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UMI
DESCRIPTIVE META-MODEL OF DECISION MAKING

DISSERTATION

Presented in Partial Fulfillment of the Requirement for

the Degree Doctor of Philosophy in the

Graduate School of The Ohio State University

By

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*****

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2000

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Several content-dependent descriptive modes of decision making have been posited in recent years (e.g., Story model, Pennington & Hastie, 1992; Reason-based choice, Shafir, Simonson, & Tversky, 1993). Although these modes appear to describe individuals' decision making processes fairly well, they specifically limit the range of decisions to which they claim to be applicable. Another line of research in decision making involves the concept of the adaptive decision maker (Payne, Bettman, & Johnson, 1993). These researchers proposed that individuals are adaptive decision makers who possess several different decision strategies that they systematically choose among in an attempt to minimize cost while maximizing accuracy. If their claim is true and individuals do systematically use different decision strategies, it should be feasible to model this selection process. Thus, a meta-model of decision making is proposed to describe and ultimately predict the selection of different decision strategies.

By hypothesizing that there must exist a mental representation of different decisions in order for one to use different strategies systematically,
two sorting studies were conducted (Tada & Weber, 1998; 1999) to examine the psychological representations of decision similarity space using clustering and multidimensional scaling (MDS). Although clustering solutions seem to be stable across studies and an adequate decision space with a three-dimensional MDS solution was obtained, interpretations of these dimensions have not been unambiguous. Three studies were conducted to examine the following: 1) the interpretation of the psychological dimensions of individual’s decision similarity space, 2) the relationship between the representation of decisions and decision strategy selection, and 3) the relationship between decision strategy selection and decision outcomes (i.e., chosen alternatives).

In Study 1, three models were created for each dimension to validate the interpretation of previously obtained psychological dimensions of decisions. It was found that the multiple-format construct model had the best fit across all dimensions, but was only marginally better than the multiple regression model, which included only one item representing the interpretation.

In Study 2, the relationship between decision strategy selection and choice was examined by assigning participants randomly to one of eight decision strategy conditions and examining their choice behavior in hypothetical but realistic decision situations. It was hypothesized that the
choice of decision strategy influenced people’s subsequent choice behavior. No relationship between decision strategy conditions and choice alternatives was found when a decision strategy was assigned. However, when participants naturally selected a decision strategy to make each decision in Study 3, some dependence between decision strategy selection and choice was found. These results, together with response/reaction time measures, suggested that: 1) individuals appear to have preferences for some decision strategies over others for use in different decision situations, and 2) several strategies seem to be preferred for a given decision situation, especially for difficult decisions.

In Study 3, the relationship between decision dimensions (i.e., relevant situational characteristics) and decision strategy selection was also examined by testing a series of structural equation models. Although effects were not strong, there was a relationship between the dimensional representations found in Study 1 and decision strategy selection. Furthermore, some personality characteristics uniquely contributed to the prediction of decision strategy selection above and beyond situational characteristics. All models examined had reasonable to close overall fit, providing some credence to the proposed meta-model conceptualization.
In memory of my father

who surely would have been ready on this occasion

for his favorite line with me:

“You did WHAT?”
ACKNOWLEDGMENTS

I consider myself to be quite independent. Despite this, or rather because of this, I feel many people deserve to be acknowledged. I would not have been where I am if it were not for them. First and foremost, I would like to thank my now unofficial adviser, Dr. Elke U. Weber. She has provided the topic of content-dependent decision making, and she was instrumental to the development of the meta-model. I also appreciate greatly her continued support despite her relocation to Columbia University. Secondly, I would like to thank my former and current adviser, Dr. Thomas Nygren. I had the privilege of having him as an adviser twice during my graduate years. Thank you for taking me back when I needed an adviser to complete my dissertation. I would also like to thank Dr. Robert MacCallum for bearing with me for all the times I came frantically into his office asking statistical and other academic questions. Your patience and guidance have certainly made my academic life easier. Special thanks should belong to Dr. Michael Walker, who, despite not being on my committee, has helped me greatly with cluster analysis and in the multidimensional scaling of my prior work, which led to
this dissertation. I also would like to thank him formally for his generosity in baking cheesecakes of my liking on a few occasions; they made my life in Columbus a happier one. I also appreciated the rest of our faculty members, Dr. Michael Browne, Dr. Barbara Mellers, and Dr. In Jae Myung, for creating a very supportive environment. Thanks should also go to Kristopher Preacher for being patient with me despite my countless English grammar questions.

Personally, my thanks go to one of my best friends, Gregg Gold. My long-distance phone bills over the first year in Columbus do not begin to describe the value of our discussions and of your friendship. You prevented me from putting an end to my Ph.D. career prematurely. I would also like to thank Bill Breland for keeping a watchful eye on me and for being an enthusiastic supporter for the first half of my Ph.D. years. You will always have a place in my heart. Fidel Quiralte also deserves recognition for providing emotional and financial support during the earlier part of my stay in the U.S. I would also like to give thanks to my brother, Yoshiki Tada, for always being there for me. It is nice to know that I can count on you even though you are on the other side of the world.

Finally, I would like to give special thanks to my former adviser in California, Dr. Donald C. Butler. You were both a great mentor and a surrogate father to me. I would not be here pursuing quantitative
psychology if you did not convince me that I would be a better quantitative
psychologist than a child clinical psychologist. You also made me realize
how much I like teaching. I cannot begin to describe how much your support
meant to me.
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dimensions of decisions: Implications for behavioral decision models. In M.
A. Gernsbacher & S. J. Derry (Eds.), Proceedings of the Twentieth Annual
Conference of the Cognitive Science Society, (pp. 1049-1054). Mahwah, NJ:
Lawrence Erlbaum Associates.

FIELD OF STUDY

Major Field: Psychology
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1.1. Traditional cognitive science

In the seminal paper of McCulloch and Pitts on logic (1943), two major assertions were made: 1) logic is the proper discipline with which to understand the brain and mental activity, and 2) the brain is a device that embodies logical principles in its neurons. These assertions provided scientists with the tools to answer questions regarding the human mind. Subsequently, the study of the mind (Cognitive Science, or originally, Cybernetics) became a new scientific pursuit, with the idea of expressing the processes underlying mental phenomena by explicit mechanisms and mathematical formalism. In two meetings held in 1956 at Cambridge and Dartmouth, researchers (including Herbert Simon, Noam Chomsky, and Marvin Minsky) put forth new ideas that were to become the major guidelines for modern cognitive science - cognitivism. There are three fundamental assumptions underlying cognitivism: 1) we inhabit a world with inherent properties, such as length, color, movement, sound, etc.; 2) we pick up or recover these properties by internally representing them; and 3) there is a
separate subjective “we” who does these things. These assumptions taken together amount to a strong, often tacit and unquestioned, commitment to realism or an objectivism/subjectivism dichotomy about the way the world is, what we are, and how we come to know the world (Varela, Thompson, & Rosch, 1993).

Many models of cognitive science have since been developed in this spirit to describe various aspects of cognitive processes (e.g., color vision). We now know much more about the brain mechanisms involved in how we come to perceive colors in the environment. However, a careful examination reveals that the explanation posited by the current models of color perception is incomplete because the cognitivistic view considers only the constant properties of the world that influence the perception of color (Varela et al., 1993). They conceptualize the phenomenon of color vision as having to solve the information-processing problem of recovering surface reflectance. If it is indeed true that color is merely surface reflectance, one should be able to match features of perceived color with corresponding features of surface reflectance. However, there is no such correspondence. The biological and ecological investigation of color vision reveals that it is concerned as much with properties that change (such as lighting, weather conditions, and time of day) as with properties that remain constant (such as surface reflectance) (Jameson & Hurvich, 1989). We also experience colors as attributes of afterimages and in dreams, memories, and synesthesia.

2
The commonality among these phenomena is not to be found in some physical structure (Hardin, 1988). Color perception, in addition, varies as a function of culture (Rosch, 1973). These variations cannot be accounted for by the traditional cognitive scientific approach.

1.2. An alternative framework in cognitive science

Traditional models based on cognitivism will not be able to incorporate these additional “irrelevant” factors. The above example illustrates the basic principles of cognitive science based on cognitivism: decomposition by function (color perception independent of form or object orientation), the conceptualization of an autonomous agent as an input-output model (a pregiven surface reflectance that is independent of a subject’s perceptual and cognitive capacities get “represented” internally in the pregiven, independent mind of the subject), and the principles of formal task definition (IF high percentage of middle-wave light THEN green). The example also illustrates how this cognitivistic philosophy poses substantial limitations in modeling cognitive processes to a satisfactory degree (Hendriks-Jansen, 1996).

Until recently, the discipline has failed to produce a coherent alternative framework. However, several cognitive scientists from various subdisciplines have recently arrived independently at an alternative framework, which can be summarized as “enactive” (or emergent) cognitive science. One group, inspired
by work such as that of Merleau-Ponty (1963), arrived at a philosophical justification for why this framework provides a better explanation of animal and human behavior (Varela et al., 1993).

They begin a description of their theory from the traditional cognitivistic view that cognition and mind are entirely explained by the particular structures of cognitive systems. This is described in Figure 1.1. Imagine, for instance, the scenario commonly found in neuroscience in which cognition is investigated by examining the properties of the brain (e.g., neurochemical compositions or neuroanatomy). One can associate these biologically based properties with cognition only through behavior (e.g., knowledge that brain activity is electrochemical comes only with the observation that change in the composition coincides with some behavior).

![Figure 1.1. Mutual specification of structure and behavior/experience.](image-url)
Upon reflection, however, we realize that any such scientific description must itself be a product of our own cognitive system. Furthermore, the act of reflection that tells us this does not come from nowhere; we find ourselves performing the act of reflection from a given background of biological, social, and cultural beliefs and practices. And yet, our very postulation of such a background is something that we are doing (e.g., we currently believe some elements in the brain should be causing some action to occur; however, many years ago, scientists believed the heart to be the action center and conducted studies accordingly): we are here as living embodied beings, sitting and thinking of this entire scheme, including what we call a background. Therefore, the entire endeavor should be captured with yet another layer indicating this embodiment here and now as in Figure 1.2. This fundamental circularity – structure and behavior reciprocally influencing each other progressively into higher orders – is crucial to the theory.

However realistic such an endeavor is in the abstract, it is extremely difficult to attempt the actual modeling of such circularity. However, the crucial lesson from this framework is obvious: both the “background” of the environment (the object) and the actor (the subject) matter. With this spirit, an attempt to incorporate aspects of the environment (content) and the actor (in
terms of individual differences) into the traditional view of cognitivism is outlined in the following.

Background of biological, social and cultural beliefs and practices

Figure 1.2. Interdependency of (a) scientific description and our own cognitive structure, (b) reflection and the background of biological, social, and cultural beliefs and practices, and (c) the background and embodiment.
1.3. Implications for decision making

A similar history can be told for a specific subarea of research in cognitive psychology, Judgment and Decision Making. Perhaps due to its origin in economics, this subdiscipline took the perspective which Varela et al. (1993) call the “economic view of the mind.” The goal of the self is assumed to maximize profit – getting the most at least cost. This perspective is exemplified in models such as the expected utility (EU) model and subjective expected utility (SEU) model, which are considered to be “normative” models.

However, a great deal of evidence has accumulated that people’s choices deviate systematically from these normative models. The predominant interpretation of these findings has been that people fail to conform to the normative model as a result of various cognitive deficiencies (e.g., Simon, 1983). There is (at least) one other interpretation. Systematic deviations occur because the model is not conceptualized correctly. The incorrect specification can happen in two ways: misspecification of the goal that individuals are allegedly striving to achieve, and incorrect notions about how processing mechanisms operate to meet the goal. Because one naturally follows the other, they are examined sequentially.
13.1. Toward content specificity

The goal for which individuals are assumed to strive is maximization of (subjective) expected utility because others presumably will take advantage of individuals who do not maximize expected utility. Yet, as Prelec & Herrnstein (1994) showed, sometimes EU/SEU models lead individuals to choices that are not satisfactory to them. Should they still be considered good decisions? What does it mean to behave as if one is not following the EU or SEU model?

According to Frisch and Clemen (1994), this does not necessarily suggest that one is making bad decisions. In their perspective, the EU/SEU model is not the normative model to which the goodness of decision making should be compared. Frisch and Clemen (1994) proposed that “decision outcomes should be used to define a model of a good decision-making process” (p. 49). What they imply is not that the outcome per se should be taken into account, but whether or not the decision maker is satisfied with the outcome given a particular decision process used. Furthermore, Higgins (1997) asserts that such satisfaction is obtained differently for different needs. When the end-state is promotion focused (aspirations and accomplishments), individuals are more likely to take the strategy of approaching a match (e.g., “Because I wanted to be at school for the beginning of my 8:30 psychology class, which is usually excellent, I woke up early this morning.” (p. 1284)), whereas when the end-state is prevention focused
(responsibilities and safety), individuals will take the strategy of avoiding a mismatch (e.g., "I wanted to take a class in photography at the community center, so I didn’t register for a class in Spanish that was scheduled at the same time." (p. 1284)).

Accordingly, a person is using a good decision-making process if that process leads her to arrive at the decision outcome that is most desirable (on average, in cases where uncertainty is involved) in a desirable fashion. Is it sensible, in this case, to presume that one becomes a good decision maker by utilizing one decision making process for all decisions? It does not appear so. Because the environment and the subject inherently interact reciprocally in any situation, it seems more than plausible that when the environment changes in an apparently "irrelevant" manner (from the EU/SEU perspective), the subject changes his or her approach to the object accordingly; subsequently, the differing behavior changes the environment. Examples of empirical support for such a position are numerous (see Payne, Bettman, & Johnson (1992) for a review; also see Gigerenzer (in press), Gigerenzer & Hug (1992), Goldstein & Weber (1995)). Indeed, as Payne, Bettman, and Johnson (1993) suggest, human beings may be quite adaptive decision makers by not using normative models all the time but by using different models depending on the situation to maximize accuracy while minimizing effort.
1.3.2. Evolutionary biological perspective

The study of human reasoning, just as numerous other cognitive processes, had initially been dominated by the search for content-independent processes. Early research started from a premise very similar to one held by Decision Making researchers — human beings reason logically (Wason & Johnson-Laird, 1972). Logical rules of inference are content independent: they generate only true conclusions from true premises, regardless of the content of the premises.

However, more than a decade of research has shown that people often do not reason according to these canons of formal logic. Moreover, researchers have found a content effect; the performance of individuals on these logical problems improved only when the problem involved certain specific contents (such as checking the age for alcoholic purchase at a bar). This result led Cosmides and Tooby (1989) to develop a computational theory of social exchange — adaptive cooperation between two or more individuals for mutual benefit — based on evolutionary biology. Social exchange is a pervasive aspect of all human cultures. By following the steps of Marr (1982), who argued that the best way to understand a mechanism was to first understand the nature of the problems it was designed to solve, Cosmides and Tooby developed what they called social contract (SC) theory. SC theory asserted that the human mind must: 1) contain algorithms that produce and operate on cost-benefit representations of exchange
interactions, and 2) include inferential procedures that make one very good at
detecting cheating on social contracts.

At least two alternative explanations have been proposed to explain the content effect. The majority of theorists try to account for content effects by positing different amounts of experience with the different content domains tested. One prominent explanation is Tversky and Kahneman’s (1973) availability heuristic, combined with associationism. It claims that the individual’s actual past experiences create associational links between terms mentioned in the selection task. The more exposure the individual has had to, for example, the co-occurrence of $P$ and $Q$, the stronger that association will be, and the easier the co-occurrence will come to mind and to become “available” as a response. Furthermore, an individual is more likely to have actually experienced the co-occurrence of $P$ and not-$Q$ for a familiar rule, thus familiar rules are more likely than unfamiliar rules to elicit logically falsifying responses.

The second alternative explanation for the content effect comes from Cheng and Holyoak (1985). Cheng and Holyoak proposed that human beings reason about realistic situations using sets of generalized, relatively abstract production rules called pragmatic reasoning schemas. One of the schemas relevant in this case is a “permission schema” for reasoning about “regulation ... imposed typically by an authority to achieve some social purpose” (p. 398). Cheng and Holyoak maintained that most of the thematic problems that have
elicited high levels of logical falsification on the Wason selection task can be characterized as using rules of the permission schema.

SC theory, however, explains the content effect found in logical inference problems parsimoniously and better than the availability heuristic explanation or the pragmatic reasoning schema theory. This was demonstrated by a series of experiments cleverly conducted by Cosmides (1989).

1.3.3. Descriptive decision models

In reaction to the failure of EU and SEU in describing the choices people actually made, some researchers shifted attention to decision models that are descriptive of how decisions are actually made. Such effort began with the prospect theory of Kahneman and Tversky (1979). Since then, many descriptive models have been proposed. A sample of such descriptive models that propose content specific decision modes (proponents of these models specify the type of decisions that can be applied) are listed below. A more comprehensive list can be found in Weber, Tada, and Blais (1999). Although each is an independently standing model of decision making on its own right, we will treat these modes as submodels for the descriptive meta-model of decision making.
Principle-based mode

Some researchers are already aware that the “normative” modes of decision making (modes based on cost-benefit analysis, such as EU/SEU) do not lead one to optimal performance even in a normative sense in some situations. Specifically, people make a more “rational” decision using principles in cases where there is: 1) temporal mismatch (where cost and benefit are separated by a long time interval), 2) saliency mismatch (where one element of the cost-benefit pair is much more salient than the other), or 3) scale mismatch (where one element is perceived to have impact only in an aggregate sense). A principle or rule is “a behavioral policy in regard to some action or class of actions... [that] overrides cost-benefit calculation with respect to that action” (Prelec & Herrnstein, 1994). Policies such as to brush one’s teeth everyday or not to smoke are examples of such principles. According to the normative models, brushing one’s teeth in any given day may not be the option one will select. The benefit one gains from brushing one day is negligible, and the cost of having to remember to brush, buying a toothbrush and toothpaste, etc. may cause one to choose not to brush. This is an example of scale mismatch. The behavioral policies are content specific. If one were to implement, for instance, the policy of not smoking, it specifically applies to smoking; this does not imply that one should stop doing other activities. Whether a principle is used as a satisficing procedure (Simon, 1957) or to overcome weaknesses of our natural cost-benefit
accounting system (Prelec & Herrnstein, 1994), it is one of the viable strategies for making certain content-specific decisions.

**Reason-based mode**

Shafir, Simonson, and Tversky (1993) suggest that when facing a difficult choice, we do not normally attempt to estimate the overall utility of each option; instead, we tend to focus on reasons for and against each option and choose based on those reasons. This framework provides a natural way to understand the conflict that characterizes the making of decisions. It can be seen that conflict occurs because we have good reasons for and against each option or conflicting reasons for competing options.

Shafir et al. (1993) conducted a series of studies to determine if indeed people’s choices seem to be more consistent with the responses predicted by the reason-based choice mode than with those predicted by the normative models. For instance, the reason-based choice model asserts that the positive features of options will be weighted more heavily when having to choose one of two options, whereas the negative features of options will be weighted more heavily when having to reject one of two options. This is because if people were to base their decisions on reasons for and against the options under consideration, they are likely to focus on reasons for choosing an option when deciding which to choose, and to focus on reasons for rejecting an option when deciding which to
reject. Under normative modes such as SEU or MAUT, however, the two tasks are equivalent and should elicit the same outcome. This was tested by Shafir (1993) with a hypothetical custody case in which Parent A was portrayed as neither extremely positive nor negative and Parent B was portrayed as having both positive and negative qualities. It was found that Parent B was the majority choice both for being awarded custody of the child and for being denied it, which supports use of the reason-based mode, but not of the normative modes. This result, as well as other claims regarding the aspects of the model, was replicated in numerous scenarios (Shafir, 1993; Tversky & Shafir, 1992). As Shafir et al. (1993) claimed, indeed sometimes focusing on reasons “seems closer to how we normally think and talk about choices” (p. 5).

**Story-based mode**

When a decision is characterized by having a massive “database” of information to be considered, presented in a scrambled sequence, full of gaps, and with interdependent pieces of information, people may follow a story-based model to make a decision. Using judicial decision making situations, Pennington and Hastie (1988) arrived at this mode, in which people construct a causal model to explain the available facts (explanation structure) and then decide based on the coherence of causal interpretation imposed on the evidence. It is different from the normative modes in that reasoning about the evidence and construction
of an intermediate, semantic representation of the evidence are the central processes in decision making according to this model. In addition, it assumes that individuals are sensitive to the interdependence among pieces of evidence and that the evidence summary is constructed in part to capture some of these interdependencies. They found strong support for the model in cleverly designed experiments that simulated jury decision making (Pennington & Hastie, 1992). In jury decision making, they found that individuals engage in the performance of three distinct subtasks: first, they attempt to make sense of the entirety of the evidence by imposing a summary structure on it that they feel captures what is true about the events referred to in the testimony. Secondly, they attempt to grasp the essentials of the judge’s instructions concerning the available decision alternatives. Finally, they engage in a deliberate effort to match the explanatory story that they had constructed on hearing the evidence with the verdict categories, seeking a best fit between one of the verdict categories and their story.

Role-based mode

In certain situations, social benefit must be considered before individual benefit. No matter how busy a doctor is, she is bound by her role as a physician to stop and help out after witnessing an accident. Certain social roles are associated with certain obligations and expectations of behavior, and situations
that prime a particular social identity will also prime those behavioral norms (March, 1994). March calls this “rule following,” which is based on a logic of appropriateness. According to this model, when encountering a decision, individuals are faced with the following questions: 1) the question of recognition (“What kind of situation is this?”); 2) the question of identity (“What kind of person am I?”); and 3) the question of rules (“What does a person such as I do in a situation such as this?”). Although the process is neither random nor arbitrary, role-based decision making proceeds in a way different from normative decision making. The reasoning process is one of establishing identities and matching rules to recognized situations.

Each individual has multiple identities - a decision maker can be a parent as well as a physician, or a friend as well as a woman. Not all parts of an individual’s identity are available at any given time. Different situations evoke different identities and rules. Noticing the relevance of identities and rules in a situation comes from an interaction among at least four common mechanisms: 1) experiential learning (individuals learn to evoke an identity in a situation by experiencing the rewards and punishments of having done so in the past); 2) categorization (responses to situations are organized around a few central concepts of self); 3) recency (identities and rules that have been evoked recently are likely to be evoked again); and 4) the social context of others (the real or imagined presence of others leads to closer conformity to social expectations).
People are presumably motivated to engage in role-based decision making because its process and outcome affirms their social roles, thus strengthening their self-image.

Affect-based mode

Although a few models of affect-based decision making are available (as described further in the next section), there appear to be two distinct types: one that incorporates anticipated emotions about outcomes (e.g., fear or regret) into an SEU-type model, and one that deals with emotions experienced at the time of the decision. Models of the former kind will not specifically be discussed here, because affective components are involved to a different degree in each of the other decision strategies; in other words, some emotional involvement is an integral, and often primary, component of cognitive processes in decision making. As a more extreme view, Zajonc (1980) asserts that affective reactions to the stimuli are often the very first reaction of an individual and can occur without extensive perceptual and cognitive encoding and, furthermore, they are made with greater confidence than cognitive judgments.

Beach and Mitchell’s (1987) Image Theory is a model of automatic and intuitive decision making. They propose that people make decisions based on comparing “images.” Decision alternatives have images. These images are matched with a decision maker’s value image (principles) and trajectory and
strategic images (existing goals and plans). This process is called the compatibility test. This process is rapid and simple, and usually involves evaluating only negative aspects (i.e., it is noncompensatory). The compatibility test requires minimal cognitive effort, and this process can be called intuitive. Evaluative affect, particularly the negative kind (“Something doesn’t feel right about this”) is key to the automatic compatibility test portion of the Image Theory. When the compatibility test admits more than one candidate and a choice must be made among them, the process switches to the profitability test (which is more analytic and compensatory). Throughout this paper, the affect-based mode refers to a model such as the intuitive aspect of Image Theory, which is based on precognitive, evaluative affect.

Nondeliberative decision mode

When “decisions” have to be made frequently and/or extensively, they become routinized. For such decisions, unreasoned influences (e.g., habits or reflexes) direct behavior (Ronis, Yates, & Kirscht, 1989). Ronis et al. developed a model of repeated behavior, differentiating habits and decisions. A habit is an action that has been done many times and has become automatic (result of an automatic cognitive process). A decision to take or not to take an action, on the other hand, involves conscious thought and the consideration of at least one
alternative to the selected course of action (result of a controlled cognitive process).

Consider, for instance, two stages in the typical career of a smoker. It appears that some youngsters start to experiment with smoking in order to establish an image of toughness, maturity, and independence from authority. Whatever the reason, they make a fully conscious and independent decision to smoke. At a much later stage, continued smoking may be partially due to conscious decisions, but the reasons or perceived benefits have changed. Long-term smokers claim they smoke in order to 1) produce positive sensations and emotions, 2) reduce anxiety, 3) reduce craving, or 4) have something to do with their hands (Ikard, Green, & Horn, 1969). Many smokers, however, are aware that they simply smoke out of habit. They may notice, for example, that they are smoking, even though they do not recall having decided to smoke or having picked up or lit the cigarette. This limited awareness is typical of an automatic process, but not at all characteristic of a controlled process. The initiation of a new pattern of behavior, whether it is an unhealthy one (e.g., smoking, heavy drinking) or a healthy one (e.g., wearing seatbelts, exercising), generally requires conscious decision making. After the decision and the action are repeated many times, the action becomes habitual and repeated decision making becomes unnecessary. The decisions made automatically are considered to be made using the nondeliberative model similar to the habit stage of Ronis et al.’s (1989) model.
1.3.4. The role of emotion in decision making

Many researchers have posited the influence of emotion on decision making. When Simon (1983) presented his concept of bounded rationality, he acknowledged the importance of emotion as serving the principal function of focusing attention. Slovic (1997) also agrees that affect is an orienting mechanism that directs fundamental psychological processes such as attention, memory, and information processing. Schwarz (1990), on the other hand, considers emotion to play a more cognitive role as information one utilizes to make decisions. Some decision theories under risk, such as Regret Theory (Bell, 1982; Gilovich & Medvec, 1994) and Decision Affect Theory (Mellers, Schwartz, Ho, & Ritov, 1997), include explicit parameters associated with such affective variables as (anticipated) regret and disappointment. Similar to Schwarz (1990), but specifically focusing on risk, Loewenstein, Weber, Hsee, and Welch (1998) conceived of emotion as information contributing to people’s responses to risk. Although the role of emotion was highlighted in the affect-based model, it appears that emotion can be considered an integral part of decision making, entering in different models in various degrees. Thus, emotional involvement can legitimately be included as a potentially important factor in the modeling effort.
1.3.5. Epstein's cognitive-experiential self theory

From integration of evidence from various disciplines (ranging from cognitive psychology to clinical psychology), Epstein (1994) asserted that people behave as if they utilize two types of processing systems at different points in time (if not simultaneously): experiential and rational-cognitive systems. Epstein uses the term "system" in the abstract sense, without the implication of the existence of such systems physically in the brain. The experiential system is primarily nonverbal, involves an affective component, and processes materials that were learned from experience. As opposed to the experiential system, the rational-cognitive system is primarily verbal and processes materials acquired through formal education or based on analytic logic.

The implication of these two systems, and the possibility that they can operate simultaneously in decision making, is that people can theoretically make decisions based solely on one system or any degree of mixture of the two systems. This will create the most experiential intuitive decision processes at one extreme and the most rational-cognitive decision processes at the other extreme. Nondeliberative and affect-based decision strategies may lie at the experiential end of the continuum. On the other hand, something analogous to EU/SEU modes may lie at the rational-cognitive end of the continuum. Similarly, decision strategies like the Elimination by Aspect (EBA) model (Tversky, 1972) may exist in the middle of this continuum. EBA is hypothesized to use the same "rational"
characteristics of a decision as the EU/SEU modes (e.g., utility and probability), although not all variables are utilized, and those that are utilized are not combined in the same manner as in normative modes. Unlike nondeliberative or affect-based decision strategies, EBA is rational to the extent that the prediction of choice can be made solely by examining the utilities and weights given to the attributes of the choice alternatives. These hypotheses are examined more systematically in Chapter 2.
CHAPTER 2

THEORETICAL FRAMEWORK OF THE
DESCRIPTIVE META-MODEL OF DECISION MAKING

The possibility of individuals utilizing different decision strategies (such as the content-dependent modes described in the previous chapter), depending on the situation, is a realistic one. It is consistent with the enactive cognitive science framework and with the concept of people as adaptive decision makers presented by Payne, Bettman, and Johnson (1990; 1993). The crucial question involves when people utilize what type of decision strategy, what factors influence selection of those decision strategies, and, subsequently, how the decision strategy selection influences selection of choice alternatives.

Currently, many descriptive models of decision making are available. Although they describe the decision process fairly well, they cover a limited range of decision situations. For example, the Story-based mode may be suitable for complex decisions when not all pieces of information are available and the decisions must be made over time. Reason-based modes, on the other hand, can
better be applied to decision making in conflict, where competing pieces of information are available. Even modes such as EU/SEU, which are assumed to apply to the entire range of decisions, are content specific - they empirically do not predict people's choices very well when there are salient contents (as seen in numerous framing studies in support of prospect theory), but predict gambling decisions fairly well. What is needed is to determine when each mode is utilized by decision makers. A descriptive meta-model of decision making is formulated to systematically determine whether such decision strategy selection occurs. It is a meta-model in the sense that this model strives to specify when each decision submodel (which we refer to as a decision strategy or decision mode) is utilized.

In line with the findings enumerated above, several fundamental assumptions will be made for the framework of this meta-model of decision making: 1) human beings are adaptive decision makers, using different decision strategies systematically at different occasions; 2) such adaptiveness arose from the necessity of surviving and adapting to the environment, following the evolutionary biological perspective; and 3) human beings make decisions so as to maximize satisfaction/happiness, although such satisfaction does not solely arise from what we consider to be conventional utility, but also from a notion of fitting decision processes (means) to decision content and outcomes (ends). With these assumptions in mind, we can hypothesize the following processes to take place in each phase of the diagram in Figure 2.1 below.
Figure 2.1. Diagram of the descriptive meta-model of decision making.
2.1. Phase 0: Psychological dimensions of decisions

If human beings are indeed adaptive decision makers who select decision strategies in a systematic fashion, there must be in their minds some representation of decisions. Here, we assume the representation of decisions to lie in a multidimensional space, where a decision is “classified” by its particular location in that space. This representation of decisions is equivalent to a categorization. Thus, categories of decisions can be found by obtaining meaningful clusters in this space. Although clusters themselves may be meaningful on their own, cluster solutions are known to be quite sensitive to the nature of items included. The ultimate goal of the modeling effort is to create a model that is generalizable across decisions we did not explicitly include. For this reason, a spatial representation, such as that obtained by multidimensional scaling, may be more useful in determining the representation of decisions. Hence, one objective of the first phase is to determine how many dimensions are required to sufficiently describe the decision space so that it would be useful in predicting decision strategy selection; the other is to determine what those dimensions signify.
2.2. Phase 1: From decision situation dimensions to decision strategy selection

From the point at which a decision situation is presented (however minor the decision may be), one will engage in making the decision in the most efficient (i.e., cognitively economical) fashion. It is reasonable to assume that if the decision situation is encountered frequently and/or extensively, a decision is made automatically, without much thought (e.g., what to do when you encounter a red traffic light). On the other hand, if the decision is important in that it affects the decision maker’s life for a long duration in a significant way (e.g., whom to marry), the decision maker is more likely to expend cognitive effort in making the decision.

A series of studies determining decision strategy selection amongst variants of cost-benefit-based modes (MAUT-like, EBA, etc.) was conducted by Payne, Bettman, and Johnson (e.g., 1988, 1990, 1993). However, no known study has examined the relationship between decision characteristics and a wider range of descriptive models for decision strategy selection in a systematic manner.

Assuming that there is a small number of important dimensions that roughly determine which decision strategy is chosen, the selection process for a decision strategy can be based on the categorization of the decision. This is plausible because some decisions are made automatically and very quickly. The hypothesized process is roughly as follows: a decision that is made very quickly
is done so because it sufficiently matched the previously stored category of
decisions. A suitable decision strategy is chosen based on this match.

Furthermore, when the chosen decision strategy is category-based, as it often is
when similar decisions are encountered frequently, another categorization takes
place in which only salient elements of the decision are taken into account and
matched, not requiring the decision maker to evaluate all elements of the
decision, to arrive at a choice. For instance, a decision to oppose euthanasia may
be made by focusing on the salient element of "killing someone," which in turn
may trigger the decision maker's role as a devout Christian.

In fact, the process could be similar to the Fiske-Pavelchak (1986) two-
mode model in evaluating persons. In this model, the authors proposed that
there are piecemeal and category-based modes available to individuals for
evaluating a person, similar to the two types of processing systems described by
Epstein (1994), although the two-mode model enumerates how the similar
systems function in the process of categorization whereas Epstein does not
elaborate on the specifics for categorization. The two-mode model is composed
of two stages: a categorization stage and an evaluation stage. The categorization
stage (prior to evaluation) involves an attempt to identify a stimulus object as a
member of a class of objects. Categories are assumed to be hierarchically
organized structures with specific members (e.g., orange) at the bottom, less
specific members (e.g., citrus fruit) at middle levels, and even more inclusive
members (e.g., fruit) at the top (Cantor & Mischel, 1979; Rosch, Mervis, Gray, &
Boyes-Braem, 1976). Categorization can occur at any level, which can lead to
different evaluations. Perceivers have schemata associated with category
members that are applied to a stimulus upon successful categorization.

Categorization is defined as the identification of an object as a member of a class
of objects at a particular level of specificity, a process that results in the activation
of the associated schematic knowledge.

Fiske and Pavelchak’s (1986) two-mode model is similar to another
category-based model proposed by Klein (1989) to describe firefighters’ decision
making processes. The Recognized-Primed Decision (RPD) model is a three-level
naturalistic decision making model posited to explain how experienced
fireground commanders could use their expertise to identify and carry out a
course of action without having to generate analyses of options for purposes of
comparison. At Level 1 (Simple Match), a situation is simple and frequently
encountered and a fireground commander reacts with the previously successful
action for the category without deliberation. A more complex situation requires
diagnosis (Level 2). Finally, sometimes the decision maker will need to make a
more deliberative assessment of a course of action in Level 3. Although this
model is schematic and not formally specified, three levels appear to correspond
to some decision strategies included in our meta-model. Thus, one could argue
that our meta-model is one way to formalize Klein’s RPD model by applying it to the domain of everyday decisions.

In person evaluation, Fiske and Pavelchak (1986) hypothesized that one’s category label (e.g., being a feminist) determines evaluation of a person if one’s attributes are consistent with the category label (i.e., if categorization of that person is possible). If they are not, then the evaluation is constructed based on the individual attributes in a piecemeal fashion. Pavelchak (1989) tested the two-mode model and arrived at the conclusion that there indeed appear to be two distinct modes of processing information.

If Pavelchak’s finding is true, there does not seem to be a reason why it does not apply to categorization of decision problems. In a similar vein, if dimensions of a decision problem match a schema of decision problems sufficiently, that decision problem is solved according to how that category group’s members have been solved. Taken broadly, then, some decision strategies can be described as category-based, while others are piecemeal. Table 2.1 describes the list of decision strategies examined in this research, and a rough classification of whether a decision is processed in a piecemeal or a category-based manner under each decision strategy. The obvious difference among the strategies within the category-based decision strategy cluster is that the qualitative nature of the category is different for each (e.g., one based on a role one plays in a decision problem vs. one based on the emotion involved in a
decision problem). It is also interesting to note that other features, such as whether a decision strategy is considered to be employed consciously or unconsciously and the degree of cognitive effort required in employing a decision strategy, differ within each classification, both of which are consistent with Epstein’s theory. Assuming that our meta-model follows decision making processes proposed by Fiske and Pavelchak (1986) and that the underlying systems are the same as those proposed by Epstein, these features aid in predicting the relationship between levels of dimensions and decision strategy selection. For example, time taken to make a decision should be short for a decision strategy that requires little cognitive effort and can be used unconsciously (e.g., the Nondeliberative decision strategy).

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Category vs. piecemeal</th>
<th>Conscious?</th>
<th>Effortful?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>Piecemeal</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EBA</td>
<td>Piecemeal</td>
<td>Yes</td>
<td>Less so</td>
</tr>
<tr>
<td>Reason-based</td>
<td>Piecemeal</td>
<td>Maybe</td>
<td>Less so</td>
</tr>
<tr>
<td>Story-based</td>
<td>Category/Piecemeal</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Principle-based</td>
<td>Category</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Role-based</td>
<td>Category</td>
<td>Maybe</td>
<td>No</td>
</tr>
<tr>
<td>Affect-based</td>
<td>Category</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>Category</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 2.1. Classification of decision strategies in terms of variables in the Two-Mode Model and Epstein’s (1994) Rational-Experiential Systems
2.3. Phase 2: From decision strategy selection to choice

Lopes (1987) and others have shown that individuals sometimes are unwilling to change their choices even after they have been told their choices are not optimal (in a normative sense). If their choices are truly suboptimal, we should ask why people continue to make decisions in this manner. From an evolutionary point of view, it does not make sense that such suboptimal behavior has continued for generations unless such behavior is somehow useful to survival. It is even more curious that human beings almost uniformly behave suboptimally in domains where they are not specifically trained to make “optimal” choices (e.g., weather forecasters make choices just as suboptimal as everyone else’s in domains other than weather forecasting).

This is where Frisch and Clemen’s (1994) perspective provides us with clues. A good decision making process is one that leads the decision maker to a desirable outcome. A desirable outcome brings us happiness. Because emotion appears to be a guiding mechanism for human beings (and we have plenty of psychosomatic illnesses to prove the importance of emotional well-being) and every human being with a fully functional brain seems to possess emotions (see Damasio, 1994 for rare exceptions), it is logical to consider satisfaction derived from the outcome as the standard in measuring optimality of a decision making process.
It is hypothesized that a particular selection of decision strategy is going to influence the outcome of the decision (i.e., which alternative is chosen). Some evidence of this can be seen in the results described in Shafir, et al. (1993) in differentiating the process of decision making based on reasons from normative, cost-benefit decision making. In addition, in cases of category-based decision strategies, it seems reasonable to assume that a particular alternative is chosen that matches the salient category (e.g., choosing not to abort a child when being a devout Catholic is the salient category). Furthermore, such a choice is unlikely to be similar to the outcome if a normative decision strategy had been used because attributes unique to the decision maker, such as one's religious affiliation, are not customarily included in the equation of the normative strategy to arrive at a choice.

2.4. Previous studies on the descriptive meta-model

Phase 0: Psychological dimensions of decision problems

To address this portion of the model, Tada and Weber (1998, 1999) conducted two experiments to examine how people categorize various decisions. Decisions used for these studies were 50 fairly representative everyday decisions we assembled from a list of decisions provided by college students. To this we added decisions people make every day but do not consider to be “decisions” (e.g., stopping at a red traffic light). In both studies, participants sorted 50
decisions; however, instructions for the sorting task differed for the two studies. In Study 1, participants were asked to sort decisions in terms of unspecified “similarity,” whereas in Study 2, they were asked to sort decisions in terms of “similarity in making these decisions.” In Study 1, the dimensions of multidimensional scaling solution reflected more surface situational characteristics (personal-professional distinction, perceived importance, and decision complexity), and in Study 2, more cognitive dimensions emerged (length of time to make decisions, emotional involvement, and availability of protocol for decisions). In both studies, a series of clustering analyses was performed, which produced four clusters of decisions stable across different methods (k-mean and hierarchical cluster analyses). They were categorized as professional/school, relationship, monetary/consumer item, and nondeliberative decisions.

**Validation study.** Although some interpretations attached to multidimensional solutions were obtained from the conventional multiple regression technique, there is no guarantee that these interpretations are accurate and sufficient descriptions of what these dimensions actually represent. In addition, interpretations for other dimensions were obtained by visual inspection, which needs to be verified empirically. Study 3 was conducted to test the validity of these interpretations. A new set of participants was given a
questionnaire, on which participants were asked to rate each decision problem in terms of the interpretations derived in Studies 1 and 2. We found that, although there were substantial correlations between the interpretations and dimensions for almost all of the interpretations (in the .60’s), they were not nearly as high as we would like for validation. Moreover, some correlations between interpretations and other dimensions were higher than anticipated (some in the .40’s) from the nature of the dimensions (which are assumed to be independent because multidimensional scaling extracts only mutually independent dimensions). Further analyses are required to determine the nature of these dimensions, if this model were to be applied to a more general population of decision problems (not limited to those samples in our studies).

Phase 1: From decision problem dimensions to decision strategy selection

Based on the results in Studies 1 and 2, it was hypothesized that length of time to make decisions, emotional involvement, and availability of protocol are major factors that directly influence the selection of decision strategies. In addition, because the general perceptions of these decisions were categorized based on situational characteristics, they may also be involved in the decision strategies indirectly. Such hypotheses were tested also in Study 3 to justify the inclusion of content in decision making and to improve the understanding of decision processes as a subset of higher cognitive processes.
In Study 3, a subset of 18 decisions from the previous 50 (representative of the four clusters formed) was utilized. Participants were asked directly about the likelihood of each decision strategy used for each decision problem. We found a negative relationship between dimension 1 in Study 1 (which we labeled the “professional-personal” dimension) and MAUT-like, Story-based, and Reason-based strategies, which suggests that decision makers are more likely to use MAUT-like, Story-based, and Reason-based decision strategies for personal decisions. Some statistically significant relationships emerged when the effect of the dimensions was examined within four domain clusters. For example, the use of the Story-based decision strategy was more likely in emotionally involved school/professional decisions than in financial decisions. Where moral issues were involved (in some “nondeliberative” decisions), people tended to use the Principle- or Role-based decision strategy. However, some results did not seem consistent with our model (e.g., the use of the MAUT-like decision strategy was more likely with personal as opposed to school/professional decisions when in fact more rational strategies such as MAUT are hypothesized to be suitable for professional decisions and NOT personal decisions). Further examination is necessary to clarify the relationship between decision situation characteristics and decision strategy selection.
CHAPTER 3

STUDY 1: VALIDATION OF PSYCHOLOGICAL DIMENSIONS OF DECISIONS

The failure to provide strong validation for dimensional interpretations in the previous studies necessitated another study. This failure can be attributed to several causes: 1) the items comprising these interpretations may have contained a substantial amount of measurement error, 2) dimensions may be more complex than their previous interpretations would suggest, or 3) the interpretations may not be descriptive of the dimensions at all. Because most of the correlations between the dimensions and their respective interpretations in the previous studies were higher than correlations among other variables, it is safe to presume that the interpretations we attached to the dimensions indeed have some relevance to their respective dimensions. The first two reasons are more plausible because each interpretation was assessed by only one item.

Study 1 therefore used multiple items to assess the relationship between the dimension and its respective interpretation for each of six dimensions found in the two previous studies. Because we did not yet know whether measurement
error or complexity of the dimensions (or both) led to the attenuation of the correlations, new items consisted of two distinct kinds: items that assessed the same construct in different ways (i.e., in different formats) and items that are related to the original interpretation but represent different aspects of the dimension. Furthermore, additional items – variables found in other research to influence decision strategy selection – were included to determine whether they influence decision strategy selection in our framework. With new interpretations representing the underlying constructs, it was hypothesized that the relationship between these new interpretations (constructs) and their respective dimensions would be strong, but that the relationship between the dimensions and the other items would be weak.

3.1. Method

3.1.1. Sample

A sample of 143 college students in the winter 1999 quarter and another sample of 74 students in the spring 1999 quarter participated in Study 1 in partial fulfillment of requirements for an introductory psychology course. Requirements for participation included fluency in English and sufficient familiarity with the Windows 95/98 environment. English fluency was necessary because cognitive processes may differ when an individual is asked to perform a task in a language with which he is not familiar. The study was
conducted on a computer, and individuals’ response times were measured as they performed the task. Unfamiliarity with the Windows environment could delay one’s response time unnecessarily.

3.1.2. Measures

A list of decisions was constructed from a pilot study, in which college students were asked to write down decisions they had made in the last six months. Fifty decisions were selected from: 1) this list, 2) decisions made every day but which may not be considered as decisions (e.g., stopping at a red traffic light), and 3) decisions that may be encountered in the future (e.g., getting married, buying a house). Ten decision situations were selected from the original decisions in such a way as to represent four cluster categories roughly equally (i.e., three decisions were selected from two categories and two decisions from the other two categories), to maximize the differences among decisions on the dimensions obtained in the previous studies, and to allow differentiation of choice alternatives selected by differing decision strategies. These decisions can be found in Appendix A.

Several questions were asked about each decision situation to determine the interpretations of the psychological dimensions of the decision space. Three different formats were used for items that assumed the same underlying construct. One was a modified Likert scale, allowing for a response on a
continuum instead of being restricted to discrete values (the original item used in the previous studies, and called Variable, e.g., Import). For example, the question, “How important is it for you to make this decision?” was to be answered on a continuum from 1 (not important) to 9 (very important) to assess the Importance construct. Another format can be described as numerical, in which participants were asked to rate the degree of the importance of each decision on a scale from 1 to 100 (NumVariable, e.g., NumImport). The last format was verbal, in which participants were asked to choose the most appropriate adjective to describe each decision (VerbVariable, e.g., VerbImport). The adjectives ranged from extremely trivial to extremely important for the Importance construct.

Another set of items (on average, three items) that were related to the original interpretation, but representing different aspects, were included. For instance, in the case of the Importance construct, a question such as, “How much do you care about the outcome of this decision?” was included to investigate the complexity of the dimension. These items were constructed because the simple question of whether a decision is important does not directly address related thoughts, such as caring about the outcome or feeling as if it is an irreversible decision. However, Dimension 2 of surface dimensions may actually represent such a complex or multi-aspect construct. The differentiation between the two constructs was important because the multiple-format constructs were meant to
remove only measurement error from the original item (but add nothing else). On the other hand, the multiple-aspect constructs were included to expand the meaning of each construct (and also remove measurement error). A complete list of items for each of six dimensions can be found in Appendix B.

3.1.3. Procedures

Participants were asked to rate 10 everyday decisions, a subset of the original 50 items, on the characteristics found to be related to the psychological dimensions in the previous studies. Because the goal of this study was to assess how participants perceived these decisions on the characteristics as they engaged in decision making, the ratings were collected after they simulated making each of the 10 decisions on a computer (Study 2). Details of this portion of the procedure are described in Chapter 4. Because participants rated multiple decisions, the order of decisions was randomized and counterbalanced for the winter quarter group. The spring groups’ order was randomized but not counterbalanced due to insufficient sample size.

3.1.4. Data analysis

The goal of Study 1 was to provide stronger validation of interpretations we attached to the multidimensional solutions in the previous studies (Tada & Weber, 1998; 1999). Because the primary reason for the weaker results was
presumed to have resulted from reliance on one-item ratings to determine the adequacy of each dimensional interpretation, a natural test was to compare the strength of relationship (in terms of regression weights) when one item was used and when a latent construct with multiple indicators was used as each of the dimensional interpretations. Two different types of constructs were developed for each interpretation: a rather simple construct with multiple forms of indicators and a more complex construct with indicators representing slightly different aspects of the construct. Therefore, three types of models consisted of three dimensional coordinates as predictors and: 1) one item serving as the dimensional interpretation, 2) a latent construct with varying format indicators, or 3) a latent construct with varying aspect indicators.

Prior to data analysis, however, some determination had to be made about the nature of the data set. Ten rating measures (one for each decision situation) were obtained from multiple individuals. In other words, the data set had a hierarchical structure, where individuals were nested within decision situations (i.e., there are multiple individuals who encountered the same decision). This is illustrated in Figure 3.1. Such a structure is suitable for multilevel modeling. However, no simple multilevel modeling software is currently available that can incorporate latent variables. The key feature of this analysis lies in understanding that there are two sources of variability, within situation (among
Level 2: Decision Level

Level 1: Individual Level

Figure 3.1. Two-level hierarchical data structure
individuals) and between situations, which translates to partitioning the covariance matrix $\Sigma$ into $\Sigma_w$ and $\Sigma_b$. Muthén (1995), however, has arrived at a method of obtaining maximum likelihood (ML) estimates of $\Sigma_w$ (the pooled-within matrix, $S_{pw}$) and $\Sigma_b$ ($c^{-1}(S_b - S_{pw})$, where $c = \left[N^2 - \sum_{g=1}^{G} N_g^2 \right][N(G-1)]^{-1}$ and reflects the group size). Once these estimates are obtained, the estimated intraclass correlation can be calculated. Furthermore, within-situation and between-situation structures can be modeled separately using conventional structural equation modeling software. $S_{pw}$ and $S_b$ were calculated for each construct according to the formulae below:

$$S_{pw} = (N-G)^{-1} \sum_{g=1}^{G} \sum_{i=1}^{N_g} (y_{gi} - \bar{y}_g)(y_{gi} - \bar{y}_g)'$$

$$S_b = (G-1)^{-1} \sum_{g=1}^{G} N_g (\bar{y}_g - \bar{y})(\bar{y}_g - \bar{y})'$$

Resulting ML estimates of $\Sigma_w$ and $\Sigma_b$ can be seen in Appendix C. The estimated intraclass correlation for elements of each covariance matrix for the six constructs was calculated by:

$$\hat{\rho} = \frac{\hat{\sigma}_b^2}{\hat{\sigma}_b^2 + \hat{\sigma}_{pw}^2} = \frac{c^{-1}(s_b^2 - s_{pw}^2)}{[c^{-1}(s_b^2 - s_{pw}^2)] + s_{pw}^2}$$

Average intraclass correlations are also displayed in Appendix C. Muthén (1995) mentions that it is wise to obtain a rough indication of whether a multilevel
analysis is warranted by examining the estimated intraclass correlations. Intraclass correlations ranged from 0.05 to 1.00, with the overall average being 0.56, indicating that there was enough variability among situations to warrant the level-2 analysis. However, Muthén (1995) warns that the ML estimate of $\Sigma_B$ is frequently not positive definite. In fact, four of the six matrices ran into estimation problems using ML; instead, OLS was used as the method of estimation to analyze $\hat{\Sigma}_g$. In addition, aggregated correlation matrices were analyzed because between-situation structure will be very similar to simply analyzing a covariance matrix obtained by aggregating ratings across individuals when intraclass correlations are high (because they imply that there is such little variability among individuals in comparison to among situations). For the sake of simplicity, results from the aggregated correlation matrices are reported here because the patterns of parameter estimates for all models across the two sets (i.e., $\hat{\Sigma}_g$ structure models using OLS and aggregated correlation structure models using ML) were similar. The structure and the order of regression weights remained consistent across two sets of matrices. The similarity was not surprising because these situations were chosen to maximize differences in these dimensional coordinates so that the decision strategy selection can be determined based on systematic variability.
A prototypical model for each of the three types of models is displayed in Figures 3.2 - 3.4. The similarities among these models are obvious. All models have three dimensional coordinates as predictors, and either a measured variable or a construct that is thought to be represented by one of the dimensions. These dimensions (as vectors) were previously obtained from multidimensional scaling and, as such, they are uncorrelated. However, dimensional coordinates in the models were specified to be correlated with each other because it is unreasonable to assume that the coordinates, representing actual decisions, would be uncorrelated with each other. The first model was analyzed by multiple regression, whereas the latter two were analyzed by structural equation modeling (SEM).

Figure 3.2. A prototypical regression model to test the validity of the interpretation of a dimension
Figure 3.3. A prototypical multiple-format construct model to test the validity of the interpretation of a dimension

Figure 3.4. A prototypical multiple-aspect construct model to test the validity of the interpretation of a dimension (in this case, Importance)
3.2. Results

Prior to both regression and SEM, a series of ANOVAs was performed on the aggregated scores to examine the possibility of order effects. Three of the 34 indicators had statistically significant order effects (the number of people participants would talk to (NumTalk, one of the Personal-Professional construct items), $F(2.27) = 6.594, p = .005, \eta^2 = .328$; the number of emotions they felt (NumEmotion, one of the Emotional Involvement construct items), $F(2.27) = 6.518, p = .005, \eta^2 = .326$; and the number of rules they would employ (NumRule, one of the Protocol Availability items), $F(2.27) = 4.105, p = .028, \eta^2 = .233$). These effects, in fact, were not order effects. Due to a program misspecification, the data from the winter quarter on these variables were recorded inaccurately. To demonstrate this point, when data are partitioned according to the quarter of data collection and analyzed, all three effects remained ($F(1.18) = 21.934, p = .001, \eta^2 = .549$, $F(1.18) = 23.222, p = .001, \eta^2 = .563$, and $F(1.18) = 26.522, p = .001, \eta^2 = .596$, respectively). Hence, separate analyses were performed for each quarter so that comparison among models could be made more appropriately.
3.2.1. Multiple regression revisited

As a first step, a series of multiple regressions was conducted to determine the adequacy of interpretations for the previously obtained multidimensional solutions. To facilitate comparison with the subsequent structural equation models, the following multiple regressions were performed on correlation matrices using RAMONA (Browne & Mels, 1997). Multiple regression can be considered a special case of a structural equation modeling where multiple measured variables influence yet another measured variable. As in the previous studies, normalization was performed on the regressions weights to convert them to direction cosines (also called optimal regression weights). A direction cosine of 1.0 indicates that the rating item/construct overlaps those dimensional coordinates completely (and the directional interpretation is the same). A tilde (~) notation is used to signify the optimal weights (\( \tilde{\beta} \)) and to differentiate them from the non-normalized weights (\( \hat{\beta} \)). In order for an item/construct to provide a satisfactory interpretation of a dimension, Kruskal and Wish (1978) claimed that two conditions must be met: 1) the multiple correlation coefficient (or likewise, \( R^2 \)) for the item/construct should be high, suggesting that it is well fitted by the coordinates of the configuration, and 2) the item/construct must have a high regression weight on that dimension, indicating that the angle between the dimension and the associated item/construct is small. In SEM, a test
statistic is presented for each of the (non-normalized) regression weights. It can be roughly interpreted as a z-statistic. Accordingly, any value larger than about 2.0 was interpreted to be statistically significant. As a convention, the three-dimensional solution obtained in Tada and Weber (1998) will be referred to as surface dimensions and the second three-dimensional solution obtained in Tada and Weber (1999) will be referred to as process dimensions throughout the current and subsequent chapters.

Surface dimensions

A multiple regression of the Personal-Professional item on the three surface dimensions replicated the previous finding for the two quarter groups. The three dimensions together accounted for a substantial proportion of the variance of the Personal-Professional item in both winter and spring quarter groups ($R^2_{w1} = 0.85$ and $R^2_{w2} = 0.88$, respectively). In both groups, the optimal regression weight of Dimension 1 on the Personal-Professional item was found to be highest ($\tilde{\beta}_{w1,1} = 0.892$, t-statistic = 5.72, and $\tilde{\beta}_{w2,1} = 0.880$, t-statistic = 5.90, respectively). Whereas the regression weights of Dimension 2 on the same items were not extremely small ($\tilde{\beta}_{w1,2} = 0.450$, t-statistic = 2.43, and $\tilde{\beta}_{w2,2} = 0.474$, t-statistic = 2.77), the regression weights of both Dimensions 2 and 3 were appreciatively smaller than those of Dimension 1, as can be seen in Table 3.1.
Similarly, the regression weight of Dimension 1 on the Importance item was highest in both groups ($\tilde{\beta}_{Q1,D2} = 0.969$, t-statistic = 3.17, and $\tilde{\beta}_{Q2,D2} = 0.967$, t-statistic = 3.02, respectively) and, furthermore, none of the weights of other dimensions was statistically significantly different from zero. However, only approximately 65% of variance of the Importance item was accounted for by the dimensions.

As found in the previous study, Dimension 3 did not predict the Complexity item very well ($\tilde{\beta}_{Q1,D3} = 0.250$, t-statistic = 0.87, and $\tilde{\beta}_{Q2,D3} = 0.207$, t-statistic = 0.66). As a matter of fact, Dimension 2 was just as predictive of the Complexity item as it was of the Importance item ($\tilde{\beta}_{Q1,D2} = 0.967$, t-statistic = 4.43, and $\tilde{\beta}_{Q2,D2} = 0.207$, t-statistic = 4.08). Additionally, the dimensions accounted for a slightly larger proportion of variance in the Complexity item than in the Importance item. Table 3.1 describes these results. According to these regression results alone, the same conclusion can be drawn as in the previous study. The interpretations for the first two dimensions seem sufficiently descriptive (although it may be more appropriate for Dimension 2 to be called Complexity than Importance); however, we are still uncertain about the interpretation of the third dimension. Due to a small number of situations ($G = 10$), most of the estimates had rather large standard errors (ranging from 0.11 to 0.26).
<table>
<thead>
<tr>
<th>Quarter</th>
<th>Proposed Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Personal-Professional</td>
<td>0.892</td>
<td>0.450</td>
<td>0.051</td>
<td>0.846</td>
</tr>
<tr>
<td>Spring</td>
<td>Personal-Professional</td>
<td>0.880</td>
<td>0.474</td>
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<td>0.884</td>
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<tr>
<td>Winter</td>
<td>Importance</td>
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<td>0.243</td>
<td>0.428</td>
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<td>0.427</td>
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<tr>
<td>Winter</td>
<td>Complexity</td>
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<td>0.967</td>
<td><strong>0.250</strong></td>
<td>0.589</td>
</tr>
<tr>
<td>Spring</td>
<td>Complexity</td>
<td>0.006</td>
<td>0.978</td>
<td><strong>0.207</strong></td>
<td>0.537</td>
</tr>
</tbody>
</table>

Table 3.1. Multiple regression results of one-item ratings on surface dimensions

**Process dimensions**

Similar results held true for the process dimensions. In both groups, the Duration item was predicted very strongly by Dimension 1 ($\tilde{\beta}_{Q1,n1} = 0.942$, t-statistic = 7.97, and $\tilde{\beta}_{Q2,n1} = 0.937$, t-statistic = 7.57, respectively), and the Emotional Involvement item was predicted well by Dimension 2 ($\tilde{\beta}_{Q1,n2} = 0.824$, t-statistic = 4.73, and $\tilde{\beta}_{Q2,n2} = 0.828$, t-statistic = 4.82, respectively). However, for both items, one of the other dimensions was also moderately predictive. In the case of the Emotional Involvement item, the regression weight of Dimension 1 was as large as 0.565. The confidence intervals of $\hat{\beta}_{n1}$ and $\hat{\beta}_{n2}$ were compared for each group and were found to overlap, suggesting that they were not statistically different from each other. As can be seen in Table 3.2, proportions of variance accounted for in both rating items, however, were high (all $R^2$'s larger than 53...
than 0.88), suggesting that both items can be well fitted by the coordinates of the configuration.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Duration</td>
<td>0.942</td>
<td>0.328</td>
<td>0.076</td>
<td>0.945</td>
</tr>
<tr>
<td>Spring</td>
<td>Duration</td>
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<td>0.344</td>
<td>0.060</td>
<td>0.901</td>
</tr>
<tr>
<td>Winter</td>
<td>Emotional Involvement</td>
<td>0.565</td>
<td>0.824</td>
<td>0.039</td>
<td>0.878</td>
</tr>
<tr>
<td>Spring</td>
<td>Emotional Involvement</td>
<td>0.560</td>
<td>0.828</td>
<td>0.040</td>
<td>0.896</td>
</tr>
<tr>
<td>Winter</td>
<td>Protocol Availability</td>
<td>0.919</td>
<td>0.384</td>
<td>0.089</td>
<td>0.971</td>
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<tr>
<td>Spring</td>
<td>Protocol Availability</td>
<td>0.917</td>
<td>0.393</td>
<td>0.073</td>
<td>0.935</td>
</tr>
</tbody>
</table>

Table 3.2. Multiple regression results of one-item ratings on process dimensions

Finally, Dimension 3 was not at all predictive of the Protocol Availability item (\( \beta_{Q1,D3} = 0.089 \), t-statistic = 1.38, and \( \beta_{Q2,D3} = 0.073 \), t-statistic = 0.79), although in both groups these dimensions accounted for a substantial proportion of variance in the Protocol Availability item (\( R^2_{Q1} = 0.97 \) and \( R^2_{Q2} = 0.94 \)). This was because the regression weight of another dimension, Dimension 1, was quite high (\( \beta_{Q1,D1} = 0.919 \), t-statistic = 6.82, and \( \beta_{Q2,D1} = 0.917 \), t-statistic = 6.74). It suggested that an availability of protocols/procedure to make a decision is associated more strongly with Dimension 1. Again, the conclusion drawn from the regression results alone is that the interpretations of the first two dimensions...
are adequate even with a single item, whereas there is still a question as to the proper interpretation for the last dimension.

3.2.2. Structural equation model 1: Multiple-format construct

As mentioned in the previous section, the first set of structural equation models considered three different scales (a Likert scale, a numerical scale, and a verbal scale) as indicators for each construct of the six dimensional interpretations. Commonly in SEM, the overall fit of each model is examined prior to the evaluation of parameter estimates. However, three conditions prevented a conventional examination of the overall fit. First, although many participants evaluated these decisions, the use of an aggregated correlation matrix implied that the relevant "sample" size for these models (i.e., the number of situations, G) was 10. Parameter estimates were more precise than when N is small (our sample size, N, was 217) because the elements of the correlation matrix were themselves more precise; however, this affected the precision only indirectly. Because the measures of overall fit are functions of the number of situations, a small number of situations should result in an imprecise estimate and a large associated confidence interval for measures such as RMSEA. Secondly, the specified models have few degrees of freedom (df = 6). MacCallum, Browne, and Sugawara (1996) have shown that when a model has few degrees of freedom, a large sample size is generally required to sufficiently
reduce the width of the confidence interval of the overall fit measure. Thirdly, most of the correlation matrices used included some very high correlations (over .90). Browne and MacCallum (personal communication, April 2000) have found that the maximum likelihood (ML) estimation method breaks down when the reproduced correlation matrix reaches near singularity, thus resulting in poor overall fit measures despite small residuals. To solve this particular problem, the generalized least squares (GLS) estimation method may be used (because it does not require the reproduced correlation matrix to be positive definite). However, for all of the following models, the obtained RMSEAs were 0.0 with the confidence intervals of (0.0, 0.0) or (0.0, 0.25), due perhaps to the other problems described above (e.g., few degrees of freedom). For these reasons, an average root mean square of the residuals (RMS) and $R^2$ were used as the primary overall measures of fit.

**Surface dimensions**

Root mean squares of residuals (RMS) for the first model including the Personal-Professional construct was quite small for both groups ($RMS_{Q1} = 0.028$ and $RMS_{Q2} = 0.031$, respectively), suggesting that this model fit well. The dimensions also accounted for a substantial portion of the variability in the Personal-Professional construct ($R^2_{Q1} = 0.85$ and $R^2_{Q2} = 0.88$). The factor loadings
of the Personal-Professional construct were very high (all above 0.97), suggesting that these indicators measured essentially the same underlying construct. The regression weight of Dimension 1 on the Personal-Professional construct, as anticipated, was high ($\bar{\beta}_{q_1 \cdot d_1} = 0.896$, t-statistic = 5.83, and $\bar{\beta}_{q_2 \cdot d_1} = 0.880$, t-statistic = 5.90) for the two groups. Although the regression weight of Dimension 2 is moderate, as seen in Table 3.3, overall, this model fit the data (and the expected pattern) closely.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
<th>RMS</th>
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<tr>
<td>Winter</td>
<td>Personal-Professional</td>
<td>0.896</td>
<td>0.440</td>
<td>0.053</td>
<td>0.849</td>
<td>0.028</td>
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<tr>
<td>Spring</td>
<td>Personal-Professional</td>
<td>0.880</td>
<td>0.474</td>
<td>0.041</td>
<td>0.884</td>
<td>0.031</td>
</tr>
<tr>
<td>Winter</td>
<td>Importance</td>
<td>0.079</td>
<td>0.970</td>
<td>0.229</td>
<td>0.441</td>
<td>0.010</td>
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<tr>
<td>Spring</td>
<td>Importance</td>
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<td>0.979</td>
<td>0.205</td>
<td>0.412</td>
<td>0.015</td>
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<tr>
<td>Winter</td>
<td>Complexity</td>
<td>0.049</td>
<td>0.967</td>
<td>0.251</td>
<td>0.596</td>
<td>0.008</td>
</tr>
<tr>
<td>Spring</td>
<td>Complexity</td>
<td>0.050</td>
<td>0.971</td>
<td>0.235</td>
<td>0.549</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Table 3.3. Structural equation modeling results of multiple-format constructs on surface dimensions

The fit of the Importance model was good in terms of RMS ($RMS_{q_1} = 0.010$ and $RMS_{q_2} = 0.015$ for the two groups). However, the dimensions together accounted for at most 44% of variance in the Importance construct. Factor loadings of the Importance construct were very high (all over 0.99). The regression weight of Dimension 2 was high on the Importance
construct in both groups ($\tilde{\beta}_{Q1,Q2} = 0.970$, t-statistic = 5.83, and $\tilde{\beta}_{Q2,Q2} = 0.979$, t-statistic = 5.90, respectively), while other dimensions' were not. The fact that the model has mixed results implies that relationships among the dimensions and the Importance indicators are explained well by the model, but in fact, the degree of those relationships is not very strong.

As in Table 3.3, the proportion of variance in the Complexity construct accounted for by the dimensions was to a small degree better ($R^2_Q = 0.60$ and $R^2_{Q2} = 0.55$) than with the Importance construct. RMS was small as well ($RMS_{Q1} = 0.008$ and $RMS_{Q2} = 0.016$), indicating a good fit. Again, factor loadings of the Complexity construct were very high (again, all above 0.99), suggesting that there was little measurement error associated with these measures (or measurement error was correlated for these indicators). However, as in the regression case, the regression weight of Dimension 3 was low on the Complexity construct for both groups ($\tilde{\beta}_{Q1,Q3} = 0.251$, t-statistic = 0.89, and $\tilde{\beta}_{Q2,Q3} = 0.235$, t-statistic = 0.76, respectively). Furthermore, the Dimension 2 weight was high ($\tilde{\beta}_{Q1,Q2} = 0.967$, t-statistic = 4.49, and $\tilde{\beta}_{Q1,Q2} = 0.971$, t-statistic = 4.03), suggesting again that complexity was a better description of Dimension 2 than of Dimension 3.
Process dimensions

The fit of the Duration construct model was excellent, as determined by both $R^2$ ($R_{q1}^2 = 0.95$ and $R_{q2}^2 = 0.92$) and RMS ($RMS_{q1} = 0.015$ and $RMS_{q2} = 0.016$). Factor loadings of the Duration construct were all above .99 (in fact, at least one indicator in each group had a boundary estimate loading of 1.0). The relationship between the construct and the corresponding dimension, Dimension 1, was strong as well ($\beta_{q1,d1} = 0.983(0.122)$ and $\beta_{q2,d1} = 0.964(0.112)$), whereas other relationships were at best moderate (the highest regression weights were in the low .30's). From this SEM, the Duration construct seems to be a solid interpretation of Dimension 1.

Overall fit of the Emotional Involvement model was good as well, in terms of $R^2$ ($R_{q1}^2 = 0.88$ and $R_{q2}^2 = 0.90$), as well as RMS ($RMS_{q1} = 0.013$ and $RMS_{q2} = 0.020$). Factor loadings of the Emotional Involvement construct were also all above .99 (with the loading of one indicator reaching the boundary). As in the regression results, the Dimension 2 weight on the Emotional Involvement construct was high for both groups ($\tilde{\beta}_{q1,d2} = 0.824$, t-statistic = 4.73, and $\tilde{\beta}_{q2,d2} = 0.828$, t-statistic = 4.82, respectively), and the Dimension 1 weight was moderate (reaching .57 in one group). Although not as solid as the Duration
construct, Emotional Involvement still appears to be a very good interpretation of Dimension 2.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>Duration</td>
<td>0.943</td>
<td>0.322</td>
<td>0.082</td>
<td>0.949</td>
<td>0.015</td>
</tr>
<tr>
<td>Spring</td>
<td>Duration</td>
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<td>0.309</td>
<td>0.041</td>
<td>0.922</td>
<td>0.016</td>
</tr>
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<td>0.878</td>
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<td>Emotional Involvement</td>
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<td>0.896</td>
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</tr>
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<td>Protocol Availability</td>
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<td>0.089</td>
<td>0.971</td>
<td>0.100</td>
</tr>
<tr>
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<td>Protocol Availability</td>
<td>0.917</td>
<td>0.393</td>
<td>0.073</td>
<td>0.935</td>
<td>0.114</td>
</tr>
</tbody>
</table>

Table 3.4. Structural equation modeling results of multiple-format constructs on process dimensions

The overall fit of the Protocol Availability model measured by RMS increased by one decimal place ($RMS_{Q1} = 0.013$ and $RMS_{Q2} = 0.020$) compared to the previous two models. Indicators of the Protocol Availability construct did not load as highly on the construct as did others, but was still in the acceptable range (the lowest was .84 in group 1). However, the expected high regression weight of Dimension 3 on the construct again did not materialize. In fact, the Dimension 3 weight was the lowest in both groups ($\tilde{\beta}_{Q1,3} = 0.089$, t-statistic = 1.38, and $\tilde{\beta}_{Q2,3} = 0.073$, t-statistic = 0.79, respectively), while the Dimension 1
weight on the construct was most prominent ($\tilde{\beta}_{Q1, D1} = 0.919$, t-statistic = 6.82, and $\tilde{\beta}_{Q2, D1} = 0.917$, t-statistic = 6.74).

3.2.3. Structural equation model 2: Multiple-aspect (complex) construct

The second set of structural equation models involved indicators chosen to represent a broader concept than previously defined for each of the interpretation constructs. As mentioned previously, some indicators (namely, the number of people to whom participants would talk (NumTalk), the number of emotions they felt (NumEmotion), and the number of rules they would employ (NumRule)) were misspecified in the winter quarter of data collection. Thus, these variables were not included in modeling the winter quarter group.

Surface dimensions

The first model examined was the model that includes NumTalk as an indicator. In this model (multiple-aspect Personal-Professional construct 1), indicators were 1) the original Likert scale item (Personal), 2) NumTalk, 3) how likely they were to talk to others about the decision (Likely), and 4) how much they would be personally affected by the decision (Affected). The RMS for this model was much higher than in the previous multiple-format model for both groups ($RMS_{Q1} = 0.222$ and $RMS_{Q2} = 0.262$), indicating a poorer fit. The surface
dimensions accounted for only approximately 50% of the variance in this new Personal-Professional construct, as can be seen in Table 3.5. Factor loadings were expected to be lower for this model than for the previous model because each indicator addressed slightly different aspects of the construct. Three of the four indicator loadings are high (over .76), although the lowest loading was that of the original Likert scale item. This was a problem because there was a strong relationship between this item and Dimension 1. The resulting construct, in fact, was better predicted by Dimension 2 ($\tilde{\beta}_{q2,d2} = 0.862$, t-statistic = 2.86) or even Dimension 3 ($\tilde{\beta}_{q2,d3} = 0.494$, t-statistic = 1.48) than by Dimension 1 ($\tilde{\beta}_{q2,d1} = 0.111$, t-statistic = 0.32). Apparently, the construct no longer involved the personal-professional continuum but perhaps included aspects of importance or decision complexity.

A similar pattern resulted for the winter quarter group when only a subset of indicators (1, 3 and 4) was included in the model (multiple-aspect Personal-Professional model 2). Loadings of Likely and Affected were high (1.0 and 0.83, respectively) but that of the Likert scale item was low (0.32). Again, Dimensions $2$ ($\tilde{\beta}_{q1,d2} = 0.899$, t-statistic = 2.78) and $3$ ($\tilde{\beta}_{q1,d3} = 0.438$, t-statistic = 1.20) were more descriptive of this construct than was Dimension 1 ($\tilde{\beta}_{q1,d1} = 0.003$, t-statistic = 0.01). Similar to the multiple-aspect model 1, the overall fit was poor in terms of RMS (0.262), and only 46% of variance in the construct was accounted
for by the dimensions. However, the pattern of regression weights was more desirable in the spring quarter group when the multiple-aspect Personal-Professional model 2 was analyzed, as seen in Table 3.5. This was because the loading of the Likert scale item was higher (0.94) in this model than in model 1. The proportion of variance accounted for was 100% (which, of course, does not seem accurate). However, RMS was just as poor as in the winter quarter group's ($RMS_{01} = 0.262$). Overall, this conceptualization of the Personal-Professional construct did not seem to be related to Dimension 1.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
<th>RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>Personal-Professional 1</td>
<td>0.111</td>
<td>0.862</td>
<td>0.494</td>
<td>0.519</td>
<td>0.222</td>
</tr>
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<td>Winter</td>
<td>Personal-Professional 2</td>
<td>0.003</td>
<td>0.899</td>
<td>0.438</td>
<td>0.461</td>
<td>0.262</td>
</tr>
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<td>Spring</td>
<td>Personal-Professional 2</td>
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<td>0.067</td>
<td>1.000</td>
<td>0.263</td>
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<td>Winter</td>
<td>Importance</td>
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<td>0.131</td>
<td>0.411</td>
<td>0.097</td>
</tr>
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<td>Spring</td>
<td>Importance</td>
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<td>0.950</td>
<td>0.288</td>
<td>0.410</td>
<td>0.088</td>
</tr>
<tr>
<td>Winter</td>
<td>Complexity</td>
<td>0.056</td>
<td>0.971</td>
<td>0.233</td>
<td>0.615</td>
<td>0.060</td>
</tr>
<tr>
<td>Spring</td>
<td>Complexity</td>
<td>0.007</td>
<td>0.992</td>
<td>0.126</td>
<td>0.539</td>
<td>0.074</td>
</tr>
</tbody>
</table>

Table 3.5. Structural equation modeling results of multiple-aspect constructs on surface dimensions

The multiple-aspect model for the Importance construct included the following indicators in both quarter groups: 1) the original Likert scale item (Importance), 2) the amount of impact the decision would have in their lives (Impact), 3) how irreversible the result of the decision would be (Irreversible).
and 4) how much they cared about the outcome of the decision (Care). Fit of this model was at best fair. Although the RMS was smaller ($RMS_{q1} = 0.097$ and $RMS_{q2} = 0.088$) than that of the multiple-aspect Personal-Professional construct models, the proportion of variance accounted for in the construct was only .41. For both groups, factor loadings were moderate to high, ranging from 0.61 to 1.00. Both groups had the expected pattern of regression weights of the dimensions to the Importance construct, where the Dimension 2 weight was high ($\tilde{\beta}_{q1q2} = 0.971$, t-statistic = 3.19, and $\tilde{\beta}_{q2q2} = 0.950$, t-statistic = 2.18) and others low (see optimal weights in Table 3.5).

The question remains as to whether Dimension 3 has anything to do with decision complexity. An alternate construct for Complexity consisted of the following indicators: 1) the original Likert scale item (Complex), 2) the number of options available (Options), 3) the number of factors/attributes necessary to take into consideration (Factors), and 4) the degree of conflict they would experience (Conflict). As found in the regression and the multiple-format construct model, the dimensions explain a larger proportion of variance in this construct ($R^2_{Q1} = 0.62$ and $R^2_{Q2} = 0.54$) than in the Importance construct. The RMS was also better ($RMS_{Q1} = 0.060$ and $RMS_{Q2} = 0.074$) than the Importance construct, although it was much worse than its multiple-format counterpart. All of the indicators loaded highly on the construct for both groups (loadings ranging from
0.83 to 0.99). Unfortunately, even defined this way, Dimension 2 was more predictive of the construct ($\tilde{\beta}_{Q1,D2} = 0.971$, t-statistic = 4.75, and $\tilde{\beta}_{Q2,D2} = 0.992$, t-statistic = 4.28) than was Dimension 3 ($\tilde{\beta}_{Q1,D3} = 0.233$, t-statistic = 0.85 and $\tilde{\beta}_{Q1,D3} = 0.126$, t-statistic = 0.40) for both quarter groups.

**Process dimensions**

The first of the process dimensional models included the Duration construct defined by the following indicators: 1) the original Likert scale item (Duration), 2) the degree of difficulty in arriving at a satisfactory decision (Difficulty), 3) whether or not the decision maker would think about the consequences of choosing different alternatives (Consequence), and 4) the degree of elaborate thinking about the consequences (Elaborate). As with the previous construct model, the process dimensions accounted for a substantial proportion of variance in this Duration construct ($R^2_{Q1} = 0.97$ and $R^2_{Q2} = 0.93$). However, RMS was substantially worse ($RMS_{Q1} = 0.086$ and $RMS_{Q2} = 0.107$) than that of the previous Duration construct model. Factor loadings for this construct were high for both quarter groups, ranging from .83 to 1.00. Dimension 1 was an excellent predictor of the construct ($\tilde{\beta}_{Q1,D1} = 0.949$, t-statistic = 8.71, and $\tilde{\beta}_{Q2,D1} = 0.950$, t-
statistic = 8.60), whereas Dimension 2 contributed a small degree in prediction ($\tilde{\beta}_{Q1,D2} = 0.310$, t-statistic = 2.73 and $\tilde{\beta}_{Q2,D2} = 0.308$, t-statistic = 2.33).

The second process dimensional model included another problem item, NumEmotion, as one of the indicators. The Emotional Involvement construct in this model was defined by the following indicators: 1) the original Likert scale item (Emotion), 2) the number of emotions they would feel (calculated by adding checks made on the list of emotions; NumEmotion), 3) the degree of intensity of emotion they would feel (Intensity), and 4) how lasting the emotions would be (Endure). This model was fit only to the spring quarter group. Approximately the same proportion of variance in this Emotional Involvement construct was explained by the process dimensions ($R^2_{Q2} = 0.87$) as with the previous one. However, the RMS was larger (0.57). Factor loadings were generally high, although the loading for NumEmotion was not as high (.73) as others (.99 - 1.00). The pattern of regression weights was very similar to that of the previous models with an Emotional Involvement construct: Dimension 2 had a high regression weight ($\tilde{\beta}_{Q1,D2} = 0.824$, t-statistic = 4.68), and Dimension 1 had a moderate weight on the construct ($\tilde{\beta}_{Q1,D1} = 0.562$, t-statistic = 3.09). Subsequently, another model with the construct excluding NumEmotion was fitted in both quarter groups. Unlike the pattern of results in the Personal-Professional construct case, the pattern here remained the same for both groups: factor loadings were high and
the pattern of regression weights generally followed what was expected. The proportion of variance explained remained approximately the same, although the RMS dropped to the same value as that of the multiple-format construct model, as seen in Table 3.6.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>R²</th>
<th>RMS</th>
</tr>
</thead>
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<tr>
<td>Winter</td>
<td>Duration</td>
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<td>0.970</td>
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<tr>
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<td>0.933</td>
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<td>Emotional Involvement 1</td>
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<td>0.874</td>
<td>0.057</td>
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<td>Winter</td>
<td>Emotional Involvement 2</td>
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</tr>
<tr>
<td>Spring</td>
<td>Emotional Involvement 2</td>
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<td>0.824</td>
<td>0.065</td>
<td>0.874</td>
<td>0.020</td>
</tr>
<tr>
<td>Spring</td>
<td>Protocol</td>
<td>0.905</td>
<td>0.419</td>
<td>0.071</td>
<td>0.951</td>
<td>0.163</td>
</tr>
</tbody>
</table>

Table 3.6. Structural equation modeling results of multiple-aspect constructs on process dimensions

Finally, another Protocol construct was developed to determine whether this conceptualization of the construct would be suitable for the interpretation of Dimension 3. This construct included three indicators: 1) the original Likert scale item (Protocol), 2) the number of rules/principles that could be applied (NumRule), and 3) the frequency of encounters with similar situations (Frequency). Again, because NumRule was only available for the spring quarter group, the analysis was performed only on the second group. The result was disappointing. NumRule did not load highly on the Protocol construct (.22), although the other two indicators did (-.87 and .99). Furthermore, the Dimension
1 weight was high ($\tilde{\beta}_{q_2,d_1} = 0.905$, t-statistic = 6.23), the Dimension 2 weight was moderate ($\tilde{\beta}_{q_2,d_2} = 0.419$, t-statistic = 2.79), and the Dimension 3 weight was non-significant and small ($\tilde{\beta}_{q_2,d_3} = 0.071$, t-statistic = 0.77).

3.2.4. Multiple regression models of other variables

Additional variables, such as Valence (the decision as a positive/negative experience), Ambiguity (the degree of uncertainty involved), Financial risk, and Social risk were measured for each decision as possible interpretations of both surface and process dimensions. These items were collected only in the spring quarter group; thus, the result should be compared only to the results of other models applied to that group. Parameter estimates are expected to be less precise than in the winter quarter group due to the smaller sample contributing to the aggregated correlation matrix.

Surface dimensions

As can be seen in Table 3.7, Dimension 2 of the surface dimensions had high optimal weights on Valence, Ambiguity, and Social risk ($\tilde{\beta}_{Q_2,D_2,Valence} = 0.953$, t-statistics = 5.18; $\tilde{\beta}_{Q_2,D_2,Ambiguity} = 0.875$, t-statistics = 4.85; and $\tilde{\beta}_{Q_2,D_2,Social} = 0.878$, t-statistics = 4.85).
t-statistics = 2.08, respectively). However, a larger proportion of Ambiguity variance ($R^2_{Q2..Ambiguity} = 0.72$) was explained by the surface dimensions than that of the Importance or the Complexity constructs. Dimension 3, on the other hand, had a moderate influence on Financial risk ($	ilde{\beta}_{Q2..D3..Financial} = 0.706$). However, the dimensions accounted only for approximately 52% of variance in the Financial risk item.

### Optimal Regression Weights

<table>
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<tr>
<th>Quarter</th>
<th>Proposed Interpretation</th>
<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>Valence</td>
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<td>Social risk</td>
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<td>0.878</td>
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</table>

Table 3.7. Multiple regression results of miscellaneous item ratings on surface dimensions

### Process dimensions

The relationship between process dimensions and the variables examined here is displayed in Table 3.8, but can also be described simply. It appeared that Dimension 1 influenced all variables highly ($\tilde{\beta}_{Q2..D1..Valence} = 0.834$, t-statistic = 5.04; $\tilde{\beta}_{Q2..D1..Ambiguity} = 0.819$, t-statistic = 4.61; $\tilde{\beta}_{Q2..D1..Financial} = 0.911$, t-statistic = 3.76; and $\tilde{\beta}_{Q2..D1..Social} = 0.761$, t-statistic = 2.95). Three of the four variables also were
predicted moderately by Dimension 2 ($\tilde{\beta}_{Q2,D2,Valence} = 0.552$, t-statistic = 3.20; $\tilde{\beta}_{Q2,D1,Ambiguity} = 0.565$, t-statistic = 3.27; and $\tilde{\beta}_{Q2,D2,Social} = 0.639$, t-statistic = 2.36).

However, even the Financial risk item, which had the highest optimal weight, did not have fit ($R^2_{Q2,Financial} = 0.539$) as good as that of the single Duration item. Hence, none of these variables were considered appropriate interpretations of the process dimensions.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Proposed Interpretation</th>
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<th>Dim. 1</th>
<th>Dim. 2</th>
<th>Dim. 3</th>
<th>$R^2$</th>
</tr>
</thead>
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<tr>
<td>Spring</td>
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<td>0.834</td>
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<td>0.592</td>
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</tbody>
</table>

Table 3.8. Multiple regression results of miscellaneous item ratings on process dimensions

3.2.5. Comparisons of models

Without relying on any statistical tests, we can draw several conclusions regarding these models. First and foremost, although disappointing, it can be easily seen that there is no substantial difference between the one-item regression models and the multiple-format construct models. Generally, the multiple-format construct models were at best marginally superior to, if not exactly the same as, the multiple regression models in terms of fit and parameter estimates.
The multiple-aspect construct models, on the other hand, yielded mixed results. In some cases (i.e., Importance, Duration, and Emotion), they appeared to be just as good as the other construct models. However, in most cases, the overall fit of these models was substantially worse than that of the multiple-construct models. Others (e.g., Personal-Professional) were worse even in terms of parameter estimates (regressions weights and loadings).

Comparison of the hypothesized models to those regression models of "irrelevant" variables (variables that were anticipated not to influence the dimensions) led to an interesting finding. It appears that these variables are actually related mainly to one of the dimensions in each type of dimensional configuration (i.e., surface and process). For the process dimensions, the relationships of these items to Dimension 1 were weaker than the relationship of the Duration construct to Dimension 1, aside from exploring the relationship between these variables and the Duration construct itself. This suggested that Duration is still the most appropriate interpretation of Dimension available. However, for the surface dimensions, the possibility now exists that items such as Ambiguity are actually a better interpretation of Dimension 2. Furthermore, perhaps Financial risk is a concept that is more closely related to Dimension 3 than to complexity. These issues are open to empirical verification.
A few implications can be enumerated in light of the findings in Study 1. Most importantly, based on the above results, we can safely eliminate the possibility that measurement error was causing the attenuation of relationship between dimensions and their hypothesized interpretations. The multiple-format construct models were created solely for the purpose of removing potential measurement error. The results not only suggest that there is little measurement error involved in the attenuation of relationship but also that the reasons for attenuation are less obvious than anticipated. Research into other possibilities (e.g., the last dimension being a degenerate dimension) may be warranted.

The multiple-aspect construct models were generally worse, in terms of both overall fit and parameter estimates. However, this should not be interpreted as proof that the dimensions are not complex in meaning. As seen in the multiple-aspect models developed for the Personal-Professional construct, one item can easily prevent a factor from representing an appropriate underlying construct. Researchers should not be discouraged. Relatively solid relationships exist for some dimensions (e.g., Duration in the process dimensions), as these effects replicated in different samples. The challenge now is to further refine the factors already identified through further empirical tests.
Most of the current modeling efforts in the area of decision making have focused on the relationship between a decision strategy (or mode) and choice. Generally, a researcher starts from the discrepancy between an individual’s actual behavior and the predicted behavior from one of the traditional models (e.g., EU, SEU) and proposes a model that better captures the individual’s actual behavior. For example, Shafir, et al. (1993) posited that when facing a difficult choice, individuals do not normally attempt to estimate overall values of each option as in EU theory; instead, we tend to focus on reasons for and against each option and choose based on those reasons. They cleverly constructed studies that let them differentiate individuals who used the Reason-based mode from those who used EU-like calculations. The findings indicated that people tended to choose alternatives that are more in line with the Reason-based mode than with EU-like calculations, thus substantiating the claim that the choice of alternatives is dependent upon the decision strategy used.
Although the pattern of expected relationships between particular
decision strategies and choice alternatives for the decision examined can be
hypothesized due to the research conducted in support of the submodels (e.g.,
the Reason-based mode), two issues are yet to be explored. It has been assumed
that some decision strategies are more suitable for some type of decisions than
are others. For example, although there is evidence that, on average, people's
choices are more consistent with those predicted by the Reason-based mode than
with those predicted by the Expected Utility theory when decisions involve
conflict (Shafir et al., 1993), whether individuals actually use the Reason-based
mode and not a utility-based mode is unclear. It is more reasonable and perhaps
productive to examine whether multiple strategies are more suitable in some
decision situations than in others. The method described below addressed this
issue, while systematic relationships hypothesized by each submodel were also
tested simultaneously.

Secondly, even assuming that individuals do use different decision
strategies systematically, whether they are able to switch to different decision
strategies if they are told to do so is another issue that has a practical implication.
Individuals sometimes make wrong decisions (that would consistently make
those individuals dissatisfied with the decisions). If they do so due to choosing a
wrong decision strategy, then it would be beneficial for them to be directed to a
more appropriate decision strategy. The level of flexibility in switching decision strategies in this sense is an important factor to be examined.

4.1. Method

4.1.1. Sample

A sample of 143 college students in winter 1999 and another sample of 74 students in spring 1999 participated in Study 2 for credits in partial fulfillment of requirements for an introductory psychology course. Requirements for participation included fluency in English and sufficient familiarity with the Windows 95/98 environment. As mentioned earlier, the same students participated in Study 1 and this study.

4.1.2. Measures

Decisions used for these studies were selected from 50 fairly representative everyday decisions we assembled from a previously composed list. The details of the procedure were described in Study 1. Because Studies 1 and 2 were conducted simultaneously to allow for a realistic evaluation of decisions in Study 1, the same ten decision situations were used for both studies. As mentioned earlier, these decisions were chosen to maximize the differences among decisions on the dimensions obtained in the previous studies and to
allow differentiation of choice alternatives selected by differing decision strategies.

A decision strategy to be used, as mentioned, was already preselected by the experimenter in Study 2. Eight decision strategies were examined in this study; thus, eight condition groups were created. The eight decision strategies are submodels posited by researchers in the field, and which have received at least some support, as described in Chapter 2. They were: 1) the Multiattribute Utility theory (MAUT) (von Winterfeldt & Fischer, 1974), 2) the Elimination by Aspect (EBA) theory (Tversky, 1972), the Reason-based model (Shafir et al., 1993), the Story-based model (Pennington & Hastie, 1988), the Role-based model (March, 1994), the Principle-based model (Prelec & Herrnstein, 1994), the Affect-based model (Beach & Mitchell, 1987), and the Nondeliberative model (Ronis, Yates, & Kirscht, 1989).

The relevant measures elicited in this study were the choices participants made in each decision given the assigned decision strategies. Choices were made by typing the answers in a box, due to the fact that the choice set for each decision, particularly depending on individuals, was not always obvious. However, a coding scheme had to be devised for a quantitative analysis of these data and the development of choice set. The coding scheme is described in detail in Appendix D. The number of categories ranged from four to seven, depending on the variety of answers and the nature of the decision itself. The largest
number of categories was created for #18, the decision about choosing a graduate school. Its choice alternatives ranged from choosing the one that “feels right” for them to the one meeting multiple criteria (e.g., financial incentive, reputation of the school, and location). In general, more categories were necessary for decisions commonly thought to be more effortful and time consuming.

Two different types of process time were recorded in Study 2. The first type will be called response time. Response time refers to the time it took for a participant to make a decision. It was measured at two different time points. Both times started at the screen where each decision is first shown; however, one response time ended at the point when the participant began typing the answer (SubTime). The other response time ended at the point when the participant finished writing the choice alternative and the reasons for choosing the particular alternative (TotalTime). The second type will be called reaction time. Reaction time refers to the time it took for participants, for instance, in the Role-based strategy condition, to start typing the role(s) they used for a particular decision. The pop-up window opened as soon as the participants clicked on the Continue button in the main window in which they wrote down their choice alternatives for that decision situation (ReactionTime). It was hypothesized that, if participants indeed used the decision strategy assigned to them, this reaction time would be short because they had just made the decision using this strategy (and the role(s) in the case of the Role-based strategy condition). However, if
they did not (or somehow were not able to) use the assigned decision strategy, then they would have had to think about what to type in the window, and thus take longer to respond.

4.1.3. Procedures

To address the issues raised above, participants were asked to simulate making multiple decisions on a computer using a specific decision strategy for all decisions, as opposed to using a strategy that comes naturally for each decision situation. Due to time constraints, only 10 of the original 50 decisions were selected. For each decision, the computer presented a) the decision situation, b) a pull-down menu of choices to help participants make the decision if they would have sought help in the real situation (e.g., asking advice from a parent), and c) a pull-down menu of choices that allowed them to describe the process they used in making the decision. Instructions on navigating the computer interface were provided both verbally in a group and on the screen, so that each participant could internalize the instructions at his or her own individual pace. The first decision (#35) was used as a sample decision to facilitate familiarization with the program. Participants were also encouraged to perform well by being informed of the possibility of winning a gift certificate if they were rated the top 5% of “good” decision makers. They were told that one of the characteristics of good decision makers is how wisely they use their time to make decisions. They were
reminded that they had two hours to complete ten decisions, but usually the whole two hours were not necessary (on average, it took approximately 1.5 hours for a participant to finish the task); thus, they were able to spend more time on some decisions if they felt it would be beneficial to do so.

One of the eight decision strategies described in the instructions at the beginning of the experiment was randomly assigned to each participant. At the beginning of each decision situation, the participants were reminded of which strategy they were supposed to be using. When they made a choice, they were asked how they made each decision by writing down the process. This was done to enforce their use of the assigned decision strategy. While they were making each decision, participants' utilities for attributes of each choice alternative were also elicited in the MAUT-like and EBA decision strategy conditions to verify whether they indeed made the choice consistent with the assigned strategies. Similarly, a list of pros and cons for those in the Reason-based strategy condition, a role for the Role-based strategy condition, and a principle for the Principle-based strategy condition were respectively elicited for each decision. After making each decision, participants were then shown the outcome of the decision (i.e., consequences that were hypothesized to take place once their decision was made), which was assigned randomly from multiple plausible outcomes. This was done to make the decision situation more realistic and to motivate participants to respond to these decisions with a little more thought than they
may usually give to hypothetical situations with no consequences. Then they were asked in multiple ways whether the outcome was desirable. Prior to making these decisions, some demographic variables (e.g., age, gender, and religion) were measured. This information was relevant for coding choice alternatives (e.g., participants’ religious affiliations were used to determine whether they decided to stay with their original religion or to switch). Because participants made multiple decisions, the order of decisions was randomized and partially counterbalanced.

4.1.4. Data analysis

When associations among nominal variables are involved, as in the case with the relationship between decision strategy and choice, chi-square contingency tables were used to analyze the data. However, for most decisions, some choice alternatives were not frequently selected (or rather, a disproportionate number of participants picked one alternative over others). Hence, most contingency tables contained cells with inadequate expected frequencies. In order for the $\chi^2$ approximation to hold, no more than 20% of expected cell frequencies should be less than five (Tabachnick & Fidell, 1989). Although inadequate expected cell frequencies generally do not lead to increased Type I error, power can be drastically reduced. Milligan (1980), however, explains that in some cases inflation of Type I error occurs with the use of the
Pearson $\chi^2$ statistic but not with $G^2$, the likelihood ratio statistic. $G^2$ was used for the contingency table to evaluate the adequacy of the independence hypothesis in each decision situation.

Analyses concerning time measures were performed using analysis of variance, with Situation as a within-subjects factor and Decision Strategy condition as a between-subjects factor. For the response time measures, the order of decisions was counterbalanced. There were not enough participants to counterbalance the order for ReactionTime.

4.2. Results

4.2.1. Confirmation of submodel hypotheses: Suitability of different decision strategies

Relationship between decision strategy conditions and coded choices

It was hypothesized that, if the decision strategy manipulation worked, there could be different patterns of responses depending upon the decision strategy condition to which participants were assigned. This was examined by a series of $8 \times n$ (where $n$ is the number of response categories for each decision) chi-square analyses.

Decision #2: Decision regarding getting up (and going to class) on a weekday morning. This is the decision that is predicted to be made using very simplifying strategies such as the Affect-based strategy or Nondeliberative
strategy. There was no statistically significant difference in choice patterns depending on the decision strategy participants were assigned,

\[ G^2(21, N = 216) = 23.717, \ p = .307 \]

Approximately 75% of cells had expected cell frequencies less than five. This result was sensible because participants overwhelmingly chose to get up in the morning (coded as 0) no matter which strategy they were assigned, as displayed in Table 4.1.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>21</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>EBA</td>
<td>21</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Role-based</td>
<td>18</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Story-based</td>
<td>24</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>Reason-based</td>
<td>19</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Principle-based</td>
<td>19</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Affect-based</td>
<td>30</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>18</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>170</td>
<td>11</td>
<td>22</td>
<td>13</td>
<td>216</td>
</tr>
</tbody>
</table>

Table 4.1. Frequency table of decision strategy by choice in Decision #2

Decision #6: Decision regarding choosing between a job and graduate school. This decision was hypothesized to be more suitable for some sort of cost-benefit analysis, similar to MAUT-like or EBA (and perhaps Reason-based) strategy. The Story-based strategy could also be appropriate because the consequences of the decision unfold over time. There was no difference across
different decision strategy conditions in selecting choice alternatives,

\[ G^2(28, N = 213) = 23.192, p = .723, \] with 58\% of expected cell frequencies less than five. It appeared that more participants in most strategy conditions decided to go to graduate school (coded as 1) than to get a job (coded as 2), and this trend did not change across different decision strategy conditions, as can be seen in Table 4.2.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Choice Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>MAUT-like</td>
<td>5</td>
</tr>
<tr>
<td>EBA</td>
<td>2</td>
</tr>
<tr>
<td>Role-based</td>
<td>4</td>
</tr>
<tr>
<td>Story-based</td>
<td>5</td>
</tr>
<tr>
<td>Reason-based</td>
<td>3</td>
</tr>
<tr>
<td>Principle-based</td>
<td>2</td>
</tr>
<tr>
<td>Affect-based</td>
<td>6</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 4.2. Frequency table of decision strategy by choice in Decision #6

Decision #12: Decision regarding religious beliefs. Again, there was not an interaction between decision strategies and choice alternatives,

\[ G^2(21, N = 215) = 21.307, p = .440, \] with 41\% of expected cell frequencies less than five. This was one of the decisions included in the Nondeliberative category in
the previous sorting studies. Accordingly, it was thought to be decided using the Nondeliberative decision strategy (or perhaps the Principle-based strategy). The coded choice 1 was the most frequent answer (to stay with their own religion) and the other cells were substantially small for the Nondeliberative strategy, which is the anticipated pattern. Unfortunately, most participants also chose 1 regardless of the strategy conditions to which they were assigned.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Choice Alternative</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td></td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>EBA</td>
<td></td>
<td>9</td>
<td>12</td>
<td>5</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Role-based</td>
<td></td>
<td>4</td>
<td>11</td>
<td>8</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Story-based</td>
<td></td>
<td>5</td>
<td>19</td>
<td>8</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>Reason-based</td>
<td></td>
<td>1</td>
<td>14</td>
<td>7</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Principle-based</td>
<td></td>
<td>5</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Affect-based</td>
<td></td>
<td>10</td>
<td>15</td>
<td>11</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td></td>
<td>5</td>
<td>15</td>
<td>3</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>43</td>
<td>112</td>
<td>54</td>
<td>6</td>
<td>215</td>
</tr>
</tbody>
</table>

Table 4.3. Frequency table of decision strategy by choice in Decision #12

Decision #16: Decision regarding earning money for the next school year. The MAUT-like decision strategy and other more rational decision strategies were anticipated to be suitable for this decision. The alternative to consider more options than only getting a job or financial aid (coded as 5) was the most frequent answer (although closely followed by only looking at the
prestige of a school/program, coded as 1) for those who were assigned to use a
MAUT-like decision strategy. This is consistent with our hypothesis. However,
again, there was no dependence of decision strategy on the selection of choice
alternative, $G^2(35, N = 215) = 40.916, p = .227$, with 65% of expected cell
frequencies less than five.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>4</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>EBA</td>
<td>7</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>Role-based</td>
<td>4</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Story-based</td>
<td>2</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>Reason-based</td>
<td>6</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Principle-based</td>
<td>2</td>
<td>16</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Affect-based</td>
<td>5</td>
<td>20</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>36</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>109</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>63</td>
<td>215</td>
</tr>
</tbody>
</table>

Table 4.4. Frequency table of decision strategy by choice in Decision #16

**Decision #18: Decision regarding choosing a graduate school.** The
MAUT-like decision strategy and other more rational decision strategies were
anticipated to be again suitable. However, for this decision, the Story-based
strategy may also be suitable because the decision and the consequences of
choosing a school unfold over time. The most frequent response was to decide
on the school that has a good program/reputation (coded as 2), closely followed by deciding on the school with the most financial support (coded as 1). There was no difference in the response pattern among different decision strategy conditions, $G^2(42, N = 194) = 51.543$, $p = .148$, with 66% of expected cell frequencies less than five.

Table 4.5. Frequency table of decision strategy by choice in Decision #18

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>EBA</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Role-based</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Story-based</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>Reason-based</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Principle-based</td>
<td>0</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Affect-based</td>
<td>7</td>
<td>6</td>
<td>11</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>2</td>
<td>9</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29</td>
<td>52</td>
<td>55</td>
<td>41</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>194</td>
</tr>
</tbody>
</table>

Decision #26: Decision regarding buying an item at one's favorite store.

This is an example of impulsive buying; thus, we hoped strategies such as the Affect-based or Nondeliberative strategies would be suitable. The majority of participants decided not to buy the item (coded as 0), followed by deciding to buy the item (coded as 1). There was no statistically significant relationship
between decision strategy and choice, $G^2(28, N = 215) = 20.969$, $p = .827$, with 40% of cell frequencies less than five.

### Table 4.6. Frequency table of decision strategy by choice in Decision #26

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>10</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>EBA</td>
<td>8</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>Role-based</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Story-based</td>
<td>9</td>
<td>10</td>
<td>2</td>
<td>8</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Reason-based</td>
<td>7</td>
<td>9</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Principle-based</td>
<td>7</td>
<td>9</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Affect-based</td>
<td>8</td>
<td>14</td>
<td>1</td>
<td>11</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>74</td>
<td>11</td>
<td>53</td>
<td>14</td>
<td>215</td>
</tr>
</tbody>
</table>

Decision #28: Decision regarding going on a date with a stranger. The Story-based strategy or the Affect-based strategy was hypothesized to be suitable for this decision. The most frequent response was to go on a date (coded as 1), regardless of the assigned condition. However, it is interesting to note that more participants in the Story-based strategy chose 3 than participants in other strategy conditions, which was to decide to go on a date only if certain conditions are met (e.g., if other friends can go with them). However, choice alternatives were not statistically dependent on decision strategy conditions.
G^2 (35, N = 216) = 42.490, p = .180, with 75% of expected cell frequencies less than five.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Choice Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>MAUT-like</td>
<td>2</td>
</tr>
<tr>
<td>EBA</td>
<td>5</td>
</tr>
<tr>
<td>Role-based</td>
<td>2</td>
</tr>
<tr>
<td>Story-based</td>
<td>7</td>
</tr>
<tr>
<td>Reason-based</td>
<td>2</td>
</tr>
<tr>
<td>Principle-based</td>
<td>6</td>
</tr>
<tr>
<td>Affect-based</td>
<td>4</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 4.7. Frequency table of decision strategy by choice in Decision #28

Decision #34: Decision regarding when to get married. Again, the Story-based or the Affect-based strategy was considered to be the most suitable strategy to be used for this decision. The most popular response was what one would expect from using those strategies (deciding to get married when it feels right, coded as 1). The second popular response was also consistent – deciding to get married when it feels right for both people involved. However, there was no dependence between strategy selection and choice because these two choice alternatives were chosen more often, regardless of which strategy condition they
were in, $G^2(28, N = 201) = 26.335$, $p = .555$, with 60\% of expected cell frequencies less than five.

\begin{table}[h]
\centering
\begin{tabular}{lrrrrr}
\hline
Decision Strategy & 0 & 1 & 2 & 3 & 4 & Total \\
\hline
MAUT-like & 0 & 13 & 5 & 3 & 0 & 21 \\
EBA & 0 & 13 & 9 & 3 & 0 & 25 \\
Role-based & 0 & 12 & 7 & 2 & 0 & 21 \\
Story-based & 0 & 16 & 11 & 2 & 1 & 30 \\
Reason-based & 0 & 14 & 5 & 5 & 0 & 24 \\
Principle-based & 0 & 10 & 9 & 3 & 1 & 23 \\
Affect-based & 2 & 18 & 8 & 5 & 2 & 35 \\
Nondeliberative & 0 & 18 & 3 & 1 & 0 & 22 \\
Total & 2 & 114 & 57 & 24 & 4 & 201 \\
\hline
\end{tabular}
\caption{Table 4.8. Frequency table of decision strategy by choice in Decision #34}
\end{table}

Decision #45: Decision regarding driving home intoxicated. When individuals are intoxicated, one would expect that they would not use more effortful decision strategies. Thus, appropriate decision strategies for this decision would be the Nondeliberative, the Affect-based, or perhaps the Principle-based strategy. However, overwhelmingly, participants chose not to drive home, an expected response, regardless of assigned strategy condition. Hence, no dependence of choice on decision strategy was found, $G^2(21, N = 216) = 19.885$, $p = .529$, with 72\% of expected cell frequencies less than five.
<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Choice Alternative</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td></td>
<td>22</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>EBA</td>
<td></td>
<td>18</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Role-based</td>
<td></td>
<td>18</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Story-based</td>
<td></td>
<td>27</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>Reason-based</td>
<td></td>
<td>19</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Principle-based</td>
<td></td>
<td>17</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Affect-based</td>
<td></td>
<td>31</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td></td>
<td>21</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>173</td>
<td>32</td>
<td>10</td>
<td>1</td>
<td>216</td>
</tr>
</tbody>
</table>

Table 4.9. Frequency table of decision strategy by choice in Decision #45

Response total time for the decision strategies

Because it is likely that the order in which participants encountered the decision situations influenced response time (due to fatigue, practice effect, or shortage of time in the end), order was included as a factor in the analysis of variance with Situation as a within-subject factor and Decision Strategy as a between-subject factor. There was no order effect. However, there was a statistically significant interaction between Situation and Order, $F(8,880) = 34.777, p = 0.001, \eta^2 = .240$. The explanation is simple. Participants in general spent less and less time deliberating on decisions as they encountered more situations. Hence, the linear effect was statistically significant when situations were ordered in which the first order group encountered them,
This can be seen in Figure 4.1. There was also a marginally significant interaction between Order and Decision Strategy, $F(1, 110) = 2.105, p = 0.049, \hat{\eta}^2 = 0.118$. Post hoc comparisons revealed that the effect was mostly due to the time spent by the group assigned to the Story-based decision strategy, $F(1, 110) = 4.386, p = 0.039, \hat{\eta}^2 = 0.038$. The first order group spent more time on making decisions using this strategy than the second order group (mean ($\bar{Y}_1 - \bar{Y}_2$) = 29.439). This also is sensible because the first group encountered simpler decisions earlier (e.g., whether to get up in the morning) whereas the second group encountered more difficult decisions earlier (e.g., when to get married). Perhaps individuals are more flexible in the amount they can elaborate in imagining what it would be like (the process involved in the Story-based strategy) than other decision processes, such as cost-benefit evaluations.

It is assumed that time taken to make a decision was different depending on the strategy one was assigned to use. For example, Payne, Bettman, and Johnson (1993) found that people systematically switched decision strategies depending on how much time is available to them. In this study, however, the strategy to which participants were assigned had only a marginal effect on the response time, $F(7, 110) = 2.082, p = 0.051, \hat{\eta}^2 = 0.117$. 

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There was an effect of Situation, as expected, $F(8,880) = 5.215, p = 0.001, \eta^2 = 0.045$, although the effect size was much smaller than that of the interaction term with Order. This implies, despite the counterbalancing, that participants spent more time making some decisions than they did others. Post hoc comparisons showed that they spent much more time deliberating on difficult decisions than easier ones. This can be seen in Figure 4.2.

Figure 4.1. Mean response TotalTime across situation for two order groups.
Unexpectedly, there was no statistically significant effect of interaction between Decision Strategy and Situation, $F(56,880) = 1.174$, $p = 0.184$, $\eta^2 = 0.070$. However, the effect size for the interaction was larger than that for the main effect of Situation.
Response SubTime for the decision strategies

Even though TotalTime results provide some indication of how participants actually responded to these decisions, it is not the best measure. TotalTime is the amount of time they took in completing the explanation of how they made each decision. More accurate information on how long it took them to make each decision can be obtained by examining the Response Subtime, which is the time it took for a participant to start typing their choices. Encouragingly, the effects found in TotalTime essentially remained. There was still no order effect. The interaction between Order and Situation still existed, 

\[ F(8, 872) = 12.968, \ p = 0.001, \ \eta^2 = 0.114, \]

although effects are much smaller in that the statistical difference between two order groups were found only in the first situation.

The effect of Situation still remained, \( F(8, 872) = 5.022, \ p = 0.001, \ \eta^2 = 0.044 \). However, with this definition of response time, a decision regarding going on a date with a stranger (#28) took as long to decide as a decision regarding choosing graduate school (#18).

Both effects of Decision Strategy and the interaction between Order and Decision Strategy decreased, \( F(7, 109) = 1.611, \ p = 0.140, \ \eta^2 = 0.094 \),

\( F(7, 109) = 1.934, \ p = 0.071, \ \eta^2 = 0.110 \). The Decision Strategy by Situation interaction remained statistically non-significant with reduced effect size.
\( F(56,872) = 0.958, p = 0.563, \) although the effect size still remained larger than that of the main effect of Situation \( (\hat{\eta}^2 = 0.056) \).

4.2.2. Violations of assigned decision strategies

Reaction time on five decision strategies

Reaction time, as mentioned, is the time it takes for participants to react to the pop-up window after they made their decisions. Reaction time was collected only for a subset of one order group, partly due to the nature of the task (there was no need to explain certain decision strategies such as the Affect-based strategy). In the MAUT-like, the EBA, the Role-based, the Principle-based, and the Reason-based strategy conditions, participants were asked either to evaluate attributes that were important in making each decision or to write down the relevant pieces of information they used to make each decision (e.g., roles employed, pros and cons). It was assumed that if they did not use the strategy they were told to use, asking them to provide these materials relevant to the particular type of strategy would make them have to pause and think about what they would say. On the other hand, if they indeed used the assigned strategy, relevant information should be very accessible.

Thus, this reaction time was examined for five strategy condition groups \((N = 45)\). Note that the order in which situations were encountered is not counterbalanced, so the results of this portion should be interpreted cautiously.
Because of a small sample size, MAUT-like and EBA groups were collapsed for the subsequent analysis because they were statistically indistinguishable from each other on the reaction time measure. As in other time measures, the main effect of Situation was statistically significant, $F(8,328) = 3.956, p = 0.001$, $\eta^2 = 0.088$. There was a trend for a gradual increase in the reaction time as they encountered more situations until they encountered the sixth decision; then the mean of the reaction time increased by over four seconds at the sixth decision, and it decreased at the eighth decision. This can be seen in Figure 4.3. Post hoc comparisons revealed that the only statistically significant difference was found between #16 (deciding how to fund their schooling for the next year) and Decision #45 (whether to drive home drunk), $(\bar{Y}_{16} - \bar{Y}_{45}) = 8.832 (2.56), p = 0.047$ with a Bonferroni adjustment.

This time, the main effect of Decision Strategy was also statistically significant, $F(3,41) = 9.802, p = 0.001, \eta^2 = 0.418$. The MAUT/EBA decision strategy produced the lowest reaction time, and the other three (Role-based, Principle-based, and Reason-based) were not statistically distinguishable from each other on average, as can be seen in Figure 4.4.

There was a marginally significant interaction between Decision Strategies and Situations, as before, $F(24,328) = 1.354, p = 0.127, \eta^2 = 0.090$, although, again, its effect size is larger than that for Situation. Interestingly, even with a
Figure 4.3. Mean Reaction Time across situations.
Bonferroni adjustment, several post hoc comparisons were statistically significant. Namely, the reaction time of participants who were assigned to the Reason-based strategy took much longer to start listing the pros and cons than participants in all other strategy conditions in deciding how to earn money for school for the next year (#16) and in deciding to drive home drunk (#45). These and other, less interesting, differences with the MAUT/EBA strategies can be examined in Figure 4.5. These results suggest that the Reason-based strategy is perhaps not one of the suitable strategies to use in Decision #16 and #45. It is
important to note that more critical comparisons came from examining differences among non-MAUT/EBA reaction times because in the MAUT/EBA conditions, participants did not need to think hard in order to start typing in the pop-up window even if they did not use the assigned strategies. The MAUT/EBA windows first elicited the ranking of attributes that are prespecified. Hence, it is also not a concern that these reaction times were fastest although the MAUT/EBA strategies were considered to be more effortful decision strategies.
Figure 4.5. Mean ReactionTime across situations for four decision strategy groups.
4.3. Discussion

Although this must be said with caution, there appeared to be some evidence from the reaction time measures that people violated instructions to follow their assigned strategies. This implies that some decision strategies may not be as suitable for some decision situations as for others, and that individuals may therefore have a difficult time using those strategies. Furthermore, the fact that there was only a marginal effect of the manipulated Decision Strategy condition on the response time measures suggests that perhaps participants ignored the instructions altogether and used whatever strategy came naturally for each decision situation.

Despite this, our results do not imply that only one decision strategy is more suitable than the others for a particular situation. As a matter of fact, the reaction time of simpler decision strategies such as the Role-based and the Principle-based strategies staying relatively constant across decisions could be an indication that individuals are more able to adopt a simpler strategy, but not necessarily a more effortful one, across a range of decision situations. This could be an area for further research. In addition, it could easily be the case that multiple strategies are suitable to a degree, and that the choice is made by an individual who prefers one strategy over the others. This suggests that

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4 Of course, another explanation exists in that the response time has nothing to do with decision strategies used. However, such an explanation will go against the findings of Payne, et al. (1993), as well as the assumption made about reaction times in many cognitive psychology experiments.
individual differences variables are going to be critical in narrowing down the choices of strategies to implement.

Lack of significant results in the relationship between decision strategy conditions and chosen alternatives in some ways is not surprising. An example may aid in illustrating the problem. One of the decision situations (#2) has to do with getting up on a weekday morning. As mentioned, the typical response was, “Yes, I would get up.” What an outside observer does not know is whether the participants said so because they thought about the alternatives (getting up or sleeping in), evaluated the pros and cons associated with each and decided to get up, or they simply, out of habit, “decided” to get up. Unlike the clever experiments devised by Shafir, et al. (1993), the open-ended answers did not differentiate people who used one strategy versus another. Therefore, a multiple-choice item was created for each decision situation with differing degrees of effortfulness to address this problem in Study 3.
CHAPTER 5

STUDY 3: META-MODEL OF DECISION STRATEGY SELECTION

The whole meta-model was tested in Study 3. The relationship between
decision dimensions and decision strategy selection was examined, as well as the
relationship between decision strategy selection and choice in a natural setting
(i.e., in the absence of experimental manipulation). Because of the possible
incongruity between behavior and behavior intentions, participants simulated
making these decisions on a computer to elicit realistic responses as they did in
Study 2. In addition, they evaluated the relevant decision characteristics found
in Study 1.

5.1. Phase 1: From decision dimensions to decision strategy selection

The findings from previous studies (particularly, Study 2 in Tada and
Weber (1999) in which participants were asked to sort decisions in terms of how
they make these decisions) suggest that individuals make decisions differently
depending on characteristics of the decisions along the dimensions obtained
from multidimensional scaling of decision mode similarity in these studies. If people utilize a range of decision strategies to make a decision, it is reasonable to assume that their choice of decision strategy depends on a small number of decision dimensions. There may be a prototypical decision that leads to each type of decision strategy in a particular location in the decision space. Decisions that are in close proximity to the prototypical decision would then lead to the same decision strategy. For instance, if the decision problem successfully matches the prototype that tends to employ the MAUT-like decision strategy (say, a monetary decision), one’s choice should be consistent with the choice alternative that maximizes the overall utility. Similarly, if the decision problem successfully matches the schema that tends to employ the Role-based strategy (say, whether to feed one’s own hungry child), one’s choice should be consistent with the role that is most salient in that context. It is thus hypothesized that a certain combination of dimension values (which correspond to a certain segment of decision space) will lead to a choice of a particular decision strategy (or strategies).

5.2. Phase 2: From decision strategy selection to choice

This study also tested the relationship between the selection of decision strategy and the subsequent choice of alternatives because the experimental paradigm made it natural to elicit the course of action (i.e., chosen alternative) in
the course of making each decision. The same 10 decisions as those used in the
previous studies were again selected. It was hypothesized that some choice
alternatives make sense if one is using a particular decision strategy, while others
do not (e.g., it makes sense for someone who uses the Role-based mode and is a
devout Catholic to choose to keep a child, although she may assign higher utility
to abortion if a MAUT-like calculation were conducted).

According to the theories of Epstein (1994) and Fiske & Pavelchak (1986),
certain decision strategies should take longer than others to produce a decision.
For example, decision strategies that are category-based and do not require much
cognitive effort (e.g., the Nondeliberative decision strategy) should be reached
much more quickly than those that are piecemeal and require substantial
cognitive effort (e.g., the Story-based decision strategy). This was tested by
measuring how long it took (response time) for each decision maker to actually
arrive at a solution for each decision problem.

5.3. Method

5.3.1. Sample

One hundred seventy-three college students participated in this study for
credits in partial fulfillment of requirements for an introductory psychology
course. Requirements for participation included fluency in English and sufficient
familiarity with the Windows 95/98 environment.
5.3.2. Procedures

As in Study 2, participants simulated making multiple decisions on a computer. The same set of decisions was used as in Studies 1 and 2. The procedure was the same as in Study 2, as well, with one exception. Participants used whichever decision strategy came naturally to them. In addition to verbally describing their choices and how they made their decisions, they were asked to choose the decision strategy they had used from a list. The computer interface was set so that multiple strategies could be selected. However, in such a case, participants also had to rank order the selected strategies. They were also asked to select the choice that best described their decision from a multiple-choice box that included five to six choices for each decision. After selecting the strategies and a choice alternative, participants saw a pop-up window for utilities and weights if they had rank ordered the MAUT-like or the EBA decision strategy as the primary strategy. Similarly, a pop-up window opened for listing the pros and cons if they had rank ordered the Reason-based strategy as first, for typing the role(s) if they had rank ordered the Role-based strategy as first, and for typing the principle(s) if they had rank ordered the Principle-based strategy as first. As in Study 2, participants were encouraged to perform well by being informed of the possibility of winning a gift certificate if they were rated among the top 5% of “good” decision makers. As before, they were told that one of the
characteristics of good decision makers was how wisely they use their time to
make decisions. They were told that they had two hours to complete ten
decisions; however, they were informed that, on average, it took approximately
1.5 hours for a participant to complete the task. Hence, they were able to spend
more time on some decisions if they felt it was beneficial to do so.

Prior to making these decisions, some demographic and relevant
individual differences variables were measured, in the anticipation of individual
differences in the decision strategy selection. Descriptions of these variables can
be found in the next section. Because participants made multiple decisions, the
order of decisions was randomized and counterbalanced.

5.3.3. Measures

Decisions used for Study 3 were the same ones selected from the original
50 decisions in Studies 1 and 2. In Study 3, the decision strategy selection was
determined by which strategy participants reported using by checking the
appropriate box out of a list of strategies after they had made each decision.
They were provided with descriptions of the eight decision strategies at the
beginning of the experiment, and a brief description was also given for each
strategy at the time of their selection. The window was programmed to allow
participants to choose multiple selections (with rank ordering) if they wished. It
was also possible for them to type in their own strategy if none of the
descriptions matched what they used. Multiple-choice selections were verified by examining their verbal reports.

Due to the findings in Study 2 of the relationship between decision strategies and choice alternatives, a multiple-choice item was created in addition to an open-ended item to access the choice alternative participants selected for each decision situation. On average, five choice alternatives were included in the item, generally ranging from an answer based on affect (e.g., “Would drive home because I feel fine”) to one that was more rational (e.g., “Would drive home because I thought about how unlikely bad things (e.g., accident) can happen”). The complete set of alternatives can be found in Appendix E.

Individual differences measures were also obtained because, as was explained in Study 2, it is quite feasible for an individual to favor some decision strategies over others. By measuring some individual characteristics, we hope to more accurately describe the decision strategy selection process, especially when several strategies are suitable for making the same decision. Three general categories of individual differences measures were obtained: 1) a scale assessing an individual’s tendency to engage in and enjoy thinking (Need for Cognition Scale, short form, Cacioppo, Petty, & Kao, 1984); 2) a scale measuring rational and experiential processing modes proposed by Cognitive-Experiential Self-Theory (Rational-Experiential Inventory, Short Form, Epstein, Norris, & Pacini, 1996); and 3) two scales together measuring aspects of desires to reach a decision
The logic behind including these specific scales is straightforward. The Need for Cognition Scale (NCS) is intended to measure “[individuals’] need to understand and make reasonable the experiential world” (Cohen, 1955, p. 291) and includes items such as “I find satisfaction in deliberating hard and for long hours,” and “I usually end up deliberating about issues even when they do not affect me personally.” Such an individual disposition can influence people’s decision processes in a specific way: people with high need for cognition tend to think about each decision more carefully and analytically than those with low need for cognition, thus, they may prefer decision strategies that are more analytical and rational in nature to those that are based on intuition. The Rational-Experiential Inventory, Short Form (REI-S) measures individual differences in two independent processing modes (Epstein, 1994) discussed in Chapters 1 and 2. The two scales can thus be related to our meta-model readily. The rational scale includes items such as “I have a logical mind,” and “I am much better at figuring things out logically than most people,” and should have the same pattern of relationships as the NCS in that people who make greater use of the rational mode are expected to use more rational decision strategies. Those who make greater use of the experiential mode (i.e., those with high scores on the experiential scale), on the other hand, would prefer to use more intuitive
decision strategies. Items in the experiential scale are such as “When it comes to trusting people, I can usually rely on my gut feelings,” and “I like to rely on my intuitive impressions.”

The Personal Need for Structure Scale (PNS) and the Personal Fear of Invalidity Scale (PFI) are scales developed specifically to capture several aspects of the desire for simple structure and several aspects of the reluctance to commit oneself to a given, potentially invalid decision, respectively. The PNS is composed of items such as “I enjoy having a clear and structured mode of life,” and “I don't like situations that are uncertain,” whereas “Sometimes I become impatient over my indecisiveness,” and “I wish I didn't worry so much about making errors,” are examples of items in the PFI. Hence, people with high PNS scores are expected to prefer decision strategies that are structured (e.g., MAUT). Moskowitz (1993) found that the level of PNS influences the extent to which people engage in the categorization process. More categorization occurs with people with higher scores on PNS. Stereotypical statements were endorsed by judges with higher PNS scores in Weinberg (1999), supporting Moskowitz’s finding. It is, therefore, also possible for high PNS scorers to use the Role-based or the Principle-based strategies that are based on categorization. Those who score highly on PFI may prefer the use of strategies that are justifiable to others.
5.3.4. Data Analysis

Structural equation modeling was used in Study 3. Two models created for each decision are described in Figures 5.1 and 5.2. The first model included the relationship between (process) decision situation characteristics and decision strategies. Because our primary hypothesis was that these situational characteristics influence which decision strategy was chosen, this was the natural choice of a starting model (model 1). However, as mentioned earlier, individual characteristics were expected to influence decision strategy selection. Thus, the individual measures such as the Need for Cognition Scale and the Experiential scale from Epstein’s Rational-Experiential Inventory were added to model 1 to create model 2.

Psychological decision dimensions

Prior to modeling the relationship between decision dimensions and decision strategy selection, issues of dimensional representations must be considered. We have concluded from Study 1 that the multiple-format construct models worked best generally. With this in mind, the multiple-format constructs were used to represent the relevant psychological dimensions. However, when this representation is used, the dimensional constructs constitute the form of a multitrait-multimethod (MTMM) matrix (Campbell & Fiske, 1959), in which case
Figure 5.1. Structural equation model 1: Relationship between situational characteristics and decision strategy selection.
Figure 5.2. Structural equation model 2: Inclusion of individual characteristics to the relationship between situational characteristics and decision strategy selection
traits correspond to the three dimensions and methods correspond to the three different formats.

There are three general methods of analyzing a MTMM matrix (Kenny, 1999). The standard confirmatory factor analysis (CFA) model can be used to have each measure load on its trait and method factors. Usually, the trait factors are correlated among themselves, as well as the method factors. However, trait factors are assumed to be independent from method factors. At least three traits and three methods are required for the model to be identified. Even when three traits and methods are available, the standard CFA model is not identified when the loadings for each factor are exactly equal or when there is no discriminant validity between two or more factors (Kenny, 1999). Although actual data never exactly satisfy the above conditions, boundary parameter estimates and convergence problems are quite often encountered during estimation. Thus, this model was not used to model our dimensional constructs.

The second method is called the correlated uniqueness model. In this model, there are no method factors. Instead, measures that share a common method have correlated errors or uniqueness. For this model to be identified, there must be at least two traits and three methods. This model does not have the difficulties associated with the standard CFA model.
The third method is the direct product model, which is sometimes referred to as the multiplicative model (Browne, 1984). In this model, the same trait measured by dissimilar methods should have a correlation of zero because the correlation between measures is the product of the similarity between methods as well as between traits. One of the advantages of this method over the correlated uniqueness method is that it estimates a correlation matrix for the methods, thus allowing for examination of the similarity between different methods (i.e., an examination of discriminant validity of the methods is possible). However, it is difficult to set up and interpret (Kenny, 1999). Because discriminant validity of the methods is not a crucial aspect of this study, the correlated uniqueness method was used for the dimensional constructs.

**Individual differences measures**

Representing individual differences measures posed another problem. Individual differences scales usually contain many items because the goal of the scales is to assess one or multiple underlying individual characteristics as accurately as possible. However, because each item is usually not highly reliable, a factor analysis of a scale with individual items as indicators generally does not result in a satisfactory solution. To remedy this predicament, parceling (simply summing multiple items) can be performed to increase reliability of indicators.
Kishton and Widaman (1994) described two different methods of parceling. One method involved randomly assigning each item into one of several internally consistent, unidimensional parcels for the particular construct. This was a useful method to construct parcels for the NCS (Cacioppo et al., 1984) and the PFI (Thompson et al., 1989). Six parcels, each consisting of three items, were constructed for the NCS, and four parcels (two three-item parcels and two four-item parcels) were constructed for the PFI.

On the other hand, the second method was used for creating domain representative parcels of the REI-S (Epstein et al., 1996). Epstein (1990) hypothesized that there are two relatively independent constructs, Rational and Experiential modes. Each construct is composed of two related dimensions (ability and preference). Three parcels were constructed for each construct, with two ability items and two preference items so that each parcel was equally representative of two dimensions in the Rational and Experiential domains.

The Personal Need for Structure Scale (Thompson et al., 1989) was composed of two factors: the desire for structure and the response to lack of structure. Two items each were randomly assigned to a parcel, creating two parcels for the first factor and four parcels for the second factor. A CFA was conducted on the resulting parcels, and it was found that two factors were moderately correlated with each other ($\hat{\phi}_{F1,F2} = 0.724 (0.060)$). If they are meant to
measure different aspects of the same construct (as the names suggest), it may be
more desirable to represent them as one factor with domain representative
parcels, as for the Rational-Experiential Inventory. Thus, four three-item parcels
were created, in each of which one item came from the desire for structure
dimension and the other two from the response to lack of structure dimension.
This factor representation was used for the PNS.

5.4. Results
5.4.1. Relationship between decision dimensions and decision strategy selection:
Structural equation models

No order effects were found on any of the decision strategies (highest Cox
& Snell $R^2 = 0.058$, $\chi^2(2, N = 172) = 10.366, p = .006$ for omnibus test of logistic
regression with two dummy order variable as predictors on the EBA decision
strategy). Alpha was adjusted to 0.0056 using the Bonferroni adjustment ($0.05/9
= 0.0056$). Thus, the whole sample was used for the subsequent analyses.

In structural equation modeling, parameter estimates are obtained by
minimizing a discrepancy function, $F(S, \Sigma)$. Researchers customarily use
maximum likelihood (ML) estimation by assuming the multivariate normal
distributions of the variables. The models examined below, however, contained
dichotomous variables as endogenous variables (i.e., decision strategies that are
either used or not used) and, thus, violated the multivariate normality assumption. The ordinary least squares (OLS) discrepancy function does not make this assumption, although this estimation method does not provide any tests of overall fit or tests of parameter estimates because of its lack of distributional assumptions. All models were examined using OLS and ML estimation. Because parameter estimates for one model usually differed only in the second decimal place, the ML parameter estimates and goodness of fit measures are reported below.

**Structural equation model 1: Decision space to decision strategy selection**

Because the primary hypothesis of the meta-model is that decision strategy selection can be predicted from characteristics of decision situations, the first set of models included only situational characteristics and decision strategies. Although both surface and process characteristics were included in Study 1, the basic modeling interest was the relationship between process dimensions and decision strategy selection. Process dimensions were obtained by specifically asking participants to sort the decisions by the way they made these decisions. If any situational characteristics were to influence decision strategy selection, these must, more so than surface dimensions because these dimensions are obtained to represent factors that directly influence how people make decisions. Hence, at this initial stage of implementing the meta-model,
only process dimensions were used as situational characteristics. Once successful, future modeling efforts should involve examining the roles of surface dimensions.

Process dimensions. Due to a high correlation between the Duration construct and the Protocol construct, most models did not provide interpretable parameter estimates (i.e., they resulted in having redundant parameters) when all three constructs were entered. Because the Protocol construct was found in Study 1 not to be very descriptive of Dimension 3, it was dropped from the subsequent models. Figures 5.2 to 5.11 show path diagrams of model 1 for all nine decision situations.

Decision #2: Decision regarding getting up (and going to class) on a weekday morning. Overall fit of this model was reasonable, \( \chi^2(91, N = 168) = 177.01, p = 0.001, \text{RMSEA} = 0.075 \) with a 90% confidence interval ranging from reasonable to mediocre fit, \((0.059, 0.092)\). This model specified the Duration and the Emotional Involvement constructs to influence only two of the eight decision strategies: the Affect-based and the Nondeliberative strategies. Other strategies were included in the model but were hypothesized not to be influenced by the constructs (i.e., to have loadings of zero). As expected from
Study 1, both dimensional constructs had high loadings on all indicators (the lowest being .74). Only one of the regression paths was of a large enough magnitude to reach statistical significance. The Duration construct influenced

![Figure 5.3. Structural equation model 1 for Decision #2](image-url)
negatively the use of the Nondeliberative decision strategy,
\[ \hat{\beta}_{\text{Duration, Nondeliberative}} = -0.210 (0.094), \text{t-statistic} = -2.23. \]
This indicates that when participants thought it would take longer to make this decision, they tended not to use the Nondeliberative strategy.

Decision #6: Decision regarding choosing between a job and graduate school.

Overall fit of this model was again reasonable, \( \chi^2(85, N = 172) = 171.00, \) RMSEA = 0.074 with a 90\% confidence interval of (0.056,0.090). In this model, use of all of the more effortful decision strategies was hypothesized and tested: the MAUT-like, EBA, Story-based, and Reason-based strategies. It was also feasible for individuals to use the Affect-based strategy as well in this situation (they could be thinking that, "I am sick of school. I just wanted to get out of school and make money."); thus, it was also included in the model. As with Decision #2, both dimensional constructs had high loadings on all indicators (absolute value ranging from 0.84 to 0.96). The effects of the Duration construct on the MAUT-like and the Reason-based decision strategies were positive,
\[ \hat{\beta}_{\text{Duration, MAUT}} = 0.237 (0.080), \text{t-statistic} = 2.97, \text{and} \quad \hat{\beta}_{\text{Duration, Reason}} = 0.253 (0.079), \text{t-statistic} = 3.20. \]
Although they did not reach statistical significance, the direction of the influence of this construct on the other effortful strategies was positive, as can be seen in Figure 5.4. However, the same construct had a
Figure 5.4. Structural equation model 1 for Decision #6
negative impact on the Affect-based strategy, \( \hat{\beta}_{\text{Duration.Affect}} = -0.236 (0.079) \), t-statistic = -2.99. These results suggest what was expected: if individuals believed that this decision would take a long time to make, they tended to use the MAUT-like or Reason-based strategy; however, if they did not, it was more likely that the Affect-based strategy was used. In this model, there was an effect of Emotional Involvement as well. This construct influenced the Affect-based strategy, \( \hat{\beta}_{\text{Emotion.Affect}} = 0.288 (0.077) \), t-statistic = 3.75, implying that when individuals believed this was an emotionally involved decision, they were more likely to use the Affect-based strategy. Furthermore, it is interesting to note that there was no influence of the Emotional Involvement construct on the MAUT-like strategy or the Reason-based strategy – strategies that are thought to be more rational.

**Decision #12: Decision regarding religious beliefs.** This model fit the data rather well, \( \chi^2(89, N = 170) = 141.179, p = 0.001 \), RMSEA = 0.059 with a 90% confidence interval of (0.040,0.077). It was hypothesized that participants would make use of the Principle-based, the Affect-based, and the Nondeliberative decision strategies. The two situational constructs were very well represented by their respective indicators, suggested by loadings ranging from 0.91 to 0.96. The Duration construct influenced the Nondeliberate decision strategy negatively,
Figure 5.5. Structural equation model 1 for Decision #12
\( \hat{\beta}_{\text{Duration, Nondelib}} = -0.350 \pm 0.073 \), t-statistic = -4.79. The direction of the Duration effect was similar with the Affect-based strategy, although not quite reaching statistical significance. As seen in Decision #6, there was a positive influence of the Emotional Involvement construct on the selection of the Affect-based strategy, \( \hat{\beta}_{\text{Emotion, Affect}} = 0.230 \pm 0.079 \), t-statistic = 2.92.

Decision #16: Decision regarding earning money for the next school year. The fit of this model was reasonable, \( \chi^2(89, N=169) = 166.88, p = 0.001 \). RMSEA = 0.072 with a 90% confidence interval of \((0.055,0.089)\). The two dimensional factor structures were good, with factor loadings ranging from 0.86 to 0.94. Monetary decisions like this were presumed to be made by using the MAUT-like strategy. The other two strategies, EBA and Reason-based, were included in the model because of their similarity to the MAUT-like strategy. As predicted, there was a positive relationship between the Duration construct and the use of the MAUT-like decision strategy, \( \hat{\beta}_{\text{Duration, MAUT}} = 0.224 \pm 0.091 \), t-statistic = 2.46, suggesting that the MAUT-like strategy tended to be employed when participants thought this decision would take a long time. The trend for a positive relationship between the Duration construct and the other strategies was present, although they did not reach statistical significance. Virtually no effect of the Emotional Involvement construct was present, although there was
Figure 5.6. Structural equation model 1 for Decision #16
a tendency toward a negative relationship with the Reason-based strategy.

**Decision #18: Decision regarding choosing a graduate school.** The fit of this model to data was reasonable, $\chi^2(87, N = 168) = 140.422$. $p = 0.001$, RMSEA = 0.061 with a 90% confidence interval of (0.041, 0.079). Factor loadings for the two dimensional constructs were high, ranging from 0.82 to 0.93. This model included more “rational” decision strategies, such as MAUT-like, EBA, and Reason-based. Also, because it is a decision that unfolds over time (and decision makers may not have all the relevant information), the Story-based strategy was included. However, the only statistically significant relationship between the two constructs and these strategies was a positive influence of the Duration construct on the use of the Reason-based strategy, $\hat{\beta}_{\text{Duration}, \text{Reason}} = 0.205(0.085)$, $t$-statistic = 2.44.

**Decision #26: Decision regarding buying an item at one’s favorite store.** The fit of this model was reasonable, $\chi^2(87, N = 171) = 173.27$. $p = 0.001$, RMSEA=0.076 with a 90% confidence interval of (0.060, 0.093). A wider range of factor loadings ranging from 0.76 to 0.98 was found for the dimensional constructs in this model. All of the more simplifying decision strategies were included because this
decision most resembled a case of an impulsive purchase. Thus, the Role-based, the Principle-based, the Affect-based, and the Nondeliberative decision strategies

Figure 5.7. Structural equation model 1 for Decision #18
Figure 5.8. Structural equation model 1 for Decision #26
were hypothesized to be affected by the dimensional constructs. There was no statistically significant relationship between the dimensional constructs and the decision strategies, although a negative relationship between Duration and the use of the Principle-based strategy approached statistical significance.

Decision #28: Decision regarding going on a date with a stranger. This model had close fit to the data, $\chi^2(87, N = 172) = 122.63, p = 0.007$, RMSEA = 0.049 with a 90% confidence interval of (0.026, 0.068). As in other analyses, the factor loadings of the two constructs were high, ranging from 0.78 to 0.96. This model included the Role-based, the Principle-based, and the Nondeliberative decision strategies as possible strategies that may be affected by the two constructs. Although the model fit well, none of the regression weights from the constructs to the decision strategies were found to reach statistical significance.

Decision #34: Decision regarding when to get married. The overall fit of the model was good, $\chi^2(89, N = 170) = 138.51, p = 0.001$. RMSEA = 0.057 with a 90% confidence interval ranging from close to reasonable fit (0.038, 0.075). The factor loadings were high with the lowest one being 0.86. This model included the Role-based, the Story-based, and the Affect-based decision strategies as
Figure 5.9. Structural equation model 1 for Decision #28
functions of the two dimensional constructs. There was a positive effect of the Emotional Involvement construct on the Affect-based strategy,

\[ \hat{\beta}_{\text{Emotion,Affect}} = 0.190(0.081), \text{ t-statistic} = 2.34, \]
indicating that if individuals perceived this decision to be more emotionally involved, they tended to use the Affect-based strategy.

**Decision #45: Decision regarding driving home intoxicated.** The overall fit of this model was reasonable, \( \chi^2(89, N = 171) = 130.49, \ p = 0.003, \ RMSEA = 0.052 \) with a 90% confidence interval of (0.031, 0.071). The factor structures of the dimensional constructs were well defined by the indicators (with loading ranging from 0.83 to 0.93). The use of the Principle-based, the Affect-based, and the Nondeliberative decision strategies was assumed to be predicted by the two constructs. It was found that the regression weight of the Duration construct on the Nondeliberative strategy had a negative effect, \( \hat{\beta}_{\text{Duration,Nondelib}} = -0.256 (0.075), \text{ t-statistic} = -3.42. \) Interestingly, the relationship between Emotional Involvement and the Nondeliberative strategy approached statistical significance although the effect was negative. This meant that there was a tendency toward non-use of the Nondeliberative strategy if participants believed this decision was more emotionally laden.
Figure 5.10. Structural equation model 1 for Decision #34
Figure 5.11. Structural equation model 1 for Decision #45
Impact of individual characteristics

In our meta-model, individual differences are hypothesized to have an impact on the selection of decision strategies in the following way. Although situational characteristics are primarily proposed to dictate the decision strategy selection, individuals also prefer one decision strategy over others across different decision situations. If individuals have such preferences, the frequency with which some strategies are used should be much higher. We have found that 73.5% of individuals used the same decision strategy in at least five out of nine decision situations when they are allowed to choose multiple strategies (i.e., the strategy could have ranked low in some situations), and 31% used the same decision strategy as the primary strategy in at least five out of nine situations.

Furthermore, preferences for the use of decision strategies did not appear to be uniformly distributed across decision strategies. As can be seen in Table 5.1, individuals consistently used the Story-based and the Affect-based strategies more often than other strategies ($\chi^2(32, N = 1548) = 348.13, p < .001$) when multiple strategies could be chosen. This pattern remained for the frequencies of the primary decision strategy ($\chi^2(32, N = 1548) = 239.14, p < .001$), suggesting that people, overall, prefer to use emotionally involved decision strategies.
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<td>13</td>
<td>8</td>
<td>39</td>
<td>172</td>
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<tr>
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<td>172</td>
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<td>20</td>
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<td>172</td>
</tr>
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<td>Nondeliberative</td>
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<td>23</td>
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<td>24</td>
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<td>172</td>
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<td>221</td>
<td>134</td>
<td>110</td>
<td>152</td>
<td>1548</td>
</tr>
</tbody>
</table>

Table 5.1. Frequency table of decision strategy use across decision situations

**Structural equation model 2: Inclusion of individual characteristics**

In this set of models, individual differences measures were added onto model 1, which specified only the relationship between process constructs and decision strategy selection. It was hypothesized that those who score high on the Need for Cognition Scale (NCS) or high on the Rational scale of the Rational-Experiential Inventory (REI-S) would be more likely to use an effortful decision strategy over a simplifying one, whereas those who score high on the Experiential scale of the REI-S would prefer a simplifying one, especially the Affect-based strategy. On the other hand, someone who scores highly on the Personal Fear of Invalidity Scale (PFI) may prefer to use strategies that are
justifiable in their mind (e.g., Reason-based strategy). Someone who is low on
Personal Need for Structure may prefer decision strategies with open-ended
aspects (e.g., Story-based strategy). A simplified path diagram (omitting
indicators of exogenous latent variables because they are not the focus of these
models) for each decision situation for model 2 can be seen in Figures 5.12 to
5.20.

Decision #2: Decision regarding getting up (and going to class) on a
weekday morning. The overall fit improved slightly from that of model 1, as can
be seen by examining RMSEA ($\chi^2 (451, N = 168) = 657.406, p = 0.001, \text{RMSEA} = 0.052 (0.055, 0.070)$). This model specified the four individual differences
measures (NCS, Experiential scale of REI-S, PNS, and PFI) to affect the same
decision strategies as the Duration and the Emotional Involvement constructs.
All factor loadings were moderate to high on the individual differences measures
(ranging from 0.66 to 0.86), and those on the process constructs remained high
(ranging from 0.70 to 0.94), as well. As in model 1, other strategies were included
in the model but were hypothesized not to be influenced by the constructs or the
individual differences measures. The same regression path from the Duration
construct to the Nondeliberative strategy remained statistically significant,

$$\hat{\beta}_{\text{Duration-Nondeliberate}} = -0.213 (0.093), \text{t-statistic} = -2.30.$$  
In addition, the NCS score had
Figure 5.12. Structural equation model 2 for Decision #2
a negative impact on selecting the Nondeliberative strategy,

$$\hat{\beta}_{NCS,Nondeliberative} = -0.181 (0.084), \text{ t-statistic } = -2.15.$$  This implies that those who are high in need for cognition tended not to use the Nondeliberative strategy.

Though not statistically significant, other parameter estimates are all in the expected directions, as seen in Figure 5.12. The path diagram includes the parameter estimates from model 1 in parentheses.

**Decision #6: Decision regarding choosing between a job and graduate school.**

Again, the overall fit of model 2 was better than that of model 1, but this time substantially so, $$\chi^2(433, N = 172) = 171.00.$$  RMSEA = 0.048 with a 90% confidence interval of (0.038, 0.057). This model specified process constructs and individual differences constructs to influence the use of the MAUT-like, the EBA, the Story-based, and the Reason-based strategies, as well as the Affect-based strategy. Again, both process constructs had high loadings on all indicators (ranging from the absolute value of 0.85 to 0.98). Individual differences constructs also maintained moderate to high loadings (ranging from 0.67 to 0.87). The effects of the Duration construct on the MAUT-like and the Reason-based decision strategies remained positive, $$\hat{\beta}_{Duration,MAUT} = 0.189 (0.079), \text{ t-statistic } = 2.40,$$ and $$\hat{\beta}_{Duration,Reason} = 0.217 (0.079), \text{ t-statistic } = 2.75,$$ whereas that on the Affect-based
Figure 5.13. Structural equation model 2 for Decision #6
strategy remained negative, $\hat{\beta}_{\text{Duration, Affect}} = -0.231 (0.094)$, $t$-statistic $=-2.45$. The Emotional Involvement construct again influenced the Affect-based strategy, $\hat{\beta}_{\text{Emotion, Affect}} = 0.222 (0.096)$, $t$-statistic $= 3.75$. As hypothesized, the PFI score had a positive influence on the MAUT-like decision strategy, $\hat{\beta}_{\text{PFI, MAUT}} = 0.195 (0.097)$, $t$-statistic $= 2.01$, suggesting that individuals who are fearful of others invalidating them (i.e., who feel the need to justify their decisions) are likely to use a more rational, MAUT-like strategy. Furthermore, the Affect-based decision strategy was influenced by the PNS score, $\hat{\beta}_{\text{PNS, Affect}} = -0.231 (0.094)$, $t$-statistic $=-2.45$. This indicates that participants who have low need for structure are more likely to use the Affect-based strategy. Again, the pattern of regression weights, as can be seen in Figure 5.13, appears reasonable.

**Decision #12: Decision regarding religious beliefs.** This model fit the data well, $\chi^2(445, N = 170) = 169.00$, $p = 0.001$. RMSEA = 0.043 with a 90% confidence interval of (0.033, 0.052). The Principle-based, the Affect-based, and the Nondeliberative decision strategies were included, as in model 1. The indicators loaded highly on their respective constructs, as usual, with loadings ranging from 0.67 to 0.96. The effect of the Duration construct on the Nondeliberate decision strategy remained negative, $\hat{\beta}_{\text{Duration, Nondeliberate}} = -0.351 (0.073)$. 

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Figure 5.14. Structural equation model 2 for Decision #12
t-statistic = -4.82. There was still a positive influence of the Emotional Involvement construct on the Affect-based strategy, $\hat{\beta}_{\text{Emotion Affect}} = 0.215 (0.079)$. t-statistic = 2.73. Although the overall fit improved slightly from model 1, none of the influences of individual differences measures reached statistical significance (although the influence of the Experiential scale on the Role-based strategy was close).

Decision #16: Decision regarding earning money for the next school year. The fit of model 2 was substantially better than that of model 1 for this decision, $\chi^2(445, N = 169) = 168.00, p = 0.002$, RMSEA = 0.035 with a 90% confidence interval of (0.022, 0.045). The two process and four individual differences factor structures were good, with factor loadings ranging from 0.65 to 0.94. Monetary decisions like this were presumed to be made by using the MAUT-like strategy. The other two strategies, EBA and Reason-based, were included in the model because of their similarity to the MAUT-like strategy. Again, the previously existing relationship between the Duration construct and the use of the MAUT-like decision strategy remained, $\hat{\beta}_{\text{Duration MAUT}} = 0.200 (0.091)$, t-statistic = 2.21. There were some individual differences measure influences on a few decision strategies that neared statistical significance, all in the predicted directions. They can be seen in Figure 5.15.
Figure 5.15. Structural equation model 2 for Decision #16
Decision #18: Decision regarding choosing a graduate school. The fit of model 2 to data was close, $\chi^2(439, N = 168) = 167.00$, $p = 0.001$, RMSEA = 0.048 with a 90% confidence interval of (0.039, 0.057). Factor loadings for the two process and four individual differences constructs were moderate to high, ranging from 0.66 to 0.93. This model included more “rational” decision strategies, such as the MAUT-like, EBA, and Reason-based, as well as the Story-based strategy. The only statistically significant relationship between the two constructs and these strategies in model 1 remained in model 2 – the positive influence of the Duration construct on the use of the Reason-based strategy, 

$$\hat{\beta}_{\text{Duration, Reason}} = 0.183 (0.083), \text{t-statistic} = 2.20.$$  

A positive relationship between the NCS and the EBA strategy was found, $$\hat{\beta}_{\text{NCS, EBA}} = 0.183 (0.086), \text{t-statistic} = 2.13,$$ suggesting that participants who had a high desire for thinking tended to use the EBA strategy more than those who did not have a desire for thinking. There was also an unexpected negative effect of the PNS on the Reason-based strategy, 

$$\hat{\beta}_{\text{PNS, Reason}} = -0.234 (0.099), \text{t-statistic} = -2.36.$$  

This implies that those who are low in need for structure have a tendency to use the Reason-based strategy. The remaining parameter estimates are displayed in Figure 5.16.
Figure 5.16. Structural equation model 2 for Decision #18
Decision #26: Decision regarding buying an item at one’s favorite store.

The fit of model 2 improved substantially over that of model 1,

$$\chi^2(445, N = 171) = 170.00, p = 0.001$$, RMSEA=0.051 with a 90% confidence interval of (0.042, 0.060). Again, factor loadings were moderate to high for all constructs (ranging from 0.67 to 0.95). The Role-based, the Principle-based, the Affect-based, and the Nondeliberative decision strategies were hypothesized to be affected by the process and individual differences constructs. There was no statistically significant relationship between the process constructs and the decision strategies, just as in model 1. However, there was a positive relationship between the Experiential scale score from the REI-S and the Nondeliberative decision strategy, \( \hat{\beta}_{\text{EXP, Nondeliberative}} = 0.177 \) (0.087), t-statistic = 2.04. This implies that the more a participant tended to rely on intuition, the more he or she tended to use the Nondeliberative strategy. Other relationships can be seen in Figure 5.17.

Decision #28: Decision regarding going on a date with a stranger.

Model 2 had close fit to the data, but it was not a dramatic improvement from model 1, $$\chi^2(442, N = 172) = 170.00, p = 0.001$$, RMSEA = 0.041 with a 90% confidence interval of (0.030, 0.050). As other analyses, the factor loadings of the
two process constructs were high, ranging from 0.71 to 0.94, and those of the four individual differences constructs were moderate to high as well (ranging from 0.71 to 0.94).

Figure 5.17. Structural equation model 2 for Decision #26
This model included the Role-based, the Principle-based, the Affect-based, and the Nondeliberative decision strategies. In this model, two of the previously non-significant effects became statistically significant. One was a positive relationship between the Emotional Involvement construct and the Principle-based strategy, \( \hat{\beta}_{\text{Emotion,Principle}} = 0.160 (0.078) \), t-statistic = 2.05, indicating that the higher the emotional involvement a participant felt for this decision, the more likely he or she was to engage in the Principle-based strategy. The other was a negative relationship between the Duration construct and the Nondeliberative strategy, \( \hat{\beta}_{\text{Duration,Nondeliberative}} = -0.196 (0.078) \), t-statistic = -2.51. In addition, the NCS influenced the use of the Role-based strategy positively, \( \hat{\beta}_{\text{NCS,Role}} = 0.223 (0.082) \), another unexpected effect. On the other hand, the influence of the NCS on the Nondeliberative strategy was in the appropriate direction, \( \hat{\beta}_{\text{NCS,Nondeliberative}} = -0.188 (0.083) \), t-statistic = -2.26.

Decision #34: Decision regarding when to get married. This was the only decision situation in which the fit of model 2 was slightly worse than that of model 1, \( \chi^2 (448, N = 170) = 170.00 \), \( p = 0.001 \), RMSEA = 0.061 with a narrower 90% confidence interval of (0.053, 0.069). Factor loadings for both process and individual differences constructs were solid, with the lowest one being 0.67. This model included the Role-based, the Story-based, and the Affect-based decision
Figure 5.18. Structural equation model 2 for Decision #28
Figure 5.19. Structural equation model 2 for Decision #34
strategies. The previously existing positive effect of the Emotional Involvement construct on the Affect-based strategy was still present but marginal, 
\[ \hat{\beta}_{\text{Emotion.Affect}} = 0.158 (0.081), \] 
t-statistic = 1.95. There was a positive influence of the Experiential scale of REI-S on the Affect-based strategy, 
\[ \hat{\beta}_{\text{Emotion.Affect}} = 0.268 (0.085), \] 
t-statistic = 3.15, which may have removed the shared variance between the Emotional Involvement construct and the Affect-based strategy. Other relationships are displayed in Figure 5.19.

**Decision #45: Decision regarding driving home intoxicated.** The overall fit of model 2 was close, \( \chi^2(448, N = 171) = 170.00, \) \( p = 0.001, \) RMSEA = 0.044 with a 90% confidence interval of (0.034, 0.053). All the factor loadings were moderate to high (ranging from 0.66 to 0.94). The use of the Principle-based, the Affect-based, and the Nondeliberative decision strategies was assumed to be predicted by the two process and four individual differences constructs. The regression weight of the Duration construct on the Nondeliberative strategy remained negative, 
\[ \hat{\beta}_{\text{Duration,Nondelib}} = -0.259 (0.073), \] 
t-statistic = -3.53. Interestingly, the negative relationship between the Emotional Involvement and the Nondeliberative strategy approached statistical significance in this model as well. Some other unexpected regression weights (e.g., a positive relationship between the PFI and the Principle-based strategy) can be found in Figure 5.20.
Figure 5.20. Structural equation model 2 for Decision #45
5.4.2. Relationship between decision strategy selection and choice: Chi-square analyses

As in Study 2, the relationship between decision strategy selection and choice was examined in Study 3, although there were two differences that may be worth repeating. One was the use of decision strategy. This time, participants were not told to use a specific strategy; they were instead instructed to use whatever decision strategy they thought would lead to being a good decision maker. The other difference had to do with the choice alternatives. Rather than asking for open-ended answers (requiring subsequent coding), a multiple-choice item was created to guide the participants’ answers.

Decision #2: Decision regarding getting up (and going to class) on a weekday morning. First, it is interesting to note that given prespecified options, participants were more likely to choose other options than the socially desired response (i.e., “Of course I would get up and go to class”). The most popular response was not getting up because sleep is more important (0), followed by the model answer of getting up because they felt they should attend classes (3). As expected, more participants used the Nondeliberative decision strategy (N = 47 out of 171). Unlike in Study 2, there was a statistically significant dependence between decision strategy selection and choice, $G^2(32, N = 171) = 48.202$. 

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$p = 0.033$, with 69% expected cell frequencies less than five. It appears that when the Nondeliberative strategy was selected, participants were most likely to get up and go to classes either because they felt they should (3) or because they were afraid they would miss something (1). This can be seen in Table 5.2.

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<td>Total</td>
<td>68</td>
<td>24</td>
<td>6</td>
<td>65</td>
<td>8</td>
<td>171</td>
</tr>
</tbody>
</table>

Table 5.2. Frequency table of decision strategy by choice in Decision #2

Decision #6: Decision regarding choosing between a job and graduate school. Similar to the open-ended answers obtained in Study 2, the most popular response was to go on to graduate school because they cannot work in their field otherwise (0). Interestingly, many people used the Story-based strategy to arrive at this decision, followed by the MAUT-like and the Reason-based strategies. There again was a statistically significant dependence between
decision strategy and choice, $G^2(40, N = 174) = 66.370$, $p = 0.005$, with 83% expected cell frequencies less than five. Given the number of participants who selected the MAUT-like strategy, a much larger proportion than expected chose to go to graduate school (0), whereas a much larger proportion of those who used the Affect-based strategy selected the option that would make them happy in the future (2) (see Table 5.3).

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>25</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>EBA</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Role-based</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Story-based</td>
<td>25</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>46</td>
</tr>
<tr>
<td>Reason-based</td>
<td>17</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Principle-based</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Affect-based</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>12</td>
<td>16</td>
<td>26</td>
<td>11</td>
<td>9</td>
<td>174</td>
</tr>
</tbody>
</table>

Table 5.3. Frequency table of decision strategy by choice in Decision #6

Decision #12: **Decision regarding religious beliefs.** Interestingly, the most frequently selected choice alternative was to adopt a new religion that seems more valid (0). However, there were quite a few participants who responded that they would stick to the same religion in which they were raised
because it seemed right to them (2), or they did not subscribe to religions (4). The majority of participants selected either the Principle-based or the Affect-based strategy. There was no statistically significant dependence of choice on decision strategy, $G^2(40, N = 171) = 51.892$, $p = 0.099$, with 82% of expected cell frequencies less than five.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>MAUT-like</td>
<td>8</td>
</tr>
<tr>
<td>EBA</td>
<td>1</td>
</tr>
<tr>
<td>Role-based</td>
<td>6</td>
</tr>
<tr>
<td>Story-based</td>
<td>10</td>
</tr>
<tr>
<td>Reason-based</td>
<td>5</td>
</tr>
<tr>
<td>Principle-based</td>
<td>27</td>
</tr>
<tr>
<td>Affect-based</td>
<td>24</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>92</td>
</tr>
</tbody>
</table>

Table 5.4. Frequency table of decision strategy by choice in Decision #12

Decision #16: Decision regarding earning money for the next school year. Similar to the open-ended answers in Study 2, an overwhelming number of participants chose to get a part-time job (0). Surprisingly, approximately evenly distributed numbers of participants selected each of the eight strategies, as seen in Table 5.5. Thus, there was no dependence between decision strategy
and choice, $G^2(40, N = 174) = 47.349$, $p = 0.198$, with 83% of expected cell frequencies less than five.

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>EBA</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Role-based</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Story-based</td>
<td>23</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>Reason-based</td>
<td>12</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Principle-based</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Affect-based</td>
<td>12</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>17</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>124</td>
<td>4</td>
<td>11</td>
<td>25</td>
<td>4</td>
<td>6</td>
<td>174</td>
</tr>
</tbody>
</table>

Table 5.5. Frequency table of decision strategy by choice in Decision #16

**Decision #18: Decision regarding choosing a graduate school.** The majority of participants chose the MAUT-like strategy ($N = 46$) or the Story-based strategy ($N = 31$). The most popular choice alternative was to choose the school that provides the most money (0), followed by choosing the best one based on all available information (2). Decision strategy selection was not related to choice for this decision, $G^2(40, N = 171) = 41.873$, $p = 0.390$, with 83% of expected cell frequencies less than five.
<table>
<thead>
<tr>
<th>Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>28</td>
<td>4</td>
<td>11</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>46</td>
</tr>
<tr>
<td>EBA</td>
<td>12</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Role-based</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Story-based</td>
<td>16</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Reason-based</td>
<td>15</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Principle-based</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Affect-based</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>17</td>
<td>35</td>
<td>1</td>
<td>22</td>
<td>8</td>
<td>171</td>
</tr>
</tbody>
</table>

Table 5.6. Frequency table of decision strategy by choice in Decision #18

**Decision #26: Decision regarding buying an item at one’s favorite store.**

The two most likely decision strategies to be selected for this decision were the Nondeliberative strategy (N = 34) and the Affect-based strategy (N = 30), as anticipated. Although participants were most likely to choose to buy the item because they have the money now (0), those who chose the Nondeliberative and the Affect-based strategies were more likely than expected to buy the item because it would make them happy (2), $G^2(40, N = 171) = 56.809, p = 0.041$. This pattern can be seen in Table 5.7.
Table 5.7. Frequency table of decision strategy by choice in Decision #26

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>EBA</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Role-based</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Story-based</td>
<td>12</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Reason-based</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>Principle-based</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Affect-based</td>
<td>12</td>
<td>2</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>12</td>
<td>6</td>
<td>14</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>34</td>
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<tr>
<td>Other</td>
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<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>29</td>
<td>37</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>171</td>
</tr>
</tbody>
</table>

Decision #28: Decision regarding going on a date with a stranger. The majority of participants used the Affect-based strategy for this decision (N = 77). In addition, the most popular choice alternative was to say “yes” because it felt right (0). Despite a larger than expected proportion of those who used the Affect-based strategy to select the most popular choice and a larger than expected proportion of those who used the Story-based strategy to choose to get a phone number before they said yes (see Table 5.8), there was a marginally significant relationship between decision strategy and choice,

\[ G^2(40, N = 173) = 53.059, p = 0.081. \]
Table 5.8. Frequency table of decision strategy by choice in Decision #28

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>7</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>EBA</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Role-based</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Story-based</td>
<td>17</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Reason-based</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Principle-based</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Affect-based</td>
<td>60</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>77</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>13</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>24</td>
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<td>Other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>2</td>
<td>26</td>
<td>5</td>
<td>15</td>
<td>4</td>
<td>173</td>
</tr>
</tbody>
</table>

Decision #34: Decision regarding when to get married. As predicted, both Affect-based and Story-based strategies were used more frequently (N = 64 and 32, respectively) than other strategies for this decision. The most popular choice alternative was to get married when both parties are ready to (0). Although there was a larger than expected number of participants who used the Affect-based strategy to choose to get married when it feels right (5), there was no statistically significant dependence between decision strategy and choice, 

$$G^2(40, N = 174) = 43.780, p = 0.314.$$
Table 5.9. Frequency table of decision strategy by choice in Decision #34

<table>
<thead>
<tr>
<th>Decision Strategy</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>EBA</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Role-based</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Story-based</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Reason-based</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Principle-based</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Affect-based</td>
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<td>1</td>
<td>0</td>
<td>3</td>
<td>21</td>
<td>64</td>
</tr>
<tr>
<td>Nondeliberative</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>13</td>
<td>13</td>
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<tr>
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<td>0</td>
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</tr>
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<td>Total</td>
<td>113</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>13</td>
<td>43</td>
<td>174</td>
</tr>
</tbody>
</table>

Decision #45: Decision regarding driving home intoxicated.

Interestingly, the most frequently chosen answer was to drive home because they felt fine (0). That was the most frequently chosen answer for those who used the Principle-based or the Affect-based strategy. However, if they used the Nondeliberative strategy, it was more likely for them not to drive home because they were afraid of what would happen if they did (1). Thus, a marginal statistical significance was found in the relationship between decision strategy and choice, $G^2(32, N = 170) = 44.983, p = 0.064$. 

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5.5. Discussion

5.5.1. Relationship between decision dimensions and decision strategy selection

A structural equation model was created for each decision to determine the relationship between situational characteristics - specifically process constructs from Study 1 - and decision strategy selection (model 1). Model 1 for each decision seemed to fit the data reasonably well (i.e., point estimates of RMSEA ranging from 0.049 to 0.075 with none of the upper confidence limits reaching 0.1), suggesting that the model specification for each decision situation was a plausible description of the data. Although factor loadings for the two process constructs were consistently high in all decision situations, parameter estimates for most of the regression weights from the process constructs to the

<table>
<thead>
<tr>
<th>Strategy</th>
<th>0</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAUT-like</td>
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<td>1</td>
<td>24</td>
</tr>
<tr>
<td>EBA</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Role-based</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Story-based</td>
<td>33</td>
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<td>9</td>
<td>0</td>
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<td>55</td>
</tr>
<tr>
<td>Reason-based</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Principle-based</td>
<td>12</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Affect-based</td>
<td>19</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Nondeliberative</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>30</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>171</td>
</tr>
</tbody>
</table>

Table 5.10. Frequency table of decision strategy by choice in Decision #45
decision strategies did not reach statistical significance. However, the regression weights that did reach significance, or were large enough to be close, were all interpretable. It is of interest to note that in most decisions, one process construct influenced decision strategy selection and not the other. Additionally, a pattern emerged across decision situations: models that did not have large enough regression weights tended to be the decision situations in which more simplifying decision strategies were predicted to be used (e.g., whether to go on a date with a stranger). This could be due to the fact that the majority of participants rated the situations the same way and chose the same strategy, thus resulting in the reduction of systematic variability.

When individual differences constructs were added, the fit of the model generally improved at least slightly (point estimates of RMSEA ranging from 0.035 to 0.061 with the highest upper confidence limit being 0.070). Unexpectedly, it appeared that the individual differences constructs did not influence the use of the same decision strategies across different decisions. This could be seen from comparing two or more situations in which the same individual differences constructs were included to determine whether the regression weights in those decisions were roughly equivalent. A formal test was theoretically possible by including the data from multiple decision situations in one covariance matrix and set equivalent constraints on the same regression paths across situations. However, in practice, it proved impossible to perform
the analysis, perhaps due to the number of variables involved (each situation contains approximately 50 variables x 9 situations). The pattern of improvement from model 1 to model 2 provided some insight. First, it appeared that in most decisions, regression weights large enough for the process constructs in model 1 remained so in model 2, despite the inclusion of individual differences constructs that were hypothesized to influence the same decision strategies. This implies that the influence of the process constructs is unique and does not become replaced or reduced substantially by the influence of individual differences constructs on decision strategies. Secondly, the inclusion of individual differences constructs seemed to substantially improve the fit only in the more effortful decisions (i.e., whether to get a job or go to graduate school). This result is consistent with the hypothesis mentioned above regarding the reduced systematic variance for frequently encountered decisions.

5.5.2. Relationship between decision strategy selection and choice

Examining the patterns of decision strategy selection and alternative selection across decision situations prior to examining the relationship between decision strategy and choice was quite informative. All of the frequently selected strategies in each decision were sensible. Participants tended to use the Nondeliberative or the Affect-based decision strategy when decisions were thought to be simple, whereas the use of more rational strategies was prominent.
in decisions thought to be effortful. A relationship between decision strategy selection and choice was found in some decision situations but not in others. The pattern was such that simpler decisions seemed to show a definite relationship between decision strategy selection and choice, with the exception of Decision #6 (choosing between a job and graduate school). A simple match occurs between decision strategy and choice in the simpler decisions: most select the Nondeliberative or the Affect-based strategy and end up choosing the cognitively less taxing choice (e.g., getting up in the morning and going to class because they feel they should). The decision situation in which it was especially difficult to see the relationship was Decision #18 (choosing a graduate school). Approximately the same proportion of participants used each of eight strategies in this decision situation.

5.5.3. Integration of results

Each phase of the meta-model in itself is sensible and interesting. For most decisions examined in Study 3, a general statement can be made. For example, in the case of getting up in the morning (Decision #2), the model accurately describes the result that participants who rated this decision to take a short time used the Nondeliberative strategy and decided to get up and go to school. However, a further investigation is definitely warranted. It appears that in more effortful decisions, the selection of decision strategies becomes more
variable to the point where any decision strategy can be employed. In such a case, determination of situational and individual characteristics that contribute to predicting the use of all decision strategies becomes critical. The constructs currently included did not contribute to predicting all decision strategies. Perhaps other variables we measured (such as surface constructs) may be helpful in this determination.
The aim of the meta-model was to describe individuals' choice behavior in fairly representative everyday decisions, and eventually to further generalize it to everyday decisions that have not been examined. To determine which situation characteristics are important in decision strategy selection, sorting studies were conducted in Tada and Weber (1998, 1999) and, as a result, multidimensional scaling solutions were obtained. Dimensional solutions from the previous studies could have been used instead of the interpretations of the dimensions in the present study to predict decision strategy selection. However, the resulting model would not be generalizable to other decisions because the location of new decisions in the decision space would remain uncertain. However, if we know what the dimensions represent, it is fairly simple to measure the situational characteristics (i.e., interpretations) and find the location of each decision empirically in order to predict how individuals would behave when making these new decisions.
6.1. Summary of the findings

Study 1 was conducted with the above purpose in mind. It is crucial for the meta-model to determine what the relevant situational characteristics are. In the previous validation study (Study 3 in Tada & Weber, 1999), we found the interpretations of the first two dimensions in both surface and process dimensional solutions to be fairly adequate. However, even those relationships were not perfect. Hence, further validation using SEM was conducted in Study 1. Results of Study 1 led us to the conclusion that the lack of perfect relationship between dimensions and their respective interpretations was not due to measurement error. Another plausible reason for the lack of perfect relationship concerned the nature of the dimensions. If each dimension were a composite of several related concepts, it would have been possible for an item that represented only a part of the dimension to have an imperfect relationship with the dimension. Although the multiple-aspect constructs in Study 1 did not produce improved relationships with the dimensions, this is still the prime candidate as an explanation for the imperfect relationship. Meanwhile, the best variables to be used for further modeling were the multiple-format constructs, but specifically the process constructs (i.e., Duration, Emotional Involvement, and Protocol Availability).
Study 2 examined the relationship between decision strategy and choice. Recent studies of content-specific decision modes give the impression that particular decision strategies are more suitable for making particular types of decisions, but not others (e.g., Shafir et al., 1993; Prelec & Herrnstein, 1994). In Study 2, each individual was randomly assigned to one decision strategy and was required to use it across all decisions. There was only a marginal effect of decision strategy on two different response time measures, although there was a situation effect. Furthermore, there was no relationship between decision strategy conditions and (coded) choice alternatives. The conclusion reached in Chapter 4 with these results, along with the interaction between decision strategy and situation on reaction time (participants took longer to start listing pros and cons in the Reason-based strategy condition more so for some decisions than for others), was that participants either did not or were unable to follow the instructions to use the same strategy for all 10 decisions. However, another explanation is possible: at least for some decisions, more than one strategy is suitable.

Study 3 extended and supported both explanations. Except for one decision situation (#18), there were definite preferences for some strategies over others, thus, most situations had two or three highly used strategies. However, except for Decision #28 (whether to go on a date with a stranger), there were always two or more highly used strategies. Even in Decision #28, the most used
strategy – the Affect-based strategy – was selected by less than half of the participants (N = 77 out of 173).

The first attempt at modeling the relationship between situational characteristics and decision strategy selection in Chapter 5 was a partial success. All of the models showed at least reasonable fit and most of the parameter estimates were sensible. Some unexpected parameter estimates were found, such as a positive relationship between the NCS scores and the use of the Role-based strategy in deciding whether to go on a date with a stranger (Decision #28). Further replication is necessary, but, if replicable, these relationships can be used to distinguish two related strategies from each other. However, the bottom line is that the effects of situational characteristics were not as strong as anticipated. These issues led to the limitations of the above studies.

6.2. Limitations and future directions

Although definite directionality of causes and effects was implied in the discussions of Studies 2 and 3, such a claim may not be warranted. Normally, it is quite natural to think of situational or individual differences characteristics as influencing decisions individuals make, as opposed to decisions influencing situational and individual differences characteristics. Furthermore, the selected decision strategy should influence the subsequent choice, not vice versa. However, the choice of decision strategy was elicited from participants after they
had already responded with their choices. Similarly, situational characteristics were elicited after they made their decisions. This had to be the order in which data were collected because avoiding the effects of eliciting relevant information (such as situational characteristics) may have biased the decision processes subsequently. Thus, such directional statements should be made with caution, though they have face validity. Another study must be conducted in which the order of various response elicitations are reversed. Only if the relationship remains can one reasonably make statements regarding directionality with confidence.

The modeling efforts in Study 3 were considered only a partial success because, even with individual differences measures included, the proportion of variance explained in the choice of decision strategies was in general very low (less than 10%). This may be because the process constructs were adequate but only imperfect substitutes of the process dimensions obtained from the multidimensional scaling solution. The low proportion of explained variance could also be due to the measurement of the decision strategies. In these models, each decision strategy was entered as a dichotomous variable. This was a legitimate way to enter the data because participants could have in theory chosen all eight strategies (plus one “other”) if they wished. Multiple strategy use was allowed. Theoretically, choosing one decision strategy did not prevent the others from being selected. This implies that, not only was the primarily used strategy
included in the model to be predicted, but also the second or third strategies used. This may have weakened the relationship between situational characteristics and decision strategies.

Results obtained by Johnson and Tversky (1984) on risk perceptions may provide another explanation for the partial success of Study 3. Three different types of data (judgments of similarity, conditional predictions, and ratings of risks on evaluative dimensions) were analyzed using three different techniques (hierarchical clustering, multidimensional scaling, and principal component analysis). They found that pairwise judgments of similarity, closely related to aggregated similarity in our study, were better represented by tree models, such as hierarchical clustering, than by spatial models. If in fact a tree structure is more suitable for analysis of the situational characteristics, the clusters obtained in Tada and Weber (1998, 1999) should provide a more accurate description of these data and thus should be used to predict decision strategy selection. As a rough estimate of the effects of clusters, a series of repeated measures ANOVAs was conducted*. A substantially greater proportion of explained variance in decision strategy use was obtained by using clusters than by using dimensional coordinates only for the Reason-based ($R^2 = .304$), Principle-based ($R^2 = .359$) and the Affect-based ($R^2 = .50$) strategies. It was found that, with academic

*It is a rough estimate because the dependent variables, decision strategies, are dichotomous variables. They violated the assumption of normality.
decisions, individuals tended to use the Reason-based strategy more than the other strategies. Among the remaining decision clusters (relationship, financial, and nondeliberative decision clusters), financial decisions led to greater use of the Reason-based strategy than did relationship-related decisions. As anticipated, the Affect-based strategy was used more frequently than any other strategy in relationship-related decisions. Overall, the results found with clusters comprising the independent variable were similar to the results with dimensions (or factors representing dimensions) as the independent variables.

Ideally, Study 3 should have been analyzed using the data from between situations and between individuals simultaneously. Because individuals’ perceptions about situational characteristics (e.g., emotional involvement) are expected to vary across different decision situations much more so than across individuals, the impact of situational characteristics should be easier to detect across situations. In fact, when all situations were included as repeated measures in model 1 as shown in Figure 6.1, most of the proportion of explained variance in the decision strategies increased (in some strategies up to 31%). Although the model fit reasonably (RMSEA = .078 with the 90% confidence interval of (0.076, 0.079)), a better prediction of decision strategy selection is desirable.
Figure 6.1. Structural equation model 1 modified to include all decision situations
Although we are reluctant to add complexity unnecessarily, the results from Studies 2 and 3 suggest that the mapping between decision strategy and choice is not straightforward. For example, two participants could easily be using the same strategy (e.g., the Principle-based strategy) and still choose two different choice alternatives (e.g., get up to go to school or do not get up). To completely model individuals’ decision processes, the submodels (i.e., decision strategies) must function as full models once these submodels are chosen. Utilities and weights for the MAUT-like and the EBA strategies, lists of pros and cons for the Reason-based strategy, roles for the Role-based strategy, and principles for the Principle-based strategy were elicited in both Studies 2 and 3; thus, those strategies can be modeled. However, others, such as the Story-based and the Affect-based strategies, may be difficult to model accurately without excessive knowledge of the individual.

Furthermore, as found in Study 3, in some effortful decisions, all eight decision strategies are used by a substantial number of individuals to make the same decisions. Although some of the individual differences measures influenced the use of certain decision strategies, not all strategies were explained by these measures. Factors that differentiate these individuals must be determined in future studies. Perhaps measures such as the Self-Doubt Inventory (Mirels & Greblo, 1994), that, similar to the PFI, measures the disposition of individuals to be indecisive or the Analytical scale of Decision
Making Styles Inventory (DMSI; Nygren, 2000) may be useful in differentiating these individuals. Particularly, Nygren (2000) has found that his Analytical scale and the NCS had different relationships with individuals' performance on the Multi-Attribute Task Battery (MAT; Comstock & Arnegard, 1992). Because the Analytical scale of the DMSI is specifically designed to measure a propensity to use more analytical decision making styles (e.g., MAUT), the relationship of the decision strategy selection with this scale may have been stronger than the relationship with the NCS.

Despite these current limitations, this model conceptualization is a useful one, and the description of, and eventually the prediction of, individuals' decision processes is anticipated to be improved by this conceptualization.
APPENDIX A

FIFTY EVERYDAY DECISIONS

(10 SELECTED DECISIONS ARE IN BOLD)
Decision Situation

**Monetary**
- 22 Ride the bus or buy a car
- 32 Which apartment to live (or stay in the dorm)
- 24 Whether to buy a new or used car
- 16 **How to earn money for the school year**
- 4 How to spend my limited funds

**School**
- 5 Which college to attend
- 15 Which major to pursue
- 10 Whether to go to class or skip
- 20 Whether to do homework
- 37 Whether to drop a class (and not graduate that quarter)

**Post-BA/S**
- 6 Whether to get a job or to go to graduate school
- 27 Whether to begin work right away after I graduate
- 35 What career to choose
- 13 Whether to get a job far away from home (with better pay) or get one close to home
- 18 Where to go for graduate school

**Relationship**
- 9 Who to have for a roommate
- 41 Whether to make a commitment to my boyfriend/girlfriend
- 17 Whether and when to sever a relationship
- 39 Who to have (and keep) for friends
- 7 Whether to go out with an older man/woman

**Moral**
- 12 Which religious belief to embrace
- 48 Whether to use birth control
- 14 Whether to give back too much change
- 43 Whether to lie to my parents or tell the truth
- 25 Whether to allow my parent to be given a shot (drug) to reduce pain but which would end his/her life
- 21 Whether to abstain from drugs

**Nondeliberative**
- 40 Stopping at the red traffic light when driving
- 2 **To get up in the morning**
- 11 Whether to curse (or swear)
- 46 Whether to cry
- 49 Whether to laugh
Impulsive

| 30 | Whether to buy a candy bar as I wait at grocery store register |
| 45 | Whether to drive home after a few drinks |
| 44 | Whether to stay in bed or get up and study |
| 26 | Whether to buy something I don't really need but like |
| 33 | When to stop eating |

"Adult"

| 42 | Whether to buy a house |
| 34 | When to get married |
| 8  | To decide if my boyfriend/girlfriend is someone whom I want to marry |
| 19 | Whether to terminate my pregnancy |
| 23 | Whether to leave my spouse of many years |

Fun

| 36 | Whether to go on a trip outside Columbus |
| 29 | Where to go on a trip for a vacation |
| 50 | What to buy when I have extra cash |
| 1  | Where to go on a Friday night |
| 28 | Whether to go out on a date with someone I just met |

Societal

| 31 | Whether to donate my organs when I die |
| 38 | Whether to recycle |
| 3  | Which charity to give money to |
| 47 | Which presidential candidate I should vote for |
APPENDIX B

A COMPLETE LIST OF ITEMS FOR

THE INTERPRETATIONS OF SIX DIMENSIONS
Questions asked for the Personal-Professional continuum interpretation

A) Do you consider that all your professional decisions are personal decisions?

B) Rate the degree of personal involvement in your work. (Circle one)

1. Not at all
2. Mostly personal
3. Mostly professional
4. Not sure

C) Choose the most appropriate answer:

1. To whom are you more closely related?
2. To whom are you financially dependent?
3. To whom do you belong to any club or organization?

D) How likely are you to be asked to do work?

1. Not at all
2. Occasionally
3. Frequently
4. Always

E) How personally relevant is your work?

1. Not at all
2. Slightly
3. Moderately
4. Very

F) How likely are you to be asked to do work?

1. Not at all
2. Occasionally
3. Frequently
4. Always

G) How personally relevant is your work?

1. Not at all
2. Slightly
3. Moderately
4. Very
Questions asked for the Importance interpretation

A) How important is the following item? 

not important... 

B) Read the paragraph below and choose the option that best describes your opinion. (e.g., who do you think...)

C) Choose the direction of the arrow to show your opinion.

D) How important is this item? 

not at all... 

E) How important is the item? 

not at all... 

F) How important is the item? 

not at all... 

G) How important is the item? 

not at all... 

Completely important
### Questions asked for the Complexity interpretation

<table>
<thead>
<tr>
<th>A) How complex is the system to understand?</th>
</tr>
</thead>
<tbody>
<tr>
<td>B) Rate the complexity of the system.</td>
</tr>
<tr>
<td>C) Changes in the system.</td>
</tr>
<tr>
<td>D) Changes in the environment.</td>
</tr>
<tr>
<td>E) How many stakeholders are involved?</td>
</tr>
<tr>
<td>F) How many times has it been used?</td>
</tr>
<tr>
<td>G) How much data is required?</td>
</tr>
</tbody>
</table>

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Questions asked for the Duration interpretation
Questions asked for the Emotional Involvement interpretation
Questions asked for the Protocol Availability interpretation

Please answer the following questions:

A) How easily can you use the protocol?
   - Extremely easy
   - Somewhat easy
   - Somewhat difficult
   - Extremely difficult

B) Rate the degree of user difficulty (on a scale of 0 to 100) for this protocol:
   - [ ]

C) Choose the most frequently used state:
   - [ ]

D) How often have you used the protocol to make decisions?
   - Never
   - Occasionally
   - Frequently
   - Constantly

E) 1) Can you think of any potential problems with the protocol?

F) 2) If so, where did you encounter problems?
   - Format
   - Purpose
   - Work across
   - Other
APPENDIX C

MAXIMUM LIKELIHOOD ESTIMATES OF
BETWEEN- AND WITHIN-SITUATION COVARIANCE MATRICES
IN MULTILEVEL COVARIANCE STRUCTURE
Surface Dimension 1: Personal-Professional Continuum

\[ \hat{\Sigma}_{pp} \]

\[
\begin{array}{cccccc}
5.089322 & 56.2455 & 651.20121 \\
5.428782 & 59.248259 & 5.856794 \\
0.015706 & -0.7034387 & 0.04646 & 0.193697 \\
1.344424 & 21.34007 & 1.244971 & 0.130301 & 2.962434 \\
0.234816 & 7.7009178 & 0.019847 & 0.08376 & 1.687561 & 1.4649 \\
1.860336 & 24.306073 & 2.037184 & -0.32632 & 0.593984 & 0.081139 & 1.986165 \\
0.940851 & 12.22057 & 1.006688 & -0.103973 & 0.65429 & 0.177968 & 0.815813 & 0.743774 \\
0.357643 & 3.9651656 & 0.341057 & 0.053656 & 0.620566 & 0.158039 & -0.14521 & 0.143053 & 0.359325 \\
\end{array}
\]

\[ \hat{\Sigma}_{w} \]

\[
\begin{array}{cccccc}
3.465 & 23.440 & 696.025 \\
2.852 & 23.659 & 5.611 \\
0.111 & -1.309 & 0.227 & 2.249 \\
0.331 & 4.366 & 0.239 & 0.437 & 5.408 \\
-0.185 & 0.292 & -0.386 & 0.191 & 1.145 & 3.658 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
\end{array}
\]

Average Intraclass Correlation

\[ \bar{\rho} = 0.59 \]
Surface Dimension 2: Importance

\[ \hat{\Sigma}_g \]

\[
\begin{array}{cccc}
2.483916 & 31.98697 & 413.6179 & -2.644665 \\
-2.644665 & -34.19002 & 2.833531 & 2.83884 \\
2.83884 & 37.10785 & -3.053859 & 3.415024 \\
1.436777 & 18.09848 & -1.522825 & 1.424101 \\
-2.156108 & 27.92954 & -2.313784 & 2.523504 \\
0.850818 & 10.08596 & -0.74228 & 0.793977 \\
0.446578 & 6.019793 & -1.160591 & 0.535214 \\
0.122422 & 2.065612 & -0.164037 & 0.228538 \\
\end{array}
\]

\[ \hat{\Sigma}_g'' \]

\[
\begin{array}{cccc}
2.991 & 29.820 & 518.740 & 3.505 \\
-2.569 & -30.780 & 2.128 & 3.092 \\
2.089 & 26.152 & -1.827 & 2.040 \\
0.921 & 11.400 & -1.007 & 1.072 \\
1.839 & 22.132 & 1.005 & 2.840 \\
0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 \\
\end{array}
\]

Average Intraclass Correlation

\[ \bar{\rho} = 0.62 \]
Surface Dimension 3: Complexity

$\hat{\Sigma}_R$

\[
\begin{array}{ccccccc}
3.377344 & 41.83822 & -51.956804 & 4.726926 \\
-4.168002 & 24.747053 & -2.364306 & 1.705071 \\
1.991934 & 27.582755 & -2.630522 & 1.294803 & 1.208501 \\
0.76776 & 10.109643 & -0.870129 & 0.77299 & 0.523947 & 0.41125 & 1.986165 \\
1.011525 & 12.630899 & -1.160591 & 0.609488 & 0.634773 & 0.605147 & 0.815813 & 0.743774 \\
0.635245 & 7.9732909 & -0.786079 & 0.369156 & 0.390057 & 0.407496 & -0.14521 & 0.143053 & 0.359325 \\
\end{array}
\]

$\hat{\Sigma}_W$

\[
\begin{array}{ccccccc}
3.496 & 35.276 & 542.063 & -3.484 & -40.620 & 5.245 \\
1.287 & 15.163 & -1.511 & 4.778 \\
1.834 & 20.766 & -2.030 & 1.849 & 4.077 \\
1.745 & 19.511 & -1.997 & 1.323 & 1.872 & 3.966 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
\end{array}
\]

Average Intraclass Correlation

$\bar{\rho} = 0.58$
Process Dimension 1: Duration

\[ \hat{\Sigma}_B \]

\[
\begin{array}{cccc}
3.168821 & 35.31664 & 539.04077 \\
-3.476629 & -45.704903 & 4.780489 \\
1.994003 & 25.930702 & -2.453604 \\
0.097371 & 1.318469 & 0.063433 \\
1.463866 & 19.221065 & -1.796888 \\
-1.041378 & -14.25396 & 1.291668 \\
0.356335 & 5.83742 & -0.394969 \\
0.739935 & 10.66149 & -0.121656 \\
\end{array}
\]

\[ \hat{\Sigma}_W \]

\[
\begin{array}{cccc}
3.092 & 30.851 & 486.659 \\
-3.019 & -36.040 & 4.759 \\
1.887 & 20.861 & -2.042 & 3.264 \\
0.089 & 1.392 & -0.117 & 0.079 & 0.104 \\
1.010 & 12.261 & -1.085 & 0.966 & 0.149 & 3.957 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
\end{array}
\]

Average Intraclass Correlation

\[ \bar{\rho} = 0.57 \]
Process Dimension 2: Emotional Involvement

\[ \hat{\Sigma}_\mu \]

\[
\begin{array}{cccccc}
2.234684 & 29.28031 & 383.7126 \\
2.757201 & -36.20978 & 2.947597 \\
0.245787 & 3.143566 & -0.298168 & 0.363332 \\
2.288108 & 29.92934 & -2.615177 & 0.246234 & 2.345385 \\
-0.660188 & -9.099701 & 0.755745 & 0.202735 & -0.669088 & 0.870695 \\
-0.377345 & -4.395448 & 0.441522 & -0.366543 & -0.351043 & -0.297876 & -0.157605 & 1.026089 \\
0.008387 & 0.944369 & 0.012602 & -0.305337 & 0.050677 & 0.097932 & -0.409827 & 0.79504 & 0.908614
\end{array}
\]

\[ \hat{\Sigma}_\nu \]

\[
\begin{array}{cccccc}
3.768 & 38.392 & 578.891 \\
-3.609 & -42.031 & 5.022 \\
0.389 & 3.791 & -0.391 & 3.404 \\
2.885 & 33.312 & -3.164 & 0.457 & 3.626 \\
2.497 & 29.040 & -2.767 & 0.515 & 2.839 & 3.761 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000
\end{array}
\]

Average Intraclass Correlation

\[ \bar{\rho} = 0.56 \]
Process Dimension 3: Protocol Availability

\[ \hat{\Sigma}_h \]

\[
\begin{array}{cccc}
1.341476 & 15.98316 & 197.7906 & 0.917359 \\
0.917359 & 8.251106 & 1.029771 & 0.030888 \\
-0.030888 & -0.821044 & 0.080775 & 0.116653 \\
-1.567264 & -17.94987 & -1.429747 & -0.153127 \\
-0.791346 & -9.598923 & -0.453077 & 0.16849 \\
-0.27181 & 2.125206 & -0.330664 & -0.160307 \\
0.289251 & 5.728159 & 0.008056 & -0.163183 \\
\end{array}
\]

\[ \hat{\Sigma}_u \]

\[
\begin{array}{cccccc}
3.747 & 27.608 & 668.609 & 1.390 & 8.370 & 5.532 \\
0.136 & 0.669 & 0.104 & 2.413 & 0.000 & 0.000 \\
-0.510 & -5.550 & -1.778 & 0.216 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 \\
\end{array}
\]

Average Intraclass Correlation

\[ \bar{\rho} = 0.51 \]
APPENDIX D

THE CODING SCHEME FOR

THE CHOICE ALTERNATIVES IN STUDY 2
Decision #2
0: Yes
1: No
2: Yes, explanation
3: No, explanation

Decision #6
0: Get a job for now (earn money to go back to school)
1: Grad school
2: Job
3: Depends

Decision #12
0: No religion
1: Remain with the current
2: Change to another
3: More than one

Decision #16
0: Unreasonable time demands on oneself
1: Job/another job
2: Ask relatives
3: Financial aid
4: Scholarship
5: Combination of 1-4

Decision #18
0: The one they like
1: Financial benefits
2: Prestige
3: In the middle ground (between 1 and 2)
4: 0 and 1
5: 0 and 2
6: More factors than above

Decision #26
0: No
1: Yes
2: No, condition
3: Yes, condition
Decision #28
0: No
1: Yes
2: No, condition
3: Yes, condition
4: No, but something less (e.g., talking on the phone) is fine
5: Maybe

Decision #34
0: Get married to please parents
1: Get married when I feel like it
2: Get married when both parties feel right about it
3: Undecided

Decision #45
0: Not drive home (have someone drive)
1: Drive home (right away)
2: Drive home after sobering
APPENDIX E

MULTIPLE-CHOICE ITEMS FOR

THE CHOICE ALTERNATIVES IN STUDY 3
Decision #2
0: Wouldn't get up because sleep is more important to me
1: Would get up to go because I am afraid I may have missed something
2: Would decide depending on the mood I am in that morning
3: Would get up because I feel I should to attend classes
4: Would decide depending on what I have to do that day and see if it is worth it

Decision #6
0: Go to graduate school because I wouldn't be able to work in my field otherwise
1: Go to work because I want to earn money
2: Choose the option I think will make me happy later in life
3: Would choose the best overall option after thinking about each option
4: I just know I want to go to graduate school
5: I just know I want to get a job

Decision #12
0: Adopt a new religion because it seems more valid to me than my family's
1: Stick with the same religion I grew up in because of my family
2: Stick with the same religion I grew up in because it seems right to me
3: Stick with the same religion I grew up in because it offers more benefits than others
4: I don't believe in religions, and I am happy the way it is
5: Adopt a new religion because someone of the religion is/was very influential in my life

Decision #16
0: Get a part-time job (or increase the hours you already work) because it is the easiest solution
1: Would try to save money (by eating in, etc.) because I need time for study, NOT for work
2: Ask for loans because I think the tradeoff (of having time and eating well) is worth it
3: Would choose the best overall option after thinking about each option
4: Would choose what I think would make me happy in the future
5: Decide on the option that comes easiest to me

Decision #18
0: Choose the one that provides most money because money is the crucial factor
1: Choose the one with best reputation because it would allow for better future prospects
2: Choose the best one based on all the available information
3: Choose the one based on location
4: Choose the one that I think will make me happy
5: Choose the one that 'feels right' to me
Decision #26
0: Buy the item because I have money for it now
1: Wouldn't buy the item because I could use the money for something else
2: Buy the item because having it would make me happy
3: Wouldn't buy the item because parents/friends/siblings may think it's a waste of money
4: Would buy because there are more uses for it than some others that you could otherwise buy
5: Wouldn't buy because there are NOT as useful as some others that you could otherwise buy

Decision #28
0: Say yes because it felt right
1: Say no because it didn't feel right
2: Get the phone number so that I can decide later (more carefully)
3: Say yes because I thought about how unlikely for him/her to be dangerous
4: Say no because I already have a partner/significant other
5: Say no because I just don't say in situations like this

Decision #34
0: Get married when we are both ready to regardless of anyone else's wishes
1: Get married at least by the age of 30
2: Get married when I am financially stable
3: Get married before I am the only one among my friends who isn't married
4: Would choose the best time after considering all the factors in my life
5: Get married when it feels right

Decision #45
0: Would drive home because you feel fine
1: Wouldn't drive home because I am afraid what might happen
2: Would drive home because I thought about how unlikely bad things (e.g., accident) can happen
3: Would drive home because I wouldn't want to ask anyone for a ride
4: Would stay a while until I felt I was okay then drive home
5: Wouldn't drive home because I thought about how it would be like to get into an accident
LIST OF REFERENCES


