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# The effect of a decision aid on risk aversion in capital investment decisions

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ABSTRACT

In this study we examine whether a decision aid is an effective means of reducing risk aversion within a capital investment decision context, and under what conditions. Participating in the experiment were 78 working adults (mid management) with a mean age 30 and enrolled in a leading U.S. MBA program. We predict and find that a decision aid will be most effective among individuals intolerance of ambiguity and exhibiting high negative affect.

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## 1. Introduction

Risk due to uncertainty or ambiguity is present to some extent in many, if not most, of life's important decisions; and, research shows that it consistently influences choice across a variety of decision contexts (Camerer and Weber 1992). Within business specifically, the outcomes of prospective capital investments are rarely known with certainty, and outcome ambiguity is the rule rather than the exception.[3] Further, uncertainty and ambiguity have been shown to negatively influence managers' resource allocation decisions (e.g. Ghosh & Ray, 1997; Ho, Keller, & Keltya, 2002, 2005). Sprinkle, Williamson and Upton (2007) note that "risk aversion leads individuals to…select "safe" projects…(that) reduce firm welfare." (p. 437). In this study, we examine the effectiveness of a decision aid to reduce risk aversion.[4]

When rendering capital investment decisions, managers often are faced with multiple options from which to choose on behalf of the firm. The uncertainty and ambiguity inherent in capital investment decisions increase choice complexity and task difficulty which, in turn, influence deliberative processes and ultimate choice (Sawers, 2005). Prior research demonstrates that individuals have limited cognitive capacity and, as a consequence, they commonly rely on simplifying heuristics and/or affective reactions in complex decision environments (Forgas & George, 2001).

Decision aids are often employed, both in practice and in research, as a means of guiding employee decision making in directions beneficial to the firm. (Bonner, 2008; Carmona, Lowe, & Reckers, 2011; Ho & Vera-Munoz, 2001). Still, while organizations invest substantial resources in the development, implementation and utilization of decision aids, desired benefits are not always realized (Bonner, 2008, Carmona et al., 2011). A variety of individual and task variables can limit or enhance the effectiveness of decision aids (Bonner, 2008; Glover, Prawitt, & Spilker, 1997). If the underlying cause(s) of suboptimal decision making are not addressed by the aid then the decision aid will not yield benefits; and development costs will be wasted. In decision contexts where outcome ambiguity may have higher salience to selected decision makers, increasing the amount of task structure and clarity through a decision aid may be an effective means of influencing choice behavior (Bonner, 2008) (Fig. 1).

Individual characteristics, such as tolerance for ambiguity and dispositional affect, have been shown to influence decision making in an environment of uncertainty and ambiguity (e.g. Cianci & Bierstaker, 2009; Curtis, 2006; Forgas & George, 2001; Ghosh & Ray, 1992; Lowe and Reckers (2012)). Specifically, tolerance of ambiguity (TOA) has been shown to influence decision making across a number of business contexts including but not limited to capital budgeting (e.g. Carmona et al., 2011; Ghosh & Ray, 1997). In business contexts set in environments of uncertainty and ambiguity, dispositional affect also has been shown to influence audit judgment (e.g., Bhattacharjee & Moreno, 2002; Cianci & Bierstaker, 2009), ethical decision making (e.g., Curtis, 2006; Lowe & Reckers, 2012), and investment decisions (Sawers, 2005). Accordingly, in the research reported herein, we hypothesize differential decision aid effectiveness across individuals exhibiting different levels of tolerance of ambiguity and levels of positive and negative affect.

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[3] "Outcome ambiguity" is defined (as in Curley and Yates, 1985, p. 274) as "uncertainty about the processes by which outcomes are determined". When estimating the return of a potential capital investment, the return could be estimated as an unambiguous 16% or could be presented as a range of outcomes (e.g. the return lies between 14 and 18%). In the latter case, ambiguity exists regarding which return will be realized.

[4] I use the term "range estimate decisions" throughout this paper to denote decisions with projected outcomes (e.g.. estimated ROI) that are ambiguous (e.g. presented as a range estimate of possible outcomes) as defined in footnote 1.

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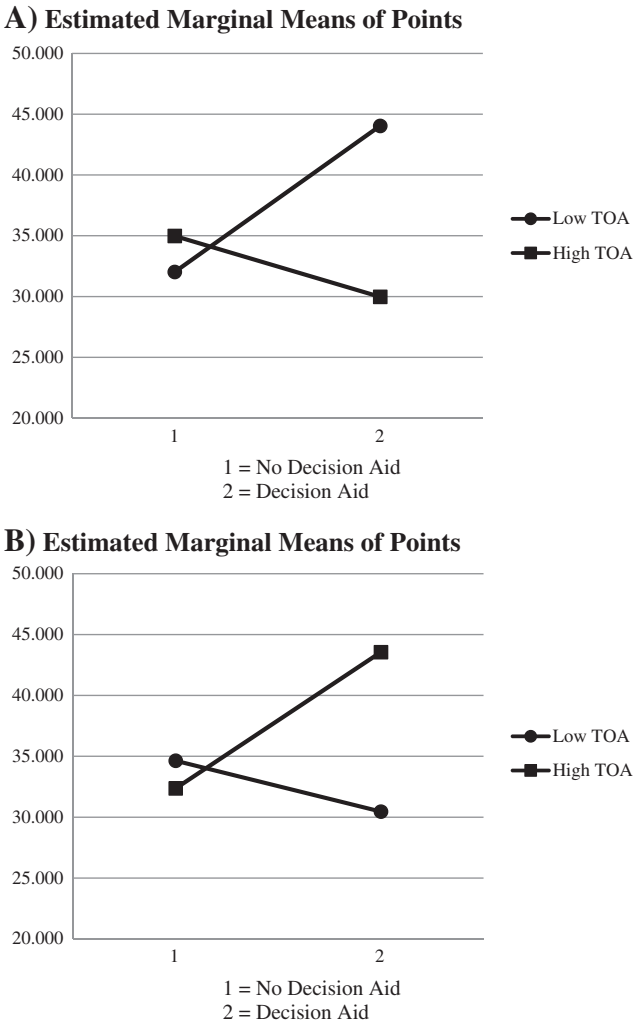



**Fig. 1.** A: Estimated marginal means of points. B: Estimated marginal means of points.

We conducted an experiment in which participants selected among three capital investment proposals with the investment proposals varying in levels of outcome ambiguity. The proposal promising the greatest contribution to corporate goals was also the proposal with the greatest outcome risk (ambiguity). All participants were provided with information about company goals (both long- and short-term) to assist in their decision making. Additionally, half the participants received a decision aid requiring assessment of the contribution of each proposal toward achieving each of the various long- and short-term strategic goals of the organization. Participants then allocated points among the three capital investment proposals according to their relative degree of support. Individual levels of tolerance of ambiguity were measured using the MacDonald (1970) tolerance of ambiguity scale; and dispositional affect was measured using a modified PANAS scale (Watson & Tellegen, 1985).

We predicted and found that decision aids would have their greatest effect among individuals reticent to make a decision on their own (those exhibiting high negative affect, consistent with Sawers, 2005) and individuals intolerant of ambiguity and seeking decision making structure (Bonner, 2008).

The results of this study have implications for decision aid use and design in capital investment decisions and contribute to existing literature regarding the factors that influence decision aid effectiveness. As most accounting decisions involve some degree of uncertainty, the factors that influence these types of decisions are of particular interest to many accounting researchers (e.g., Bonner, 2008; Haka, 2007; Loewenstein, Rick, & Cohen, 2008).

The remainder of this paper is organized as follows: Section II provides the theoretical issues and develops the hypotheses for this study. The research methodology is described in section III, followed by the results in Section IV. Section V summarizes the results and discusses implications, limitations and directions for future research.

## 2. Theoretical issues and hypothesis development

### *2.1. Decision making processes and outcome ambiguity*

Prior research has demonstrated that individuals do not always behave "rationally". The concept of "bounded rationality" encompasses the idea that individuals are often but not always strictly "rational". Individuals have frequently been found to make decisions that do not optimize expected (economic) value. Explanations for such behavior include cognitive limitations (Kahneman & Tversky, 1979) and affective disposition (Forgas and George, 2001). Decision makers frequently rely on shortcuts or heuristics to assist them in making decisions or default to affective reactions when faced with difficult decision tasks. Though these heuristics and affective reactions can lead to normatively correct decisions, in some situations they also have been shown to lead to suboptimal decision making. Errors and/or biases in judgments and decisions may result in managerial decisions that are inconsistent with the long-term interests of a firm or society (e.g., Cianci & Bierstaker, 2009; Ghosh & Ray, 1992, 1997; Ho & Vera-Munoz, 2001; Sprinkle, Williamson, & Upton, 2007).

Ambiguity is one factor that has consistently been shown to influence choice behavior (e.g. Einhorn & Hogarth, 1986; Ellsberg, 1961; Ghosh & Ray, 1997; Ho et al., 2002; Viscusi & Magat, 1992). Ellsberg (1961) examines choice behavior related to ambiguity. In a choice between two items that are identical except for the degree of ambiguity in the probabilities, he finds that people tend to choose the option with lower ambiguity. Many subsequent studies also report ambiguity aversion (e.g., Einhorn & Hogarth, 1986; Viscusi & Magat, 1992) or participants' willingness to pay a premium to avoid ambiguity (e.g., Camerer and Weber 1992; Becker and Brownson, 1964).

The precise mechanisms through which ambiguity aversion influences decisions remains unclear (Loewenstein et al., 2008; Camerer and Weber 1992); however, most proposed explanations incorporate a difference in the salience of the ambiguous information to the decision maker (Du & Budescu, 2005; Loewenstein et al., 2008). The increased salience of ambiguous information leads decision makers to selectively focus on a small subset of information in the decision task. Selective attention influences the way that decisions are made and the options that are selected (Krantz & Kunreuther, 2007; Weber & Johnson, 2009). Several studies suggest that changing the salience of the information will alter the decision maker's tendency to select ambiguity averse options (e.g. Du & Budescu, 2005; Ho et al., 2002). Ho et al. (2005) examine the influence of outcome ambiguity and irrelevant information on capital budgeting decisions and find that in a gain context, managers select investments that do not maximize firm value. To ensure that managers at various levels of the organization are focusing on the factors that the organization finds most relevant to capital investment decisions, Ho et al. (2005) suggest implementing systems that explicitly state the items to consider throughout the capital budgeting process. Together, these research findings suggest a decision aid designed to refocus attention on all salient aspects of the decision may be an effective means of reducing aversion to outcome ambiguity in managerial decision making.

### *2.2. Decision aids*

Decision aids are widely employed in practice and in research as a means overcoming biases in individual judgments and decision making

(Bonner, 2008; Carmona et al., 2011; Larrick, 2004; Roberts, Albright, & Hibbets, 2004; Sawers, 2005). Decision aids can improve cognitive processes and create more structure in tasks leading to less complexity and higher quality judgments and decisions (Bonner, 2008).

Companies may invest substantial resources in the development, implementation and utilization of decision aids. However, prior research has demonstrates that the potential benefits of decision aids are not always realized. A variety of individual (cognitive limitations, biases and affective reactions) and task variables can limit the effectiveness of decision aids (Bonner, 2008; Glover et al., 1997). Decision aids which have addressed these problematic issues have been shown to be effective. Specifically, evidence suggests that decision aids may reduce the effects of many biases that influence decisions under risk and uncertainty (Ghosh & Crain, 1993; Mackay, Barr, & Keltke, 1992). In a capital investment decision context, Sawers (2005) examined the effectiveness of a decision aid in overcoming decision avoidance (induced by negative affect) in complex and uncertain decision environments. The decision tool utilized was designed to promote a problem-focused (versus emotion-focused) approach to decision making in order to overcome choice avoidance associated with negative affect. This aid was found to be effective in overcoming decision avoidance for tasks in which negative emotional responses to choice difficulty would normally lead to choice avoidance. However, this study did not evaluate whether or not the aid was effective in overcoming ambiguity-averse choice behavior or other biases in the actual decision.

In a Balanced Score Card performance evaluation decision context, Roberts et al. (2004) examined the effectiveness of a decision aid in advancing participants' consideration of more rather than fewer decision cues. The decision tool utilized was designed to require disaggregation of a complex judgment task. This aid was found to be effective in overcoming the "common measures" bias reported elsewhere (Lipe & Salterio, 2000).

In another study, Slovic and Tversky (1974) examine whether providing information about ambiguity aversion and alternate decision techniques is an effective aid to reducing ambiguity aversion in choice behavior. Despite receiving this information aid, the majority of subjects still selected the ambiguity-averse option. Other research has shown that instructions or warnings of this nature produce a mixed record at improving choice behavior (Arkes, 1991; Fischhoff, 1982). The reason for this may be that, while the decision maker becomes aware of the potential bias, the aid does not restructure the task (Bonner, 2008).

The decision aid used in our study is directly linked to company strategic objectives as suggested in prior research (e.g. Ho et al., 2005; Kaplan & Norton, 2004, 2006; Roberts et al., 2004). In addition, the aid provides structure, yet is simple to apply. Further, the aid assists the user in decomposing the essential elements of each investment option according to the impact on each of the organization's strategic objectives. Each of these decision aid elements (e.g. ease of use, structure, decomposition, links to strategic objectives) have been shown to increase the usefulness and effectiveness of decision aids (Bonner, 2008).

Taken together, this research suggests that a decision aid may be an effective means of redirecting attention to a focus on relevant information queues related to the organizations' long- and short-term strategic goals. This method should reduce task complexity, a factor associated with ambiguity in choice options, and reduce the effort and uncertainty involved in the decision making process.

### 2.3. Tolerance of ambiguity

However, the effectiveness of our decision aid may be conditional on characteristics of the participant. We consider first Tolerance of Ambiguity (TOA). TOA has been described as both a cognitive orientation and a stable personality trait (e.g. Duncan, 1972; Furnham & Ribchester, 1995; MacDonald, 1970; Pratt, 1980) and defined as the degree to which individuals perceive ambiguous situations or stimuli as desirable. Ambiguous situations or stimuli involve unfamiliar, complex, or incongruent cues that are difficult to structure or categorize (Budner, 1962; Furnham & Ribchester, 1995). High TOA individuals tend to see ambiguous situations as *desirable, stimulating, and challenging* (Furnham & Ribchester, 1995). Individuals who are low in TOA, on the other hand, tend to avoid ambiguous stimuli, tend to seek supportive rather than objective information, and *have a greater need for clarity* (Furnham & Ribchester, 1995). Previously, Ghosh and Ray (1997) find that individual levels of TOA determine choice behavior in range estimate decisions.

Individuals' TOA also can influence how investment options are framed (Ghosh & Ray, 1992). While a decision aid can guide the decision maker toward a more appropriately framing of a decision (thereby reducing uncertainty and adding clarity to the decision evaluation process (Bonner, 2008)); a decision aid may differentially affect low and high TOA individuals. Individuals low in TOA have a tendency to "resort to black-and-white solutions" (Carmona et al., 2011; Frenkel-Brunswik, 1949), tend to have a greater need for clarity (Furnham & Ribchester, 1995), and tend to see ambiguous situations as threatening (e.g. Budner, 1962; Furnham & Ribchester, 1995; Liedtka, Church, & Ray, 2008). Consequently, these individuals may be more receptive to a decision aid that assists in the minimization or elimination of the perceived threat. Therefore, we expect that low TOA individuals will be more likely to be influenced by a decision aid in range estimate decisions.

Ghosh and Ray (1997) find that individuals who are less risk averse and have more TOA tend to have greater confidence in their choices. Greater confidence in choices in turn has been associated with less willingness to rely on a decision aid (Bonner, 2008). In a study within an investment decision context, Nelson, Krische, and Bloomfield (2003) found that confidence is negatively related to reliance on a decision aid. Therefore, to the extent that high TOA individuals have more confidence in decisions, we expect high TOA individuals to be less likely to be influenced by a decision aid in range estimate decisions. This literature leads to our first hypothesis that the decisions of individuals less tolerant of ambiguity (those seeking greater task clarity) will be more greatly influenced by the provision of a decision aid than will be individuals more tolerant of ambiguity (those feeling more comfortable if not more stimulated and challenged to render an un-aided decision).

**H1.** The effectiveness of decision aids in reducing risk aversion is conditional on the tolerance of ambiguity of the individual decision maker, such that, a decision aid will be more likely to mitigate the effect of outcome ambiguity aversion in subjects measuring low in tolerance of ambiguity relative to those measuring high in tolerance of ambiguity.

### 2.4. Dispositional affect

As discussed above, we believe the effectiveness of our decision aid may be conditional on certain characteristics of the participant. We now consider the potential influence of dispositional affect. Research has shown that to fully understand decision behavior one must jointly consider cognition and affect (Ding & Beaulieu, 2009; Kida, Moreno, & Smith, 2001; LeDoux, 1996). In fact, Forgas (1995) argues that the influence of affect is so pervasive that decisions made solely on cognition (and without affect) are the exception rather than the rule. Researchers initially separated affect into orthogonal state categories based on valence; these categories were labeled positive and negative valence states (Cianci & Bierstaker, 2009; Stone & Kadous, 1997).[5] Affective influences, however, have been found to

[5] Although the terms positive and negative affect suggest that these states are opposites (i.e., negatively correlated), they have been found to be independent states (Connelly et al., 2004; Watson & Tellegen, 1985).

be very complex; and, research on affect has been beset by mixed results with affective states of the same valence often producing differential behavior. Accordingly, researchers now go beyond the general dichotomous categories of positive and negative valences and are focusing on specific states that may vary on other dimensions such as active versus passive orientation (Druckman & McDermott, 2008; Laros & Steenkamp, 2005).

The term "affect" is used to describe moods and emotions (Forgas & George, 2001; Kida et al., 2001). Moods have often been described as being of a relatively long duration, and without a single discrete identifiable antecedent cause (Ding & Beaulieu, 2009; Moreno, Kida, & Smith, 2002). In contrast, emotions arguably are a product of both pre-existing mood and a triggering event; as such, emotions are characterized as of higher intensity and have a definitive identifiable cause, and potentially a response target (Forgas, 1992). The boundaries between moods and emotions are "unsharp" and emotions are conditional upon mood states (Frijda, 1986). Accordingly, one can envision affect along a continuum ranging from short-term task-related emotion to more enduring measures of affective mood (Fiske & Taylor, 1991; Stone & Kadous, 1997).

Early research tended to neglect the highly interdependent nature of affect and cognition (Forgas & George, 2001; George & Brief, 1992, 1996). As a consequence, a commonly held erroneous belief was that affect could only interfere with rational decision making in an unfavorable manner; i.e., it could only lead to flawed decisions. The emerging view is that affect is an essential component of normal decision making and behavior in a wide variety of real-life contexts and not always dysfunctional (Adophs & Damasio, 2001; Birnberg, 2011; Libby, Tan, & Seybert, 2008). For example, the affective state of fear can often be justified and lead to normative precautionary responses. There is considerable evidence that cognition and affect are actually separate but interacting mental functions (Bhattacharjee & Moreno, 2002; LeDoux, 1996). Affect serves as an orienting mechanism that guides information processing and informs decision makers which strategies are appropriate in certain circumstances (Stone & Kadous, 1997). Emotional reactions also serve as a means to evaluate and react to the outcomes of decisions. Affect has been shown to be one of the primary aspects of organizational behavior and few if any work-related behaviors can be fully understood without taking affect into account (Bhattacharjee & Moreno, 2002; Kida et al., 2001; Zajonc, 1980).

Historically, affective states were most often grouped based on their positive or negative valence (Chung, Cohen, & Monroe, 2008, 2011; George & Jones, 1997). Positive affect is associated with (but not limited to) such *active* self-descriptive adjectives as enthusiastic, excited, inspired and also such *passive* adjectives as happy, content, pleased, satisfied. Negative affect is typified by feelings of anger (an *active* state) or anxiety, frustration/depression, or fear (*passive* states). In experimental research to date, the direction and intensity of behaviors linked to various states have often been difficult to predict (Bless, 2000; Connelly, Helton-Fauth, & Mumford, 2004; Lazarus, 1991) and reactions are now believed to be potentially task (context) dependent (Au, Chan, Wang, & Vertinsky, 2003; Cianci & Bierstaker, 2009; Creyer & Kozup, 2003). In addition, it has been found that it is problematic to categorize all affective states simply as positive or negative affect. For instance, "surprise" is considered a neutral affect and, therefore, does not fit into a purely positive and negative valence (Laros & Steenkamp, 2005; Storm & Storm, 1987). Further, the negative affect states of anger and fear consistently lead to directionally opposite behaviors in many contexts (Connelly et al., 2004; Druckman & McDermott, 2008).

The study of affect in business contexts to date has been limited and may have failed to embrace the full complexity of the phenomenon. Results have been mixed and not always in line with researcher hypotheses (e.g. Chung et al., 2008; Cianci & Bierstaker, 2009; Lowe & Reckers, 2012; Reckers-Sauciuc & Lowe, 2010). Perplexing to some, affective states of the same valence (positive or negative) have been found to influence behavior in opposite directions (Caruso & Shafir, 2006; Druckman & McDermott, 2008; Laros & Steenkamp, 2005). For example, Lerner and Keltner (2000) found that different negative affective states drove different judgments because the negative affect construct indeed consisted of several distinct states. This research indicates that fear led to pessimistic judgments and anger resulted in optimistic judgments, suggesting the negative but passive state of fear was anchored in a belief of lack of control of the future, while the negative but active state of anger was anchored in a belief of some considerable control of the future. Researchers increasingly suggest that it is important to look beyond the general positive and negative valence categories and provide for a more fine-grained analysis of affect (Connelly et al., 2004; Lazarus, 1991; Lerner & Tiedens, 2006). In addition, certain aspects of positive and negative affect may be more salient for different cognitive tasks than others, which may necessitate examining specific affect states (i.e., happiness, frustration, fear, anger, arousal). Moreover, it is important to examine whether the specific affect state is passive or active, as prior research (e.g., Connelly et al., 2000, 2004; Helton, Benavidez, & Connelly, 2000) indicates that this aspect of affect can guide understanding and expectations. See Exhibit I.

While individuals experience frustration after a confrontation, individuals who are also fearful do so prior to a confrontation (Lazarus, 1991). Individuals with feelings of fear anticipate that poor decision choices will bring about future unpleasant outcomes and feelings (Connelly et al., 2004; Kida et al., 2001; Loewenstein, Hsee, Weber, & Welsh, 2001). To prevent these feelings, individuals tend to avoid risky decisions by deferring them (conforming) to their superiors, colleagues or arguably decision aids (Birnberg, 2011; Dacin & Murphy, 2009; Lerner & Keltner, 2000). That is, individuals who are fearful are looking for an "easy way out", or the alternative that has the least course of resistance (Anderson, 2003). Sawers (2005) found that individuals with fear were more apt to avoid the responsibility for making decisions. In addition, Connelly et al. (2004) notes that fear contributes to pessimistic perceptions of the future as individuals view future events as uncontrollable, difficult to cope with, and uncertain. Given this literature, we hypothesize that fearful individuals are more likely to avoid or defer decisions to decision aids. This is then our second hypothesis.

**H2.** The effectiveness of decision aids in reducing risk aversion is conditional on the level of dispositional negative affect of the individual decision maker, such that, a decision aid will be more likely to mitigate the effect of outcome ambiguity aversion in subjects measuring high in negative affect (specifically fear) relative to those measuring low in negative affect.

Finally, we hypothesize that individuals scoring high in the positive and active affective state of arousal (denoted by subscription to such adjectives as excited, enthusiastic, inspired) will exhibit less risk aversion in their capital budgeting choices (Druckman & McDermott, 2008; Gaudine & Thorne, 2001). We do not predict an interaction of this participant characteristic with the decision aid, but include it primarily as a control variable, recognizing individuals vary in risk preferences/aversion.

**H3.** Individual decision makers scoring higher (lower) in the positive active affective state of arousal will exhibit less (more) risk aversion in their capital budgeting decisions.

## 3. Research design and experimental method

### 3.1. Participants

Participants in this study were 79 MBA students enrolled in evening courses at a major university in the United States. Descriptive

**EXHIBIT I**

**The Circumplex Model of Affect**

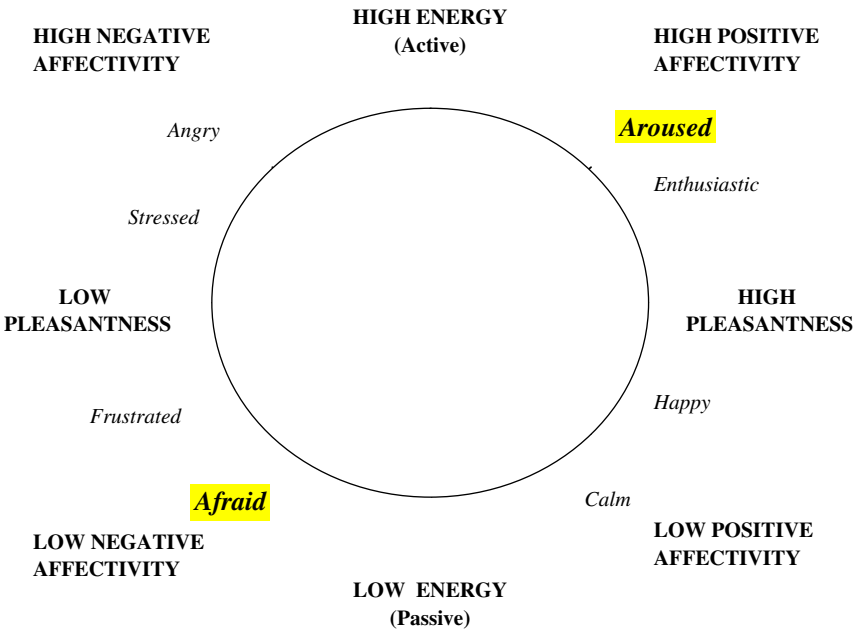



**Exhibit I.** The circumplex model of affect.

statistics for the sample are included in Table 1. Approximately 75% percent of the participants in this experiment were male. The average ages of participants were 31 years and 29 years for males and females, respectively. Subjects came from a variety of backgrounds: engineering, information systems/technology, management, finance and other fields.

### 3.2. Task

Participants assumed the role of a member of the Investment Committee of a publicly held corporation. The committee had responsibility for selecting which of several investment proposals would receive funding. Information about company goals was provided as criteria for evaluating each investment proposal. The main criterion was the long-term corporate goal of increased shareholder value. Participants were told that the company has implemented a Balanced-Scorecard (BSC) Management philosophy and recognizes simultaneous advancement in each of four operational categories (Learning & Development, Internal Processes, Customer Value, and Financial Performance) as essential for achieving and sustaining the long-term goal of increased shareholder value.

Following this narrative description of the evaluation guidelines, subjects were provided with a table summarizing the corporate long- and short-term goals, as follows:

| | |
|---|---|
| Long-Term Goal: | Increased Shareholder Value |
| Short-Term Goals: | Learning & Development (HR) |
| | Internal Processes (Operations) |
| | Customer Value (Marketing) |
| | Financial Performance |

Participants were instructed to consider contributions to all categories in selecting which investment proposal most merits funding. In addition, participants were provided with the corporate strategy map of company goals and antecedents. The strategy map further emphasized visually the causal linkage between each of the four short-term operational goals and the creation of long-term shareholder value.

After the description of company goals and strategy, detailed information was provided for each of three investment proposals. Each proposal was described in narrative form, including information regarding how elements of each proposal would contribute to any of the BSC strategic goal categories. Each proposal required an equal amount of funding from the firm. See Appendix A for a copy of the instrument.

Each proposal description was followed by a table showing return on investment (ROI) projections for each year of the project for the first 5 years after project implementation. The yearly ROI projection for each proposal was presented as a range (i.e. 6–8%). Each proposal had the same projected *average* return for each of the five years; however, there was increasingly greater variation in the range of projected returns between project proposals. Additionally, return variation increased from year to year with more variation in later years and the greatest variation in proposal three. Proposal three

**Table 1**
Descriptive statistics.

| | Males | Females |
|---|---|---|
| Number | 59 | 21 |
| Mean Age | 31 years | 29 years |
| Background: | | |
| Engineering | 14 | |
| Info Systems/Technology | 12 | |
| Management | 12 | |
| Finance | 13 | |
| Other | 29 | |

was also designed to have the greatest alignment with and contribution toward the multiple strategic goals of the company. In other words, proposal three was designed to have the greatest merit in terms of the overall strategic goals of the company in the long-term, but potentially be unappealing in the range or ambiguity of short-term financial outcomes. Pilot tests were conducted to confirm that this manipulation functioned as planned.

After reviewing each of the investment proposals, participants were instructed to allocate 100 points among the three investment proposals to indicate the degree to which they believe each proposal merits funding. A higher number of points allocated to a proposal indicates greater relative support for funding the proposal.

### 3.3. Decision aid

Approximately half (38) of the participants were provided with a decision aid as part of the case materials. Before allocating points among the three investment proposals, participants provided with a decision aid were asked to assess the contribution of each investment proposal to each of the organization's short- and long-term strategic goals and then rank each proposal on each of the four balance scorecard criteria.

### 3.4. TOA scale

Subjects also completed the MacDonald (1970) tolerance of ambiguity (TOA) scale. The scale consists of 16 statements designed to measure the degree to which an individual is tolerant of ambiguity. Participants responded to questions on a 7-point scale with 1 indicating strong agreement with the statement and 7 indicating strong disagreement with the statement. Participant responses were coded and combined to create a TOA score, which was split at the mid-point to create a dichotomous variable indicative of relative levels of tolerance of ambiguity (high or low).

### 3.5. Positive affect negative affect schedule

We used the Positive Affect Negative Affect Schedule (PANAS) to measure participants/ affective disposition. The PANAS is a psychometric scale developed to measure the independent constructs of positive and negative affective state categories and components therein. The PANAS scale is based on the model set forth in Watson and Tellegen (1985). This scale has been shown to be internally consistent, reliable and stable over time (Crawford & Henry, 2004; Russell & Carroll, 1999; Watson, Clark, & Tellegen, 1988).

The positive and negative scores are orthogonal/uncorrelated; that is, their names are potentially misleading to many as they are not two ends of one scale. Our modified PANAS scale consists of 14 adjectives related to positive affect of which some states are passive (e.g., happy, content, satisfied) and others are active (e.g., enthusiastic, determined, inspired). The scale also contains 18 adjectives of negative affect, including some passive states (e.g., frustrated, worried, fearful) and some active states (e.g., angry). The scale requires participants to indicate their feelings on a five-point scale: (1) "Very slightly or not at all", (2) "A little", (3) "Moderately", (4) "Quite a bit", and (5) "Extremely."

Consistent with prior literature, we sought to identify the factors from the PANAS scale that would be utilized in measuring various positive/negative and active/passive affective states. Participant responses to the PANAS scale were factor-analyzed using principal components analysis to determine the degree of correspondence between scale questions and the positive and negative affect factors. Varimax rotation was used with the selection criteria to retain variables being eigen-values greater than 1.0 and factor loadings greater than .50.

The principal components analysis for the positive affect questions yielded two interpretable factors. Seven positive active attributes (enthusiastic, inspired, excited, determined, strong, interested and attentive) loaded onto a factor which we label "Enthusiastic/Aroused." This factor is the subject of hypothesis three (H3). Six other positive attributes (happy, pleased, content, optimistic, active and alert) loaded onto a factor which we call "Happiness". Collectively, these two factors explained 70 percent of the variance for the positive affect questions. Cronbach's alpha was computed for each factor representing the attributes that loaded onto the respective principle components. The alpha coefficient levels (each above 80%) indicate reasonable levels of scale reliability (Iacobucci & Duhachek, 2003; Nunnally & Bernstein, 1994). The former of these was the subject of hypothesis three (H3). The other positive affective factor neither registered significance directly nor interactively in our model, and thus is not discussed further in the paper.

Likewise, a principal components analysis for the negative affect questions yielded two interpretable factors. Four negative passive attributes (afraid, embarrassed, guilty, hostile) loaded onto a factor which we label "Afraid". This factor is the subject of hypothesis two (H2). Six additional negative attributes (frustrated, disappointed, disgusted, angry, upset, and irritable) loaded onto a factor which we call "frustrated". The attributes representing these two factors had Cronbach alphas exceeding .70. The former of these was the subject of hypothesis two (H2). The other negative affective factor neither registered significance directly nor interactively in our model, and thus is not discussed further in the paper.

### 3.6. Independent variables and covariate

We include one independent variable (decision aid use) and three measured variables (tolerance of ambiguity, negative affect and positive affect) in this study. Decision aid use was manipulated at two levels (decision aid, no decision aid). Tolerance of ambiguity and negative affect (as described above) were included in the model as dichotomous variables (low/high midpoint splits); positive affect was included as a continuous variable (covariate).

### 3.7. Dependent variable

The dependent variable in this study is the participant's capital investment proposal recommendations. Participants were asked to allocate points among three investment proposals according to the relative degree to which they believed each project warranted funding. The question of interest in this study is whether subjects would be more likely to indicate relatively greater support for the more ambiguous investment option when a decision aid was provided. Therefore, the dependent variable was operationalized as the percentage of total points participants allocated to proposal three.

## 4. Analysis and results

To test the hypotheses we use a $2\times2\times2$ ANCOVA design. In Table 2, panel A, we report the ANCOVA results using the percentage of points allocated to Project 3 as the dependent variable. Recall that Project 3 was the capital investment proposal with the widest range estimate/highest outcome ambiguity. The independent variables are decision aid use (decision aid, no decision aid), tolerance of ambiguity (low, high) and negative affect (low, high). Positive affect serves as a covariate.

H1 predicted an interaction of Decision Aid and Tolerance Of Ambiguity. This hypothesis is supported ($F=5.096$, $p=.027$). Table 2, Panel B provides relevant cell means which further support H1: one finds that decision aids are only applied by individuals predisposed to use them. In this instance, those are individuals low in tolerance for ambiguity.

**Table 2**

Panel A: ANCOVA on points[a].

| Source of variation | Type III sum of squares | *df* | Mean square | *F* | Sig. |
|---|---|---|---|---|---|
| Corrected model | 6084.142 | 8 | 760.518 | 2.866 | .008 |
| Intercept | 92,531.715 | 1 | 92531.715 | 312.534 | .000 |
| Positive affect (arousal) | 1,602.604 | 1 | 1,602.604 | 6.040 | .017 |
| Decision aid (DA) | 227.437 | 1 | 227.437 | .857 | .358 |
| TOA | 578.326 | 1 | 578.326 | 2.179 | .144 |
| Negative affect (fear) | 526.937 | 1 | 526.937 | 1.986 | .163 |
| DA × TOA | 1352.322 | 1 | 1352.322 | 5.096 | .027 |
| DA × Fear | 1109.066 | 1 | 1109.066 | 4.180 | .045 |
| TOA × Fear | 903.583 | 1 | 908.583 | 3.405 | .069 |
| DA × TOA × Fear | 4.346 | 1 | 4.346 | 0.016 | .899 |
| Error | 18,309.358 | 69 | 265.353 | | |
| Total | 117,233.000 | 79 | | | |
| Corrected total | 24,393.500 | 77 | | | |

*R* squared = .249

Panel B: least squares means: points

| | Decision aid | |
|---|---|---|
| | No | Yes |
| TOA | | |
| Low | 32.021 | 44.040 |
| High | 34.986 | 29.975 |

Panel C: least squares means: points

| | Decision aid | |
|---|---|---|
| | No | Yes |
| Fear | | |
| Low | 34.641 | 30.459 |
| High | 32.366 | 43.557 |

[a] Percentage of points allocated to Project 3 (high ambiguity project).

H2 predicted an interaction of Decision Aid and Dispositional Negative Affect (specifically Fear). This hypothesis is supported ($F = 4.180$, $p = .045$). In Table 2, Panel C we provide relevant cell means which further support H2: one finds that decision aids are only applied by individuals predisposed to use them. In this instance, those are individuals high in dispositional negative affect (fear).

Table 2, Panel A also provides support for H3. Dispositional positive affect (Arousal) is positively and significantly correlated with support for the high risk/ambiguity proposal (proposal three).

## 5. Discussion and conclusion

This research project was conducted to learn how decision aids can influence capital budgeting decision making (choice among investment options) under conditions wherein investment options exhibit differing degrees of ambiguity risk. That is, while the investment options all promised the same ROI (point estimates), the range around the ROI point estimates varied across the projects from low to medium to high. The results of this analysis show that, as a method for overcoming ambiguity-averse choice behavior in capital investment decisions, a decision aid was only effective for a subset of participants. Specifically, receptive participants were those who were predisposed by low tolerance of ambiguity or high dispositional negative affect. Tolerance of ambiguity arguably is a stable personal trait which may be difficult to change. Negative affect (specifically fear) is often a product of past experience in the work place; and as such, may be altered by changes made to the work environment.

Similarly, individuals exhibiting high dispositional positive affect (arousal) were observed to be more risk seeking. This is consistent with prior research outside of business. A rich literature exists with respect to dispositional affect and its antecedents as well as its consequences. These finding highlight potential areas for future research regarding effective decision aid development and implementation.

This study contributes to the literature on the influence of individual differences in capital investment decision making and decision aid effectiveness. The results highlight the importance of personality traits in designing effective aids to decision making and the importance of the work environment as an antecedent to dispositional affective states. The current study also contributes to the growing accounting literature examining the influence of outcome ambiguity in capital investment decisions and the factors that influence ambiguity-averse choice behaviors in this setting.

While this study provides additional insights into decision aid effectiveness, there are several limitations. First, this study was conducted using MBA students as surrogates for managers. In decentralized firms, managers at various levels of the organization are involved in the capital budgeting process; however, more experienced managers may have different incentives and may incorporate organizational strategy more fully into their decisions.

Second, this study was conducted in an experimental setting and tasks elements were necessarily simplified to accommodate the experimental setting, time constraints, and the need to isolate specific variables of interest. Real-world capital budgeting decisions are much more complex and involve greater quantities of information. In addition, the salience of the work environment may be greater in a real world setting than in the lab study, and thus the distribution of affective states may be greater and with that greater dispersion, still stronger effects might be expected to register.

The results of this study have implications for decision aid use and design in capital investment decisions. But, our findings may contribute to a better understanding of decision making processes beyond the capital budgeting context. Most accounting decisions involve some degree of uncertainty and an understanding of the factors that influence these types of decisions is important for improving judgment and decision making quality (Bonner, 2008; Haka, 2007; Loewenstein et al., 2008). Prior research has established that individual choices are influenced by the presence of ambiguous information in the decision task and has identified many factors that may influence ambiguity aversion and choice behavior. We contribute to this literature by examining a potential method for reducing the influence of outcome ambiguity on choice behavior in resource allocation decisions.

## Appendix A

Positive Affect Negative Affect Schedule (PANAS).

| | | | |
|---|---|---|---|
| Interested | (P) | Afraid | (N) |
| Distressed | (N) | Happy | (P) |
| Excited | (P) | Pleased | (P) |
| Upset | (N) | Worried | (N) |
| Strong | (P) | Content | (P) |
| Guilty | (N) | Depressed | (N) |
| Scared | (N) | Frustrated | (N) |
| Determined | (P) | Optimistic | (P) |
| Hostile | (N) | Angry | (N) |
| Enthusiastic | (P) | Disgusted | (N) |
| Proud | (P) | Unhappy | (N) |
| Nervous | (N) | Attentive | (P) |
| Irritable | (N) | Disappointed | (N) |
| Alert | (P) | Embarrassed | (N) |
| Ashamed | (N) | Active | (P) |
| Inspired | (P) | Jittery | (N) |

Participants indicated their feelings on a five-point scale: (1) "Very slightly or not at all", (2) "A little", (3) "Moderately", (4) "Quite a bit", and (5) "Extremely."

## Appendix B

EXPERIMENTAL INSTRUMENT (with Decision Aid)

**Instructions**: Assume you serve on the ***Investment Committee*** of a publicly held corporation charged with deciding which of several investment proposals should be funded. There are limited funds, so the process is competitive and the committee ultimately can support/fund only one proposal.

Three proposals will be described below. You will be asked to evaluate each; and allocate 100 points across the three proposals. The allocation should reflect your relative support for each proposal; the more points, the greater the support. The main selection criterion is advancement of the Long-Term Corporate Goal of ***Increased Shareholder Value***. However, the firm follows a Balanced-Scorecard Management philosophy, explicitly recognizing that a number of agenda need to be advanced to ultimately support ***Increased Shareholder Value***. Accordingly, short-term goals are to be advance for each of four operational goals; goals relating to ***corporate learning and development*** processes (human capital), goals related to enhancements of ***internal processes*** (production operations), the ***customer value*** proposition (marketing) and ***financial performance*** goals. Each of these four operational goals should be consider in selection of the investment proposal.

| | |
|---|---|
| Long-Term Goal: | Increased Shareholder Value |
| Short-term Goals: | Learning & Development (HR) |
| | Internal Processes (Operations) |
| | Customer Value (Marketing) |
| | Financial Performance |

The Corporate Strategy mapping of goals and antecedents is shown below in Exhibit 1. Each proposal requires an equal amount of funding.

### Proposal 1

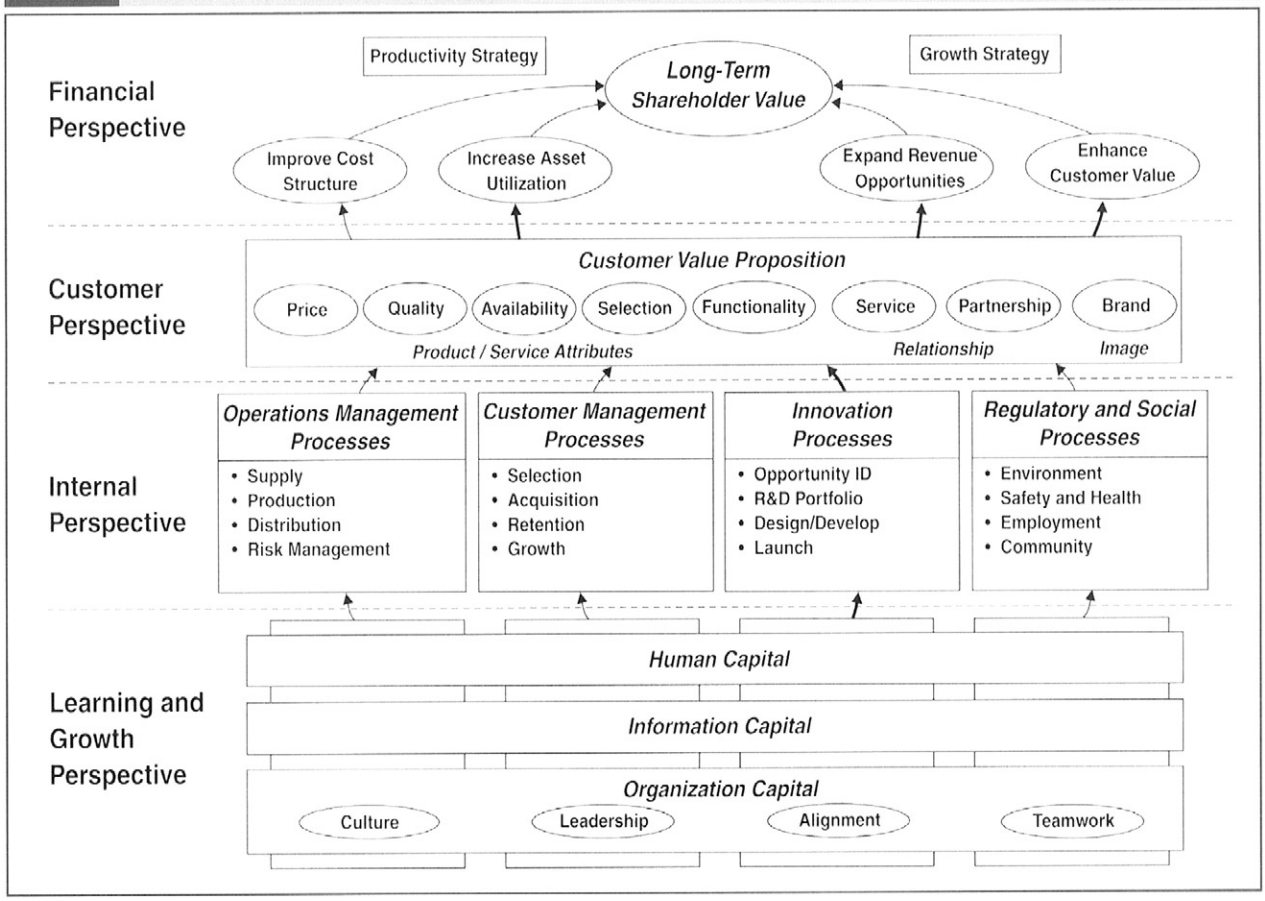
Proposal 1 relates to enhancements of corporate learning and development processes (human capital). Proposal 1 proposes funding for new HR information systems software the purpose of which is to replace several currently disparate data-base systems (training, payroll, scheduling, travel/expense reimbursements) with one integrated system. The new system holds out the promise of greater speed as well as fewer systems' errors, thus boosting employee and management satisfaction. Finally the system is predicted to reduce employee time and systems maintenance costs by eliminating redundant data entry of common information into several data bases. The Return on Investment across the next five years is projected to be:

Year 1 6–8%
Year 2 9–11%
Year 3 9–11%
Year 4 14–16%
Year 5 21–23%

### Proposal 2

Proposal 2 relates to enhancements of operational processes (an internal perspective focused on production). Proposal 2 proposes funding for new inventory tracking systems software, hardware and training. The software would allow management to more effectively monitor inventory levels nationwide leading to improved risk management. The software further holds out the promise of improved product availability and delivery time for customers (and thus improved customer satisfaction) by avoiding stock-out situations. In addition to potentially increasing sales, the firm also may experience

Exhibit 1 A strategy map represents how the organization creates value



reduce production costs by improved coordination of production schedules and trans-shipments among locations. The Return on Investment across the next 5 years is projected to be:

Year 1 5–9%
Year 2 8–12%
Year 3 8–12%
Year 4 12–18%
Year 5 19–25%

**Proposal 3**

Proposal 3 relates to all aspects of the business. Proposal 3 proposes funding for a corporate wide knowledge management system. The knowledge management system would provide for an easily searchable electronic repository of lessons-learned and best practices. The Knowledge Management system would apply to each area of the business and would save money by eliminating time consuming processes to "re-invent the wheel" every time a problem developed or opportunity presented itself. In addition by replicating past successes and avoiding past mistakes and improving the speed with which members of management can form strategies and make decisions, competitive advantages may develop in areas including but not limited to marketing proposals to customers, negotiations with vendors, environmental planning and compliance. Proposal 3 incorporates more risk but also exhibits greater upside potential than Proposals 1 and 2, as reflected in Return on Investment figures across the next five years:

Year 1 0–14%
Year 2 2–18%
Year 3 2–18%
Year 4 5–25%
Year 5 8–36%

I. Please ***RANK*** each proposal on each of the balanced scorecard criteria as 1 (highest), 2 (middle) or 3 (lowest).

| Criteria/Proposal | Proposal 1 | Proposal 2 | Proposal 3 |
|---|---|---|---|
| Learning & Development | | | |
| Operations & Production | | | |
| Customer Value Proposition | | | |
| Financial Performance | | | |

II. Please provide an overall project recommendation by allocating 100 points across the three investment proposals to reflect the relative degree to which they warrant to be the proposal funded. (More points indicate greater support).

| Project/Points | POINTS |
|---|---|
| PROJECT 1 | |
| PROJECT 2 | |
| PROJECT 3 | |
| | 100 |

**PARTICIPANT PROFILE – A**

| | | | |
|---|---|---|---|
| GENDER: (Circle one.) | FEMALE | MALE | AGE: _____ |
| BACKGROUND: (Circle One.) | ACCOUNTING/FINANCE | OTHER | |

**PARTICIPANT PROFILE-B**

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate number. Indicate to what extent you feel right now, that is, at the present moment. Use the following scale for your answers:

| 1 Very slightly or not at all | 2 A little | 3 Moderately | 4 Quite a bit | 5 Extremely |
|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Interested | 1 | 2 | 3 | 4 | 5 | Attentive | 1 | 2 | 3 | 4 | 5 |
| Distressed | 1 | 2 | 3 | 4 | 5 | Happy | 1 | 2 | 3 | 4 | 5 |
| Excited | 1 | 2 | 3 | 4 | 5 | Pleased | 1 | 2 | 3 | 4 | 5 |
| Upset | 1 | 2 | 3 | 4 | 5 | Optimistic | 1 | 2 | 3 | 4 | 5 |
| Strong | 1 | 2 | 3 | 4 | 5 | Content | 1 | 2 | 3 | 4 | 5 |
| Guilty | 1 | 2 | 3 | 4 | 5 | Depressed | 1 | 2 | 3 | 4 | 5 |
| Scared | 1 | 2 | 3 | 4 | 5 | Frustrated | 1 | 2 | 3 | 4 | 5 |
| Hostile | 1 | 2 | 3 | 4 | 5 | Angry | 1 | 2 | 3 | 4 | 5 |
| Enthusiastic | 1 | 2 | 3 | 4 | 5 | Disgusted | 1 | 2 | 3 | 4 | 5 |
| Proud | 1 | 2 | 3 | 4 | 5 | Unhappy | 1 | 2 | 3 | 4 | 5 |
| Irritable | 1 | 2 | 3 | 4 | 5 | Disappointed | 1 | 2 | 3 | 4 | 5 |
| Alert | 1 | 2 | 3 | 4 | 5 | Embarrassed | 1 | 2 | 3 | 4 | 5 |
| Ashamed | 1 | 2 | 3 | 4 | 5 | Worried | 1 | 2 | 3 | 4 | 5 |
| Inspired | 1 | 2 | 3 | 4 | 5 | Jittery | 1 | 2 | 3 | 4 | 5 |
| Nervous | 1 | 2 | 3 | 4 | 5 | Active | 1 | 2 | 3 | 4 | 5 |
| Determined | 1 | 2 | 3 | 4 | 5 | Afraid | 1 | 2 | 3 | 4 | 5 |

**PARTICIPANT PROFILE-C**

Please indicate the strength of your agreement or disagreement (using the scale below) by circling the appropriate number.

| 1 Strongly Agree | 2 Moderately Agree | 3 Slightly Agree | 4 Neutral | 5 Slightly Disagree | 6 Moderately Disagree | 7 Strongly Disagree |
|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | An expert who doesn't come up with a definite answer probably doesn't know too much. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. | In the long run, it is possible to get more done by tackling small, simple problems than by tackling large and complicated ones. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. | Many of our most important decisions in life are based upon insufficient information | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. | People who fit their lives to a schedule probably miss most of the joy of living. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. | There is really no such thing as a problem that can't be solved. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. | It is more fun to tackle a complicated problem than a simple one. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. | People who insist on a "yes" or "no" answer just don't know how complicated things really are. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. | A good job is one where what is to be done and how it is to be done are always clear. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. | The sooner we all acquire similar values and ideas, the better. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. | A person who leads an even, regular life in which few surprises or unexpected happenings arise, really have a lot to be grateful for. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. | I would like to live in a foreign country for awhile. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. | Teachers or supervisors who hand out vague assignments give a chance for one to show initiative and originality. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13. | What we are used to is always preferable to what is unfamiliar. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. | I like parties where I know most of the people more than ones where all or most of the people are complete strangers. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. | A good teacher is one who makes you wonder about your way of looking at things. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 16. | Often, the most interesting and stimulating people are those who don't mind being different or original. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

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