks might consider the role of emotion (i.e., dreadedness) in their appeals. That is, while fear might not be the most pleasant selling point, this research does indicate that dread and perceived risk are related. Again, drawing attention to the fear of blindness might be an effective means to promote protective eyewear. For the manufacturer of a product that entails risk, it would be advantageous to downplay the emotional aspects of the product's hazards, and focus on presentation of "objective" information. Again, for the manufacturer of protective devices, the importance of availability indicates that product hazards should be portrayed vividly and frequently, vividness and frequency being related to availability. Finally, knowing that catastrophic potential is a determinant of perceived risk, manufacturers of materials, detergents and so on that are environmentally safe and do not pollute should stress that attribute.

In addition, these findings could be useful in product design as it relates to health and safety. Controllability is a particularly important variable with respect to product design. A product which allows a consumer to exert more personal control over the probability of an accident or negative consequence, for example, mirrors placed on bicycles, can influence the risk perceived in a product. Similarly, research and development directed towards reversing negative outcomes is warranted; consider for example the market potential of products to reverse the ill effects of sun exposure. Similarly, this research indicates that consumers consider the broader implications of their actions beyond themselves (catastrophic potential). Research and development directed towards materials that do not pollute the environment and damage the ozone layer is warranted as well.

Similarly, it is important for marketers to understand how consumers make judgments of product acceptability. Beneficialty and perceived risk both play important roles in making that judgment, with beneficialty the more important of the two. Most promotion of products focuses on product benefits, which is appropriate; however, this research indicates that perceived risk plays an important role as well, and that consumers need accurate information about product risks in order to make well-informed choices. Given that consumers do relate risk with acceptability, marketers would be well-advised to see to it that consumers have accurate information such that risks are not over- or under-estimated. Although confidence plays a much less important role, it is a variable that is subject to marketing influence, to a degree, in that information about product risks can be made available by incorporating product information and education into the strategic plan.

Legal: The legal implications are also many and varied. Consider, for example, the recent controversy over manufacturer liability for lung cancer and disease caused

by cigarette smoking. One of the important issues related to whether the manufacturer had fully disclosed information available about the associated health risks; that is, do consumers have a true picture of tobacco-related risks? This research indicates that a person's understanding of risk is multi-dimensional, and goes beyond merely having the facts about probability and outcome. It could be argued that without full information about the reversibility of lung cancer or emphysema, without full understanding of the kind of illness involved (i.e., slow and painful), without full information about the risks of second-hand smoke to others, a consumer doesn't truly have a clear perception of the risks of tobacco. Clearly, this research indicates that it is debatable whether the public has full access to and understanding of health risk information. Similarly, it is only recently that nicotine has been recognized as an addiction, with clear implications as to the reversibility of conditions associated with smoking (some conditions are alleviated with cessation, but addiction makes cessation difficult for all and impossible for some). In other words, consumers who don't fully understand the addictive nature of nicotine don't really fully understand the risks of cigarette smoking. The consumers perception of what the risks are when they choose to use a product are clearly implicated in questions of product liability.

Public Policy: There are also important public policy implications. Consider the following as an example of the importance of this research domain in the area of policy related to consumer health and safety. The Food and Drug Administration requires that information in the form of patient package inserts (PPIs), be dispensed with a small number of prescription drugs, notably oral contraceptives and estrogen. These inserts are written in non-technical language and inform the user about the potential benefits and risks of the drug. It has been proposed that this information program be extended to other prescription drug products, but the program is rela-

tively controversial. Keown (1983) presents the following arguments from both sides. Proponents argue that PPIs would (a) promote patient understanding and adherence to drug therapy, (b) permit the patient to avoid adverse interactions with other drugs or goods, (c) prepare the patient for possible side effects, and (d) permit the patient to share in the decision to use the drug. Opponents argue that PPIs would (a) encourage self diagnosis and treatment, (b) produce adverse reactions through suggestion, (c) frighten patients unnecessarily and cause non-compliance with treatment, (d) require physicians and pharmacists to spend an inordinate amount of time providing explanations and reassurance about the material, and (e) increase the cost of drug products and health care in general. Guarino (1979) has stated that proposals for legislation regarding PPIs are premature given the lack of knowledge about how to design such statements. He argues for "careful, deliberate and scientific study (of these problems), as would be required of any other component of our health care system" (1979, p. 120). This research is in the vein that he has suggested. It relates specifically to several of the issues mentioned. A useful PPI would need to include information not just on probability and severity of outcome, but on controllability, reversibility and catastrophic potential as well. An important example of catastrophic potential related to prescription drugs is that of Accutane, a prescription drug administed for acne. This drug has been suggested to cause birth defects in the offspring of women who use it; the catastrophic potential through the effect of the drug on women's offspring is evident. The concern of frightening patients unnecessarily is justified, given the role of dreadedness in perceptions of risk; it would be important to convey information in PPIs objectively and without provoking undue fear.

An important public policy issue is the necessity to convey an accurate portrayal of product risks, without either overstating or understating risks. For example, it is likely that we will see an increase of advertising of condoms given it's role in prevention of transmission of the AIDS virus, and such advertising over television and radio has been a question of considerable debate. Public policy questions arise of what constitutes socially responsible advertising; for example, how responsible is it to focus on heterosexual transmission, and possibly overstate those risks, in order to increase condom sales? Accurate representation of product risks, in all the ways that people understand them, is necessary. There should be careful consideration of whether marketers are deliberately trying to deceive, or misrepresent, product risks through their messages, by way of any of the variables found to be important in this research.

Finally, environmental campaigns can benefit from this research, for example by making use of the importance that catastrophic potential has to consumers. Environmental campaign messages should incorporate the fact that such pollutants as detergents, second-hand smoke, coolants, propellants, and containers that destroy the earth's protective ozone layer have a wide impact beyond the individual user.

In summary, models of risk perception and acceptability shed light on what variables, and how those variables, influence peoples' perceptions of risk and their evaluations of the acceptability of hazardous products and activities. The findings of this research can help manufacturers and marketers better understand and know the needs and concerns of their target market, help them design products that are seen as acceptable by that market, and help them communicate information that is relevant and useful, and that later might prevent liability in lawsuits. It can guide public policy makers, and shed insight in product liabiity debate.

Boundaries and Limitations of the Research

This research involves two levels of empirical inquiry; it is in part descriptive, and in part relational. Both of these two levels as they relate to the proposed research will be discussed in turn.

Descriptive research has three objectives beyond the apparent one of telling "how things are" (Rosenthal and Rosnow 1984). Those are (1) to provide a structure for making sense of an ambiguous or unfamiliar situation, (2) to establish the boundaries of a research problem by, for example, establishing frequencies of events or of limiting demographic conditions, and (3) to uncover ideas that can then be tested by either relational or experimental research.

This research met all three objectives. It brings into focus constructs that have been elusive and controversial, it establishes the error in looking for a single unified model across products and across people, and it verified relational aspects that can be further explored.

Similarly, relational research has three objectives. Those are (1) to uncover the relations among different variables, (2) to allow comparisons where time is the independent variable, to suggest trends and growth patterns (in the case of diachronic research which takes place over successive periods of time), and (3) to aid in the establishment of the validity of intervening variables or constructs, where these countless abstractions are "validated only by relating subjects' performance in a variety of situations as the construct would predict" (Rosenthal and Rosnow 1984, p. 61). This research used an analytic survey to explore the relationships among variables, less oriented toward representativeness and more toward finding associations

and explanations (Oppenheim, 1966). The analytic survey has been compared with both naturalistic observation (because it examines what is happening in its natural state), and with experimentation, having been called the "poor man's experiment" (Oppenheim,1966) in that it uses statistical controls to help in the analysis of relationships. Variables are controlled by excluding them, by holding them constant, or by random sampling (Rosenthal and Rosnow 1984). This research is synchronic, in that variables were observed as they exist at one period in time, without consideration of their development.

When evaluating the contribution to knowledge, and the confidence that can be placed in that knowledge, that a particular research finding makes, it is important to establish the scope and limits of that research finding (McGrath & Brinberg 1983). The Validity Network Schema developed by Brinberg and McGrath (1982, 1985) is useful in organizing the facets to consider when assessing the scope and limits of an empirical finding. Essentially, that schema involves three interrelated but analytically separate domains: substantive (some content or phenomenon of interest), conceptual (the ideas that interpret or explain the phenomenon), and methodological (the methods for studying the explanation of the phenomenon). Each of the three domains can be divided into two levels: elements and relations. The methodological domain contains measures at an element level and design features at a relations level. The substantive domain contains states and actions of individuals at an element level and patterns of two or more states or actions of individuals at a relations level. The conceptual domain contains attributes of states or actions of individuals at an element level and relations among attributes at a relations level. Integration of these domains produces three different possible paths of study: experimental (combining conceptual and methodological), theoretical (combining conceptual and substantive)

and empirical (combining substantive and methodological). This research actually followed two of those paths. It was theoretical in that it combines elements and relations from the conceptual and substantive domains to produce hypotheses that can be tested by applying elements and relations from the methodological domain. It was also empirical in that it combined elements and relations from the substantive and methodological domains to form a set of observations that could be interpreted with reference to the conceptualizations about the phenomenon.

One of the weaknesses of this entire domain is the lack of work along an experimental path; this research suffers the same weakness. It did, though, better define elements and relations at the conceptual level such that experimental work can progress in the future.

Another weakness of the study is its reliance on induction, with its many associated problems. First, it assumes that it is legitimate to generalize from a finite list of singular observations statements to a universal law. However, inductive arguments are not logically valid arguments, in that it is possible for the conclusion of an inductive argument to be false and for the premises to be true and yet for no contradiction to be involved. Second, inductivism assumes that observation and reasoning are objective. In fact, observation and reasoning are done by biased and prejudiced observers. Consider for example, the examination of commonalities across products in search of one common model across products. It would have been very possible, for example, to say that the Cp or PRESS value for a particular model was "good enough" when, in fact, there were models whose Cp and PRESS values were really much better. There is considerable latitude of interpretation in this type of research, and an effort was made to balance results and conclusions based upon a priori expectations with those based upon empirical findings. Third, obser-

vation itself is guided by theories, theories that may be incomplete or fallible. Thus, "observation statements...are always made in the language of some theory and will be as precise as the theoretical or conceptual framework that they utilize is precise" (Chalmers 1979, p.27). In this particular research, theories, however vague and implicit, have guided both the choice of regressor and dependent variables, as well as their conceptual and operational definitions.

Specific Methodological Limitations

One methodological limitation of this research relates to the assumptions of a regression analysis. Independent variables are assumed not to be random and are assumed to be measured with negligible error. The use of multiple indicator constructs helps the measurement issue to some extent. Multiple measures can tap a construct more completely than single-item measures, and there is more assurance that the only source of error is random.

Another methodological problem relates to the specific way that respondents were asked to evaluate product risks. They were presented with a product along with one associated negative outcome; they were then asked to focus on this single outcome when evaluating the independent variables. Their evaluation of the product, however, did not ask them to focus on this single outcome. There undoubtedly are many other negative outcomes which enter into a consumer's judgment of a product's risk and acceptability. Future research might explore a variety of outcomes associated with a particular product. Furthermore, respondents may not have remembered the negative consequence that they were asked to focus on, in that the survey was fairly long (requiring approximately 30 minutes to complete), and the list of negative consequences appeared on only one page at the beginning of the survey.

Additionally, products were presented without specific information about that product or its means or frequency of use.

The fact that respondents may have been considering other negative consequences than the one provided brings up another limitation: this research focused on health and safety risks, but there are many other types of risks (e.g., psychological, social, financial) which may have entered into their judgements as well.

Suggestions for Future Research

There are many research questions that remain unexamined and unanswered in this domain; questions and approaches stimulated by this study are discussed below.

1. A Typology of Perceived Risk and Acceptability

In the current research, the set of products used was carefully chosen to represent the shortest possible number of products that would represent low, medium and high levels of each construct. The combination of these two criteria necessarily resulted in a set of products which were very distinct from one another, with no two products having the same profile. Therefore, it is not surprising that patterns among the models of perceived risk and acceptability could not be discerned. Future research might seek out those patterns deliberately, for example by examining products with very similar variable profiles, to see if indeed patterns exist and a useful typology could be created, or if in fact consumers perceive the risks and acceptability of individual products idiosyncratically. Such a typology could be useful in that it

would be known which variables are relevant for a particular product. This research does not, however, indicate what the basis for such a typology would be.

2. Role of Individual Variables

This study examined the relationship among a set of variables in it's goal of determining the antecedents of judgments of risk and acceptability, and identified many instances where other variables, specifically availability, controllability, catastrophic potential, dreadedness, and reversibility, in addition to probability and severity, influence consumers' judgments of risk and variables including perceived risk, beneficiality, and confidence influence acceptability. Future research might examine more closely the precise role of those variables, possibly in an experimental context to examine size of effect and causal relationships, both in isolation and as they interact with other variables.

3. New Theoretical and Substantive Contexts

There are also a variety of theoretical and substantive contexts in which the individual variables used in this study could be further examined. Dreadedness, for example, being defined as an emotional response, might be studied in the theoretical contexts of affect and mood, areas which are receiving considerable attention in consumer research. Controllability might benefit from the integration of knowledge acquired in the contexts of influence, leadership and power, again, areas that have received wide attention in marketing, although not necessarily in consumer research. The understanding of the role of availability might be enhanced by knowledge from the domain of memory and cognition, as well as script theory. Catastrophic potential has ties to the areas of social responsibility and even moral development, to better understand consumers' perceptions of the broader implications of their individual choices and actions. Confidence might be more closely examined in the con-

text of the distinction between risk and uncertainty. Finally, the antecedents of perceived beneficiality might be studied in a manner similar to the way perceived risk and acceptability were studied in this research, for example, by considering components of beneficiality such as meeting a need, or being profitable, pleasureable or important. The domain of utility theory would provide a good foundation in which to further study beneficiality. In summary, this area is very rich in heuristic value, with a variety of theoretical frameworks and substantive contexts from which to draw.

4. Personal vs. Social Acceptability

Past research has considered consumer's judgments of social acceptability, that is, whether an option is acceptable to society as a whole. This research considered personal acceptability, that is, whether an option is acceptable to an individual. Future research might look for similarities and differences between personal and social acceptability. (Is what's good for the gander good for the goose?) Do consumers use the same or different criteria in evaluating personal and social acceptability?

5. Causal Modeling Approach

As knowledge of the domain of risk and acceptability increases and there exists a better understanding of the relevant variables and their relationships to another, a causal modeling approach using LISREL could be fruitful. LISREL is used to estimate the unknown coefficients in a set of linear structural equations. Variables in the system of equations can be either directly observed variables or unmeasured latent variabless (i.e., hypothetical constructs). In general, the LISREL model assumes that there is a causal structure among a set of latent variables, with the latent variables acting as underlying causes of the observed variables. LISREL's ability to

handle models with latent variables, measurement errors, and reciprocal causation make it a tool with particular potential in this domain.

6. Role of Demographic Differences

This research found distinct differences between faculty and staff. The fact that there were differences is not surprising given the very different demographic profiles, with regard to sex, education and income, between the two groups. However, the particular differences found would not have been predicted given the theoretical foundation of this research. Future research might investigate the theoretical explanations for the demographic differences that apparently exist in this domain.

Summary

In summary, this research established a comprehensive model of the perceived risk and the acceptability of hazardous products and activities. While the definition of perceived risk as a function of probability and severity of outcome that is so common in marketing, and even across other disciplies, remains appropriate, this research establishes that additional variables belong in that comprehensive model, those variables including availability, controllability, reversibility, catastrophic potential, and dreadednes. Further, it established that consumers evaluate both benefits and risks, and to a lesser degree, confidence that they can determine risks if they need to, in their determinations of product acceptability.

Despite several limitations in this research, numerous theoretical, methodological, and substantive contributions were made, and a variety of future research ideas were stimulated.

Chapter 6

References

Anderson, Paul F. (1983), "Marketing, Scientific Progress, and the Scientific Method," *Journal of Marketing*, 47 (Fall), 18-31.

Arndt, Johan (1968a), "New Product Diffusion: The Interplay of Innovativeness, Opinion Leadership, Learning, Perceived Risk and Product Characteristics," *Markeds Kommunikasjon*, 2, 1-9.

_____ (1968b), "A Test of the Two-Step Flow in Diffusion of a New Product," *Journalism Quarterly*, 45, 457-65.

Bagozzi, Richard P. (1979), "Toward a Formal Theory of Marketing Exchange," in *Conceptual and Theoretical Developments in Marketing*, O.C. Ferrel, Stephen Brown, and Charles Lamb (eds.), Chicago: American Marketing Association.

Barach, Jeffrey (1969), "Advertising Effectiveness and Risk in the Consumer Decision Process," *Journal of Marketing Research*, 6 (August), 314-20.

Bauer, Raymond A. (1960), "Consumer Behavior as Risk Taking," in *Dynamic Marketing for a Changing World*, Robert S. Hancock, ed., Chicago: American Marketing Association, 389-98.

Bechtel, Gordon G. and James B. Wiley (1982), "Probabilistic Measurement of Attributes: A Logit Analysis by Generalized Least Squares," Discussion Paper 67, Center for Econometrics and Decision Sciences, University of Florida.

Bechtel, Gordon G. and Jaime Ribera (1983), "Risk Acceptability in Segments With Distinct Value Orientations," in *Advances in Consumer Research*, Vol. 10,

Richard P. Bagozzi and Alice M. Tybout eds., Ann Arbor, MI: Association for Consumer Research, 590-5.

Bettman, James R. (1972), "Perceived Risk: A Measurement Methodology and Preliminary Findings," in Venkataesan, M., Ed., *Proceedings 3rd Annual Conference of the Association for Consumer Research,* College Park, MD: Association for Consumer Research, 394-416.

Bettman, James R. (1973) "Perceived Risk and its Components: A Model and Empirical Test", *Journal of Marketing Research,* 10 (May), 184-90.

Bettman, James R., John W. Payne and Richard Staelin (1986), "Cognitive Considerations in Designing Effective Labels for Presenting Risk Information", *Journal of Public Policy and Management,* 5, 1-28.

Bounds, Paula, Betty Feather and John Vann (1986), "Clothing-Related Risk Perceptions of Disabled People," in *Advances in Consumer Research,* Vol. 13, Richard J. Lutz ed., Provo, UT.: Association for Consumer Research, 662.

Brooker, George (1984), "An Assessment of an Expanded Measure of Perceived Risk", *Advances in Consumer Research,* Vol. 11, Thomas Kinnear ed., Ann Arbor, MI: Association for Consumer Research, 439-41.

Churchill, Gilbert A. (1979), "A Paradigm for Developing Better Measures of Marketing Constructs", *Journal of Marketing Research,* 16 (February), 64-73.

Coombs, Clyde H., Robyn M. Dawes, and Amos Tversky (1970), *Mathematical Psychology: An Elementary Introduction,* Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Corstjens, Marcel L. and David A. Gautschi (1983), "Formal Choice Models in Marketing," *Marketing Science,* 2, 19-56.

Coughlin, Maureen and P.J. O'Connor (1984), "Risk Shifting in Joint Consumer Decision Making", *Advances in Consumer Research,* Vol. 11, Thomas Kinnear, ed., Ann Arbor, MI: Association for Consumer Research, 165-9.

Covello, Vincent T., Joshua Menkes, and Jiri Nehnevajsa (1982), "Risk Analysis, Philosophy, and the Social and Behavioral Sciences: Reflections on the Scope of Risk Analysis Research", *Risk Analysis,* 2 (No. 2), 53-8.

Cox, Donald (1967), "Risk Handling in Consumer Behavior -- an Intensive Study of Two cases," in Donald F. Cox ed., *Risk Taking and Information Handling in Consumer Behavior,* Boston: Harvard University Press, 34-81.

Crouch, E.A.C. and R. Wilson (1982), *Risk/Benefit Analysis,* Cambridge, MA: Ballinger, Inc.

Cunningham, Scott (1967a), "The Major Dimensions of Perceived Risk," in Donald F. Cox ed. *Risk Taking and Information Handling in Consumer Behavior*, Boston: Harvard University Press, 82-108.

_____ (1967b), "Perceived Risk as a Factor in Informal Consumer Communications," in Donald F. Cox (ed.) *Risk Taking and Information Handling in Consumer Behavior*, Boston: Harvard University Press, 265-88.

Dardis, Rachel and Julie Stremel (1981), "Risk-Benefit Analysis and the Determinants of Acceptable Risk," *Advances in Consumer Research*, Vol. 8, Kent B. Monroe ed., Ann Arbor, MI: Association for Consumer Research, 553-8.

Day, George S., "Assessing the Effects of Information Disclosure Requirements," *Journal of Marketing*, 40 (April), 42-52.

Day, Ellen and Stephen B. Castleberry (1986), "Defining and Evaluating Quality: The Consumer's View," *Advances in Consumer Research*, Vol.13, Richard Lutz ed., Provo, UT: Association for Consumer Research, 94-8.

Dedler, Konrad, Ingrid Gottschalk and Klaus Grunert (1981), "Perceived Risk as a Hint for Better Consumer Information and Better Products: Some New Applications of an Old Concept," *Advances in Consumer Research*, Vol. 8, Kent B. Monroe ed., Ann Arbor, MI: Association for Consumer Research, 391-7.

Douglas, Mary and Aaron Wildavsky (1982), "How Can We Know the Risks We Face? Why Risk Selection is a Social Process", *Risk Analysis*, 2, (No. 2), 49-51.

Dwyer, F. Robert (1978), "An Experimental Study of Consumer Use of Supplemental Drug Information," Unpublished Ph.D. Dissertation, College of Business, University of Minnesota.

Einhorn, Hillel J. and Robin Hogarth (1985), "Ambiguity and Uncertainty in Probabilistic Inference", *Psychological Review*, 92,(No.4), 433-59.

Evans, Richard H. (1982), "Measuring Perceived Risk: A Replication and an Application of Equity Theory," in *Advances in Consumer Research*, Vol. 9, Andrew Mitchell ed., Ann Arbor, MI: Association for Consumer Research.

Ferber, Robert (1977), "Research by Convenience," *Journal of Consumer Research*, 4, pp.57-8.

Fischhoff, Baruch, Paul Slovic, Sarah Lichtenstein, S. Read and B. Combs (1978), "How Safe is Safe Enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits," *Policy Sciences*, 8, 127-52.

Fischhoff, Baruch, Sarah Lichtenstein, Paul Slovic, S. Derby and R. Keeney (1981), *Acceptable Risk*, New York: Cambridge University Press.

_____ and Don MacGregor (1983), "Judged Lethality: How Much People Seem to Know Depends Upon How They Are Asked", *Risk Analysis*, 3, (No.4), 229-36.

_____, S.R. Watson and C. Hope (1984), "Defining Risk", *Policy Sciences*, 17, 123-39.

Green, C. H. (1980), "Risk: Attitudes and beliefs," in D.V. Canter ed., *Behavior in Fires*. Chichester: Wiley.

Green, C.H. and R.A. Brown (1978), "Counting Lives," *Journal of Occupation Accidents*, 4 (May), 18-24.

Grunert, Klaus G. (1980), "Consumer Information by Objectives: An Approach for Defining Goals and Measuring Results", *Advances in Consumer Research*, Vol. 7, Jerry Olson ed., Ann Arbor, MI: Association for Consumer Research, 664-8.

Hayes, William L. and Robert L. Winkler (1970), *Statistics: Probability, Inference, and Decision, Volume II:* Holt, Rineart, and Winston, Inc.

Hisrich, Robert D., Ronald J. Dornoff, and Jerome B. Kernan (1972), "Perceived Risk in Store Selection," *Journal of Marketing Research*, 9 (November), 435-439.

Hughes, Marie Adele (1985), "Perceived Risk: An Exploration of Construct Validity," in *1985 Proceedings Southwestern Marketing Association Conference*, John Crawford and Barbara Garland, eds., Denton: North Texas State University, 46-9.

Hugstad, Paul and James Taylor (1979), "Risk Theory and the Science of Marketing," in O.C. Ferrell, et al. eds., *Conceptual and Theoretical Developments in Marketing*, Chicago: American Marketing Association.

Hunt, Shelby D. (1976), "The Nature and Scope of Marketing," *Journal of Marketing*, 40 (July), 17-28.

Ingene, Charles A. and M.A. Hughes (1985), "Risk Management by Consumers," in *Research in Consumer Behavior*, 1, Elizabeth Hirschman, ed., Greenwich,CT: JAI Press, 103-58.

Isen, W., R. Pratkanis and P.Slovic (1984), "The Influence of Postive Affect on Decision Making and Cognitive Organization," in *Advances in Consumer Research*, Vol. 11, Thomas Kinnear ed., Ann Arbor, MI: Association for Consumer Research, 334-7.

Jacoby, Jacob and Leon Kaplan (1972), "The Components of Perceived Risk," in M. Venkatesan (ed.), *Proceedings*, Third Annual Convention of the Association for Consumer Research, College Park, MD: Association for Consumer Research, 382-93.

_____ (1981), "Some Perspectives on Risk Acceptance", *Advances in Consumer Research*, Vol.8, Kent B. Monroe ed., Ann Arbor, MI: Association for Consumer Research, 511-16.

Johnson, Eric J. and Amos Tversky (1983), "Affect, Generalization, and the Perception of Risk," *Journal of Personality and Social Psychology*, 45, 21-31.

Johnson, Eric J. and Amos Tversky (1984), "Representations of Perceptions of Risks," *Journal of Experimental Psychology: General*, Vol. 113, No. 1, 55-70.

Joreskog, Karl G. and Dag Sorbom (1978), *Lisrel IV Analysis of Linear Structural Relationships by the Method of Maximum Likelihood*, Chicago: National Educational Resources Distributed by International Educational Services.

Kahneman, Daniel and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47 (March), 263-91.

Kahneman, Daniel and Amos Tversky (1984), "Choices, Values, and Frames", *American Psychologist*, 39, (No.4), 341-50.

Kaplan, Leon, Szybillo, George J., and Jacoby, Jacob (1974), "Components of Perceived Risk in Product Purchase: A Cross-Validation," *Journal of Applied Psychology*, 59, 287-91.

Kaplan, Stanley and B. John Garrick (1981), "On The Quantitative Definition of Risk," *Risk Analysis*, (1), 11-27.

Kasper, Raphael G. (1980), "Perceptions on Risk and Their Effects on Decision Making," in *Societal Risk Assessment: How Safe is Safe Enough?* R. Schwing and W. A. Albers eds., New York: Plenum Press.

Keown, Charles F. (1983), "Risk Judgments and Intention Measures After Reading About Prescription Drug Side Effects in the Format of a Patient Package Insert," *Journal of Consumer Affairs*, 17, 277-289.

Lehmann, Donald (1982), "Some Comments on Multi-Attribute Preference Models," in *Advances in Consumer Research*, Vol. 9, Andrew Mitchell, ed., Ann Arbor, MI: Association for Consumer Research.

Locander, William B. and Peter W. Herman (1979), "The Effect of Self- Confidence and Anxiety on Information Seeking in Consumer Risk Reduction," *Journal of Marketing Research*, 16 (May), 268-74.

Lowrance, William W. (1976), *Of Acceptable Risk*, Los Altos, CA: William Kaufman.

Lutz, Richard J. and Patrick Reilly (1973), "An Exploration of the Effects of Perceived Social and Performance Risk on Consumer Information Acquisition," in S. Ward and P. Wright eds., *Advances in Consumer Research*, 1, Urbana, IL: Association for Consumer Research, 393-405.

McMillan, J.R. (1972), "The Role of Perceived Risk in Vendor Selection Decisions," Unpublished doctoral dissertaion, Ohio State University.

Mischel, W. (1974), "Instrumental Ideation in Delay of Gratification," *Child Development*, 45 (4), 1083-8.

Montgomery, A.H. and J.R.Peck (1982), *Applied Multiple Linear Regression Analysis*, New York, Allyn-Bacon, Inc.

Morgan, Gareth (1983), *Beyond Method: Strategies for Social Research*. Beverly Hill, CA: Sage Publications, Inc.

Myers, Raymond H. (1987), *Topics in Regression*, McGraw-Hill Book Company.

Newton, D.A. (1967), "A marketing communications model for sales management," in Donald F. Cox ed., *Risk Taking and Information Handling in Consumer Behavior*. Boston: Harvard University Press, 579-602.

Nicosia, Franco M. (1969), "Perceived Risk, Information Processing, and Consumer Behavior: A Review Article," *Journal of Business*, 42, 162-6.

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

Olson, Jerry C. (1981), "Presidential Address: 1981, Toward a Science of Consumer Behavior," in *Advances in Consumer Research*, Vol. 9, Andrew Mitchell, ed., Ann Arbor: Association for Consumer Research.

Oliver, Richard L. (1980), "Predicting Sales Promotion Effects: Assimilation, Attribution, or Risk Reduction?", in *Advances in Consumer Research*, Vol. 7, Jerry Olson ed., Ann Arbor, MI: Association for Consumer Research, 314-7.

Otway, H.J. (1973), "Risk Estimation and Evaluation," (International Institute for Applied Systems Analysis, Laxenburg, Austria), PC-3.

Otway, H.J. and M. Fishbein (1976), "The Determinants of Attitude Formation: An Application to Nuclear Power," (International Institute for Applied Systems Analysis, Laxenburg, Austria), RM-76-80.

Otway, H.J. and D. von Winterfeldt (1982), "Beyond Acceptable Risk: on the Social Acceptability of Technologies," *Policy Sciences*, 14, 247-56.

Peter, J. Paul and Michael J. Ryan (1976), "An Investigation of Perceived Risk at the Brand Level," *Journal of Marketing Research*, 13 (May), 184-8.

Peter, J. Paul and L.X. Tarpey, Sr. (1975), "A Comparative Analysis of Three Consumer Decision Strategies," *Journal of Consumer Research*, 2, 29-37.

Pitz, Gordon (1977), "Decision Making and Cognition," in *Decision Making and Choice in Human Affairs*, H. Jungermann and G. DeZeeuw eds., Dordrecht, Hollard: Reidel.

Poiesz, Theo B.C. (1986), "Perceived Risk as a Mediator in Repetition- Affect Relationships," *Advances in Consumer Research*, Vol. 13, Richard J. Lutz, ed., Ann Arbor, MI: Association for Consumer Research, 387-91.

Popielarz, Donald T. (1967), "An Exploration of Perceived Risk and Willingness to Try New Products," *Journal of Marketing Research*, 9, (November), 368-72.

Pras, Bernard and John O. Summers (1978), "Perceived Risk and Composition Models for Multiattribute Decisions," *Journal of Marketing Research*, 15 (Aug.), 429-437.

Rethans, Arno J. and Gerald S. Albaum (1981), "Towards Determinants of Acceptable Risk: The Case of Product Risks," *Advances in Consumer Research*, Vol. 8, Kent B. Monroe ed., Ann Arbor, MI: Association for Consumer Research, 506-10.

Rethans, Arno J. and Manoj Hastak (1982), "Representation of Product Hazards in Consumer Memory," in *Advances in Consumer Researach*, Vol. 9, Andrew Mitchell ed., Ann Arbor, MI: Association for Consumer Research.

Robertson, Thomas S. and Scott Ward (1973), "Consumer Behavior Research: Promise and Prospects," in *Consumer Behavior: Theoretical Sources*. Scott Ward and Thomas Robertson, eds., Englewood Cliffs: Prentice-Hall, 3-42.

Roselius, Ted (1971), "Consumer Rankings of Risk Reduction Methods," *Journal of Marketing*, 35, (January), 56-61.

Rosenthal, Robert and Ralph L. Rosnow (1984), *Essentials of Behavioral Research: Methods and Data Analysis*, McGraw-Hill Book Company.

Ross, Ivan (1975), "Perceived Risk and Consumer Behavior: A Critical Review," in *Advances in Consumer Research*, Vol. 2, Mary Jane Schlinger ed., Urbana, IL: Association for Consumer Research, 1-19.

Rowe, W.D., *An Anatomy of Risk*, John Wiley, New York, 1977.

Russo, J. Edward, Richard Staelin, Catherine Nolan, Garry Russell and Barbara Metcalf (1985), "Nutrition Information in the Supermarket," *Journal of Consumer Research*, 12 (December).

Schiffman, Leon (1972), "Perceived Risk in New Product Trial by Elderly Consumers," *Journal of Marketing Research*, 9, (February) 106-8.

Shimp, Terence A. and William O. Bearden (1980), "Warranty and Other Extrinsic Cue Interaction Effects on Consumers' Confidence", in *Advances in Consumer Research*, Vol. 7, Jerry Olson ed., Ann Arbor, MI: Association for Consumer Research, 308-313.

_____, _____ (1982), "Warranty and Other Extrinsic Cue Effects on Consumers' Risk Perceptions", *Journal of Consumer Research*, 9, (June) 38-46.

Sjoberg, Lennart (1980), "The Risks of Risk Analysis," *Acta Psychologica*, 45 (August), 301-21.

Slovic, Paul, Baruch Fischhoff, and Sarah Lichtenstein (1977), "Behavioral Decision Theory," *Annual Review of Psychology*, 28, 1-39.

Slovic, Paul, Baruch Fischhoff, and Sarah Lichtenstein (1980), "Facts and fears: Understanding perceived risk," in *Societal Risk Assessment: How Safe Is Safe Enough?* R. Schwing and W. A. Albers Jr. eds., New York: Plenum Press.

_____, _____, and _____ (1981), "Characterizing Perceived Risk," in *Technological Hazard Management*, eds. R.W. Kates and C. Hohenemser, MA: Oelgeschlager, Gunn, and Hain.

_____, _____, and _____ (1982), "Why Study Risk Perception?", *Risk Analysis*, 2,(No.2), 83-93.

_____, _____, and _____ (1982b), "Response Mode Framing and Information Processing Effects in Risk Assessment," in R. Hogarth ed., *New Directions for Methodology of Social and Behavioral Science: Question Framing and Response Consistency*, no. 11, San Francisco: Jossey-Bass, 21-36.

_____, _____, and _____ (1984), "Behavioral Decision Theory Perspectives on Risk and Safety," *Acta Psychologica*, 56, 183-203.

Spence, Homer E., James F. Engel and Roger D. Blackwell (1970), "Perceived Risk in Mail Order and Retail Store Buying," *Journal of Marketing Research*, 7, 364-9.

Starr, C. (1969), "Social Benefit Versus Technological Risk," *Science*, 165, 1232-8.

Stern, Louis L. (1967), "Consumer Protection via Increased Information," *Journal of Marketing*, 31 (April), 48-52.

Stone, Robert N. and Frederick Winter (1985), "Risk in Buyer Behavior Contexts: A Clarification", Faculty Working Paper no. 1216, College of Commerce and Business Administration, University of Illinois at Urbana- Champaign.

Svenson, Ola (1985), "Cognitive Strategies in a Complex Judgment Task: Analysis of Concurrent Verbal Reports and Judgments of Cumulated Risk over Different Exposure Times," *Organizational Behavior and Human Decision Processes* 36 (Aug.), 1-15.

Taylor, James W. (1974), "The Role of Risk in Consumer Behavior," *Journal of Marketing*, 38, 54-60.

Tversky, Amos (1969), "The Intransitivity of Preferences," *Psychological Review*, 76, 31-48.

Tversky, Amos and Daniel Kahneman (1974), "Judgment Under Uncertainty: Heuristics and Biases," *Science*, 185, 1124-31.

Tversky, Amos and Daniel Kahneman (1982), "The Framing of Decisions and the Psychology of Choice," in R. Hogarth (ed.), *New Directions for Methodology of Social and Behavioral Science: Question Framing and Response Consistency*, no. 11, San Francisco: Jossey-Bass, 3-20.

U.S. Consumer Product Safety Commission (1979), *Annual Report*, Part I and II, Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce (1978), *Interagency Task Force on Product Liability: Final Report*, Springfield, VA: National Technical Information Service.

Upah, Gregory D. (1980), Applying the Concept of Perceived Risk to Buying Influence in Industrial Firms, *Advances in Consumer Research*, Vol. 7, Jerry Olson ed., Ann Arbor, MI: Association for Consumer Research, 381- 86.

Vann, John W. (1984), "A Multi-Distributional, Conceptual Framework for the Study of Perceived Risk", in *Advances in Consumer Research*, Vol. 11, Thomas Kinnear ed., Ann Arbor, MI: Association for Consumer Research, 442-6.

Vlek, C. and P.J. Stallen (1980), "Rational and Personal Aspects of Risk," *Acta Psychologica*, 45, 273-300.

Vlek, C. and P.J. Stallen (1981), "Judging Risks and Benefits in the Small and in the Large," *Organizational Behavior and Human Performance*, 28, 235-71.

Wendler, Eric R. (1983), "Consumer Information and Confidence: Moderating Effects of Perceived Comprehension and Risk," in *Advances in Consumer Research*, Vol. 9, Richard Bagozzi and Alice Tybout eds., Ann Arbor, MI: Association for Consumer Research.

Wildavsky, A. (1979), "No Risk is the Highest Risk of All", *American Scientist*, 67, 32-7.

Wilkie, William and Pessemmier, Edgar B. (1973), "Issues in Marketing's Use of Multiattribute Attitude Models," *Journal of Marketing Research*, 10, 428-41.

Wilkie, William L. (1974), "Analysis of Effects of Information Load," *Journal of Marketing Research*, 11 (November), 462-6.

Woodruff, Robert B. (1972), "Measurement of Consumers' Prior Brand Information," *Journal of Marketing Research*, 9 (August), 258-263.

Wu-Chien, Jya Syin and George Apostolakis (1983), "Prospect Theory and Limit Lines," *Risk Analysis*, 3 (no. 3), 181-8.

Zikmund, W.G. and Scott, J.E. (1973), "A Multivariate Analysis of Perceived Risk, Self Confidence and Information Sources," in S. Ward and P. Wright eds., *Ad-*

vances in Consumer Research, Vol. 1, Urbana, IL: Association for Consumer Research, 406-16. the Fourth Annual Copnvention of the Association for Consumer Research, 406-416.

Appendix A

Prior Measures of Risk Characteristics

Appendix A

Prior Measures of Risk Characteristics

Immediacy of effect
To what extent is the risk of death immediate -- or is death likely to occur at some later time?

effect immediate	1	2	3	4	5	6	7	effect delayed

Knowledge about risk (Confidence)
To what extent are the risks known precisely by the persons who are exposed to this risk?

Risk level known precisely	1	2	3	4	5	6	7	Risk level not known

To what extent are the risks known to science?

Risk level known precisely	1	2	3	4	5	6	7	Risk level not known

Control over Risk
If you are exposed to the risk, to what extent can you, by personal skill or diligence, avoid death?

personal risk can't be controlled	1	2	3	4	5	6	7	personal risk can be controlled

Familiarity
Is this risk new and novel or old and familiar?

new	1	2	3	4	5	6	7	old

Chronic-catastrophic

Is this a risk that kills people one at a time (chronic risk) or a risk that kills large numbers of people at once (catastrophic risk)?

chronic	1	2	3	4	5	6	7	catastrophic

Common-dread
Is this a risk that people have learned to live with and can think about reasonably calmly, or is it one that people have great dread for - on the level of a gut reaction?

common	1	2	3	4	5	6	7	dread

Severity of Consequences
When the risk from the activity is realized in the form of a mishap or illness, how likely is it that the consequence will be fatal?

certain not to be fatal	1	2	3	4	5	6	7	certain to be fatal

Appendix B

Initial Item Generation

Appendix B
Initial Item Generation

Immediacy of Effect

1. To what extent would the negative consequence to a consumer's health and safety of using this product or engaging in this activity be immediate -- or would it be likely to occur at some later time?

consequence occurs immediately ... consequence occurs later

2. How delayed would the negative consequence of using this product or engaging in this activity be?

not at all delayed ... delayed quite a long time

3. How soon after you use this product or participate in this activity would you expect to suffer a negative consequence, if one occurred?

negative consequence would occur right away ... negative consequence would occur sometime in the future

Controllability

1. To what extent can a person who uses this product or engages in this activity control the probability of suffering a negative consesequence to their health and safety?

probability can be controlled ... probability cannot be controlled

2. Other than abstinence, to what extent can the negative outcome of using this product or engaging in this activity be avoided?

negative outcome can be avoided completely ... negative outcome cannot be avoided at all

3. Are there safeguards, or protective measures, available that a person can use to protect him or herself from the negative outcome associated with using this product or participating in this activity?

highly effective safeguards exist ... no effective safeguards exist

4. Can a person who uses this product or participates in this activity reduce the probability of suffering a negative outcome by either personal skill or diligence?

negative outcome can be completely controlled by personal skill or diligence ... negative outcome cannot be controlled at all by personal skill or diligence

5. Can a person protect themselves from suffering a negative outcome associated with the use of this product or the participation in this activity?

person can protect themselves completely ... person cannot protect themselves at all

Reversibility

1. To what extent are the negative consequences associated with this product or activity reversible?

consequences cannot be reversed ... consequences are completely reversible

2. Can a person "undo" the negative consequences that might occur from the use of this product or the participation in this activity?

consequences can be "undone" ... consequences cannot be "undone"

3. Are the negative consequences associated with the use of this product or the participation in this activity permanent?

consequences are completely permanent ... consequences are not at all permanent

Dreadedness

1. Is the negative consequence of using this product or participating in this activity one that people can think about reasonably calmly and without emotion?

can think about perfectly calmly ... cannot think about calmly at all

2. Is the negative outcome associated with using this product or participating in this activity one that is dreaded – on the level of an emotional, gut reaction?

outcome greatly dreaded ... outcome not dreaded at all

3. Does the negative consequence associated with using this product or participating in this activity seem particularly gruesome to you?

consequence extremely gruesome ... consequence not at all gruesome

Availability

1. How easy is it for you to imagine the risk associated with the use of this product or the participation in this activity?

risk is extremely easy to imagine ... risk is extremely difficult to imagine

2. Does the risk associated with the use of this product or the participation in this activity come quickly to your mind?

risk comes very quickly to mind ... risk comes to mind slowly and with difficulty

3. How readily can you recall instances of people suffering from the risk associated with the use of this product or the participation in this activity?

risks are easy to recall ... risks are difficult to recall

4. How vivid are the risks associated with the use of this product or the participation in this activity?

extremely vivid ... not at all vivid

5. How real etc. (as above)

Catastrophic Potential

1. Is the risk associated with the use of this product or the participation in this activity one that effects one person at a time, or large numbers of people at once?

effects one person at a time ... effects large numbers of people at once

2. Would the risk associated with the use of this product or the participation in this activity be considered an individual risk, or a group risk?

individual risk ... group risk

3. Would you call the risk associated with this product or activity catastrophic, in that many people are affected at once?

highly catastrophic ... not at all catastrophic

Confidence

1. To what extent can the risk be known precisely by the persons who engage in this activity or use this product?

risk level known precisely ... risk level unknown

2. Is the risk of using this product or engaging in this activity generally familiar, or is it novel and unfamiliar?

familiar ... unfamiliar

3. To what extent do scientists, or "experts", know the risk of engaging in this activity or using this product?

risk level known precisely ... risk level unknown

4. How knowledgeable are you about the risk of using this product or engaging in this activity?

extremely knowledgeable ... not at all knowledgeable

Severity of Consequences

1. If you were to suffer a negative consequence to your health and safety as a result of using this product or engaging in this activity, how bad would that be?

not bad at all ... extremely bad

2. How severe are the negative consequences associated with the use of this product or the participation in this activity?

not at all severe ... extremely severe

3. When you think of the negative consequence to a person's health and safety that could occur as a result of using this product or participating in this activity, how "negative" would you judge that consequence to be?

extremely negative ... not very negative at all

Magnitude of probability

1. How likely is that a person using this product or engaging in this activity would experience a negative consequence to their health and safety?

highly unlikely ... quite likely

2. How high is the probability that a person using this product or engaging in this activity would experience a negative consequence to their health and safety?

highly probable ... highly improbable

3. What do you think the chances are that a person will suffer a negative consequence to their health and safety as a result of using this product or participating in this activity?

very little chance ... very high chance

Perceived Risk

1. In general, how risky is this product or activity?

extremely risky ... not at all risky

2. Overall, do you perceive the risk of using this product or participating in this activity to be high or low?

very high ... very low

3. To what extent is a person who uses this product or engages in this activity taking a risk?

taking almost no risk ... taking a very large risk

Appendix C

Survey: Pre-test 1

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

Dear Respondent,

Thank you for taking the time to participate in this survey concerning consumer perceptions and acceptance of health and safety related risks. The stakes in research on consumer perceptions and acceptance of risk are high. The acceptance and viability of new technology-based products, the willingness of consumers to accept health-related treatments, and public concern with safety and health all indicate the need for risk analysis research. The following questions are meant to help us gain understanding of how people evaluate and make judgments about products and activities that may present potential risks to a person's health and well-being.

This research is part of an ongoing research effort, both at Virginia Tech and at other universities across the country, to better understand issues related to health and well-being. Your individual responses to each question will be of great value. The findings of this research will help manufacturers and marketers better understand and know your needs and concerns about risky products, help them design products that you believe are acceptable, and help them communicate information that is relevant and useful. Please take your time in answering the questions, and consider each one carefully.

We believe your responses to questions about health and well-being to be very important, as well as highly individualized and personal. Therefore, all information in this survey will be held confidential, and will not be shared with anyone not directly connected with the research. Analysis of the data will be on an aggregate basis, and no individual person will be identifiable on the basis of the data or the reports that stem from it. Your name was selected at random from the Montgomery County telephone book. Please answer each question frankly, knowing that there are no "right" or "wrong" answers; your honest and thoughtful opinion is what matters.

Based on preliminary studies, we have found that it takes approximately x minutes to complete this survey. If you have questions about the survey please call or write me at the address given below. Results of this survey will be made available to all participants who complete it. It is anticipated that these results will be available on a preliminary basis by fall, 1988. To receive a copy of the results, please complete the last page of the survey, which will be detached from the rest.

Please return the survey in the self-addressed, stamped envelope provided, within the next few days if at all possible. Again, thank you for your help in this research.

Sincerely,

Janet E. Oglethorpe
Department of Marketing
Virginia Tech
Blacksburg, Virginia 24061
(703-961-5025, office)

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

For the purpose of this research, risk is defined as the negative consequence, ranging from mild discomfort to death, that might occur to a person's health and well-being as a result of using a product or participating in an activity. For example, the risk of using a power mower would be the chance of suffering bodily injury.

You will be asked a series of questions about various potentially risky products and activities. Listed below are a set of products and activities, and a potential negative consequence associated with each one. Please refer to this list when answering the following questions, even though you may be able to think of other negative consequences in addition to the one listed.

sun-tanning beds	skin cancer
bicycles	head injury
homosexual activity	AIDS
heterosexual activity	unwanted pregnancy
downhill skiing	broken leg
cigarette smoking	lung cancer
high cholesterol diet	heart disease

Please detach this sheet from the rest of this questionnaire so that you can refer to it as you need to.

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

PART I: The first set of questions will be of the form shown below. Please answer the sample question to become familiar with this type of question and response.

Please **CIRCLE** the number that best describes your answer for each product or activity.

To what extent is the negative consequence associated with the use of this product or the participation in this activity increasing, that is, occuring with greater frequency over time?

	consequence decreasing			consequence not changing			consequence increasing
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

For example, if you felt that the incidence of skin cancer due to suntanning beds was increasing very slightly, you might circle the number 5 next to the words 'skin cancer', and so on for each different product or activity.

Please answer the following questions, in the format that you used above.

1. Would the potential negative consequence of using this product or engaging in this activity occur immediately – or would it be likely to occur at some later time?

	immediately			somewhat later			much later
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

2. How easy is it for you to imagine the negative consequence associated with the use of this product or the participation in this activity?

	extremely easy			neither easy nor difficult			extremely difficult
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

3. Would you say the negative consequence associated with using this product or participating in this activity is dreaded – that is, feared emotionally?

	greatly dreaded			somewhat dreaded			not at all dreaded
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

4. Does the negative consequence with using this product or participating in this activity affect one person at a time, or large numbers of people at once?

	one at a time			a few at a time			large numbers at a time
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

5. Does the negative consequence associated with using this product or participating in this activity seem particularly gruesome to you?

	extremely gruesome		somewhat gruesome				not at all gruesome
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

6. How soon after people use this product or participate in this activity would you expect them to suffer the negative consequence, if it occurred?

	right away		after a delay				in the distant future
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

7. How severe is the negative consequence associated with using this product or participating in this activity?

	not at all severe		somewhat severe				extremely severe
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

8. Does the negative consequence associated with using this product or participating in this activity come quickly to your mind?

	very quickly		somewhat quickly				not at all quickly
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

13. Would you, at least in theory, be willing to use this product or participate in this activity?

	extremely willing		somewhat willing				not at all willing
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

9. To what extent is a person who uses this product or engages in this activity taking a risk?

	almost no risk			moderate risk			very large risk
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

10. Would you say the negative consequence associated with using this product or participating in this activity is catastrophic, in that many people are affected at once?

	highly catastrophic			somewhat catastrophic			not at all catastrophic
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

11. If you were to suffer the negative consequence of using this product or engaging in this activity, how bad would that be?

	not bad at all			somewhat bad			extremely bad
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

12. How appealing to you is the thought of using this product or engaging in this activity?

	extremely appealing			somewhat appealing			not at all appealing
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

14. Does this product or activity need to be regulated or altered in any significant way, in order to be acceptable to society?

	absolutely			maybe			absolutely not
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
homosexual activity	1	2	3	4	5	6	7
heterosexual activity	1	2	3	4	5	6	7
downhill skiing	1	2	3	4	5	6	7
cigarette smoking	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7

PART II: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

Please write the number that indicates your response in the space next to each product or activity, in accordance with the scale provided.

To what extent is the negative consequence fatal?

0% 10 20 30 40 50 60 70 80 90 100%
never fatal — always fatal

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

For example, if you felt that the negative consequence associated with suntanning beds was almost never fatal, you might have written the number '10' next to 'suntanning beds', and so on for each product or activity. If you wish, you may choose a number between any two points, for example 15.

Please answer the following questions, in the format that you used above.

---

1. To what extent are effective safeguards available that people can use to protect themselves from the negative consequence associated with using this product or participating in this activity?

0% 10 20 30 40 50 60 70 80 90 100%
no effective safeguards exist — totally effective safeguards exist

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

2. To what extent can a person who uses this product or participates in this activity reduce the chance of suffering a negative consequence by either personal skill or diligence?

0% 10 20 30 40 50 60 70 80 90 100%
cannot be reduced at all — can be totally reduced

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

3. To what extent is the negative consequence associated with this product or activity reversible?

0% 10 20 30 40 50 60 70 80 90 100%
consequence cannot be reversed — consequence is totally reversible

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

4. To what extent can the risk be known precisely by the persons who engage in this activity or use this product?

0% 10 20 30 40 50 60 70 80 90 100%
risk level unknown — risk level known precisely

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

5. What is the probability that a person using this product or engaging in this activity would experience the associated negative consequence?

0% 10 20 30 40 50 60 70 80 90 100%
totally improbable — highly probable

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

6. To what extent is the negative consequence associated with the use of this product or the participation in this activity permanent?

0% 10 20 30 40 50 60 70 80 90 100%
not at all permanent — completely permanent

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

7. How likely is it that a person using this product or engaging in this activity would experience the associated negative consequence?

0% 10 20 30 40 50 60 70 80 90 100%
highly unlikely — extremely likely

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

8. To what extent can people protect themselves from suffering a negative consequence associated with the use of this product or the participation in this activity?

0% 10 20 30 40 50 60 70 80 90 100%
no protection possible — total protection possible

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

9. To what extent do scientists, or "experts", really know the risk of engaging in this activity or using this product?

0% 10 20 30 40 50 60 70 80 90 100%
risk level unknown — risk level known precisely

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

10. How confident are you in your knowledge about the risk of using this product or engaging in this activity?

0% 10 20 30 40 50 60 70 80 90 100%
not at all confident — totally confident

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

11. In general, how much risk is a person taking by using this product or participating in this activity?

0% 10 20 30 40 50 60 70 80 90 100%
taking no risk — taking a complete risk

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

PART III: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

For the following statement please indicate the degree that you agree or disagree with the statement for each product or activity. Please write in the number that indicates your response in the space next to each product or activity, in accordance with the following scale.

strongly agree	moderately agree	agree	neither agree nor disagree	disagree	moderately disagree	strongly disagree
1	2	3	4	5	6	7

The occurrence of the negative consequence associated with the use of this product or the participation in this activity is becoming more frequent.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

For example, if you simply agree with the statement as it relates to suntanning beds, you would have written a '3' next to the words 'suntanning beds'. But, if you have a stronger sense of agreement, you would have written a 2 or even a 1.

---

1. The negative consequence from using this product or participating in this activity is very delayed.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

2. It is possible to think about the negative consequence of using this product or participating in this activity calmly and rationally and without emotion.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

3. It is easy to recall or remember instances of people suffering from the negative consequence associated with the use of this product or the participation in this activity?

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

4. The risk associated with using this product or participating in this activity is an individual risk, rather than a group risk.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

5. The negative consequence that could occur as a result of using this product or participating in this activity is extremely "negative".

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

strongly agree	moderately agree	agree	neither agree nor disagree	disagree	moderately disagree	strongly disagree
1	2	3	4	5	6	7

6. The idea of using this product or participating in this activity is extremely attractive to me.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

7. A person who uses this product or engages in this activity cannot control the chances that the negative consequence will occur.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

8. A person can "undo" the negative consequence that might occur from using this product or participating in this activity.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

9. The chances are great that a person who uses this product or participates in this activity will suffer the associated negative consequence.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

10. Overall, I perceive the risk of using this product or participating in this activity to be very high.

sun-tanning beds ____
bicycles ____
homosexual activity ____
heterosexual activity ____
downhill skiing ____
cigarette smoking ____
high cholesterol diet ____

PART IV: To help us understand and interpret your answers in comparison to other people, we need to ask a few questions about yourself. Please feel free to refrain from answering any question.

What is your date of birth? ___/___/___

What sex are you?
____ Female
____ Male

Please indicate the highest level of education that you have completed.
____ Grade school
____ High school
____ Associate degree
____ Bachelors degree
____ Masters degree
____ Doctoral or Professional degree (e.g., M.D., or J.D.)
____ Post-doctoral study

What is your occupation? _____

Please indicate your approximate yearly family income.
____ below $10,000
____ between $10,000 and $19,999
____ between $20,000 and $29,999
____ between $30,000 and $39,999
____ between $40,000 and $49,999
____ between $50,000 and $59,999
____ between $60,000 and $69,999
____ above $70,000

What is your religious preference? _____

Thank you for your help. Please return this questionnaire in the self-addressed, stamped envelope provided.

Appendix D

Survey: Pre-test 2

PLEASE NOTE THE TIME YOU STARTED THIS SURVEY: _____

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

Dear Respondent,

As consumers, we are surrounded by products that present potential risks to our health and well being. Some of those risks are small; others are quite severe. Unfortunately, very little is known about how each of us decide which products are risky and which are not, and which of those products that may be risky are nonetheless considered acceptable. What we do know is that people, in general, have difficulty making judgments about risks, and that there seems to be a lot of misunderstanding.

We are conducting a research project to better understand what risk means to people. The findings of this research will help manufacturers and marketers better understand your needs and concerns about risky products, help them design products that you believe are acceptable, and help them communicate information that is relevant and useful. Your help by filling out the enclosed survey would be of great value in this project.

All information in this survey will be held confidential. Your name was selected at random from ... Please answer each question frankly, knowing that there are no "right" or "wrong" answers; your honest and thoughtful opinion is what matters. Please take your time in answering the questions, and consider each one carefully.

We have found that it takes approximately x minutes to complete this survey. If you have questions about the survey please call or write me at the address given below. To receive a copy of the results, please complete the last page of the survey, which will be detached from the rest.

The stakes in research on risk are high. Please return the survey in the self-addressed, stamped envelope provided, within the next few days if at all possible. Thank you very much for your help in this research.

Sincerely,

Janet E. Oglethorpe
Department of Marketing
Virginia Tech
Blacksburg, Virginia 24061
(703-961-5025, office)

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

For the purpose of this research, risk is defined as the negative consequence, ranging from mild discomfort to death, that might occur to a person's health and well-being as a result of using a product. For example, the risk of using a power mower would be the chance of suffering bodily injury.

You will be asked a series of questions about various potentially risky products. Listed below are a set of products, and a potential negative consequence associated with each one. Please refer to this list when answering the following questions, even though you may be able to think of other negative consequences in addition to the one listed.

MSG (monosodium glutamate - flavor enhancer)	headache
canned tuna	mercury poisoning
Sushi (raw fish)	salmonella poisoning
city drinking water	parasitic infection
aspirin	stomach bleeding/ulcer
hair dryer	electric shock
cosmetics	skin irritation
sun-tanning beds	skin cancer
bicycles	head injury
downhill skis	broken leg
cigarette smoking	lung cancer
high cholesterol diet	heart disease
blood transfusions	AIDS

Please detach this sheet from the rest of this questionnaire so that you can refer to it as you need to.

EVALUATING THE RISKS OF CONSUMER PRODUCTS AND ACTIVITIES

PART I: The first set of questions will be of the form shown below. Please answer the sample question to become familiar with this type of question and response.

Please **CIRCLE** the number that best describes your answer for each product.

To what extent is the negative consequence associated with the use of this product increasing, that is, occurring with greater frequency over time?

	consequence decreasing			consequence not changing			consequence increasing
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7

For example, if you felt that the incidence of headaches due to the use of MSG (monosodium glutamate flavor enhancer) was increasing very slightly, you might circle the number 5 next to the words 'MSG', and so on for each different product.

Please answer the following questions, in the format that you used above.

1. How easy is it for you to imagine the negative consequence associated with the use of this product?

	extremely difficult			neither easy nor difficult			extremely easy
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

2. Would the potential negative consequence of using this product occur immediately – or would it be likely to occur at some later time?

	immediately			somewhat later			much later
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

3. Would you say the negative consequence associated with using this product is dreaded -- that is, feared emotionally?

	not at all dreaded			somewhat dreaded			extremely dreaded
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

4. Does the negative consequence with using this product affect one person at a time, or large numbers of people at a time?

	one at a time			a few at a time			large numbers at a time
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

5. Does the negative consequence associated with using this product come quickly to your mind?

	not at all quickly			somewhat quickly			very quickly
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

6. How soon after people use this product would you expect them to suffer the negative consequence, if it occurred?

	right away			after a delay			in the distant future
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

7. How severe is the negative consequence associated with using this product?

	not at all severe			somewhat severe			extremely severe
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

8. Does the negative consequence associated with using this product seem particularly gruesome to you?

	not at all gruesome			somewhat gruesome			extremely gruesome
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

9. To what extent is a person who uses this product taking a risk?

	almost no risk			moderate risk			very large risk
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

10. Would you say the negative consequence associated with using this product is widespread, in that many people are affected at once?

	not at all widespread			somewhat widespread			highly widespread
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

11. How bad would it be to suffer the negative consequence of using this product?

	not bad at all			somewhat bad			extremely bad
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

12. How appealing to you is the thought of using this product?

	not at all appealing			somewhat appealing			extremely appealing
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

13. Would you, at least in theory, be willing to use this product, given the opportunity?

	not at all willing			somewhat willing			extremely willing
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

14. Does this product need to be better regulated or altered in any significant way, in order to be acceptable to society?

	absolutely not			maybe			absolutely
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

15. To what extent do scientists, or "experts", really know the risk of using this product?

	risk level unknown						risk level known precisely
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

16. Apart from any risk involved, to what extent does this product entail advantages, for example, meet a need, perform a desired function, give pleasure, or is beneficial or important?

	not at all advantageous						extremely advantageous
MSG	1	2	3	4	5	6	7
Sushi (raw fish)	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
canned tuna	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
hair dryers	1	2	3	4	5	6	7
cosmetics	1	2	3	4	5	6	7
sun-tanning beds	1	2	3	4	5	6	7
bicycles	1	2	3	4	5	6	7
downhill skis	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high cholesterol diet	1	2	3	4	5	6	7
blood transfusions	1	2	3	4	5	6	7

PART II: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

Please write the number that indicates your response in the space next to each product, in accordance with the scale provided.

To what extent is the negative consequence fatal?

0% 10 20 30 40 50 60 70 80 90 100%

never fatal — always fatal

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna

For example, if you felt that the negative consequence associated with MSG was almost never fatal, you might have written the number '10' next to 'MSG', and so on for each product. If you wish, you may choose a number between any two points, for example '5'.

Please answer the following questions, in the format that you used above.

---

1. To what extent are effective safeguards available that people can use to protect themselves from the negative consequence associated with using this product?

0% 10 20 30 40 50 60 70 80 90 100%

no protection possible — complete protection possible

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

2. To what extent can a person who uses this product reduce the chance of suffering a negative consequence?

0% 10 20 30 40 50 60 70 30 90 100%

cannot be reduced at all — can be completely reduced

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

3. To what extent is the negative consequence associated with this product reversible?

0% 10 20 30 40 50 60 70 80 90 100%

consequence can never be reversed — consequence can always be reversed

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

4. To what extent can the risk be determined precisely by the persons who use this product?

0% 10 20 30 40 50 60 70 80 90 100%

risk cannot be known at all — risk can be known precisely

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

5. What is the probability that a person using this product would experience the associated negative consequence?

0% 10 20 30 40 50 60 70 80 90 100%

highly improbable — highly probable

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

5 (a). How confident are you in that probability assessment?

0% 10 20 30 40 50 60 70 80 90 100%

not at all confident — highly confident

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

6. To what extent is the negative consequence associated with the use of this product permanent?

0% 10 20 30 40 50 60 70 80 90 100%

not at all permanent — extremely permanent

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

7. How likely is it that a person using this product would experience the associated negative consequence?

0% 10 20 30 40 50 60 70 80 90 100%

extremely unlikely — extremely likely

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

8. To what extent can people who use this product protect themselves from suffering the associated negative consequence?

0% 10 20 30 40 50 60 70 80 90 100%

no protection possible — total protection possible

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

9. How likely is it that scientists, or "experts", really know the risk of using this product?

0% 10 20 30 40 50 60 70 80 90 100%

highly unlikely — highly likely

___ MSG
___ Sushi (raw fish)
___ city drinking water
___ canned tuna
___ aspirin
___ hair dryers
___ cosmetics
___ sun-tanning beds
___ bicycles
___ downhill skis
___ cigarettes
___ high cholesterol diet
___ blood transfusions

10. How confident are you that you could determine, if you needed to, the risk of using this product?

0% 10 20 30 40 50 60 70 80 90 100%

not at all confident — extremely confident

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

11. In general, how risky is using this product?

0% 10 20 30 40 50 60 70 80 90 100%

not at all risky — extremely risky

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

12. Ignoring any risk involved, how beneficial is the use of this product?

0% 10 20 30 40 50 60 70 80 90 100%

not at all beneficial — extremely beneficial

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

PART III: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

For the following statement please indicate the degree that you agree or disagree with the statement for each product. Please write in the number that indicates your response in the space next to each product, in accordance with the following scale.

disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly
1	2	3	4	5	6	7

The occurrence of the negative consequence associated with the use of this product is becoming more frequent.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna

For example, if you agree slightly with the statement as it relates to MSG, you would have written a '5' next to the words 'MSG'. But, if you have a stronger sense of agreement, you would have written a 6 or even a 7. Please use the agree/disagree scale to answer the following questions.

---

1. The negative consequence from using this product does not occur immediately.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

2. The negative consequence of using this product is horrible, such that one cannot think about it calmly and rationally and without emotion.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

3. It is easy to bring to mind, or imagine, instances of people suffering from the negative consequence associated with the use of this product.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

4. The negative consequence associated with using this product is one that effects a group of people at a time, rather than one individual at a time.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly
1	2	3	4	5	6	7

5. The negative consequence that could occur as a result of using this product is extremely severe.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

6. The idea of using this product is extremely attractive to me.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

7. People who suffer the negative consequence that might occur from using this product live with that negative consequence for the rest of their lives.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

8. The chances are great that a person who uses this product will suffer the associated negative consequence.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

9. Overall, I perceive the risk of using this product to be very high.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

10. Aside from any risk involved, people who use this product derive a great amount of benefit from it.

____ MSG
____ Sushi (raw fish)
____ city drinking water
____ canned tuna
____ aspirin
____ hair dryers
____ cosmetics
____ sun-tanning beds
____ bicycles
____ downhill skis
____ cigarettes
____ high cholesterol diet
____ blood transfusions

PART IV: To help us understand and interpret your answers in comparison to other people, we need to ask a few questions about yourself. Please feel free to refrain from answering any question.

In what year were you born? _____

What sex are you?
____ Female
____ Male

Please indicate the highest level of education that you have completed.
____ Grade school
____ High school
____ Associate degree
____ Bachelors degree
____ Masters degree
____ Doctoral or Professional degree (e.g., M.D., or J.D.)
____ Post-doctoral study

What is your occupation? _____

Please indicate your approximate yearly family income.
____ below $10,000
____ between $10,000 and $19,999
____ between $20,000 and $29,999
____ between $30,000 and $39,999
____ between $40,000 and $49,999
____ between $50,000 and $59,999
____ between $60,000 and $69,999
____ above $70,000

Thank you for your help. Please return this questionnaire in the self-addressed, stamped envelope provided.

PLEASE NOTE THE TIME YOU FINISHED THIS SURVEY: _____

Appendix E

Survey: Pre-test 3

EVALUATING THE RISKS OF CONSUMER PRODUCTS

Dear Respondent,

As consumers, we are surrounded by products that present potential risks to our health and well being. Some of those risks are small; others are quite severe. Unfortunately, very little is known about how each of us decide which products are risky and which are not, and which of those products that may be risky are nonetheless considered acceptable. What we do know is that people, in general, have difficulty making judgments about risks, and that there seems to be a lot of misunderstanding.

We are conducting a research project to better understand what risk means to people. The findings of this research will help manufacturers and marketers better understand your needs and concerns about risky products, help them design products that you believe are acceptable, and help them communicate information that is relevant and useful. Your help by filling out the enclosed survey would be of great value in this project.

All information in this survey will be held confidential. Your name was selected at random from ... Please answer each question frankly, knowing that there are no "right" or "wrong" answers; your honest and thoughtful opinion is what matters. Many of the questions on this survey will seem redundant. Please be patient with this repetition; it is necessary to be repetitive in order to get accurate results. Please take your time in answering the questions, and consider each one carefully.

We have found that it takes approximately x minutes to complete this survey. If you have questions about the survey please call or write me at the address given below. To receive a copy of the results, please complete the last page of the survey, which will be detached from the rest.

The stakes in research on risk are high. Please return the survey in the self-addressed, stamped envelope provided, within the next few days if at all possible. Thank you very much for your help in this research.

Sincerely

Janet E. Oglethorpe
Department of Marketing
Virginia Tech
Blacksburg, Virginia 24061
(703-961-5025, office)

EVALUATING THE RISKS OF CONSUMER PRODUCTS

For the purpose of this research, risk is defined as the negative consequence, ranging from mild discomfort to death, that might occur to a person's health and well-being as a result of using a product. For example, the risk of using a power mower would be the chance of suffering bodily injury.

You will be asked a series of questions about various potentially risky products. Listed below are a set of products, and a potential negative consequence associated with each one. Please refer to this list when answering the following questions, even though you may be able to think of other negative consequences in addition to the one listed.

MSG (monosodium glutamate flavor enhancer)	headache
city drinking water	parasitic infection
styrofoam	depletion of earth's protective ozone layer
phosphate detergents	water pollution
cigarette smoking	lung cancer
walkman	hearing loss

Please detach this sheet from the rest of this questionnaire so that you can refer to it as you need to.

EVALUATING THE RISKS OF CONSUMER PRODUCTS

PART I: The first set of questions will be of the form shown below. Please answer the sample question to become familiar with this type of question and response.

Please CIRCLE the number that best describes your answer for each product.

To what extent is the negative consequence associated with the use of this product increasing, that is, occurring with greater frequency over time?

	consequence decreasing			consequence not changing			consequence increasing
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7

For example, if you felt that the incidence of headaches due to the use of MSG (monosodium glutamate flavor enhancer) was increasing very slightly, you might circle the number 5 next to the words 'MSG', and so on for each different product.

Please answer the following questions, in the format that you used above.

1. How easy is it for you to imagine the negative consequence associated with the use of this product?

	not at all easy			somewhat easy			very easy
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

2. Would the potential negative consequence of using this product occur immediately – or would it be likely to occur at some later time?

	immediately			somewhat later			much later
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

3. Is this negative consequence one that you react to emotionally, that is, with dread or fear?

	not at all emotional			somewhat emotional			extremely emotional
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

4. When an individual uses this product, is only that individual affected by the negative consequence, or is a large group of people, in addition to the user, affected?

	affects the individual						affects the group
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

5. Does the negative consequence associated with using this product come easily to your mind?

	not at all easily			somewhat easily			very easily
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

6. How soon after people use this product would you expect them to suffer the negative consequence, if it occurred?

	right away						in the distant future
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

7. How severe is the negative consequence associated with using this product?

	not at all severe			somewhat severe			extremely severe
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

8. Does the negative consequence associated with using this product seem particularly gruesome, or horrible, to you, such that it is difficult to think about without emotion?

	not at all gruesome			somewhat gruesome			extremely gruesome
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

9. Does this negative consequence have a large impact, in that, if one person uses the product, a large number of people are affected by the negative consequence?

	very small impact						very large impact
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

10. How bad would it be to suffer the negative consequence of using this product?

	not bad at all			somewhat bad			extremely bad
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

11. How appealing to you is the thought of using this product?

	not at all appealing			somewhat appealing			extremely appealing
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

12. Would you, at least in theory, be willing to use this product, given the opportunity?

	not at all willing			somewhat willing			extremely willing
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

13. Does this product need to be better regulated or altered in any significant way, in order to be acceptable to society?

	absolutely not			maybe			absolutely
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

14. To what extent is "scientific" or "objective" information available to people about the risk of using this product?

	information unavailable						information available
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

15. Apart from any risk involved, to what extent does this product entail advantages, for example, meet a need, perform a desired function, give pleasure, or is beneficial or important?

	not at all advantageous						extremely advantageous
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

16. To what extent is a person who uses this product taking a risk?

	almost no risk			moderate risk			very large risk
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

PART II: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

For the following statement please indicate the degree that you agree or disagree with the statement for each product. Please circle the number that indicates your response on the scale next to each product.

The occurrence of the negative consequence associated with the use of this product is becoming more frequent.

	disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7

For example, if you agree slightly with the statement as it relates to MSG, you would have circled a '5' next to the words 'MSG'. But, if you have a stronger sense of agreement, you would have circled a 6 or even a 7. Please use the agree/disagree scale to answer the following questions.

---

1. The negative consequence from using this product occurs immediately.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

2. The negative consequence of using this product is horrible, such that you cannot think about it calmly and rationally and without emotion.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

3. It is easy to bring to mind, or imagine, instances of people suffering from the negative consequence associated with the use of this product.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

4. The negative consequence associated with using this product is one that effects numbers of people, not only the individual who uses it.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

5. The negative consequence that could occur as a result of using this product is extremely severe.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

6. The idea of using this product is extremely attractive to me.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly
1	2	3	4	5	6	7

7. People who suffer the negative consequence that might occur from using this product live with that negative consequence for the rest of their lives, that is, it cannot be "fixed" or "cured".

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

8. The chances are great that a person who uses this product will suffer the associated negative consequence.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

9. Overall, I perceive the risk of using this product to be very high.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

10. Aside from any risk involved, people who use this product derive a great amount of benefit from it.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

11. The idea of using this product is very acceptable to me.

	disagree						agree
MSG	1	2	3	4	5	6	7
city drinking water	1	2	3	4	5	6	7
styrofoam	1	2	3	4	5	6	7
phosphate detergent	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
walkman	1	2	3	4	5	6	7

PART III: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

Please circle the number that indicates your response on the scale next to each product.

To what extent is the negative consequence fatal?

	0% never fatal	10	20	30	40	50	60	70	80	90	100% always fatal
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100

For example, if you felt that the negative consequence associated with MSG was almost never fatal, you might have circled the number 10, and so on for each product.

Please answer the following questions, in the format that you used above.

---

1. Assuming that people use this product, can they protect themselves from the associated negative consequence, for example, by using a protective device or preventive safeguard, or by being careful or diligent?

	no protection possible										complete protection possible
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

2. To what extent is the negative consequence associated with this product reversible, that is, something that heals or goes away with time?

	consequence is irreversible										consequence is reversible
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

3. Is it possible for people, if they want to, to get objective information about what the risks of using this product are?

	risk cannot be known at all										risk can be known precisely
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

4. What is the probability that a person using this product would experience the associated negative consequence?

	highly improbable										highly probable
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

4 (a). How confident are you in that probability assessment?

	not at all confident										highly confident
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

5. To what extent is the negative consequence associated with the use of this product permanent?

	not at all permanent										extremely permanent
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

6. How likely is it that a person using this product would experience the associated negative consequence?

	extremely unlikely										extremely likely
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

7. Given that people use this product, to what extent can they control, or influence, the likelihood of suffering the associated negative consequence?

	no control possible										total control possible
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

8. How confident are you that you could get information, if you needed to, about the risk of using this product?

	not at all confident										extremely confident
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

9. In general, how risky is using this product?

	not at all risky										extremely risky
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

10. Ignoring any risk involved, how beneficial is the use of this product?

	not at all beneficial										extremely beneficial
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

11. Once a person uses this product, can he or she reduce the chance of suffering the negative consequence?

	cannot be reduced at all										can be completely reduced
MSG	0	10	20	30	40	50	60	70	80	90	100
city water	0	10	20	30	40	50	60	70	80	90	100
styrofoam	0	10	20	30	40	50	60	70	80	90	100
phosphates	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
walkman	0	10	20	30	40	50	60	70	80	90	100

PART IV: To help us understand and interpret your answers in comparison to other people, we need to ask a few questions about yourself. Please feel free to refrain from answering any question.

In what year were you born? __

What sex are you?
- Female
- Male

Please indicate the highest level of education that you have completed.
- Grade school
- High school
- Associate degree
- Bachelors degree
- Masters degree
- Doctoral or Professional degree (e.g., M.D., or J.D.)
- Post-doctoral study

What is your occupation? _____

Please indicate your approximate yearly family income.
- below $10,000
- between $10,000 and $19,999
- between $20,000 and $29,999
- between $30,000 and $39,999
- between $40,000 and $49,999
- between $50,000 and $59,999
- between $60,000 and $69,999
- above $70,000

Thank you for your help. Please return this questionnaire in the self-addressed, stamped envelope provided.

Appendix F

Survey: Final

EVALUATING THE RISKS OF CONSUMER PRODUCTS

You will be asked a series of questions about various potentially risky products. For the purpose of this research, risk is defined as the negative consequence, ranging from mild discomfort to death, that might occur to a person's health and well-being as a result of using a product. For example, the risk of using a power mower would be the chance of suffering bodily injury.

Listed below are a set of products, and a potential negative consequence associated with each one. **Please refer to this list when answering the following questions, even though you may be able to think of other negative consequences in addition to the one listed.**

PRODUCT	NEGATIVE CONSEQUENCE
MSG (monosodium glutamate flavor enhancer)	headache
sun-tanning bed	skin cancer
bicycle	head injury
aerosol cans	depletion of earth's protective ozone layer
hair dryer	electric shock
aspirin	stomach bleeding/ulcer
cigarette smoking	lung cancer
high-cholesterol diet	heart disease

Please detach this sheet from the rest of this questionnaire so that you can refer to it as you need to.

EVALUATING THE RISKS OF CONSUMER PRODUCTS

PART I: The first set of questions will be of the form shown below. Please answer the sample question to become familiar with this type of question and response.

Please CIRCLE the number that best describes your answer for each product.

To what extent is the negative consequence associated with the use of this product changing in frequency, that is, occurring with greater or lesser frequency over time?

	consequence decreasing			consequence not changing			consequence increasing
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7

For example, if you felt that the incidence of headaches due to the use of MSG (monosodium glutamate flavor enhancer) was increasing very slightly, you might circle the number 5 next to the words 'MSG', and so on for each different product.

Please answer the following questions, in the format that you used above.

---

1. How easy is it for you to imagine the negative consequence associated with the use of this product?

	not at all easy			somewhat easy			very easy
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

2. Would the potential negative consequence of using this product occur immediately after use -- or would it be likely to occur at some later time?

	immediately			somewhat later			much later
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

3. Is this negative consequence one that you react to emotionally, that is, with dread or fear?

	not at all emotional			somewhat emotional			extremely emotional
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

4. When an individual uses this product, is only that individual affected by the negative consequence, or is a large group of people, in addition to the user, affected?

	affects the individual						affects the group
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

5. Does the negative consequence associated with using this product come easily to your mind?

	not at all easily			somewhat easily			very easily
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

6. How soon after people use this product would you expect them to suffer the negative consequence, if it occurred?

	right away						in the distant future
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

7. How severe is the negative consequence associated with using this product?

	not at all severe			somewhat severe			extremely severe
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

8. Does the negative consequence associated with using this product seem particularly gruesome, or horrible, to you, such that it is difficult to think about without emotion?

	not at all gruesome			somewhat gruesome			extremely gruesome
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

9. Does this negative consequence have a wide impact, in that, if one person uses the product, a number of people are affected by the negative consequence (either to a small or large degree)?

	very narrow impact						very wide impact
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

10. How bad would it be to suffer the negative consequence of using this product?

	not bad at all			somewhat bad			extremely bad
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

11. How appealing to you is the thought of using this product?

	not at all appealing			somewhat appealing			extremely appealing
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

12. Would you, at least in theory, be willing to use this product, given the opportunity?

	not at all willing			somewhat willing			extremely willing
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

13. Does this product need to be better regulated or altered in any significant way, in order to be acceptable to society?

	absolutely not			maybe			absolutely
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

14. Can people who want or need to get objective information about the risk of using this product do so?

	information unavailable						information available
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

15. Apart from any risk involved, to what extent does this product entail advantages, for example, meet a need, perform a desired function, give pleasure, or is beneficial or important?

	not at all advantageous						extremely advantageous
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

16. To what extent is a person who uses this product taking a risk?

	almost no risk			moderate risk			very large risk
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

PART II: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response. For the following statement please circle the number that indicates the degree that you agree or disagree with the statement for each product.

The occurrence of the negative consequence associated with the use of this product is becoming more frequent.

disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly

MSG	**1**	**2**	**3**	**4**	**5**	**6**	**7**
sun-tanning bed	**1**	**2**	**3**	**4**	**5**	**6**	**7**

For example, if you agree slightly with the statement as it relates to MSG, you would have circled a '5' next to the words 'MSG'. Please use the agree/disagree scale to answer the following questions.

---

1. The negative consequence from using this product occurs immediately after it is used.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

2. Overall, I perceive the risk of using this product to be very high.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

3. The negative consequence of using this product is horrible, such that you cannot think about it calmly and rationally and without emotion.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

4. It is easy to bring to mind, or imagine, someone suffering from the negative consequence associated with the use of this product.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

5. When an individual uses this product, the negative consequence affects a number of people, not only the individual who uses it.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

6. The negative consequence that could occur as a result of using this product is extremely severe.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

7. People who suffer the negative consequence that might occur from using this product live with that negative consequence for the rest of their lives, that is, it cannot be "fixed" or "cured".

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

8. The chances are great that the use of this product will result in the associated negative consequence.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

9. Aside from any risk involved, people who use this product derive a great amount of benefit from it.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

10. The idea of using this product is very acceptable to me.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
sun-tanning bed	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
hair dryer	1	2	3	4	5	6	7
aspirin	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7
high-cholesterol diet	1	2	3	4	5	6	7

PART III: The next set of questions will be of the form shown below. Again, please answer the sample question to become familiar with this type of question and response.

Please circle the number that indicates your response on the scale next to each product.

To what extent is the negative consequence fatal?

	0%	10	20	30	40	50	60	70	80	90	100%
	never fatal										always fatal
MSG	0	10	20	30	40	50	60	70	80	90	100
tanning bed	0	10	20	30	40	50	60	70	80	90	100

For example, if you felt that the negative consequence associated with MSG was almost never fatal, you might have circled the number 10, and so on for each product.

Please answer the following questions, in the format that you used above.

---

1. Assuming that people use this product, can they <u>protect themselves</u> from the associated negative consequence, for example, by using a protective device or preventive safeguard, or by being careful or diligent?

	no protection possible										complete protection possible
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

2. To what extent is the negative consequence associated with this product <u>reversible</u>, that is, <u>something that heals or goes away with time?</u>

	consequence is irreversible										consequence is reversible
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

3. Is it possible for people, if they want to, to <u>get objective information</u> about what the risks of using this product are?

	risk cannot be known at all										risk can be known precisely
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

4. What is the <u>probability</u> that the negative consequence associated with this product would occur?

	highly improbable										highly probable
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

4 (a). How confident are you in that probability assessment?

	not at all confident									highly confident
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

5. To what extent is the negative consequence associated with the use of this product permanent?

	not at all permanent									extremely permanent	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

6. How likely is it that the negative consequence associated with the use of this product would happen?

	extremely unlikely									extremely likely	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

7. Given that people use this product, to what extent can they control, or influence, the likelihood of suffering the associated negative consequence?

	no control possible									total control possible	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

8. How confident are you that you could get information, if you needed to, about the risk of using this product?

	not at all confident									extremely confident	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

9. In general, how risky is using this product?

	not at all risky									extremely risky	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

10. Ignoring any risk involved, how beneficial is the use of this product?

	not at all beneficial									extremely beneficial	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

11. Assuming that a person uses this product, can he or she reduce the chance of suffering the negative consequence?

	cannot be reduced at all									can be completely reduced	
MSG	0	10	20	30	40	50	60	70	80	90	100
sun-tanning bed	0	10	20	30	40	50	60	70	80	90	100
bicycle	0	10	20	30	40	50	60	70	80	90	100
aerosol cans	0	10	20	30	40	50	60	70	80	90	100
hair dryer	0	10	20	30	40	50	60	70	80	90	100
aspirin	0	10	20	30	40	50	60	70	80	90	100
cigarettes	0	10	20	30	40	50	60	70	80	90	100
cholesterol diet	0	10	20	30	40	50	60	70	80	90	100

PART IV: To help us understand and interpret your answers in comparison to other people, we need to ask a few questions about yourself. Please feel free to refrain from answering any question.

In what year were you born? ____

What sex are you?
____ Female
____ Male

Please indicate the highest level of education that you have completed.
____ Grade school
____ High school
____ Associate degree
____ Bachelors degree
____ Masters degree
____ Doctoral or Professional degree (e.g., M.D., or J.D.)
____ Post-doctoral study

What is your occupation? _____

In what department do you work? _____

Please indicate your approximate yearly family income.
____ below $10,000
____ between $10,000 and $19,999
____ between $20,000 and $29,999
____ between $30,000 and $39,999
____ between $40,000 and $49,999
____ between $50,000 and $59,999
____ between $60,000 and $69,999
____ above $70,000

To be included in the raffle, write your name and telephone number in the space below. Please fold this questionnaire so that the return address shows, staple or tape it closed, and return it through the campus mail. Thank you very much for your help.

Appendix G

Survey: Non-respondents

The R. B. Pamplin College of Business
Department of Marketing

September 3, 1988

Dear Professor, Ms. or Mr.:

A few weeks ago I sent you a rather lengthy survey dealing with the perceived risks of potentially hazardous consumer products as part of my dissertation research being conducted under the direction of Professor Kent B. Monroe in the Department of Marketing. I appreciate that the 30 minutes required to fill out that survey is a lot to ask, particularly at the end of spring quarter, and many people chose not to participate. As a follow-up to that survey and to confirm the results that I did get, I need to ask those people who did not participate to answer just a few questions. The attached survey will take only about five minutes to complete, and it will be of great help in assuring the success and accuracy of my project. Please answer each question frankly, knowing that there are no "right" or "wrong" answers; your honest and thoughtful opinion is what matters.

To return the survey, simply fold it so that the return address is showing, staple or tape it closed, and return it through campus mail. Thank you for your willingness to participate.

Sincerely,

Janet E. Oglethorpe
Doctoral Candidate, Department of Marketing
552-2328

EVALUATING THE RISKS OF CONSUMER PRODUCTS

Listed below are a set of products, and a potential negative consequence associated with each one. **Please refer to this list when answering the following questions, even though you may be able to think of other negative consequences in addition to the one listed.**

PRODUCT	NEGATIVE CONSEQUENCE
MSG (monosodium glutamate flavor enhancer)	headache
bicycle	head injury
aerosol cans	depletion of earth's protective ozone layer
cigarette smoking	lung cancer

For the following statements please circle the number that indicates the degree that you agree or disagree with the statement for each product. Please respond according to the following scale.

disagree strongly	disagree	disagree slightly	neither agree nor disagree	agree slightly	agree	agree strongly
1	2	3	4	5	6	7

1. The negative consequence from using this product occurs immediately after it is used.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

2. Overall, I perceive the risk of using this product to be very high.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

3. The negative consequence that could occur as a result of using this product is extremely severe.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

4. The chances are great that the use of this product will result in the associated negative consequence.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

5. Aside from any risk involved, people who use this product derive a great amount of benefit from it.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

6. The idea of using this product is very acceptable to me.

	strongly disagree						strongly agree
MSG	1	2	3	4	5	6	7
bicycle	1	2	3	4	5	6	7
aerosol cans	1	2	3	4	5	6	7
cigarettes	1	2	3	4	5	6	7

Please fold this questionnaire so that the return address shows, staple or tape it closed, and return it through the campus mail. Thank you very much for your help.

The three page vita has been removed from the scanned document. Page 1 of 3

The three page vita has been removed from the scanned document. Page 2 of 3

The three page vita has been removed from the scanned document. Page 3 of 3