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Running Head: PRACTICAL PROBLEMS

Practical Problems and Decision Making: The Effect of Strategy and Experience

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Abstract

What is the most effective way to make a decision? To examine the impact of strategy at varying levels of experience, 270 undergraduates solved problems in college life. Participants at three Levels of Experience (First Years, Sophomores, and Residential Life Staff) were assigned to one of four Strategy Conditions (Analysis, Holistic Intuition, Time Limit and Control). Results showed a marginal main effect of Level of Experience, a main effect of Strategy Condition, and an interaction of the two. Time Limit was detrimental for all conditions, except for Staff. First Years performed better with Intuition than Analysis, and Staff scored nonsignificantly better with Analysis than Intuition. The time limit was most detrimental to Sophomores. Staff performed equally well across Strategy Conditions.

Practical Problems and Decision Making: The Effect of Strategy and Experience

Two nurses are in the same hospital, caring for geriatric patients on bed rest post surgery. One is a rather new nurse, a year out of school with no prior experience in this type of unit. The other has been working in this unit for more than a decade. During the morning while on her rounds, the first nurse is carefully reading the chart of a patient who has been on bed rest for four days. The patient seems agitated and begins complaining to the nurse, expressing that he feels like something bad is going to happen and that he is going to die soon. The nurse automatically begins to reassure the patient and tells him that he will be fine and on his way home soon. Later that same day, the older nurse checks in on the same patient. He is still agitated and again expresses his fears of soon dying. After glancing at the chart and noting the patient's condition and current state, she immediately starts the patient on oxygen, calls for a doctor, and begins treatment for a pulmonary embolism.

Why is it that the second nurse was able to ascertain the problem in a moment while the first nurse was unable to do so even though she has carefully read the patient's chart? The second nurse automatically knew what to do based on a very small amount of information whereas the first nurse was not paying attention to the most important cues. A heuristic is a mental shortcut where a decision is made based on limited information and in a short amount of time (Gigerenzer, 2004). In situations when there is not enough time or there is too much information to consciously process, heuristics are a way of finding a solution while operating within the contextual constraints of the situation. Because everyday problems often do not allow people the time to consciously and logically analyze situations until the single best solution is found, it is beneficial to

understand how to have adaptive heuristics that will be effective and have a satisfactory result. The purpose of this study is to explore how the level of experience attained by an individual interacts with problem solving strategy, especially under time pressure, as well as how individual differences such as cognitive style affect this process. This study investigates what kind of problem solving strategy: analysis, intuition, heuristics under time pressure is optimal for people at different levels of experience.

Theoretical Views on Decision Making

There are several theories that propose the most effective strategies for solving a problem and how the decision making process occurs. These theories vary widely in approach and how well they work in everyday life and different situations.

Some theories of decision making are based on dual process models of the mind (Hogarth, 2001). Dual process models are based on the basic idea that the mind has two complementary processes, one analytical and the other intuitive, that can work together or against each other. According to one dual process theory, the cognitive-experiential self theory (CEST) of thought, there are two systems that operate in parallel: the rational system and the experiential system (Epstein, Pacini, Denes-Raj & Heier, 1996). The rational system involves analytical and conscious processing while the experiential system is unconscious, intuitive, and affected by emotional concerns. The systems usually interact in decision making but may come into conflict in some cases (Denes-Raj & Epstein, 1994).

There are several internal and external factors that can influence which process is dominant in different situations. One such aspect is the individual's inclination to use one process more than the other in everyday life (cognitive style), to be more rational or

more experiential. Perhaps the first nurse in the example was too logical in this situation and did not see anything in the chart that would indicate a problem. The second nurse might have balanced the two processes better. For example, perhaps the experiential process indicated that there might be a problem based on the patient's concern, and the rational process was able to analyze the possibility of health complications based on the recent surgery.

The format of the problem to be solved is a determining factor in the process. For instance, in a logically based problem, such as a mathematical problem that is best solved with statistics or probability, it is more effective to use the rational process. However, in interpersonal situations it may be more helpful to use the intuition of the experiential process rather than try to break it down for analysis (Epstein et al., 1996). Research by McMackin and Slovic (2000) found that explicit reasoning or analysis is detrimental to decisions in intuitive tasks, but is advantageous in analytical tasks.

The experiential process is similar to theories of intuitive processing. The intuitive process takes in the problem holistically, views it globally without breaking it down or analyzing any single piece of information or even necessarily thinking about it consciously (Lewicki & Hill, 1987). Intuition is the same concept as the experiential process in CEST. The processing capacity of the conscious human mind is severely limited compared to that of the unconscious. Research has shown that the unconscious mind is able to find and process patterns and stimuli that the conscious mind cannot (Lewicki, Hill & Czyewska, 1992). Similarly, studies have found that a period of incubation is more effective in making complex decisions than using the same amount of time to consciously analyze the problem. Dijksterhuis (2004) found that those who

consciously focused on a separate task made better decisions than people who analyzed the problems for the same amount of time. This was attributed to unconscious processing. It has been found that, at times, analysis may actually lead to worse decision making due to crystallization of information and a mental set that traps the thought process in a single track rather than allowing alternatives (Schooler & Melcher, 1995). McMackin and Slovic (2000) also found that explicit reasoning or analysis of an intuitively structured problem led to worse problem solving. If the first nurse intuitively felt that something might be wrong, she may have ignored this feeling because she thought it necessary to have a rational and immediate explanation. Because intuition is unconscious, it is often difficult to articulate clear reasons for decisions made this way while analytical reasoning has a coherent path even if leads to the wrong decision.

Analytical processing is a major part of classical decision making theory. According to classical decision making theory, utilizing probability and statistics is the most effective course in making a decision (Tversky & Kahneman, 1974). In this strategy, one would break down the problem, analyzing every piece of information available and the probability of success until arriving at the most logical result. Research by Epstein et al. (1996) and McMackin and Slovic (2000) have shown the necessity of analytical problem solving in some cases. Problems that are framed analytically and are not conducive to intuition are best solved using analysis. It was once believed that people use this method to make all their decisions, breaking down any problem requiring a decision and analyzing it in full, but research has shown that people often make decisions that are not optimal in terms of probability (Hammond, Hamm, Grassia & Pearson, 1987). It has been concluded that while employing probability and statistics may at times

be the best method for optimally solving a problem, it is rarely used in day to day life. This is because problems often consist of large amounts of information that make problems very complex, very taxing on the limited processing capabilities of the human brain, and practically impossible to solve in a limited time (Gigerenzer & Goldstein, 1996). Because of the limitations of the conscious mind, it may instead employ shortcuts or heuristics based on smaller pieces of information to be able to make a decision.

Heuristics are often considered to be a detrimental and biased process in decision making. In theory, heuristics are mental shortcuts that fail to take into account all aspects of the problem, believed to lead to mistakes or less optimal decisions (Tversky & Kahneman, 1974). Heuristics such as the representativeness and availability heuristics lead to biases in thought and skew perceptions as well, especially when used in problems concerning probability and statistics. The representativeness heuristic is based on stereotypes or preconceived expectations of a schema, thus this heuristic may violate the rules of probability. For example, if a professor of Women's Studies was mentioned in a gender neutral context, most people would likely assume that this professor was female due to the area of study. However, based purely on probability, it is more likely that this professor is male since there are more male professors than female professors. The availability heuristic is utilized when basing a belief of the frequency of an event on how easily it is to think of past occurrences. Rather than being based on the actual frequency of the event, it is based on the experience and perhaps biased memory of the individual. For instance, one might think that men make better politicians because it is easier to think of several famous male politicians, but this is invalid when one thinks of the limited time in which women have been able to be politicians and the situations that women deal with

in trying to break into a traditionally male dominated field. While these assumptions may be incorrect, the information presented often leads to them, thus if the correct information were available, heuristics would not necessarily lead to incorrect decisions.

More recently, some psychologists have argued that heuristics can be adaptive strategies in the decision making process. Adaptive heuristics are viewed as a positive and efficient method of decision making because they allow people to focus only on the information relevant and important to the problem and are based in knowledge and expertise (Goldstein & Gigerenzer, 2002). Gigerenzer (2004) argues that heuristics are the way people actually make decisions in everyday life due to their speed and simplicity. The second nurse was able to effectively use a heuristic because she knew what the important information was. The first nurse did not come to the right conclusion because she tried to take in too much information without focusing on what was important. The concept of heuristic problem solving is based on Simon's (1956, 1982, as cited in Gigerenzer & Goldstein, 1996) model of bounded rationality which stated that rather than finding the optimal solution, people satisfice, or find a solution that is good enough in order to operate in the real world with limitations of time and knowledge. For instance, in relationships one does not necessarily find the best possible partner in the world due to constraints such as time and geographical location. Eventually, however, most people find a partner who meets the requirements to be a good enough partner and are satisfied. Like intuition, it is possible to learn how to use heuristics in an efficient manner. With knowledge and experience, one may learn what information is important and what can be ignored. By learning what to focus on, it becomes possible to make a decision quickly and accurately.

In heuristic processing, there are one or two pieces of information on which a decision is based, but in holistically intuitive processing, the problem is viewed globally, without considering any single piece of information out of the context of the total problem. Often there is not an articulate or explicable reason for a decision made with intuition, though it may still be a good decision. Klein (1998) viewed intuition as the ability to recognize large patterns and react to those cues. Hill (1987) differentiated between the views of intuition as an inferential heuristic and holistic intuition based in unconscious processing. The inferential heuristic view of intuition views the heuristic as a representation of a logical process that unconsciously skips over some of the logical steps to the answer. Holistic intuition is the perception of the whole problem without breaking it down. A study by Dijksterhuis (2004) found that holistic intuition was more effective than analysis in complex problem solving due to unconscious processing over a period of time.

Effects of Context

The environment or context in which a problem occurs is an important aspect in decision making because it interacts with and may determine the success of the decision making strategy utilized. Various factors of the environment and its structure could have a significant impact on the success and efficiency of the decision making process. The amount and quality of information available, as well as factors such as time pressure and stress, are also potentially determining parts of the environment. The environment in the decision making process would be the presentation and format of information (Gigerenzer, 1996).

The way that the information is presented will greatly determine the ability of an individual to utilize the various decision making strategies effectively. Gigerenzer (1996) showed that physicians had less success solving problems presented in the form of probability than in solving the same problem presented in frequency format. It was believed that since people generally have a better understanding of frequency problems they are also better able to use cognitive algorithms or heuristics when dealing with frequency problems than probability. This study also found that a heuristic that focused on the single best piece of information in regards to a problem performed as well as a much more complex model.

The context of the problem in the form of domain and learning structure are also important. The complexity, organization, and uniqueness of the domain controls how well people will be able to solve problems in that domain, whether or not they have preexisting knowledge and experience (Zachary, Ryder & Hicinbothom, 1998). The learning structure of the environment is also significant in how well people are able to learn from their mistakes and successes as they make decisions in a domain (Hogarth, 2001). The quality of feedback after a decision and the consequence of errors in judgment allow people to learn to make better decisions. If feedback is irrelevant and consequences are exacting, the environment is "wicked" and does not allow for learning as a "kind" environment would. A "kind" environment will lead to better decision making overall. A class in which there is inconsistent or unreliable feedback would be a "wicked" environment as students would be unable to gauge their performance and level of knowledge. If this class had only one test on which the grade was based, the consequences would be exacting. This combination of poor feedback and exacting

consequences results in a "wicked" environment for learning. A class that gives consistent feedback throughout the semester would be an example of a "kind" learning environment. Problems in everyday life can often be a "wicked" environment because there is not always clear or immediate feedback. Those with more experience might be better able to deal with a wicked environment due to knowledge gained from past situations.

The amount and quality of the information available is also important. If large amounts of irrelevant or redundant information are presented, making a decision becomes much more complex if one tries to analyze every factor (Gigerenzer & Goldstein, 1996). A smaller amount of information that is relevant is much more conducive to making an optimal decision. The first nurse was trying to take in all the available information on the patient's chart, but did not connect the important information with the patient's concern like the second nurse did.

Research also showed that adding time pressure or stressors to an environment can have significant effects on decision making. Stress occurs due to environmental demands (Driskell, Salas, & Johnston, 2006) and has an impact on thoughts and actions. The interaction of amount of stress or arousal and the complexity of the task or decision results in a variety of potential outcomes. According to the inverted U hypothesis, a high level of arousal is beneficial for simple tasks, but a low level of arousal is necessary for optimal performance on complex tasks (Driskell et al., 2006). Time pressure has been found to be a major stressor that often decreases success as deficient strategies are adopted to adjust for time constraints.

Results vary on the effects of time pressure on decision making behavior. Some research suggested that decision making alone is stressful due to the mental conflict and potential negative consequences of the decisions (George, 1974 as cited in Ben Zur & Breznitz, 1981). The additional stress of time pressure, therefore, makes decision making an unusually stressful process if one is to go about the process in the same way as without time constraint. While it would seem that this necessarily leads to worse decisions, research suggested that decisions under time pressure can be as good, if not better, than decisions without time pressure. Gigerenzer and Goldstein (1996) found that when a heuristic is used that focuses on the single most important piece of information, decisions are faster and more accurate than when the problem is analyzed for a longer amount of time.

Research about how the mind deals with decisions under time pressure mostly suggests three options of how processing changes to deal with the time pressure. Miller (1960, as cited in Ben Zur & Breznitz, 1981) illustrated these options well in his research, referring to them as acceleration, avoidance, and filtration. In acceleration, the information is processed at a faster rate than usual, but in the usual way, potentially overloading processing capacity. Avoidance denotes either making a random choice or no choice at all. The final option is filtration, in which one focuses only on the most important information, ignoring the rest. Bodenhausen (1990, as cited in Kaplan, Wanshula & Zanna, 1993) found that under conditions of stress, including time pressure, people are less apt to weigh individual details and consider possible relationships with other variables. This leads to the use of heuristics. The idea of filtration is very similar to what Gigerenzer (2004) refers to as adaptive heuristics. If people under these

conditions learned how to effectively use heuristics rather than merely trying to make decisions faster with the same strategy, the outcomes would be much more positive. This would also be qualified, however, by the abilities of the individual based on certain differences.

Individual Differences

Individual differences are a key aspect in the outcome of the decision making process. The level of preexisting knowledge of the situation in the form of expertise can have a strong impact on how well one makes a decision. Differences in cognitive style also affect the decision making process.

The level of expertise one has achieved in a specific domain has a large impact on decision making ability in that domain (Ericsson & Charness, 1997). Expertise is determined by the ability one has achieved in a domain as well as the amount of knowledge they have acquired prior to being presented with a problem. This internal knowledge is believed to be a key factor in differentiating between the abilities of novices and experts in a domain (Zachary et al., 1998). Experts are able to distinguish between relevant and irrelevant information, base their decisions on little information, and discern cues that those with less expertise would not (Gigerenzer, 2004). According to the model of recognition-primed decision making (Klein, 1998), experts form prototypes of situations in their experience that allow them to recognize the appropriate response or decision without weighing various options against one another. Perhaps the second nurse had seen situations similar to this patient before and knew how to handle the situation based on that experience. Recognition-primed decision making also allows decision makers to satisfice, especially in situations that call for efficiency and quick action rather

than optimality. Ben Zur and Breznitz (1981) found that previous experience led to less risky decisions as well as speedier decisions based on less information.

Cognitive style also affects the decision making process. Pacini and Epstein (1999) found that there are individual differences in rational and experiential thinking. Aspects of the personality such as optimism, anxiety, empathy and many others can also have a large impact on which process is preferred, as well as how information is processed (Teglasi & Epstein, 1998). Epstein et al. (1996) found that scores of the Rational-Experiential Inventory are reliably related to differences in behavior and responses to vignettes. Two individuals may process the same information differently based on their cognitive style or personality, and thus have different responses to a problem. Kaplan (1976, as cited in Kaplan, Wanshula & Zanna, 1993) found that decisions were often based on not only the information presented, but preexisting beliefs as well. Verplanken (1993) found that differences in the need for cognition made people more or less likely to use heuristics. Under time pressure, those with low need for cognition were more likely to use heuristics than those with high need for cognition due to the need to organize and structure the task mentally. Other research has also found that those with a naturally high level of need for structure operate better under time pressure. Jamieson and Zanna (1989, as cited in Kaplan, Wanshula & Zanna, 1993) found that when cognitive capacity is put under pressure, one is likely to rely on prior conceptions, leading to the use of heuristics.

Interaction of Strategy and Experience

The decision making strategy, the environmental context of the problem, and individual differences each strongly influence the course of the decision making process.

However, the way in which these three aspects come together and interact determine the success of making a decision.

Baylor (2001) suggested a U-shaped curve for the interaction of strategy and experience and the effect on available intuition (the possibility of intuitive thought) and expertise. Baylor suggests that novices and experts would employ intuition more than those with an intermediate amount of experience. Novices have "immature" intuition because they lack knowledge of the domain and they are able to make novel insights into problems. Experts have a high level of knowledge and mental structure in the domain that leads to "mature" intuition. Those with an intermediate level of knowledge and experience in the domain would use analysis in their thought processes as they have some knowledge on which to base a decision, but not enough to be an expert.

Previous research on problem solving strategies and expertise also found that there are differences in strategy optimality for people with different levels of expertise. Pretz (2004) found that novices performed best when using intuition and worst when trying to solve problems analytically. It was also found that experts were most successful when using analysis to solve problems, but do worse with intuition. These findings somewhat conflict with Baylor's (2001) conception of available intuition, but the availability of intuition is not necessarily the same as the accuracy of decisions made with intuition. The "mature" intuition that Baylor attributes to experts would be beneficial in analysis because of the well-developed knowledge structure off of which they can base further decisions. One issue with the study by Pretz was that Freshman students were used as novices and Junior students were experts. There was likely not enough of a difference between the groups to show expertise differences in strategy use, or it

demonstrated the difference between novice and intermediate levels of expertise. If the Juniors were in fact at an intermediate level, these findings would be following those of Baylor.

Rationale

This study investigated the ways in which strategy and individual differences influence optimality in decision making. The focus was on the success of adaptive heuristics as a problem solving strategy and in what situations they are as good as or better than more traditional problem solving techniques. The purpose of this was to find what problem solving strategies worked best for varying levels of experience. There has been much research on Analysis and Intuition, but not often in conjunction with differences in experience level. Heuristics have not traditionally been viewed as a viable problem solving strategy (Tversky & Kahneman, 1974), but it may be important to examine their efficacy at various levels of experience. Researching this area could help learn how to purposefully develop adaptive heuristics, which would be extremely beneficial in certain domains. The use of heuristics in combination with varying levels of experience is not a heavily researched area, leaving questions to be answered. While studies have investigated the relationship of expertise and decision making, it is unknown how the strategy employed and individual differences affect the outcome of the decision making process. It is also unknown how the interaction of heuristic processing and experience will affect the success of the decision making process. It may also be useful to learn more about how people at varying levels of experience could best go about solving a problem.

In this study, there are two independent variables: decision making strategy (i.e. analysis, intuition, or heuristics induced by time limit) and Level of Experience. The decision making strategy was manipulated by the Strategy Condition. Groups were able to solve problems as they normally would (control group), were instructed to use analysis or intuition, or put under time pressure to induce heuristic processing. There were three Levels of Experience based on class year and training as a residential life staff member: First Year, Sophomore, and Staff (Junior and Senior Resident Assistants and Greek Peer Counselors). In addition, cognitive style, the preference for analytical and intuitive processing, was measured. The study investigated the effects each of these variables has on the success of problem solving, and the interactions between the variables that qualify the main effects.

Hypotheses

Hypothesis 1 is that there will be an effect of Level of Experience on problem solving performance. Individuals with more experience will be more successful at solving these problems. Staff will be most successful in problem solving and First Years will be the least successful.

Hypothesis 2 is that the Strategy Condition will affect problem solving performance in interaction with Level of Experience. Hypothesis 2.1 is that more experienced participants (Staff) are expected to have more success in the Analysis condition than the Intuition condition as found in previous research with a similar measure (Pretz, 2004). According to Baylor's U-curve (2001), experts should do best using mature intuition, in this case similar to heuristics, so Staff would do better in the Time Limit condition than other conditions, but due to the constraints of the domain and

based on previous research, it was believed that they would more likely perform better with Analysis. In addition, First Years will do better in Intuition than Analysis because they will focus on the wrong information or try to take in too much information if they try to break down the problem (Pretz). Sophomores will be more successful in Analysis than any other condition because they are mid-range in the U-curve of available intuition (Baylor).

Hypothesis 2.2 is that Staff will perform better in the Time Limit condition than Control because they are more likely to focus in on the important information and base their decisions on that (Gigerenzer, 2004). First Years will score better in the Control condition than Time Limit because they lack the knowledge to focus on the relevant information under the time constraint (Gigerenzer, 2004).

Method

Participants

A total sample of 270 undergraduate students was recruited to participate. There were 179 female participants and 91 male. The mean age of the participants was M=19.00, SD=1.09. There were 114 First year students, 107 Sophomores, and 49 Staff members. First Year students participated within their first two months of college, so they have little experience in college life. The Sophomores had approximately 2-3 semesters of experience in college, but are not necessarily experts in college life. The Staff members were Junior and Senior Resident Assistants (RAs) and Greek Peer Counselors (GPCs). These students not only have more experience in college, but they had also received approximately 120-180 hours of training to aptly assist students in problems with college life.

Participants were assigned to one of four Strategy Conditions: Analysis (N=67), Intuition (N=61), Control (N=69), or Time Limit (N=73). The participants were recruited from general psychology classes for research credit or through the Office of Residential Life for a ten dollar gift certificate.

Materials

The Rational Experiential Inventory (Epstein et al., 1996) was the first questionnaire, a measure of cognitive style. The 40 items are split into four 10-item subscales: Rational Ability measures level of ability to think logically and analytically such as "I usually have clear, explainable reasons for my decisions"; Rational Engagement measures enjoyment of and reliance on thinking logically and analytically such as, "I enjoy intellectual challenges"; Experiential Ability refers to level of ability to form intuitive impressions and feelings like, "I hardly ever go wrong when I listen to my deepest 'gut feelings' to find an answer"; Experiential Engagement is the extent to which the participant relies on and enjoys using feelings and intuition to make decisions such as, "I like to rely on my intuitive impressions." (See Appendix A for the complete questionnaire.) Overall scales for Rational and Experiential thinking are to be determined by summing the subscales on engagement and ability. The items are rated on a Likert scale from one (definitely false) to five (definitely true). The REI is one of the few measures of cognitive style and is used in much research involving decision making and processing styles.

An abridged version of the Myers-Briggs Type Indicator (MBTI) (McCaulley, 1990) was the second questionnaire. It consists of 26 forced-choice items in three sections (see Appendix B). The items chosen to be on this questionnaire focus on the

aspects of personality that are believed to contribute to decision making and problem solving, specifically the Intuitive/Sensate subscale. The Myers-Briggs Type Indicator is a common measure of personality characteristics that is widely used in research. One such item would be "If you were a teacher, would you rather teach: a) fact courses, or b) courses involving theory?" Each response to an item on the MBTI indicates a preference for sensate or intuitive processing. The items showing an intuitive preference are summed to create the MBTI intuition score.

The Practical Problem Solving Survey (PPSS) consists of 20 problems that college students might encounter in everyday life. It is based on two scales, the Everyday Situational Judgment Tacit Knowledge Inventory (ESJI) and the College Student Tacit Knowledge Inventory (CSTKI) (PACE Center, 2002). Each item includes a brief description of a problem scenario with 4-14 possible solutions to be rated on a 7-point Likert scale for solution quality. An example item can be seen in Box 1 along with the consensus means based on expert scores. Items with higher means were rated as better solutions to the problem than those with lower means. According to the consensus means, the best options would be to greet the professor and remind him of who you are or to greet him and ask him for an appointment the following day. The worst solutions would be to ignore him or to greet him and offer to buy him and his kids drinks. The PPSS items were rated by Staff supervisors to determine how much better qualified an RA or GPC's training and experience made them to solve the problem presented in the item. The items were rated on a 5-point Likert scale (1 = no more experienced than the average IWU student; 5 = much more experienced than the average IWU student). The

10 items rated at 3 (somewhat more experienced than the average IWU student) or above were included in the scoring. (Items are included in Appendix C.)

Box 1

"You have decided to apply for an internship during the upcoming break, and want to ask one of your professors for a letter of recommendation. The professor you have in mind is teaching a fairly large class, and he does not know you very well. One day you run in to him in the coffee shop, where he is sitting with what you assume are his kids. Given this situation, rate the quality of the following options:
a) You decide that this is a good time to talk to him about the letter. *M*=3.05
b) You go up and greet him, reminding him of your name and what class you are in. *M*=5.48
c) You greet him and then start chatting with his kids. *M*=4.00
d) You nod but do not talk to him. *M*=3.58
e) You pretend you have not seen him. He probably does not want to deal with students outside of his workplace. *M*=2.85
f) You ask if you can sit down with him and his kids and talk about different things. *M*=3.26
g) You greet him and ask for an appointment with him the following day. *M*=5.03
h) You greet him and offer to buy him and his kids coffee or sodas. *M*=2.90

The accuracy of the answers given was based on distance scores from a mean based on ten Staff in each Strategy Condition. Five men and five women were randomly selected from each of the four Strategy Conditions to form the consensus means on each item. Each participant's score was then calculated based on how far their rating on each item was from the consensus. The absolute value difference was calculated between the participant's rating of each response option and the expert consensus rating of that response option. This difference was then divided by the standard deviation of that response option to account for normal variation. The sum of the difference scores for each response option was then computed for each problem scenario. These item scores were then averaged across all the problems to form the overall distance score.

After the PPSS, the Strategy Use Questionnaire (Pretz, 2004) was administered. This questionnaire assesses the strategies that the participant used in the problem solving

process. There are 11 items based on a 5-point Likert scale as well as an open ended item to describe the participants' problem solving strategies. The questionnaire asks for the items to be rated to indicate the extent to which the participant used the strategy indicated. One sample item is, "Break the problem down into steps." Items measuring the use of heuristics are: "Respond with your initial, gut reaction" or "I would have made more accurate ratings if there had not been a time limit." (See Table 1 for a complete listing).

The final portion of the session was a demographic survey to determine participants' age, year in school, major, and extracurricular activities. This also included a self report item on believed competency in solving the problems they were presented with.

Procedure

The procedure for the Analysis, Intuition, and Control Strategy Conditions was the same, but differed for the Time Limit condition in order to enforce a reliable and consistent time limit on each item. The materials were administered by trained assistants. The Analysis, Intuition, and Control conditions were done in a classroom setting, without a time limit, and with paper and pencil. The participants first completed the REI and MBTI measures. The Analysis and Intuition conditions then received instruction to solve the problems in the PPSS analytically or intuitively. Participants in the Analysis condition were instructed to break the problem down into steps, analyze every piece of information, and assess the probability of success. The Intuition condition received instruction to view the problem holistically, not to consciously analyze any single piece of information, and to skip the problem if stuck. The Control condition received no

special instruction. There was no time limit in these conditions. Once the PPSS was completed, the participants completed the SUQ and demographics survey. The Time Limit condition was administered in a computer lab on an individual basis. First participants worked at their own pace on the paper questionnaires, then the assistants set up the computer portion. The Time Limit condition PPSS problems were presented via the computer program E-Prime. Participants read the problem and then were allotted eight seconds per potential solution to read and rate. Once the participants completed the computer portion, they were instructed to fill out the SUQ and the demographics survey. Once finished, they were given a debriefing sheet. The duration of the total session was between 45 and 60 minutes.

Results

Preliminary results will first be presented, followed by an in-depth analysis as related to the hypotheses earlier presented.

Preliminary Results

The reliability of the measures was calculated using Cronbach's alpha. The Practical Problem Solving Survey was found to have a strong reliability of $\alpha = .852$. The rational subscale of the Rational-Experiential Inventory had a reliability of $\alpha = .844$ and the experiential subscale had a reliability of $\alpha = .888$. The Myers-Briggs Type Inventory intuitive subscale was found to have a reliability of $\alpha = .909$.

The Strategy Use Questionnaire (SUQ) is a manipulation check to measure how well the participants followed the strategic condition in which they participated. Half of the items indicate a use of analytical strategies, while the others are intuitive. The mean scores of each strategy condition on all SUQ items can be seen in detail in Table 1. SUQ

items 2-8 showed a significant effect of Strategy Condition, indicating that the Strategy Conditions significantly differed in the extent to which they utilized the strategies. The effect of Condition on item 1 (imagine the situation vividly) was marginally significant ($F(3,264)=2.40$, $p=.069$), as all the Strategy Conditions had means above 4.00. The Analysis condition had the highest ratings on all but one of the analytical SUQ items, while the Intuition condition had the highest ratings on all but the first of the intuitive items. The means on SUQ items for Control and Time Limit conditions were in between those of the Analysis and Intuition conditions, though Time Limit participants had the lowest scores on items 1 and 8. This indicates that the Time Limit participants viewed themselves as less likely imagine the situation vividly or consider implied information that was not mentioned than the other Strategy Conditions. The Control condition had the lowest scores on items 3, 6, and 7, thus they were less likely to view the problem from a variety of perspectives, monitor their problem-solving process, or skip the problem when stuck.

The Time Limit Strategy Condition SUQ contained three additional items. The item measuring how much the participants responded with their initial, gut reaction had a mean of 3.71 ($SD=1.11$), indicating that the manipulation was successful in this respect. Another item asked how much they felt the time limit forced them to respond more quickly than normal, $M=4.13$, $SD=.90$, again demonstrating the manipulation was effective. The final SUQ item asked if they felt they would have made more accurate ratings without the time limit, $M=3.60$, $SD=1.14$. Overall, the manipulation check was successful.

Pearson correlations were carried out to examine the relationships among the Practical Problem Solving Survey (PPSS), REI rational, REI experiential, and MBTI intuition. There was a small though significant positive correlation between the REI experiential and the MBTI intuition (r=.186, p=.002) and a small significant positive correlation between the REI rational and the MBTI intuition (r=.139, p=.023). While it seems unusual that there be a significant correlation between the rational and intuition subscales, it is due to some similarities in the items. This correlation has been found in other studies as well (Pretz & Totz, in press). There were no significant correlations of cognitive style measures with PPSS (see Table 2).

In order to ascertain group differences in cognitive style, a univariate factorial analysis of variance was carried out on each measure of cognitive style with Level of Experience and Strategy Condition as fixed factors (means and standard deviations can be seen in detail on Table 3). Level of Experience had a marginal main effect on the REI rational subscale, $F(2,258)=2.45$, p=.088, and the MBTI intuition subscale, $F(2,258)=2.46$, p=.088. The Staff group scored marginally higher on the REI rational subscale than the First Year group (p=.096). The Sophomore group scored non-significantly lower on the MBTI intuition subscale than the First Year and Staff groups. No group differences were found on the REI experiential subscale. Because of these potentially confounding group differences, the MBTI intuition and REI rational subscales were included as covariates in ANCOVA analyses.

Hypotheses

It was hypothesized that there would be a main effect of Level of Experience as well as a significant interaction of Strategy Condition and Level of Experience on

problem solving score. An analysis of covariance was conducted on problem solving score with the independent variables of Level of Experience and Strategy Condition with REI rational and MBTI intuition as covariates (Table 4 details the adjusted means for each Level of Experience and Strategy Condition, and Table 5 shows the summary ANCOVA table). A test of between-subjects effects found a marginal main effect of Level of Experience, $F(2, 256)=2.481$, $p=.086$. This lends support to our hypothesis that more experienced participants would perform better than those with less experience. We also found a significant main effect of Strategy Condition, $F(3, 256)=6.530$, $p<.001$. Contrast analyses showed that the Time Limit condition was generally detrimental for all participants, $F(3, 256)=6.530$, $p<.001$. A significant interaction of Level of Experience and Strategy Condition was also found, $F(6, 256)=3.131$, $p=.006$ (see Figure 1).

The finding of an interaction effect was followed with a series of simple effects analyses. These showed that the effect of Strategy Condition was significant for First Years ($F(3, 256)=3.685$, $p=.013$) and highly significant for the Sophomore group ($F(3, 256)=10.631$, $p<.001$). The effect was not significant among Staff ($F(3,256)=1.384$, $p=.248$). First Years in the Analysis condition scored significantly worse than in the Control ($p=.010$) and Intuition ($p=.014$) Strategy Conditions. First Years in the Time Limit condition also scored significantly worse than in the Control ($p=.030$) and Intuition ($p=.042$) Strategy Conditions. The Sophomore group in the Time Limit condition scored significantly worse from Sophomores in all other Strategy Conditions ($p<.001$). While there was no significant difference in problem solving scores among the Staff, they did best in the Analysis condition ($M=.69$, $SD=.13$) and worst in the Time Limit condition ($M=.86$, $SD=.17$).

Simple effects analyses also showed that the simple effect of Level of Experience was significant for Analysis ($F(2,256)=7.49$, $p=.001$) and the Time Limit condition ($F(2, 256)=3.61$, $p=.028$). The effect was not significant for Control ($F(2,256)=.168$, $p=.846$) and Intuition ($F(2,256)=.292$, $p=.747$). First Years scored significantly worse in Analysis than Sophomores ($p=.006$) and Staff ($p<.001$). Sophomores in the Time Limit condition scored significantly worse than First Years ($p=.029$) or Staff ($p=.025$). There were no significant differences in PPSS scores between Sophomores and Staff in any of the Strategy Conditions except Time Limit.

Discussion

The goal of this study was to investigate the effects of strategy and experience on problems and decision making, and to explore how heuristics differ from the strategies of intuition and analysis.

It was found that First Years performed best in the Intuition and Control conditions. They scored significantly worse in the Time Limit and Analysis conditions. Sophomores had similar scores in all conditions except for Time Limit in which they scored significantly worse. Sophomores in the Time Limit condition performed worse than any other group of participants. There were no significant differences across Strategy Conditions for Staff, although they did comparatively best in Analysis and worst in Time Limit.

The first hypothesis was that there would be a main effect of Level of Experience on problem solving scores. This hypothesis was partially supported. Staff were significantly more successful than First Years overall, but there was no difference between Sophomores and First Years or Staff.

The second hypothesis was that there would be an interaction of Level of Experience and Strategy Condition. This was supported with a significant interaction effect, indicating that there were differences depending on the participant's experience and the strategy to which they were assigned. Hypothesis 2.1 predicted that Staff would benefit more from Analysis than Intuition. While there was no significant difference across Strategy conditions for Staff, they did perform comparatively best in Analysis. It was also predicted that First Years would perform better with Intuition than Analysis. This was supported in that First Years had the least success in Analysis and the most in Intuition. The final prediction of 2.1 was that Sophomores would benefit more from Analysis than any other condition. This was not supported as they scored similarly in Analysis, Intuition, and Control.

Hypothesis 2.2 predicted that Staff would perform better in the Time Limit Condition than Control. The result did not support this hypothesis. There were no significant differences among Staff, and Staff scored non-significantly better in Control than Time Limit. The final prediction was that First Years would score better in Control than Time Limit. This hypothesis was supported as First Years scored significantly worse in Time Limit than in the Control or Intuition conditions.

Most of the hypotheses were supported, but there were some unexpected results. The performance of the Sophomores was especially surprising. Although there was a main effect of Level of Experience, there was not a significant difference in scores between Sophomores and First Years or Sophomores and Staff. This may be because there was not enough difference between the Levels of Experience to show the expected effect. It was expected that Sophomores would do best in Analysis, but they might not

have enough experience to analyze well enough to show a benefit of Analysis over the other Strategies. Sophomores scored worst overall in the Time Limit condition. This may be because they have the least amount of intuition available to them (Baylor, 2001) and they need to analyze problems more in depth. The time constraint would not allow this analysis to occur, making that condition extremely detrimental. In addition, Sophomores rated themselves as relying on guesses or hunches (SUQ item 5) less in the Time Limit condition than Staff did in the Time Limit condition, demonstrating Sophomores' lack of heuristics or intuition. Furthermore, Sophomores showed the lowest levels of intuition on the MBTI. Although cognitive style was controlled for, this may still have had some impact.

Another surprising finding was the lack of significant differences across Strategy Conditions for Staff. This may be due to the high amount of experience that Staff have combined with the 120-180 hours of training in how to deal with problems in college life they receive every year, as well as a higher level of social maturity.

The most perplexing finding was that Staff and First Year scores did not significantly differ in the Time Limit condition, while Sophomores scored significantly worse than both. One possible explanation of this is that the Time Limit condition may not have induced the same behavior or use of heuristics in these groups. According to Miller (1960, as cited in Ben Zur & Breznitz, 1981), there are three ways processing may change when under time pressure: acceleration of the normal process, avoidance by making a random choice or no choice, or filtration by focusing on the most relevant information. It may be that First Years were falling back on their intuitive process in the Time Limit condition, but scored worse because they did not have enough time to use

holistic intuition. Sophomores might have been trying to analyze the problems, but the time constraint would not allow them to fully analyze, thus they scored much worse. Staff might have been using actual heuristics due to their experience and knowledge, or they might have just tried to speed up their analytical processing. These differences in Time Limit performance across Levels of Experience may also be showing actual differences in heuristic processing, indicating that it is the best test of experience. As a behavioral manipulation it is more restrictive and requires that heuristics be used or other strategies be accelerated, both of which are not as effective without an adequate amount of knowledge and experience. Another possibility is that the high level of time pressure was an overly stressful manipulation and increased stress arousal to a point where the Sophomores could not make effective decisions as they need to analyze problems. (Driskell, et al., 2006).

This study has several strengths in its design and method. First, in order to approximate expertise, the participants for the Levels of Experience spanned a wide range of experience in the domain of college life. The First Years participated in the first two months of their first semester in college. Sophomores were not much older than First Years, but they had much more experience in dealing with college life than First Year students. The Staff were Juniors and Seniors Residential Life Staff, so they not only have the most experience, but they have many hours of special training in assisting other college students with problems they encounter. A second strength of this study was that the Time Limit condition was a behavioral manipulation to induce heuristic processing and that it did change performance. A further strength is that this study manipulated four different problem solving strategies, and showed significant differences among them. The

use of the SUQ was another strength of this study. With this manipulation check it was possible to make sure that the strategy instruction was effective, thus making the Strategy Conditions viable. The use of the MBTI and REI also allowed cognitive style to be controlled for in the PPSS scores so that these individual differences did not skew the effects of Strategy Condition and Level of Experience. This study is also easily replicable in many settings and domains.

There were two key limitations to this study. The first was the question of expertise. The participants in this study were very similar in age and background, and the Staff, though significantly more experienced than First Years, do not have ten years of experience in the field, a standard definition of expertise (Ericsson & Charness, 1994). In order approximate expertise, a range of experience was used, but findings would be more convincing and perhaps stronger if the domain had allowed for actual experts to be studied.

Another limitation lies in the Time Limit condition. It was intended to induce heuristic processing, but we cannot be sure that the participants were actually using heuristics in this condition. Different processes may have been induced by the time constraint for different Levels of Experience. Rather than using actual heuristics, the groups may have used different processes depending on their level of experience and knowledge. The time constraint was most detrimental to Sophomores, perhaps because (according to the U-curve of available intuition) they are least able to use intuition and need to use analysis, hence they need more time to solve problems. The Staff may have been using heuristics, or they may have just sped up their analytical thought process. First Years might have used intuition, but the time limit was detrimental to that process,

and holistic intuition on complex tasks takes more time due to the unconscious processing.

There is also an issue with how the consensus scores were calculated. In this study they were calculated based on scores of Staff in different conditions, but it would have been a better estimate to have a completely separate group form the consensus scores. There may also be individual differences that were not accounted for in this study that altered the results such as previous school and job experiences, level of social maturity, and experience in time pressure situations. Although much of this experience is variable and likely randomly distributed throughout the sample, there may have been some group effects.

There are many implications about what strategies work best for people depending on their knowledge and prior experience. In general, time pressure does not allow people to make the best decisions possible, but those with a high level of experience will not be as negatively affected as those with less experience. Those with very little experience in a domain should not try to analyze the problem, instead they need to rely on their intuition. Those with some experience will do relatively well regardless of their strategy, as long as they are not under a time constraint. Perhaps because they are beginning to learn what is important in a problem, they need more time to weigh their alternatives. Those with a high level of experience do best when analyzing the problem, but they will do reasonably well regardless of the strategy or if they are under time pressure.

This information may be applicable in many settings, especially in settings that involve a learning process. Often people who are new to a task or domain are told to

analyze the problem carefully, but this study shows that analyzing is the worst strategy for one with little experience. Instead it is important for those with little experience to trust their intuition. As people gain more experience, they may need more time to process through what knowledge they have to come to the correct conclusion, so a high amount of time pressure may be distracting and detrimental in this process. Those with a lot of experience will perform similarly using any strategy, even under time pressure they will not do significantly worse than any other strategy. To come to the best conclusion possible, however, these results suggest they should use analysis.

Further research is needed to determine the relationship of heuristic processing to experience, how to best induce heuristic processing, and what this process entails. It may be possible to give instruction that induces heuristics, such as telling participants to quickly focus on one or two pieces of key information, and base their decision on these. After each problem the participants could write down what information seemed most important in the decision making process or what information they based their decision on. Alternatively, the participants could somehow mark the important information as they read the problem. The effect of individual differences may also be important. It would be interesting to examine the problem solving differences among those inclined to be highly analytical, highly intuitive, both, or neither. Future studies in this area would be better if the domain allowed for a more acceptable range of experience to call expertise such as law enforcement or medicine.

By learning how people with varying levels of knowledge and experience can best make decisions, we can teach people to use the strategies that will help them the most, resulting in better decisions. This research may be of most use in high pressure domains

that require fast decision making with potentially harmful results. Without the intervention of the more experienced nurse, the young nurse's suboptimal decision could have had disastrous results.

References

Baylor, A. L. (2001). A u-shaped model for the development of intuition by level of expertise. *New Ideas in Psychology, 19,* 237-244.

Ben Zur, H., & Breznitz, S.J. (1981). The effect of time pressure on risky choice behavior. *Acta Psychologica, 47,* 89-104.

Denes-Raj, V., & Epstein, S. (1994) Conflict between experiential and rational Processing: When people behave against their better judgment. *Journal of Personality and Social Psychology, 66,* 819-829.

Dijksterhuis, A. (2004). Think different: The merits of unconscious thought in preference development and decision making. *Journal of Personality and Social Psychology, 87,* 586-598.

Driskell, J.E., Salas, E., & Johnston, J.H. (2006). Decision making and performance under stress. *Military Life: The Psychology of Serving in Peace and Combat, 1,* 128-154.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology, 71,* 390-405.

Ericsson, K.A., & Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychologist, 49*(8), 725-747.

Ericsson, K. A., & Charness, N. (1997). Cognitive and developmental factors in expert performance. In P.J Feltovich, K.M. Ford & R.R. Hoffman (Eds.), *Expertise in context: Human and machine* (pp. 3-41). Menlo Park, CA: American Association for Artificial Intelligence.

Gigerenzer, G. (1996). The psychology of good judgment: Frequency formats and simple algorithms. *Medical Decision Making, 16,* 273-280.

Gigerenzer, G., & Goldstein, D.G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103,* 650-669.

Gigerenzer, G. (2004). Fast and frugal heuristics: The tools of bounded rationality. In D.J. Koehler & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making* (pp. 62-88). Malden, MA: Blackwell Publishing.

Goldstein, D.G., & Gigerenzer, G. (2002). Models of ecological rationality: The recognition heuristic. *Psychological Review, 109,* 75-90.

Hammond, K.R., Hamm, R.M., Grassia, J., & Pearson, T. (1987). Direct comparison of the efficacy of intuitive and analytical cognition in expert judgment. *IEEE Transactions on Systems, Man, and Cybernetics, 17,* 753-770.

Hill, O.W. (1987). Intuition: Inferential heuristic or epistemic mode? *Imagination, Cognition and Personality, 7*(2), 137-153.

Hogarth, R. M. (2001). *Educating Intuition.* Chicago: The University of Chicago Press.

Kaplan, M.F., Wanshula, L.T., & Zanna, M.P. (1993). Time pressure and information integration in social judgment. In O. Svenson & J. Maule (Eds.), *Time Pressure and Stress in Human Judgment and Decision Making* (pp. 255-267). New York: Plenum Press.

Klein, G. (1998). *Sources of power: How people make decisions.* (pp. 1-44). Cambridge, MA: The MIT Press.

Lewicki, P., & Hill, T. (1987). Unconscious processes as explanations of behavior

in cognitive, personality, and social psychology. *Personality and Social Psychology Bulletin, 13,* 355-362.

Lewicki, P., Hill, T., & Czyzewska, M. (1992). Noncsonscious acquisition of information. *American Psychologist, 47,* 796-801.

McCaulley, M. H. (1990). The Myers-Briggs Type Indicator: A measure for individuals and groups. *Measurement and Evaluation in Counseling and Development, 22,* 181-195.

McMackin, J., & Slovic, P. (2000). When does explicit justification impair decision making? *Applied Cognitive Psychology, 14,* 527-541.

PACE Center. (2002). College Student Tacit Knowledge Inventory. Unpublished manuscript.

PACE Center. (2002). Everyday Situational Judgment Tacit Knowledge Inventory. Unpublished manuscript.

Pacini, R., & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology, 76,* 972-987.

Pretz, J.E. (2004). Strategy use and experience in complex everyday problem solving: Holistic intuition helps novices and analysis aids experts. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 65,* 1571.

Pretz, J.E. & Totz, K.S. (in press). Measuring individual differences in affective, heuristic, and holistic intuition. *Personality and Individual Differences.*

Schooler, J.W., & Melcher, J. (1995). The ineffability of insight. In S.M. Smith,

T.B. Ward & R.A. Finke (Eds.), *Creative Cognition Approach* (pp. 97-133). Cambridge, MA: MIT Press.

Teglasi, H., & Epstein, S. (1998). Temperament and personality theory: The perspective of cognitive-experiential self theory. *School Psychology Review, 27,* 534-550.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185,* 1124-1131.

Verplanken, B. (1993). Need for cognition and external information search: Responses to time pressure during decision-making. *Journal of Research in Personality, 27,* 238-252.

Zachary, W.W., Ryder, J.M., & Hicinbothom, J.H. (1998). Cognitive task analysis and modeling of decision making in complex environments. In J.A. Connon-Bowers & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training* (pp. 315-344). Washington D.C.: American Psychological Association.

Table 1
Strategy Use Questionnaire by Condition.

Strategy	Analysis (n=67) *M*	*SD*	Intuition (n=61) *M*	*SD*	Control (n=69) *M*	*SD*	Time Limit (n=71) *M*	*SD*	ANOVA *F*(3, 264)
1. *Imagine the situation very vividly.*	4.40	(.70)	4.38	(.68)	4.17	(.91)	4.10	(.88)	2.40+
2. Break the problem down into steps.	3.71	(.75)	2.47	(1.12)	2.89	(1.12)	3.04	(1.11)	15.69***
3. *View the problem from a variety of perspectives.*	4.14	(.74)	4.16	(.70)	3.50	(1.01)	3.56	(1.14)	10.11***
4. Carefully define the problem.	4.12	(.66)	3.27	(1.10)	3.49	(.96)	3.80	(.94)	10.33***
5. *Rely on guesses or hunches.*	2.91	(1.06)	4.27	(.73)	3.24	(1.16)	3.48	(.94)	21.85***
6. Monitor your problem-solving process.	3.47	(.84)	2.63	(1.15)	2.45	(.98)	2.80	(1.04)	13.07***
7. *Skip the problem when you are stuck.*	1.55	(.92)	2.14	(1.25)	1.48	(.88)	1.94	(1.09)	5.99**
8. Consider information that is implied about the situation that is not mentioned in the problem description.	3.87	(.93)	4.07	(.78)	3.82	(.85)	3.59	(1.02)	3.12*

Note: +p<.10, *p < .05; **p < .01, ***p < .001. Strategies rated 1-5 for frequency of use. Intuitive strategies are italicized while analytical strategies are underlined.

Table 2
Correlations Among Measures of Problem Solving and Cognitive Style

Subscale	1	2	3	4
1. PPSS	--	-.022	.039	-.002
2. REI-experiential		--	-.013	.186**
3. REI-rational			--	.139*
4. MBTI-intuition				--

Note: *p < .05, **p < .01.

Table 3
Means and Standard Deviations of REI and MBTI

Expert Group	Analysis (n=67)		Intuition (n=61)		Control (n=69)		Time Limit (n=73)		Total (n=270)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
REI rational										
First Year	71.75	(11.97)	70.39	(10.53)	74.59	(9.14)	74.20	(9.05)	72.93	(10.16)
Sophomore	75.67	(8.85)	72.77	(7.96)	73.20	(7.60)	74.17	(8.00)	73.98	(8.09)
Staff	72.62	(10.79)	77.25	(7.46)	78.40	(9.40)	76.90	(8.06)	76.35	(9.10)
Total	73.45	(10.60)	72.75	(9.13)	74.91	(8.77)	74.56	(8.45)	73.97	(9.24)
REI experiential										
First Year	68.61	(11.02)	71.35	(9.13)	71.03	(11.03)	68.23	(10.57)	69.67	(10.48)
Sophomore	71.85	(9.23)	69.83	(7.90)	70.48	(10.89)	70.79	(9.02)	70.75	(9.19)
Staff	69.92	(10.21)	65.91	(9.21)	66.40	(10.52)	73.90	(10.49)	68.67	(10.29)
Total	70.15	(10.14)	69.63	(8.72)	69.83	(10.87)	70.03	(10.02)	69.92	(9.95)
MBTI intuition										
First Year	13.89	(8.62)	15.21	(5.55)	16.27	(7.05)	17.26	(7.24)	15.77	(7.29)
Sophomore	15.37	(6.56)	13.23	(5.98)	12.84	(6.49)	13.75	(6.48)	13.82	(6.37)
Staff	14.67	(7.47)	14.33	(7.29)	17.06	(6.55)	17.10	(6.40)	15.82	(6.85)
Total	14.63	(7.56)	14.20	(6.06)	15.20	(6.90)	15.85	(6.96)	15.01	(6.90)

Table 4
Means and Standard Errors of adjusted PPSS scores

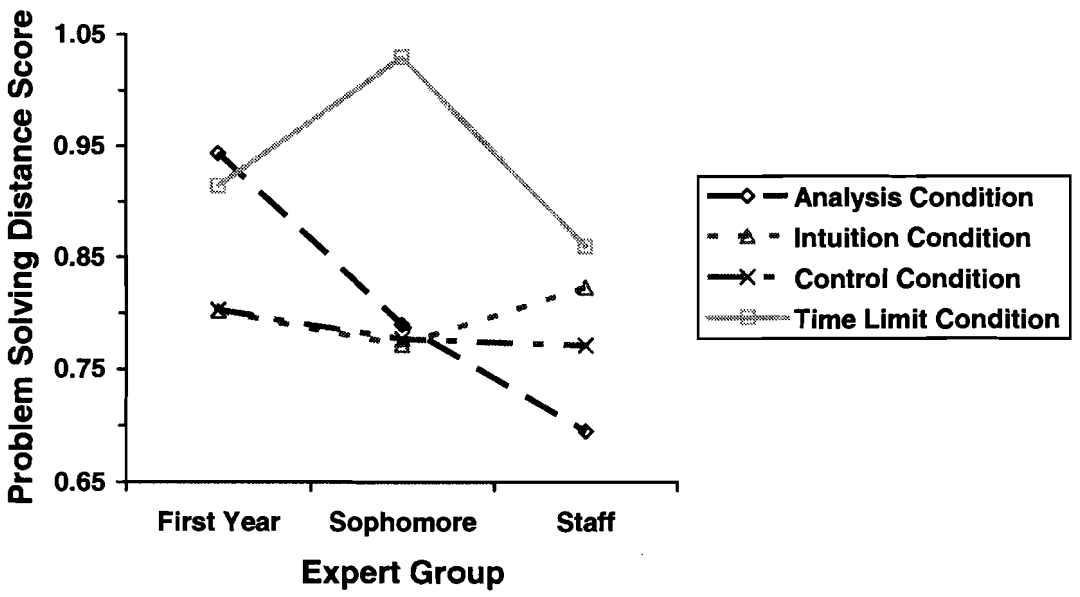
	Analysis		Intuition		Control		Time Limit	
Expert Group	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
First Year	.94	(.04)	.80	(.04)	.80	(.04)	.92	(.04)
Sophomore	.79	(.04)	.77	(.04)	.77	(.04)	1.03	(.04)
Staff	.70	(.06)	.82	(.06)	.77	(.05)	.86	(.07)

Note: Covariates: MBTI intuition and REI rational subscales.

Table 5
Summary ANCOVA Table

Source	Sum of Squares	df	Mean Square	F	p
MBTI intuition	.000	1	.000	.011	.917
REI rational	.025	1	.025	.613	.434
Level of Experience	.206	2	.103	2.481	.086
Strategy Condition	.812	3	.271	6.530	.000
Experience x Strategy	.778	6	.130	3.131	.006
Error	10.607	256	.041		
Total	205.891	270			

Figure 1
Effect of Strategy and Level of Experience on Problem Solving Scores



Note: The y-axis represents distance scores from the consensus of the expert group. Lower values reflect better problem solving performance. MBTI intuition and REI rational subscales were controlled for.

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Appendix A

Rational-Experiential Inventory

Please rate the following statements about your feelings, beliefs, and behaviors using the scale below. Write the number corresponding to your response on the line before each statement.

1	2	3	4	5
Definitely false	Mostly false	Undecided (Equally true and false)	Mostly true	Definitely true

____ 1. I'm not that good at figuring out complicated problems.

____ 2. If I were to rely on my gut feelings, I would often make mistakes.

____ 3. I prefer complex to simple problems.

____ 4. I generally don't depend on my feelings to help me make decisions.

____ 5. I have no problem in thinking things through clearly.

____ 6. When it comes to trusting people, I can usually rely on my gut feelings.

____ 7. Thinking is not my idea of an enjoyable activity.

____ 8. I like to rely on my intuitive impressions.

____ 9. I am not a very analytical thinker.

____ 10. I believe in trusting my hunches.

____ 11. I enjoy solving problems that require hard thinking.

____ 12. I think it is foolish to make important decisions based on feelings.

____ 13. I suspect my hunches are inaccurate as often as they are accurate.

____ 14. I usually have clear, explainable reasons for my decisions.

____ 15. Knowing the answer without having to understand the reasoning behind it is good enough for me.

____ 16. I would not want to depend on anyone who described himself or herself as intuitive.

____ 17. Using logic usually works well for me in figuring out problems in my life.

____ 18. I enjoy intellectual challenges.

____ 19. I can usually feel when a person is right or wrong, even if I can't explain how I know.

____ 20. I often go by my instincts when deciding on a course of action.

____ 21. My snap judgments are probably not as good as most people's.

____ 22. Reasoning things out carefully is not one of my strong points.

____ 23. I don't like situations in which I have to rely on intuition.

____ 24. I try to avoid situations that require thinking in depth about something.

____ 25. I trust my initial feelings about people.

____ 26. I have a logical mind.

____ 27. I don't think it is a good idea to rely on one's intuition for important decisions.

____ 28. I don't like to have to do a lot of thinking.

____ 29. I don't have a very good sense of intuition.

____ 30. I am not very good in solving problems that require careful logical analysis.

____ 31. I think there are times when one should rely on one's intuition.

____ 32. I enjoy thinking in abstract terms.

____ 33. Using my "gut feelings" usually works well for me in figuring out problems in my life.

____ 34. I don't reason well under pressure.

____ 35. I tend to use my heart as a guide for my actions.

____ 36. Thinking hard and for a long time about something gives me little satisfaction.

____ 37. I hardly ever go wrong when I listen to my deepest "gut feelings" to find an answer.

____ 38. I am much better at figuring things out logically than most people.

____ 39. Intuition can be a very useful way to solve problems.

____ 40. Learning new ways to think would be very appealing to me.

Appendix B

Myers-Briggs Type Indicator (abridged)

Please circle the letter corresponding to your answer on the answer sheet.

Part I Which answer comes closest to describing how you usually feel or act?

1. If you were a teacher, would you rather teach
   (a) fact courses, or
   (b) courses involving theory?

2. Do you usually get along better with
   (a) imaginative people, or
   (b) realistic people?

3. Would you rather be considered
   (a) a practical person, or
   (b) an ingenious person?

4. Are you more attracted to
   (a) a person with a quick and brilliant mind, or
   (b) a practical person with a lot of common sense?

5. Would you rather have as a friend someone who
   (a) is always coming up with new ideas, or
   (b) has both feet on the ground?

6. In reading for pleasure, do you
   (a) enjoy odd or original ways of saying things, or
   (b) like the writers to say exactly what they mean?

7. In doing something that many other people do, does it appeal to you more to
   (a) do it in the accepted way, or
   (b) invent a way of your own?

Part II Which word in each pair appeals to you more? Think about what the words mean, not about how they look or how they sound.

8. (a) abstract (b) solid

9. (a) facts (b) ideas

10. (a) statement (b) concept

11. (a) no-nonsense (b) theoretical

12.	(a) theory	(b) certainty
13.	(a) idea	(b) actuality
14.	(a) imaginative	(b) matter-of-fact
15.	(a) make	(b) create
16.	(a) sensible	(b) fascinating
17.	(a) production	(b) design
18.	(a) concrete	(b) abstract
19.	(a) build	(b) invent
20.	(a) imaginative	(b) realistic
21.	(a) theory	(b) fact
22.	(a) possibilities	(b) certainties
23.	(a) novel	(b) already known
24.	(a) practical	(b) innovative

Part III Which answer comes closest to describing how you usually feel or act?

25. Do you generally prefer courses that teach
    (a) concepts and principles, or
    (b) facts and figures?

26. Would you rather
    (a) support the established methods of doing good, or
    (b) analyze what is still wrong and attack unsolved problems?

Appendix C

Practical Problem Solving Survey

Items included in scoring

2. You share a room with another student, and on the whole, you get along well. There is, however, one thing in your roommate's behavior that drives you mad. Your roommate keeps borrowing things from you, like Advil, for example, and never replaces them (although she promises to). So when you have a headache you inevitably find the bottle empty. Given the situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____ a) Tell your roommate not to borrow anything from you.

_____ b) Start borrowing things from your roommate and not replacing them.

_____ c) Tell your roommate how annoyed you are by this situation.

_____ d) Put up a sign in a strategic place saying "always replace what you borrow."

_____ e) Ask your roommate to sit down with you and discuss *do's* and *don'ts*.

_____ f) Present your roommate with the bill for whatever you have had to replace yourself.

_____ g) Ignore it. After all, it is just a detail.

_____ h) Write down everything that bothers you about your roommate's behavior and ask her to do the same about your behavior.

6. Your college is pretty open about students decorating their rooms in any way they want. The deal, however, is that by the summer time, when students are moving out, the rooms should be TOTALLY clean (including the walls). Your roommate is a creative artist. At the beginning of the year she painted a wall in your room (and you agreed that she could do it--at the time the deal was that together the two of you would fix the wall before the move out). All of a sudden, one day before you have to be out of your room, she has a family emergency (her Dad is in the hospital) and has to leave urgently. You are stuck with this wall. Given this situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____ a) Go to a store, buy some paint, and fix the wall yourself.

_____ b) Use the yellow pages and find someone to paint the room. Send the bill to your friend and ask her to pay half.

_____ c) Appeal to your common friends-ask a bunch of them to come over and offer refreshments and snacks.

_____ d) Call your parents and get them to pay the painters.

_____ e) Just leave. You will deal with the situation next year, upon your return to campus.

_____ f) Call your friend and tell her that you need to come up with a solution NOW.

_____ g) Go to the building administrator and explain the situation to him; ask for advice.

_____ h) Find your best friend on campus and tell her that in this instance you really need immediate assistance.

10. One evening, you come to the dining hall and attempt to join the crowd of friends you usually eat with. You get your food, approach the table, and are about to say "Hi, guys!" when, all of a sudden, you notice that nobody greets you or smiles at you. Quite the contrary, some people are looking down while others are just staring at you. Given this situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____ a) Ask your friends what is wrong.
_____ b) Stare back at them and wait for someone to say something.
_____ c) Take a seat at the table, start eating, and pretend that you are not noticing anything.
_____ d) Turn around and find an empty seat elsewhere.
_____ e) Pick the friend of whom you think the most highly and ask him to explain to you what is going on.
_____ f) Find a table of acquaintances (but not friends), go there, and ask them whether they know what is going on.
_____ g) Tell your friends that if they have anything to tell you they can find you at a given seat (and indicate a seat where you will be).
_____ h) Pretend that you are not noticing their reaction and act as if you were joining another group of people.

14. Your roommates and you have established a timetable for the different chores to be done (cleaning, dishes, taking out the garbage, and so on), and today it's your turn to clean the bathroom. This is one of the tasks you most dislike. Cleaning toilets and disgusting bathtubs is not something you enjoy! Given this situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____ a) Suggest to your roommates that you share tasks and always work in pairs--at least you can talk while doing the boring chores.
_____ b) Tell your roommates that you are feeling ill, or come up with another excuse not to accomplish your task.
_____ c) You know it has to be done, so you might as well get it over with as soon as possible.
_____ d) Put it off until the last minute and then do it grudgingly.
_____ e) Promise yourself a treat (like going out and doing something fun, or buying something you have been longing for) once you have finished cleaning.
_____ f) Just clean the most visible parts of the bathroom and leave it to the next person to do a more thorough job.
_____ g) Ask a roommate to switch tasks--you'd rather be vacuuming than cleaning bathrooms.
_____ h) Try to find someone you can pay to do the task for you.

15. Sending you to college has put financial strain on your family. You would like to work in order to make some money and be less of a burden, but such work would take time away from academics, and you feel a strong pressure to succeed academically. Your parents have told you to concentrate on your studies and not to take a job. But you know that the money you could make would be useful. Given this situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____ a) Take a weekend job and study hard during the week.
_____ b) Decide not to take a job: If you do well in college you will get a better job, earn more money, and be able to financially to help your parents in the future.
_____ c) Decide not to take a job because your parents urge you not to.
_____ d) Work a few hours a week but do not tell your parents about it.
_____ e) Take a flexible job that you can do at home (proof-reading, rating, ...) and do it late at night, after you have finished studying.
_____ f) Look for a well-paid summer job rather than an internship.
_____ g) Ask other relatives or friends for money.
_____ h) Switch from a 4-year to a 2-year college in order to start working sooner.

18. Nancy is a college senior. She wants to seek information regarding prestigious colleges to which she might apply for graduate school in mathematics. Rate the quality of each of her following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____a) Ask her academic adviser, who is likely to have information about college graduate programs on file.
_____b) Ask the math professor whom she knows the best, who can assess the merits of different programs.
_____ c) Ask her English professor, who attended a prestigious college and who has two children who also attend prestigious colleges.
_____d) Consult the local university library to see what information is available from college catalogs and from reference books that compare programs.
_____e) Ask her fellow math major classmates where they are applying to graduate school.

22. You are a student representative to a committee that has the power and the money to reform your school system. Your input will help to decide where to allocate the money. You want your contribution to have a lasting impact on the school, but you also want to do something that will be well-received by the students you represent. Rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____a) Give every student a 10% break on their yearly tuition.
_____b) Purchase new uniforms for the track team. The old ones are almost ten years old.
_____c) Invest the money so that it is available in five years to bring state-of-the-art student apartments to your campus.
_____d) Sponsor a refugee family for the year.
_____e) Start a tradition to throw an all-campus, end-of-the-year festival every spring.
_____f) Allocate funds to enable the University to install wireless network technology in the largest dorm on campus.

26. You are in a very challenging class that emphasizes class discussion as the primary basis for a grade. You consider yourself intelligent, curious about ideas, but very shy, self conscious and non-assertive. You learn from the discussion around you but it is very painful to feel that you have to contribute in order to get a good grade. You don't know anyone else in the class, and you don't know the professor. You have to get a good grade in this class to keep a decent GPA. Rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____a) Drop the class, and take another one that better fits your personality and one that you can succeed in.
_____b) Force yourself to ask at least one question in class each day, even if you think your question might make you look stupid.
_____c) Read about the discussion topic ahead of time and ask questions from the readings which you prepared in advance even if your questions don't fit in well with the discussion.
_____d) Keep quiet. You can make up for what you lack in the discussion category by scoring well on quizzes and tests.

27. Someone is talking loudly on her cell phone at the next table in the library while you are trying to write a paper. A courtesy policy exists that states that students may use cell phones in the library if they use them in the stairwell. Rate the quality of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____a) Politely ask the girl to go to the stairwell if she wants to use her cell phone.
_____b) Do nothing.
_____c) Make a mental note to buy earplugs before your next study session in the library.
_____d) Talk loudly to yourself. The person talking on the cell phone will realize how annoying that she is being.
_____e) Go to the librarian and tell her about the problem.
_____f) Say to your friend who is sitting next to you, "Don't you hate it when people talk on cell phones in the library," loud enough for the perpetrator to hear.
_____g) Move to a table that is out of earshot.

30. You are assigned to oversee a big project. You know you need to break the project down into a series of concrete tasks. Given the present situation, rate the quality of each of the following options:

1	2	3	4	5	6	7
Extremely Bad	Very Bad	Somewhat Bad	Neither Bad Nor Good	Somewhat Good	Very Good	Extremely Good

_____a) Calculate how long the project will take.
_____b) Figure out what is the most interesting aspect of the project.
_____c) Figure out how many people it will take to do the project.
_____d) Ask one of your colleagues how she would organize the project.
_____e) Figure out which individual tasks need to be done in order for the whole project to come together.
_____f) Assemble a committee and then ask them to decide how to organize the project.
_____g) Thoroughly analyze the benefits of this project.
_____h) Figure out how this project compares with others that you have done in the past.

Appendix D

Strategy Use Questionnaire

We are interested in the strategies you used to solve these everyday problems. Below is a list of strategies you may have used in rating the response options for the problem scenarios you just solved. Using the scale below, please indicate **the extent to which you used each strategy in solving this set of problems**. We are interested in what strategies **you actually used** in solving these problems. (Circle the number that corresponds to your response.)

	Not at all		**Sometimes**		**Frequently**
Imagine the situation very vividly.	1	2	3	4	5
Break the problem down into steps.	1	2	3	4	5
View the problem from a variety of perspectives.	1	2	3	4	5
Carefully define the problem.	1	2	3	4	5
Rely on guesses, hunches, or feelings.	1	2	3	4	5
Monitor your problem-solving process.	1	2	3	4	5
Skip the problem when you are stuck.	1	2	3	4	5
Consider information that is implied about the situation that is not mentioned in the problem description.	1	2	3	4	5
Respond with your initial, gut reaction.	1	2	3	4	5

Please indicate whether you agree or disagree with the following statements.

	Strongly Disagree		**not sure**		**Strongly Agree**
The time limit caused me to respond more quickly than I normally would have.	1	2	3	4	5
I would have made more accurate ratings if there had not been a time limit.	1	2	3	4	5

If you would like to tell us more about your problem-solving strategies for these problems, please comment below.

_____

_____