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Trait Anxiety as a Moderator of Problem Structuring Effects on Solution Generation

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This study investigated the effects of problem structuring and anxiety on the quantity and quality of solutions generated for ill-structured, complex problems. Trait anxiety, the tendency to feel anxious across a wide variety of situations, has been shown to impair problem solving performance in certain conditions. Trait anxiety was examined as a possible moderator of the relationship between problem structuring and solution generation. Participants were 184 undergraduate psychology students. Participants completed a trait anxiety measure (State-Trait Anxiety Inventory; Spielberger, 1983) and generated solutions to an ill-structured problem, with varying levels of structuring (no objectives, one-objective-at-a-time, conflicting objectives). The quantity and resolving power of solutions generated was assessed by raters. Participants in the one-objective-at-a-time condition generated more solutions than those in the no objectives condition or the conflicting objectives condition, as predicted. Contrary to hypothesis, trait anxiety did not moderate the relationship between problem structuring and solution generation.

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> Even the mild stress that arises when a decision maker anticipates slight losses or uncertain risks may have discernible effects on the quality of his search and appraisal activities. (Janis & Mann, 1977, p. 49)

Problem solving and decision making are crucial skills needed by managers. On a daily basis, managers are confronted with complex, multi-faceted problems that require satisfactory resolution. Compounding the difficulty of this real-world problem solving is the presence of multiple objectives, and the fact that satisfying one objective often comes at the expense of neglecting others. One can readily call to mind examples of managers who were more and less successful at this problem solving task. There are many possible sources for these differences in problem solving success. Characteristics of the situation, of the problem, and of the problem solver may all be partly responsible for differences in the quantity and quality of solutions generated to ill-structured problems. The present study was designed to examine variables that may predict the problem solving success of individuals when faced with ill-structured problems. Two independent variables were examined for their effect on the quantity and quality of solutions generated; trait anxiety and problem structuring.

Research on decision making has identified possible moderators of the relationship between problem structuring and the quantity and quality of

solutions generated. Possible moderators include situational forces, characteristics of the problem, and characteristics of the problem solver.

One characteristic of problem solvers that has been examined is level of knowledge or experience in problem solving (Butler & Scherer, 1997). Another possible moderator is trait anxiety. The distinction between state and trait anxiety was first proposed by Cattell and Scheier (1960). State anxiety is a temporary emotional state, while trait anxiety is a predisposition to feel state anxiety across a wide variety of situations (Spielberger, 1972). Trait anxiety has been shown to impair performance on a variety of cognitive and problem solving tasks (e.g., Montague, 1953). The cognitive tasks examined in prior research, however, could all be classified as well-structured problems; a neglected area of research is the effect of trait anxiety on the solution generation process for ill-structured problems.

Problems can be classified by their level of structure. Well-structured problems have known, fixed alternatives. The decision maker's task is simply to choose from among these alternatives (Abelson & Levi, 1985). Ill-structured problems, in contrast, have unknown objectives and unknown alternative choices. This type of complex problem is frequently encountered by individuals in daily life. In order to find the best solution to ill-structured problems, individuals can limit and organize the available information through structuring (Butler & Scherer, 1997).

One way to structure a problem is to consider objectives that one wants to address. Pitz, Sachs, and Heerboth (1980) discussed the idea that giving a problem solver objectives aids decision making by calling to mind certain information from memory and limiting the interference of other information. Pitz et al. found that giving participants one objective at a time led them to generate more solutions than participants given no objectives or conflicting objectives. A possible explanation for this result is that fewer constraints had to be satisfied for a solution to be generated when only one objective was present; thus solution generation in the one-objective-at-a-time condition was more prolific. Scherer and Billings (1999) and Butler and Scherer (1997) examined the effects of structuring not only on the quantity, but also on the quality of solutions generated. They found that structuring the problem through the presentation of objectives influences the quantity and resolving power of solutions.

The present study examined the role of trait anxiety as a moderator of the effect of problem structuring on solution generation using a real-world problem. This research is important because it has implications for managers who need to be aware of their workers' personality traits which may predispose employees to impairments in problem solving. Finding that high trait anxious individuals suffer impairments under certain structuring conditions would suggest that modifying the problem solving situation, attempting to reduce the individual's anxiety, or both, would facilitate the generation of high quality solutions.

The remainder of this chapter will be devoted to discussion of problem structuring, solution generation, and anxiety. First, an overview of problem solving/decision making research will be presented, including models for how the process works or should work. Next, research on problem structuring using objectives will be reviewed. Then, a discussion of research on anxiety and its effect on cognitive task and problem solving performance will point out the need for research on trait anxiety and ill-structured problem solving. Finally, the present study will be discussed as an investigation of the role of trait anxiety in the problem structuring/solution generation relationship.

Models of Problem Solving/Decision Making

Many researchers have attempted to outline the stages that are involved in the process of problem solving/decision making. Several models have been proposed (e.g., Abelson & Levi, 1985; Bazerman, 1986; Kepner & Tregoe, 1965). There is no widely agreed-upon model, but several possibilities will be discussed here. These models generally involve the use of "steps" that people adhere to or should adhere to in order to make the best choice. The discussion will begin with prescriptive models; that is, what steps decision makers *should* follow. Then descriptive models, describing what decision makers *actually* do, will be discussed. The bulk of this discussion will center on Abelson and Levi's model of decision making.

One prescriptive model of problem solving/decision making is that of

Kepner and Tregoe (1965). In their model, problem solving involves seven phases. The first is to establish objectives. Objectives outline what the decision maker is trying to accomplish, and they lay the groundwork for the decision making process. According to Kepner and Tregoe, objectives should be specific and should describe the goal precisely. For example, if a manager has to solve a problem regarding profit decreases, an objective might be to "increase profit 10% by the next accounting year." The second phase is to classify objectives according to importance. The third phase is to generate alternatives. Kepner and Tregoe suggest examining each objective by itself and analyzing what alternatives would satisfy that objective. The fourth phase is to evaluate alternatives against the objectives to make a choice. The individual can use a numerical scale for this, and rank each alternative according to each objective. Fifth, the decision maker should choose the best alternative tentatively, with "best" being defined as the alternative with the highest weighted score. The sixth phase is to assess possible adverse consequences from the choice, and finally, to control effects of the final decision. The model proposed by Kepner and Tregoe is a prescriptive model which discusses what managers *should* do when they are presented with a problem.

Another prescriptive model was offered by Bazerman (1986). Bazerman outlined six steps in a rational decision-making process. The first is to define the problem, the second is to identify the criteria, the third is to weight the criteria,

the fourth is to generate alternatives, the fifth is to rate each alternative on each criteria, and the last is to compute the optimal decision. The last step refers to a process of multiplying several variables to find an expected value for each alternative. The alternative with the highest expected value is then chosen. This model assumes that people have the cognitive resources and are willing to expend the effort to follow an orderly series of steps and to apply complicated judgements to their decision making tasks. Bazerman's model indicates what people *should* do when making a decision, not what they actually do.

The previous models have in common their assumption that decision makers are cognitive "spenders"; that is, that they are willing and able to exert cognitive energy towards applying complex formulas to the problem solving task. These models seem to apply only to well-defined decision problems. The discussion will now turn to research on ill-defined decision problems.

In their classic review of decision making research, Abelson and Levi (1985) made an important distinction between well-defined and ill-defined decision problems. A well-defined problem is characterized by fixed alternatives from which one must choose. The objectives and their probability of occurring are known. An example of a well-defined problem is choosing from among various automobiles to purchase. Ill-defined problems, in contrast, are characterized by uncertainty. Luce and Raiffa (1957, as cited in Abelson & Levi, 1985) defined uncertainty as "the inability to assign specific probabilities to

outcomes." In solving an ill-defined problem, a decision maker may try to reduce this uncertainty, thus turning the problem into a well-defined one. Several methods can be used to reduce decision uncertainty.

Abelson and Levi (1985) outlined a phase theorem which describes the process one follows in solving an ill-defined problem. The stages are as follows: (1) problem recognition, (2) identification of alternatives, (3) evaluation of alternatives, and (4) selection of an alternative. Each of these stages will now be discussed in detail.

The first stage in Abelson and Levi's (1985) phase theorem is problem recognition. A problem is said to exist when there is a perceived discrepancy between an actual state and a desired state. The problem must be sufficiently arousing to motivate the individual to act, and the individual must also perceive that he/she has the necessary ability to come to a satisfactory resolution. Abelson and Levi pointed out that there is very little research on this phase of problem solving, and attributed this neglect to the fact that the problem recognition stage is simply taken for granted.

The second stage in Abelson and Levi's (1985) model is identification of alternatives. The first step in identifying alternatives is often structuring the problem (Abelson & Levi, 1985; von Winterfeldt, 1980). Structuring involves identifying properties, outlining the decision context, and generating alternatives (Butler & Scherer, 1997). According to von Winterfeldt (1980), problem

structuring is probably the most important part of decision analysis. He discussed the structuring process in terms of three phases: (a) identifying the problem, (b) developing an overall structure, and (c) refining the problem elements and relations.

The stage of problem structuring is the focus of this investigation; thus, research on problem structuring will be considered in depth. Problem structuring research is in its infancy and only three studies have been conducted to empirically examine this process. These three studies will be considered at length.

The first study to systematically manipulate problem structuring was that of Pitz et al. (1980). These researchers discussed the lack of problem structuring research as troublesome because of the tendency for problem solvers to omit important elements at this stage. A decision maker can become fixated on certain aspects of the problem, leading to a discounting of other important aspects. Another possible error at this stage occurs when schemata are evoked by the problem. Once certain schemata are evoked, it may be difficult for the problem solver to deviate and develop new ways of thinking about the problem. The goal of the researchers was to examine structuring as a way to improve decision quality by insuring that all relevant alternatives were considered. As Scherer and Billings (1999) noted, the researchers seemed to equate solution quantity with quality, and assumed that the best way to increase the quality of

the ultimate decision would be to insure that all possible relevant alternatives were generated.

Pitz et al. (1980) asked participants to generate alternative solutions to personal choice dilemmas, such as a dilemma regarding what to do about a roommate who uses marijuana. Participants were encouraged to list all alternatives that might be relevant; however, the responses were then scored on the basis of how sensible they were. Points were given for generating solutions, but points were taken away for unrealistic solutions. As noted by Scherer and Billings (1999), this may have constrained the participants' generation of alternatives.

Seven conditions were used in the Pitz et al. (1980) study. They were derived from three kinds of treatments: categorization, objectives, and controls. The categorization category involved two treatments in which participants were presented with examples of solutions arranged in either a hierarchical form by the objectives each satisfied, or an unorganized form. The purpose of this treatment was to see if the structuring of example alternatives led participants to generate more alternatives. The second treatment was the manipulation of objectives. Eight objectives were generated by the experimenters and their presentation to the participants was varied. Participants were assigned to the following objective conditions: all eight objectives simultaneously, one objective at a time, or two objectives at a time. Finally, two control groups were used. In

one control condition, participants were told that objectives are an important consideration, but were not given any objectives to consider. The second control group received no special instructions.

The dependent variable in the Pitz et al. (1980) study was quantity of solutions generated. This variable was assessed by first creating a list of all alternatives generated by all participants. These alternatives were organized into broad categorizes, excluding ones that were too similar to distinguish or that were frivolous. The number of alternatives generated that appeared in the list were then counted for each participant. Pitz et al. found that only the one-objective-at-a-time condition differed from the others. Participants generated significantly more alternatives in this condition than in the other conditions. Post-hoc analyses of the novelty of alternatives generated were conducted to determine whether the extra responses in the one-objective-at-a-time condition were more unusual than alternatives generated in the other conditions. This variable was assessed by calculating the average relative frequency for each alternative a participant generated. When analyzed as a covariate, no differences were found for the novelty variable. This means that participants who generated a large quantity of solutions did not necessarily generate more unusual or novel solutions.

Pitz et al. (1980) offered two possible explanations for their findings. One possibility was attributed to Gettys, in personal communication with the first

author. Gettys suggested that the presentation of one objective at a time leads decision makers to feel fewer constraints in their generation of alternatives. The idea is that when only one objective is present, the decision maker is less constrained in his/her attempt to generate solutions that satisfy that objective. The more objectives that are presented, the more constraints there are in alternative generation. The other possible explanation is that the one-objective-at-a-time condition leads to a more thorough cognitive search than the other conditions. The researchers concluded with the prescription that decision makers should attempt to consider alternatives not previously considered, and that this should increase decision quality.

Scherer and Billings (1999) pointed out several limitations of the Pitz et al. (1980) study. One of these is the assumption that the best way to increase decision quality is to insure that the decision maker generates a large number of alternatives. Scherer and Billings hypothesized that different results of structuring would be obtained for quantity and quality, and that an increase in one did not necessarily correspond to an increase in the other. Another limitation of the Pitz et al. study was the instruction given to only list sensible alternatives. Scherer and Billings instead supplied brainstorming instructions, so that participants would not be restrained in their generation of alternatives. Scherer and Billings examined the effect of various structuring techniques on the quantity and resolving power of solutions generated. They used two of the problems from the

Pitz et al. study; one about a college student whose roommate smokes marijuana, and the other about a research assistant who is unhappy with her assigned project.

Scherer and Billings (1999) manipulated problem structuring through the presentation of objectives. The objective conditions were as follows: (a) one objective at a time, (b) two conflicting objectives at a time, (c) two congruent objectives at a time, and (d) no objectives. The dependent variables were quantity and resolving power of solutions generated. Two measures of quantity were considered; the number of non-repeating alternatives and the number of different categories represented by the alternatives. Resolving power was defined as the degree to which a solution addresses conflicting aspects of the problem (Upshaw, 1975). It was operationalized both as the average resolving power of all alternatives generated by each participant, as well as the number of highly resolving solutions (those rated 5 through 8 on an 8-point scale) generated by each participant.

Scherer and Billings (1999) hypothesized that the one-objective-at-a-time condition would lead to the generation of the greatest number of alternatives, followed by the congruent objectives condition, the conflicting objectives condition, and the no objectives condition. The second major hypothesis was that the conflicting objectives condition would result in solutions with higher resolving power than the other three conditions. The final hypothesis was that

quantity and resolving power would be negatively correlated.

Participants in the Scherer and Billings (1999) study generated solutions to a pre-test problem and two test problems. Analysis of covariance was applied to the results with the quantity and resolving power of solutions generated to the pre-test problem serving as the covariate. Pilot research was conducted to determine which of the problems used in the Pitz et al. (1980) study could be applied to the Scherer and Billings study. Only the marijuana problem and the research problem yielded a set of four objectives that could be matched to form congruent and conflicting pairs. Thus, these two problems were used as the problems in the main experiment.

In the Scherer and Billings (1999) study, participants were instructed to generate all the alternatives they could think of. The effort each individual expended, as measured by time spent generating solutions, was kept constant. Each participant was constrained to think about the problem for 20 minutes. In the one-objective-at-a-time condition, participants were instructed to turn each of the four pages at 5-minute intervals. In the conditions where four objectives were presented in pairs, participants were given 10 minutes for each set of objectives. Finally, in the no objectives condition, participants spent the entire 20 minutes thinking about the problem and generating solutions with no objectives. It is important to note that the presentation of objectives merely made the essential conflict of the problem salient. Participants were not told to only list alternatives

that satisfied the objectives presented. Problem structuring through the use of objectives simply highlights the essential conflict of the problem.

The hypothesis regarding solution quantity was strongly supported. Participants generated more solutions and more categories of solutions in the one-objective-at-a-time condition than in the no objectives or conflicting objectives conditions. The no objectives condition resulted in the fewest alternatives being generated. This finding suggests that any objective presentation is better than no objectives in increasing the number of alternatives generated.

For solution resolving power, the results were complicated by a three-way interaction between structuring, problem, and presentation order. Results were more supportive of the predictions for the research problem than for the marijuana problem, and also for resolving power operationalized as the number of resolving solutions than for the average resolving power of solutions. For average resolving power, significant main effects were found for the research problem regardless of the order in which it was presented. The average resolving power in the conflicting objectives condition was significantly higher than that in the one-objective-at-a-time condition, as predicted. The average resolving power in the no objectives condition was also significantly higher than in the one-objective-at-a-time condition. In addition, the research problem produced a set of alternatives of higher average resolving power ($\underline{M}$ = 4.48) than the marijuana

problem (M = 3.79).

For resolving power operationalized as the quantity of resolving alternatives (those rated five through eight), a significant interaction between structuring and order of problem presentation was obtained. When the marijuana problem was presented first, no significant differences were obtained for quantity of resolving alternatives by structuring condition. When the research problem was presented first, however, the conflicting objectives condition resulted in more resolving alternatives than any of the other conditions, as predicted. In addition, the congruent objectives and one-objective-at-a-time conditions resulted in more highly resolving alternatives than the no objectives condition. Similar to results obtained for average resolving power, a greater number of resolving alternatives was generated for the research problem (M = 3.96) than the marijuana problem (M = 2.67).

Moderate support was obtained for the third hypothesis, that of an inverse relationship between quantity and resolving power of alternatives. The one-objective-at-a-time condition resulted in more alternatives than the conflicting objectives condition, but fewer highly resolving alternatives and alternatives with lower average resolving power. There was a significant, negative correlation between the quantity of non-repeating alternatives and the average resolving power of alternatives, as predicted. However, the correlation between the quantity of non-repeating alternatives and the quantity of resolving alternatives

was not negative as predicted, but positive.

Scherer and Billings (1999) concluded that problem structuring through the use of objectives does influence the way a decision maker generates solutions, in terms of both solution quantity and quality. In discussing their results, Scherer and Billings noted that the alternatives generated for the marijuana problem had overtones of emotionality, and that this emotionality may have restricted participants' ability or willingness to pay attention to structuring. For emotionally involving problems, decision makers may be more likely to "take sides" rather than examine the various aspects of the problem. The research problem, with its lower emotional involvement, may have led participants to be more objective and receptive to information in the problem, thus leading them to generate more highly resolving alternatives. Another possible influence offered by Scherer to explain the complex pattern of results was a moderator such as familiarity with the problem. Familiarity could play a role through determining which scripts are activated. If the problem is very familiar, the decision maker may simply follow a script that was useful for previous instances, and disregard the problem structure.

Several important points can be made about this study. First, it separated the influence of structuring on the two independent variables of solution quantity and resolving power of solutions. Second, it raised the possibility that some other variables may be moderating the relationship between structuring and solution

generation. Familiarity with the problem and emotionality aroused by the problem were suggested as possible moderators. Finally, this study was the first test of a structuring manipulation on solution generation with instructions to participants that maximized their reporting of alternatives.

Butler and Scherer (1997) conducted a third examination of problem structuring through objectives. In addition, they examined the effect of a moderator variable, that of expertise. The variables examined were problem structuring through objectives, expertise, and order of problem presentation. The dependent variables were the quantity and quality of solutions, with quality defined as the resolving power of the solutions. Resolving power was calculated three ways: as a proportion of alternatives that received a three or higher (out of six) on a resolving power scale, as the number of alternatives rated three or higher, and as the highest rating given to that set of alternatives.

In the Butler and Scherer (1997) study, experts and novices generated alternatives to two problems; one about a female lawyer experiencing sexual harassment (Carol's problem), and another about an organization facing competition for its engineers (Acme's problem). The expert group consisted of 57 graduate business students, and the novice group consisted of 72 undergraduate students enrolled in psychology courses. Participants were given either one objective at a time, two conflicting objectives simultaneously, or no objectives. All participants generated solutions to both problems, with the order

of problem presentation varied. It was predicted that experts would diverge from novices in both the quantity and quality of their solutions. Specifically, experts were predicted to generate fewer alternatives, but more resolving alternatives, than novices. The conflicting objectives condition was expected to elicit solutions with higher resolving power than the one-objective-at-a-time condition. Finally, the one-objective-at-a-time condition was expected to elicit more solutions than the conflicting objectives condition.

Replicating the results of the Pitz et al., (1980) and Scherer and Billings (1999) studies, participants in the one-objective-at-a-time condition generated significantly more alternatives than those in the conflicting objectives condition. Contrary to prediction, experts generated more alternatives than did novices. Results for quality of solutions varied depending on the operationalization of resolving power. For number of resolving alternatives, the effects of structuring and expertise were complicated by a significant two-way interaction between expertise and problem, and a significant three-way interaction between expertise, problem, and problem order. Follow-up comparisons indicated that for the Acme problem, participants who received one objective at a time generated a larger number of resolving alternatives than those who received no objectives. Consistent with predictions, experts generated significantly more resolving solutions than did novices, for both problems.

For resolving power calculated as the proportion of resolving alternatives,

a significant interaction was found between objectives, problem, and problem order. Post hoc comparisons revealed one significant difference: The Acme problem elicited a greater proportion of resolving alternatives in the one-objective-at-a-time condition versus the no objectives condition, when it was presented second. Finally, for resolving power calculated as the highest resolving solution, no significant main effects or interactions were found.

Further analysis by Butler and Scherer (1997) of the problem and order effects revealed that participants generated significantly more resolving solutions, and had a higher rated top alternative, for the Acme problem than the Carol problem. Previous research had found the Carol problem to elicit more feelings of emotional involvement than the Acme problem. Thus, Butler and Scherer had expected higher quality solutions to be generated for the Acme problem than for the Carol problem. In addition, participants who received the Acme problem first generated fewer resolving solutions than those who received the Carol problem first. For all three operationalizations of resolving power, experts generated more resolving alternatives for the Acme problem than the Carol problem.

To summarize the results of Butler and Scherer (1997) relevant to the present study, the presentation of one objective at a time generally led to a larger number of alternatives being generated than the presentation of two conflicting objectives or no objectives. Presenting one objective at a time led to

the generation of alternatives with higher resolving power as compared to no objectives. The conflicting objectives condition elicited more resolving alternatives than the no objectives condition, although this effect did not reach significance.

The results obtained by Butler and Scherer (1997) for the effect of structuring on quality differ somewhat from those obtained by Scherer and Billings (1999). Recall that Scherer and Billings found the conflicting objectives condition to elicit more resolving alternatives generally than the other conditions. In the Butler and Scherer study, different problems were used and the effects of structuring were complicated by an interaction between objectives, problem, and problem order. This interaction may indicate that characteristics of the problem may influence the effects of structuring on solution generation. One potentially important difference between the Scherer and Billings study and the Butler and Scherer study is that the former used problems about students, and the participants probably had experience with similar problems. The Butler and Scherer study deliberately used problems to which students would be unlikely to relate. An acceptable conclusion seems to be that structuring influences the quality of solutions to a greater extent for non-emotionally involving problems than for emotionally involving problems.

Only three studies have examined the effect of structuring through the presentation of objectives on the quantity and quality of solutions generated to ill-

structured problems. One conclusive finding has been that the way a problem is structured has important implications for the quantity and quality of solutions generated (Butler & Scherer, 1997; Pitz et al., 1980; Scherer & Billings, 1999). Presenting one objective at a time leads problem solvers to generate more alternatives than presenting them with conflicting objectives or no objectives. But these solutions, although numerous, are not necessarily of high quality. Quality has been shown to be affected by the structuring method applied (Butler & Scherer, 1997; Scherer & Billings, 1999), by the particular problem for which alternatives are generated and the order of problem presentation (Butler & Scherer, 1997; Scherer & Billings, 1999), and by expert status in the domain of problem solving (Butler & Scherer, 1997).

Returning to the discussion of Abelson and Levi's (1985) phase theorem for decision making, Abelson and Levi outlined two different methods for developing a structure for a problem. The first method is structuring by matching. This technique is likely to be used when the problem solver has lots of experience or expertise in the domain of the problem. In this method, the problem is assigned to a category based on experience with similar problems. This assignment to a category enables the individual to reduce the uncertainty present in an ill-structured problem but does not necessarily insure that the optimal solution will be reached. The technique may lead the problem solver to neglect information unique to this particular situation.

The second method for structuring a problem is structuring by hypothesis generation. This method is typically used by decision makers with little knowledge or expertise in the area. It involves generating hypotheses about how and why the decision problem arose. This process was discussed by Gettys and Fisher (1979; as cited in Abelson & Levi, 1985) as one in which memory searches are used to generate hypotheses. Problem structuring is an important area of the problem solving process to consider, for the requirements and phases involved in well-structured and ill-structured problem solving may differ substantially. According to Pitz et al. (1980), "When problems are less well defined, there are serious obstacles to be overcome before a decision analysis can be used" (p. 396).

After structuring the problem, the decision maker has to identify alternative actions. Abelson and Levi (1985) point out the importance of framing, or what they call diagnosis, to this process of generating alternatives. For example, a manager's diagnosis of a productivity problem as being due to the laziness of his/her current staff implies a different set of actions than a diagnosis of incompetent management. According to Abelson and Levi, diagnoses can advance or inhibit the alternatives that are generated.

The third stage in Abelson and Levi's (1985) model is evaluation of alternatives. The overriding theme in this stage seems to be that people are limited in their cognitive processing capacity. When evaluating alternatives,

people's preferences are often ambiguous and variable, but the overall goal of the evaluation process is to reduce uncertainty inherent in an ill-structured problem. This evaluation of alternatives may involve strategies such as predicting how likely various outcomes are or predicting the ways in which these outcomes will affect one's goals, and drawing a conclusion or "best guess" about how likely various outcomes are.

Finally, the fourth stage in Abelson and Levi's (1985) model is selection of an alternative. This stage may involve emotions such as stress, disappointment, and regret. Abelson and Levi stressed that the phase model is a convenient way to capture the decision making process, but that problem solvers often do not follow an orderly sequence in their efforts and may cycle back to earlier stages in the model.

As was noted earlier, there is no single agreed-upon model for the ill-structured problem solving process. However, variations on the basic form of the model just discussed are quite common in the literature. As concluded by Abelson and Levi: "These phases correspond more or less to the modal pattern used by most decision theorists as a framework to organize research on ill-defined decision problems" (p. 277).

In a descriptive study of problem solving effectiveness and individual differences, Heppner, Hibel, Neal, Weinstein, and Rabinowitz (1982) identified several differences between traditionally "effective" and "ineffective" problem

solvers. The goal of the study was to extend the knowledge of variables affecting the real-life problem solving process. Heppner et al. used the Problem Solving Inventory (PSI; Heppner & Petersen, 1982), a self-report measure of personal problem solving behavior and attitudes, to identify successful and unsuccessful problem solvers. They then conducted structured interviews with the 20 highest and 20 lowest scorers on the PSI about their cognitive, behavioral, and affective reactions to interpersonal and intrapersonal problems. After the interview, participants completed the Mooney Problem Checklist, which asks respondents to report instances of problems falling into various categories such as finances, adjustment to college work, and social-psychological relations.

Heppner et al. (1982) found a variety of differences between successful and unsuccessful solvers of real-life problems. Specifically, participants who perceived themselves in ways consistent with effective problem solving rated themselves as being more systematic in problem solving, less impulsive and less avoidant, and reported having clearer understanding of problems. Effective problem solvers also were more motivated to solve problems, expected a more positive outcome of problem solving, and were more likely to brainstorm, than ineffective problem solvers. The authors noted the limitation of correlational research, and pointed out the need for further research on the relationship between self-reported problem solving effectiveness and objective analysis of problem solving skill with real-world problems.

The Heppner et al. (1982) study provides a foundation for the examination of trait anxiety as a possible moderator of the relationship between problem structuring and solution generation. Heppner et al. discovered that many differences exist between those who perceive themselves as effective or ineffective problem solvers. As will be discussed in the following section, level of trait anxiety may be one of these differences.

The focus of the chapter will now turn to anxiety. The first issues to be discussed include theories of anxiety and differences between anxiety and other constructs. Next, literature examining the effects of anxiety on various tasks will be presented. The chapter concludes with a summary of relevant research, and outlines the present investigation of the effect of trait anxiety on the relationship between problem structuring and solution generation.

Anxiety as a Construct

Anxiety is one of the most prevalent emotions discussed in psychological literature and theory. Every normal human experiences anxiety in his/her lifetime, and many on a daily basis. Anxiety can be beneficial or detrimental to performance, depending on factors related to the individual, the task, and the situation. The present section of the chapter will review several definitions of anxiety, and outline the one adopted for this investigation.

Many definitions of anxiety have been proposed, but there is no single agreed-upon definition. Theorists typically focus on either the physiological

aspects of anxiety or on the psychological elements. One definition of anxiety that incorporates both components was developed by Spielberger (1983). According to Spielberger, anxiety refers both to an unpleasant emotional state, and to a relatively stable personality trait. He described state anxiety as being characterized by "subjective feelings of tension, apprehension, nervousness, and worry, and by activation or arousal of the autonomic nervous system" (Spielberger, 1983, p. 4). The distinction between anxiety as a temporary subjective state and anxiety as a personality trait is central to his Trait-State Anxiety Theory, (Spielberger, 1972) to be discussed later in the chapter.

A second definition to be considered is the one adopted in the current investigation. Janis and Mann (1977) outlined the effects of stress that can result from dealing with certain kinds of decisional conflicts. Later in the chapter, the differences between stress and anxiety will be considered. Despite Janis and Mann's use of the term "stress" rather than "anxiety", their definition will be adopted because it seems to overlap more with common definitions of anxiety than of stress.

According to Janis and Mann (1977), "psychological stress" refers to a negative emotional state evoked by environmental incidents or stimuli which the individual perceives as threatening. They elaborated on this definition, stating,

> A 'stressful' event is any change in the environment that typically induces a high degree of unpleasant emotion (such as anxiety, guilt, or shame),

and affects normal patterns of information processing. (p. 50)

This definition was adopted as a definition of anxiety because it focuses on the psychological and cognitive processing components of anxiety.

Attempts have been made to distinguish anxiety from the similar constructs of fear, stress, and worry. Many examples can be found in the literature of researchers using the three terms interchangeably, although different processes seem to be involved in each. Although the affective states of fear, stress, worry, and anxiety may share certain characteristics, distinctions will be attempted for the sake of clarity.

Anxiety versus fear. The first distinction to be made is between anxiety and fear. A common distinction made by researchers between anxiety and fear lies in the source of the emotion. Anxiety is defined as having a largely unknown or unrecognized cause, while the source of fear tends to be consciously recognized. Spielberger (1976) agreed with this conception, and added that the amount of fear a person feels is generally in proportion to how much objective danger is present, while the magnitude of anxiety can reach far beyond the level warranted by the situation. Levitt (1980), and Lazarus (1966), took a different position, stating that fear and anxiety are interchangeable terms. Despite having perhaps slightly different shades of meaning, Levitt claimed that it is not meaningful to distinguish the two. In the anxiety literature, researchers often use the two terms interchangeably.

Anxiety versus stress. Stress is another term that tends to be used interchangeably with anxiety in the literature. A problem that arises when attempting to distinguish between stress and anxiety is the fact that there is no agreed-upon definition of either construct. Many different definitions of stress have been advocated by researchers, with definitions focusing variously on the situation, the reactions by the individual, or the state of the individual. Spielberger (1972) outlined a process that relates stress, threat, and anxiety. He asserted that stress refers to the objective properties of a situation. Cognitive appraisal is the next step; if a person perceives a situation as stressful, he/she is said to be feeling threat. Spielberger used the term state anxiety to refer to the result of this perceived threat.

Lazarus (1966) distinguished between physiological stress and psychological stress. One difference between the two is that physiological stress is a response to damage already incurred, while psychological stress refers to a feeling of impending harm indicated by signals in the environment. According to Lazarus, stress involves three classes of variables: (a) stimuli or situations that are harmful or dangerous, (b) cognitive appraisal that moderates the relationship between stressors and physiological changes that occur in stressful situations, and (c) stress reactions, which include emotional arousal and behaviors. Many other definitions of stress have been promoted. For example, Seyle (1980) defined stress simply as "the nonspecific response of the body to any demand"

(p. 127). To summarize, stress is typically considered a stimulus in the environment or a physiological reaction to a stimulus, versus a subjective emotional reaction.

Anxiety versus worry. A final term that is often confounded with anxiety in the literature is that of worry. Worry seems to be the closest of the three terms to anxiety, and its definition has generated considerable debate; therefore, it will receive the most discussion. Borkovec, Robinson, Pruzinsky, and DePree (1983) proposed a definition of worry which follows:

> Worry is a chain of thoughts and images, negatively affect-laden and relatively uncontrollable. The worry process represents an attempt to engage in mental problem solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes. (p. 10)

O' Neill (1985) disagreed with this conception of worry for two reasons. First, he claimed that the definition does not correspond with the casual use of the term. For example, if one is "worried" after taking an exam because he/she fears the score may be low, he/she is not engaging in problem solving, but just feeling worried about the result (O' Neill, 1985). The second argument was that adding the term worry does not add to the understanding of behavior, because worry is the cognitive component of anxiety. O' Neill cited studies that demonstrated that worry and anxiety both affect behavior in the same way;

hence, he felt is not meaningful to distinguish the two.

Borkovec (1985) responded to the objection to worry being considered apart from anxiety by pointing out that studying worry, as one component of anxiety, could lead to a greater understanding of anxiety as a complex phenomenon. Borkovec also claimed that problem solving cognition is present in examples such as a student awaiting a test result. Borkovec framed the issue in "What if..." terms. For example, the student might say, "What if I get kicked out of school?", or "What if I have to move home?", and this, according to Borkovec, represents a form of problem solving.

Worry appears to be the key component of both trait anxiety and of generalized anxiety disorder (Eysenck, 1992). According to Eysenck, worry is a major component of anxiety, specifically, the cognitive component.

To summarize the discussion of anxiety versus other constructs, an overriding problem is that there is no consensus regarding how the constructs should be defined, let alone a consensus on how to distinguish them. In the author's opinion, anxiety is different from fear in that fear generally results from a localized source, while the source of anxiety can be diffuse. Anxiety differs from stress in that stress refers to the properties of a situation or stimulus, whereas anxiety results from the interpretation of the stimulus as threatening. Finally, the construct of worry, according to most researchers, can be subsumed under the category of anxiety, namely, as its cognitive component.

Theories of Anxiety

Since the time of Freud, numerous theories of anxiety have been proposed. These theories originate from diverse perspectives in psychology, including physiology, cognition, emotion, and affect. The difficulty lies in the fact that none of these theories is widely accepted. Writing in 1989, McReynolds concluded:

> At the present time there is no generally accepted overall theory of anxiety. Rather, there are a number of restricted conceptions that concentrate upon limited aspects of the human anxiety experience. (p. 3)

Several theories of anxiety will be reviewed here. The first is that of Spence and Spence (1966). The theory holds that individuals differ in their emotional responsiveness, and that they react with different drive (anxiety) levels as a function of this emotional responsiveness. This variation in drive level (anxiety level) is said to result in variations in performance on cognitive tasks. Spence and Spence found that high-anxious individuals tended to make task-irrelevant responses which impaired their performance in some situations, compared to low-anxious individuals. Whether or not high-anxious individuals suffered performance decrements on a particular task depended on whether task-irrelevant responses were detrimental or facilitating to performance. Spence and Spence found that under conditions of stress or threat, task-irrelevant responses resulted in detriments in performance for high-anxious individuals.

Spielberger (1966) conducted a series of experiments to test the presumptions of drive theory, in the context of anxiety's effect on complex learning and academic achievement. Spielberger found support for Spence and Spence's theory, in that high-anxious individuals performed worse than their low-anxious counterparts on complex or difficult tasks that elicited a number of competing responses, compared to simple learning tasks that elicited few competing response tendencies. Spielberger also found that inducing anxiety maximized the performance differences between high and low anxious individuals. At the time, the most frequent measure of anxiety was the Manifest Anxiety Scale (Taylor, 1953, as cited in Spielberger, 1966). Spielberger was unclear whether he was assessing characteristics of the situation or characteristics of the individual using this instrument; this may have led to his development of the Trait-State Anxiety Theory, to be discussed next.

Possibly the most prominent theory in the anxiety literature is Spielberger's (1972) Trait-State Anxiety Theory. The distinction between transient, short-term (state) anxiety, and the chronic predisposition to (trait) anxiety, was first identified by Cattell and Scheier (1960). According to Spielberger, state anxiety is a temporary emotional state characterized by subjective feelings of worry and apprehension and autonomic arousal. He claimed that an individual will experience state anxiety in situations that are subjectively regarded as threatening, even if there is no objective danger

present. Trait anxiety, in contrast, represents a predisposition in an individual to feel state anxiety across a wide variety of situations. It is a relatively stable personality characteristic. Spielberger's theory predicts that people high in trait anxiety are likely to perceive a larger variety of situations as threatening, and to feel anxiety with greater intensity, than those low in trait anxiety.

Spielberger's (1972) theory also identified which situations would be likely to be perceived as threatening for high and low trait anxious individuals. According to Spielberger, those high in trait anxiety are likely to find evaluative situations as more threatening than those low in trait anxiety. Situations involving a threat of physical danger, in contrast, tend to be perceived similarly in threat level for those low and high in trait anxiety. The theory predicts differences in performance on cognitive tasks for high and low trait anxious individuals. According to Spielberger, high trait anxious individuals will be likely to suffer performance decrements when they feel threatened (when state anxiety levels are elevated), and that this is likely to occur when: (a) the task or its instructions involve direct or implied threats to self-esteem, or (b) the task is difficult. Spielberger noted that there are individual differences in what situations one finds threatening, and that it is important to take actual measures of state anxiety rather than assume a given situation will be threatening and will result in elevated state anxiety.

Tests of Spielberger's (1972) theory have yielded mixed results. It

appears that the relationship between trait anxiety, state anxiety, and performance on cognitive tasks is more complex than Spielberger might have predicted. Research has attempted to outline the differences in the cognitive processing, physiological responses, and behavior of high trait anxious and low trait anxious individuals. While gains have been made in predicting the circumstances under which trait anxiety moderates various outcomes, no theoretical model has yet been advanced to explain these results. As Eysenck (1991) pointed out:

> It is very clear from the literature that individuals high and low in trait anxiety differ significantly in behavioral, physiological, and cognitive functioning, and it seems important for theory to account for these differences. This might not be necessary if responses from all three systems were concordant, but there are numerous cases in which little or no concordance has been obtained. (p. 82)

While Eysenck (1991) did not offer a theoretical model to fill this void in the research, he did conduct one of many empirical studies in the area, attempting to delineate the effects of trait anxiety on one outcome: cognitive processing. In this study, Eysenck used a dichotic listening task with threatening and non-threatening cues to determine the processing differences between low and high trait anxious individuals. He found that high trait anxious individuals devoted more cognitive processing to threatening words than did low trait

anxious individuals. While interesting, this result does not directly translate into predictions about the implications of such processing. It could be that increased processing leads to higher quality outcomes because of more thorough search, or conversely, that increased processing leads to hypervigilance and lower quality outcomes. As noted by Eysenck, a theoretical model is needed to fully explain the antecedents and consequences of the differences in processing between low and high trait anxious individuals.

As in the study by Eysenck (1991), most research on trait anxiety has involved a manipulation of threat. As will be discussed in more detail later in the chapter, the purpose of manipulating threat has been to maximize the differences between high and low trait anxious individuals. According to Spielberger (1972), the main difference between low and high trait anxious individuals lies in their perception of and response to threat.

The remainder of the chapter will outline research on the effects of anxiety on cognitive tasks and problem solving. In the following section, research will be reviewed which has examined the effect of anxiety on well-defined problems. The research in this area is vast and contains a wide variety of manipulations and variables. For example, some researchers have examined the effect of trait anxiety, some have examined state anxiety as it exists naturally, others have induced state anxiety, and others have studied the joint effects of state and trait anxiety. Several of the most relevant studies will be reviewed.

Consequences of Anxiety

Many researchers have studied the effect of varying intensity levels of state anxiety on cognitive processing and problem solving. The results for participants experiencing extreme levels of state anxiety have been consistent: Extreme anxiety has an adverse effect on almost any activity. One study of the effect of high state anxiety on a task was conducted by Patrick (1934). He used a task which had been developed by Hamilton in 1916. The problem consisted of an enclosure that had four exit doors evenly spaced. On each trial, only one of the doors was unlocked, and the position of the unlocked door changed on each trial. The participant's task was to find this open door. The most efficient way to do this was to try each of the other three doors that had not been locked on the previous trial.

Patrick found a range of solutions that were typically used by both human and animal participants. As would be expected, humans who were solving the problem under normal conditions tended to use optimal solutions, while rats, under normal conditions, exhibited less effective methods for finding the open door. Under conditions of severe anxiety (cold water streams blasted at participants, electric shocks), however, human responses tended to mimic those of rats, becoming much more ineffectual. The effect of extreme anxiety on problem solving is clear.

For moderate levels of anxiety, the effect of anxiety on behavior and

problem solving is more complex, and is moderated by characteristics of the task, characteristics of the situation, and characteristics of the individual. The literature in this area is vast and rather disconnected, in that no agreed-upon theory of anxiety guides the predictions. Many of the researchers whose work will be reviewed have examined competing theories regarding why anxiety has an effect on problem solving performance, in addition to predicting whether or when anxiety will affect performance.

In one of the earliest studies on anxiety and problem solving, Montague (1953) found that high anxious participants performed slightly better on an easy list of nonsense syllables they were to memorize, but poorer on a difficult list, than their less-anxious counterparts. Montague explained his results in terms of drive theory, contending that with difficult tasks there are more competing responses, and that high-anxious individuals are especially likely to be affected by these, resulting in impaired performance. The distinction between trait and state anxiety had not yet been made; it is unclear whether Montague was measuring a stable personality characteristic or some temporary effect of the situation. It is possible that the difficult task induced state anxiety in high trait-anxious participants and this elevated state anxiety impaired performance; conversely, it is possible that the task (whether easy or difficult) did not induce anxiety, and that the findings indicated that high trait-anxious individuals perform more poorly on difficult tasks regardless of elevated state anxiety.

Another study that examined the interfering cognitive responses of those high in anxiety was that of Fabry and Dvorakova (1992). These researchers studied the effect of anxiety on risky decision making in chemical operators. They found that under conditions of threat, anxiety reduces cognitive control and prolongs the time needed to come to a decision. The explanation given by Fabry and Dvorakova involves the shift of focus in high and low anxious individuals. According to Fabry and Dvorakova, under conditions of threat or stress, high anxious individuals tend to focus on themselves and on cues irrelevant to the task, while low anxious individuals tend to focus on cues relevant to the task. This task-irrelevant focusing by high anxious individuals leads to prolonged time being used for problem solving and to the generation of lower quality solutions.

In a third study on the possible cognitive interference experienced by those high in anxiety, Zarantonello, Slaymaker, Johnson, & Petzel (1984) examined the effects of anxiety and depression on several components related to anagram performance. Seventy-two participants were selected on the basis of their (high or low) scores on the trait form of the State-Trait Anxiety Inventory (Spielberger, 1983), the Beck Depression Inventory, or both. Each participant was given 60 anagrams to solve in 5 minutes. They then completed a questionnaire which assessed their feelings of cognitive interference and their subjective evaluation of their performance on the task.

Results of the Zarantonello et al. (1984) study revealed that high trait

anxious participants tended to solve fewer anagrams than their low trait anxious counterparts. High trait anxious participants reported spending significantly longer thinking about how well they were performing the task (cognitive interference), and reported a significantly more negative evaluation of their performance, than low anxious participants. The authors attributed their findings to the effect of trait anxiety. An alternative explanation, however, is that the instructions to participants to complete as many anagrams as they could in 5 minutes elevated their state anxiety, and thus the high trait anxious participants suffered performance impairments on the task. It can be therefore be argued that the results obtained by Zarantonello et al. were a combined function of high trait and state anxiety induced by a time limit. State anxiety data were not collected, so this hypothesis is merely speculatory.

To summarize the three previous examinations of anxiety on problem solving performance, it is possible that individuals high in trait anxiety will experience impaired problem solving performance when: (a) the task is difficult, or (b) the decision maker is under stress or threat.

The focus of the chapter will now turn to studies examining competing theories of why anxiety has an effect on performance. The first to be discussed was conducted by MacLeod and Donnellan (1993). According to these researchers, two characteristics of the task have been found to reliably influence the relationship between anxiety and problem solving success: task difficulty and

task requirements, in terms of the need for strategic processing (MacLeod & Donnellan, 1993). Highly anxious individuals tend to experience performance deficits on relatively difficult cognitive tasks, but not on easy tasks. Eysenck's (1982) review of this research reported that over 20 studies have found that the performance of highly anxious individuals suffers most for difficult, as compared to easy, tasks. MacLeod and Donnellan reported that anxiety deficits are most often found when the task requires strategic, rather than automatic, processing of information. Eysenck's explanation of this finding incorporates the need for working memory capacity. According to Eysenck, complex cognitive tasks are more likely to make use of strategic processes, which require more working memory resources than those tasks that make use of automatic processes. This latter moderator of the relationship between anxiety and problem solving is more controversial than the first; thus, MacLeod and Donnellan sought to provide a more definitive examination of it.

MacLeod and Donnellan (1993) measured decision latencies on a grammatical reasoning task, performed under conditions of either a low or a high memory load. Three hypotheses were tested. The first was that the performance deficit resulting from high anxiety on complex tasks would be manifested through longer decision latencies for high than for low anxious participants. The second was that all participants would show longer decision latencies under the high simultaneous memory load condition than under the low simultaneous memory

load condition. The final prediction was that an interaction between the first two hypotheses would be found. Specifically, it was predicted that high anxious participants would show especially slow decision latencies under the high simultaneous memory load condition.

The results of this study indicated that higher trait anxiety is related to performance deficits on complex cognitive tasks. Specifically, high trait anxious participants exhibited significantly longer response latencies than low trait anxious participants. The results of this study were consistent with Eysenck's (1982) theory that working memory is the crucial factor in explaining the performance deficits experienced by high trait anxious individuals performing complex cognitive tasks.

In another attempt to predict and explain the effects of anxiety on problem solving performance, Paulman and Kennelly (1984) examined test anxiety and exam skills in the context of cognitive task performance. Their goal was to attempt to resolve the conflicting findings in studies on the performance of high and low anxious individuals. Most studies had found that high anxious individuals perform worse on cognitive tasks than those low in trait anxiety, but some studies had found no deficit for high anxious individuals. Paulman and Kennelly identified the skill of being able to focus one's attention as a moderator which may account for these results. A person high in trait anxiety who is able to focus his/her attention may suffer no performance deficit on the primary task, but if

additional, concurrent tasks are presented, performance should be worse than that of low anxious individuals.

Leon (1989) examined the extent to which state anxiety influences the inclusiveness of information processing. Leon reviewed previous research which had generally found that anxiety impairs performance on a variety of tasks. She noted that most researchers explain this decrement in performance in terms of the anxious individual's failure to include all relevant information. Leon examined several possible processes which could account for the incomplete processing of information by high state anxious individuals. The first is the possibility that anxious individuals have a reduced range of cue utilization. The second is the tendency of high anxious individuals to divide their limited processing resources between task relevant and task irrelevant concerns. Support for this possibility comes from research findings that indicate high anxious individuals experience more unrelated cognitions, engage in more off-task glancing, spend less time attending to the task, and work more slowly on tasks than low anxious individuals. The third possibility is a reduction in working memory capacity caused by high anxiety. This theory was developed by Eysenck (1979) who assumed that anxious individuals have reduced processing capabilities, and divide their limited resources among task-relevant and task-irrelevant information, thus creating a dual-task situation. Eysenck further posits that working memory is the part of the processing system most directly affected by

this concurrent processing. The capacity of working memory is limited, and the division of this limited capacity among task relevant and task irrelevant concerns leads to performance decrements for high anxious problem solvers.

Leon (1989) used an analogical reasoning task to accomplish two goals: first, to assess the inclusiveness of information processing for high and low state anxious individuals, and second, to identify the cognitive processes responsible for any differences in performance between high and low anxious individuals. The task was such that participants were allowed to make two types of errors. The first type was errors of exclusion, in which an incorrect solution would result from excluding relevant information. The second type was errors of inclusion, in which an incorrect solution would result from the inclusion of irrelevant task information. Several variations on the analogy task were used.

Related to the first purpose of examining the inclusiveness of information processing, Leon (1989) found that high state anxious individuals made significantly more inclusion errors regardless of task, and more exclusion errors with few-transformation analogies, than low anxious participants. Related to the second purpose of the study, that of examining cognitive processes responsible for the performance decrement for high anxious participants, Leon found support for the second set of predictions made by attentional theory and working memory capacity theory. These predictions are that high state anxious participants are in a dual-task situation, and will thus experience a reduction in processing speed

which leads to a strategy of lowered information processing. Leon concluded that state anxiety leads people to divide their attentional and/or working memory resources between relevant and irrelevant information. This division of cognitive resources leads to a reduction in information processing rate, and lowers the amount of information processed.

The previous studies examined the influence of anxiety on task performance. But can state or trait anxiety be induced or elevated by the problem solving task itself? Riedel, Taylor, and Melnyk (1983) sought to answer this question. They examined the effect of creative and non-creative problem solving on state and trait anxiety. Humanistic theorists had claimed that creative problem solving raises state anxiety, and Riedel et al. sought to examine this prediction. They tested two hypotheses using 57 undergraduate participants. The first hypothesis was that a divergent (creative) problem solving task would raise state anxiety as compared to a convergent or neutral problem solving task, and second, that trait anxiety would be unaffected by the type of problem solving task. Participants completed both the state and trait scales of the State-Trait Anxiety Inventory (Spielberger, 1983), before and after the task. The task in all conditions involved a list of thirty common objects, such as "book", "tie", "rope", etc. In the divergent condition, participants were instructed to list as many possible uses for each object as they could. In the convergent condition, instructions were to define each word. Finally, in the neutral problem solving

condition, participants were to copy each of the thirty words sixty times, as quickly as they could. In addition, participants rated the problem solving task in terms of adjectives such as "difficult," "boring," etc.

Contrary to the first hypothesis, Riedel et al. (1983) found that the neutral problem solving condition led to the largest increase in state anxiety. The divergent (creative) problem solving condition led to the smallest increase in state anxiety, and the convergent problem solving condition resulted in a moderate increase in state anxiety. Consistent with the second hypothesis, trait anxiety scores were unaffected by the problem solving condition. For the post-task evaluation scale, divergent problem solving was rated as more enjoyable, less stressful, less annoying, and less difficult than convergent and neutral problem solving.

Several points can be made about this study. First, as noted by the researchers, instructions in the neutral condition to copy the words as fast as one could eliminated this condition as an effective control group. One of the most common methods for inducing state anxiety has been to administer time pressure, so it was to be expected that this condition would result in the greatest increase in state anxiety. The authors pointed out that a better test of this hypothesis would have been to keep the instructions consistent across conditions, except for the manipulation. Second, the fact that trait anxiety (as measured by the State-Trait Anxiety Inventory) did not increase across the three

conditions supports Spielberger's (1983) claim that the trait anxiety scale is "relatively impervious to the conditions under which it is given" (p. 11). Third, the results demonstrate that state anxiety can be affected (increased) by the problem solving task, although the researchers did not examine the effects of this increased anxiety on the solutions generated in any of the conditions. Perhaps elevated anxiety would have resulted in impaired performance; for example, a lower number of possible uses for items in the divergent condition, less correct definitions of words in the convergent condition, and fewer words copied in the neutral condition. Finally, the researchers in this study did not examine differences in state anxiety and perceptions of the problem solving task as a function of participants' trait anxiety. Perhaps trait anxiety would have moderated the extent to which participants' state anxiety was increased by the task, as well as possibly influencing the quality and quantity of the solutions they generated.

Much of the research on anxiety and problem solving has been focused on well-defined tasks that have one correct answer, such as anagram completion and word definition. Several studies have attempted to increase the generalizability of anxiety research, and two of these will be reviewed next.

In one study that attempted to increase the generalizability of anxiety research, Mayer (1977) examined the joint effects of trait and state anxiety on task performance, with both clerical or "rote" tasks and general reasoning or

"cognitive" tasks. Mayer sought to improve the generalizability of anxiety research by including more complicated problems than had been previously used. Mayer employed a task overload manipulation by giving participants a set of problems to solve without enough time to finish. The independent variables were trait anxiety (high versus low), pacing (self-paced versus experimenter paced), and type of task (rote versus general reasoning/cognitive). The dependent variables were solution time and proportion correct. Mayer predicted interactions between pacing and task, between pacing and trait anxiety, and between trait anxiety and task.

The tasks used in Mayer's (1977) study were classified into clerical/"rote" and tasks and general reasoning/"cognitive" tasks. The rote tasks included a target search for all instances of a particular letter in a passage and 60 division and subtraction problems with two- and three-digit numbers. The cognitive tasks included anagrams, a matchstick problem, connecting nine dots with four consecutive lines, and a card trick. Each participant was assigned to a trait anxiety condition based on his/her score on the STAI, and randomly assigned to a pacing condition. Each participant completed all eight tasks. The hypotheses were tested in three separate studies.

Experiment one examined pacing and type of task, without regard to trait anxiety. Results revealed that self-paced participants performed better (higher proportion correct) on the rote tasks, and poorer on the cognitive tasks, than

experimenter-paced participants. Experiment two examined trait anxiety and pacing. Eight tasks (4 rote, 4 cognitive) were completed by all participants. Mayer found that self-pacing had no effect on the performance (proportion correct) of low trait anxious participants, but improved the performance of high trait anxious participants. Results for solution times were similar. Further analysis of this result indicated that the performance of the self paced / high anxious individuals increased during the second half of the experimental session.

Experiment three examined trait anxiety and pacing, with all participants completing four rote and four cognitive tasks. Results of experiment three indicated that for solution times: (a) self-pacing led to better performance than experimenter-pacing, (b) high trait anxiety led to lowered performance, (c) self-pacing had no effect on low-anxious, but improved the performance of high-anxious participants, and (d) high and low anxious participants performed about the same on the rote tasks, but high anxious individuals performed much worse on the cognitive tasks. For proportion correct, results followed a similar pattern.

Mayer (1977) devoted a brief discussion section to the seemingly conflicting findings that high anxiety led to better performance regardless of task when pacing was self-administered, but led to poorer performance regardless of pacing when the task was a cognitive one. Mayer cited Sarason's (1960) concept of "situational reaction", which states that high-anxious individuals may at first react to self-pacing in task-irrelevant ways, but eventually gain momentum as the

experimental session continues. Perhaps self-pacing allowed high trait anxious participants to reduce the state anxiety that would normally be induced by the time limit in which to solve the problems. As noted earlier, trait anxiety generally leads to performance decrements only under conditions of elevated state anxiety. The finding that trait anxiety led to poorer performance when the task was more complex is consistent with prior research.

The present author would argue that this study did not meet its goal of increasing the generalizability of anxiety research. While a target search for a particular letter in a passage is admittedly less complex and "real-world" than connecting nine dots with four lines, it is arguable whether either task actually "approximates the circumstances of the overburdened worker" (p. 283), as Mayer asserted. Both the rote and the cognitive tasks used in this study had a correct answer, and could be classified as well-defined problems. In the real world, individuals must face unstructured, ill-defined problems that have many possible correct solutions; the study of these would increase the generalizability of anxiety research.

In another examination of real-world problem solving, Nezu (1985) conducted a correlational study of psychological distress in self-appraised effective and ineffective problem solvers. According to Nezu, social problem solving refers to the process by which individuals discover effective ways to cope with the problems encountered in daily life. The goal of this study was to

examine the role of individual differences in everyday problem solving effectiveness. Participants were 213 undergraduates who completed the Problem Solving Inventory, a measure of individuals' self-reported problem solving behavior and attitudes. Those who scored at least one standard deviation above or below the mean were recruited for the remainder of the study as ineffective and effective problem solvers, respectively.

The participants in Nezu's (1985) study completed four additional inventories: (a) Beck Depression Inventory, (b) State-Trait Anxiety Inventory, (c) Rotter Internal-External Locus of Control Scale, and (d) Problem Check List. The results were analyzed for sex differences; the responses of males and females did not differ significantly on any of the measures. Nezu found that self-reported ineffective problem solvers were significantly more depressed, experienced higher state and trait anxiety, had a more external locus of control, reported more frequent current problems and were more distressed by these problems, than self-reported effective problem solvers.

As noted by Nezu, the correlational design of this study prevents any conclusions regarding causation. It is possible that effective problem solving leads one to have fewer problems, and thus less depression and anxiety, or that being depressed and anxious impairs one's problem solving ability. Another limitation noted by the author was that the sample included only the extreme ends of the problem solving continuum. The findings may not be readily

generalizable to the typical problem solver. A follow-up to this study would be to add some real-world problems and measure participants' actual problem solving effectiveness, not just their self-appraised effectiveness.

It is difficult to draw clear-cut conclusions from the previous research on state and trait anxiety. The independent and dependent variables examined in these studies, the hypotheses advanced, the conclusions drawn, and the quality of the research, vary significantly. Despite this difficulty, several findings have been rather consistent across the variables examined and level of anxiety measured: (a) decrements in performance of those high in trait anxiety are generally only observed under conditions of elevated state anxiety, and when state anxiety is elevated, those high in trait anxiety are generally less effective at completing cognitive tasks, (b) the aforementioned performance decrement is more likely to occur when the task is complex and/or difficult, and (c) state anxiety can be induced by the problem solving task itself.

This Investigation

Overview. The research presented thus far has examined a crucial step in the problem solving/decision making process, that of solution generation. When generating solutions to a problem, one technique for assisting the problem solver is to provide some structure to the problem. The structuring method examined in the previously discussed research was the presentation of objectives. Objectives do not add additional information beyond that which is already present in the

problem, they merely make certain aspects of the problem more salient so as to highlight the essential conflict inherent in the problem. This presentation of objectives, it is hypothesized, will lead to a larger number of solutions, higher quality solutions, or both, depending on how the objectives are presented.

Prior research has shown that the way a problem is structured influences the quantity and quality of solutions generated to ill-structured problems. Pitz et al. (1980) were the first to examine the question of how the presentation of objectives, as a structuring technique, influences the solution generation process. Their goal was to examine structuring as a way to improve decision quality by insuring that all relevant alternatives are considered. Pitz et al. asked participants to generate solutions to several real-world problems, for which eight objectives each had been identified. Participants were randomly assigned to objective conditions, in which they were given either all eight objectives simultaneously, one objective at a time, two objectives at a time, or no objectives. The dependent variable was the quantity of solutions generated. Pitz et al. found that presenting one objective at a time led participants to generate more alternatives than presenting many objectives simultaneously or two objectives at a time. While this study provided an important foundation for future work in the area of problem structuring and solution generation, several questions remained. For example, does the generation of *more* alternatives necessarily equate with the generation of more *good* alternatives? What factors,

such as individual difference variables, influence the relationship between structuring and solution generation? Later research by Scherer and Billings (1999) and Butler and Scherer (1997) examined these questions.

Scherer and Billings (1999) used two real-world problems that had been used in the Pitz et al. (1980) study. Participants were assigned to one of four objective conditions: one-objective-at-a-time, two conflicting objectives, two congruent objectives, or no objectives. Scherer and Billings expanded the research of Pitz et al. by using two measures of quantity (number of non-repeating alternatives and number of categories of alternatives) and by adding a measure of quality (resolving power). Resolving power is defined as the degree to which a solution addresses conflicting aspects of the problem (Upshaw, 1975). It was operationalized both as the average resolving power of all alternatives generated by each participant, as well as the number of highly resolving solutions generated by each participant. Scherer and Billings hypothesized that structuring through objectives would influence both the quantity and quality of alternatives generated. As predicted, presenting one objective at a time led participants to generate more solutions than presenting no objectives or conflicting objectives. For solution quality, the results were more complex. Scherer and Billings found that whether problem structuring through the presentation of objectives led to higher quality solutions depended on the type of problem, the operationalization of quality, and the order of problem presentation.

In addition, significant two- and three-way interactions complicated the findings. In interpreting the complex results, Scherer and Billings hypothesized that the emotional overtones present in the solutions for one of the problems may have been an indicator that emotions were clouding the participants' judgements and restricting their ability and/or willingness to pay attention to the structuring manipulation. Scherer and Billings also hypothesized that moderators could be influencing the results, such as familiarity or emotional involvement with the problem.

Butler and Scherer (1997) further expanded this line of research by adding a moderator variable, that of expertise. They found that presenting one objective at a time led to the generation of alternatives with higher resolving power than presenting no objectives. Also, the conflicting objectives condition elicited more resolving alternatives than the no objectives condition, although this effect did not reach significance. Again, the results were complicated by a significant three-way interaction between objectives, problem, and problem order. An acceptable conclusion to be drawn from the research on problem structuring through objectives seems to be that structuring influences the quality of solutions to a greater extent for non-emotionally involving problems than for emotionally involving problems.

This area of research is in its infancy, as the three studies noted above are the only ones examining problem structuring effects on solution generation

for ill-structured problems. The present study seeks to replicate and further explore the findings of these previous studies, as well as to examine another possible moderator of the problem structuring/solution generation relationship, that of trait anxiety.

Trait anxiety has been shown to affect performance on a variety of cognitive tasks or problems. However, all of these tasks could be classified as well-structured, well-defined problems. No studies have identified the effects of trait anxiety on the solving of ill-defined, real-world problems. As noted by Heppner et al. (1982):

> Much of the earlier problem-solving research examined how people solved impersonal predefined laboratory problems such as puzzles, anagrams, and water-jar problems. These predefined problems are different than the real-life personal problems that daily confront people, and there is evidence to suggest that the manner in which the laboratory problems are solved may be less complex than personal problems. (p. 580)

Many researchers have examined the effects of high trait anxiety on performance of well-defined problems. For example, Zarantonello et al. (1984) found that high trait anxious individuals tended to solve fewer anagrams, to report spending longer thinking about how well they were performing the task (cognitive interference), and to report a more negative evaluation of their

performance, than their low trait anxious counterparts. Other research has generally confirmed this finding, that when state anxiety is elevated, and/or when the task is difficult or complex, anxiety typically leads to a decrement in performance on cognitive tasks.

In an attempt to increase the generalizability of anxiety research, Mayer (1977) studied the effects of trait anxiety, type of task ("rote" versus "cognitive"), and pacing (self-paced versus experimenter paced) on performance. Mayer found that: (a) self-pacing led to better performance than experimenter pacing, (b) high trait anxiety led to lowered performance, (c) self-pacing had no effect on low-anxious, but improved the performance of high-anxious participants, and (d) high and low anxious participants performed about the same on the rote tasks, but high anxious individuals performed much worse on the cognitive tasks. The present author would argue that this study did not meet its goal of increasing the generalizability of anxiety research, because even the "cognitive" tasks were well-defined decision problems, with definite correct answers.

As discussed earlier, it is difficult to draw clear-cut conclusions from the previous research on anxiety. Several findings have been rather consistent across the variables examined and level of anxiety measured: (a) decrements in performance of those high in trait anxiety are generally only observed under conditions of elevated state anxiety, and when state anxiety is elevated, those high in trait anxiety are generally less effective at completing cognitive tasks, (b)

the aforementioned performance decrement is more pronounced when the task is complex and/or difficult, and (c) state anxiety can be induced by the problem solving task itself.

The first independent variable in the current investigation was problem objectives. Participants received either one objective, conflicting objectives, or no objectives. The second independent variable was trait anxiety, measured using the trait form of the State-Trait Anxiety Inventory (Spielberger, 1983). All participants generated solutions to an ill-structured problem which appears in Appendix A. The dependent variables were quantity and quality (resolving power) of solutions generated.

Predicted effects of problem structuring and trait anxiety on solution quantity. Prior research (Butler & Scherer, 1997; Pitz et al., 1980; Scherer & Billings, 1999) has found that the presentation of one problem objective at a time leads participants to generate a greater number of solutions than the presentation of no objectives or the presentation of conflicting objectives. Presenting objectives one at a time facilitates the generation of a large number of alternatives.

Hypothesis one. Both low and high trait anxious participants will generate more alternatives in the one-objective-at-a-time condition than in the conflicting objectives condition and the no objectives condition.

Predicted effects of problem structuring and anxiety on resolving power of solutions. Baron and Kenny (1986) describe a moderator effect as an "...interaction between a focal independent variable and a factor that specifies the appropriate conditions for its operation" (p. 1174). In the present study, it was predicted that trait anxiety would serve as a moderator of the relationship between problem structuring and resolving power of solutions generated. In other words, trait anxiety would specify when problem structuring would have an effect on solution generation.

Prior research has found that high trait anxiety generally impairs performance under conditions of elevated state anxiety. It was predicted that the resolving power of solutions would be reduced in the no objectives and conflicting objectives conditions, as compared to the one-objective-at-a-time condition. This hypothesis is based on the notion that being presented with conflicting objectives simultaneously or no objectives will increase high trait anxious participants' state anxiety. Riedel et al. (1983) found that state anxiety could be elevated by a problem solving task, but did not examine this elevation as a function of trait anxiety. It is predicted that participants high in trait anxiety will suffer performance decrements due to elevated state anxiety, and that this state anxiety elevation will occur in the conflicting objectives condition and the no objectives condition. As noted by Pitz et al. (1980), structuring may improve decision quality by insuring that all relevant alternatives are considered. The no

objectives condition should elevate state anxiety relative to the one-objective-at-a-time condition because this helpful aid is not present. Prior research has shown that giving participants conflicting objectives simultaneously leads them to generate fewer solutions than when given objectives one at a time (Butler & Scherer, 1997; Scherer & Billings, 1999). This finding can be taken as evidence that the task of generating solutions is more complex and/or difficult under the condition of conflicting objectives than under the one-objective-at-a-time condition. When presented with conflicting objectives simultaneously, participants are considering more information about the problem, and the essential conflict of the problem is made salient. Mayer (1977) found that trait anxiety is more likely to lead to performance decrements for complex tasks. The author would argue that presenting conflicting objectives simultaneously increases the complexity of the task, beyond that of the one-objective-at-a-time condition. Participants high in trait anxiety will suffer performance decrements (reductions in resolving power of solutions) in both the conflicting objectives and no objectives conditions, but for different reasons.

Hypothesis two. Participants high in trait anxiety will generate solutions lower in resolving power than those low in trait anxiety in the conflicting objectives condition and in the no objectives condition, as compared to the one-objective-at-a-time condition.

Method

Overview

The study used a regression model to examine the effect of problem structuring (conflicting objectives versus one objective versus no objectives) and trait anxiety (high versus low) on the quantity and quality of solutions generated. Data collection was carried out in two parts. Participation in Part I consisted of completing three questionnaires. Order of the three scales was counterbalanced, with each of the six possible order combinations being equally represented. Participation in Part II consisted of generating solutions to a problem and completing several questionnaires. Students had to complete both parts of the study in order to receive research credit. Packets given to participants in Part I of the study were randomly labeled yellow, orange, and red, and when participants arrived at Part II they were given packets with none, one at a time, and conflicting objectives, respectively. Dividing the experiment into two parts allowed time to elapse between the administration of the anxiety measure (trait anxiety scale of the State-Trait Anxiety Inventory; Spielberger, 1983) and the generation of alternatives in order to avoid sensitizing participants to the nature of the investigation. Embedding the anxiety measure among two other scales in the packet (Need for Cognition Scale, Cacioppo, Petty, & Kao, 1984; and a social problem solving scale, a variation of the Social Problem-Solving Inventory, D'Zurilla & Nezu, 1990) served to further mask the purpose of the study. This

method of data collection served to increase the number of participants willing to volunteer because some of the materials could be completed at their convenience, as well as increasing participation rates for Part II because completion of both parts of the study was required in order to receive credit.

Participants classified as either high or low trait anxious, generated alternatives to an ill-structured problem under one of the three problem structuring conditions. The dependent variables were quantity and quality of solutions generated.

Participants

Participants were 184 undergraduate students enrolled in psychology courses at the University of Nebraska at Omaha. The sample consisted of 48 males and 135 females (and one participant who did not report gender). Participants were volunteers who received course credit for participating. The strategy for sampling was to approach potential volunteers at the end of their psychology classes. Students were introduced to the purpose and nature of the study, and were informed that both parts of the study must be completed in order for them to receive research credit. Volunteers then received a packet and signed up for a time to participate in Part II. An informed consent form was the first item in the packet. Participants were instructed to read the consent form before they completed any of the measures, and a label on the packet gave

them instructions on where to return the packet if they read the consent form and then decided not to participate.

Problem

All participants generated solutions to an ill-structured problem, which depicted a college-aged student research assistant who needs research experience to gain admission to graduate school but is unhappy with the current assignment. The problem used was created by Pitz et al. (1980) and appears in Appendix A. This problem was included in a taxonomy study of affective and cognitive reactions to problems (Scherer, Weiss, Reiter-Palmon, & Goodman, 1996). Table 1 presents a comparison between the cognitive and affective reactions of participants to the research problem and across the twelve problems examined by Scherer et al. Participants perceived the research problem as being lower in complexity, more boring, and easier to solve (higher problem-based efficacy), than the average of the twelve problems. This may indicate that the research problem, although complex and ill-structured, was not extremely difficult, but more likely of moderate difficulty. The name of the central figure in the problem was changed from "Joan" (Scherer et al.) to "Chris" in order to achieve gender neutrality.

Table 1

Cognitive and Affective Reaction Scale Means and Standard Deviations for the Research Problem

	Research Problem		Overall	
	Mean	SD	Mean	SD
Problem complexity	3.3	1.0	3.8	1.2
Problem realism	4.8	0.9	5.1	0.8
Problem-based efficacy	4.1	1.1	3.9	1.2
Reaction to conflict resolution	3.4	0.9	3.9	1.0
Emotional involvement	2.8	1.0	3.3	1.0
Negative arousal	3.6	0.8	3.9	0.9
Elation	3.1	0.6	3.0	0.7
Fear	3.5	0.9	3.8	1.0
Boredom	3.9	3.9	3.1	1.1
Positive arousal	3.2	3.2	3.5	0.8

Note. Scale ranges from 1 - 7; higher numbers indicate a higher level of the construct. N = 2148.

Independent Variables

Trait anxiety. The first independent variable was trait anxiety. Participants completed the trait form of the State-Trait Anxiety Inventory (Spielberger, 1983). Participants scoring above the median were classified as high trait-anxious and those scoring below the median were considered low trait-anxious. The median trait anxiety score was 38.

Anxiety was measured using the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The STAI is a self-report instrument which measures both state and trait anxiety. The state anxiety scale of the STAI consists of twenty statements for which individuals rate the extent to which they feel that way *right*

now on a 4-point scale, using (1) not at all, (2) somewhat, (3) moderately so, and (4) very much so. The trait anxiety scale of the STAI also consists of twenty statements, only with instructions for respondents to identify how they *generally* feel. Spielberger (1983) defined trait anxiety as "relatively stable individual differences between people in the tendency to perceive stressful situations as dangerous or threatening and to respond to such situations with elevations in the intensity of their state anxiety reactions" (p. 5).

The STAI underwent a major revision in 1979. Spielberger (1983) noted three reasons for this revision: (a) to more clearly differentiate between anxiety and other constructs (such as depression), (b) to replace items with weak psychometric properties, and (c) to improve the factor structure of the trait anxiety scale. The STAI includes items that assess anxiety as well as items which assess calmness and serenity, such that an individual's score can be placed on a continuum that ranges from very calm, to somewhat anxious, to very anxious (Spielberger, 1972).

The STAI has been used in a wide variety of settings including clinical, psychiatric, military, and college settings. It has been used in over 2,000 studies (Spielberger, 1983) and has been translated into over thirty languages. The STAI was used in the present study due to its demonstration of reliability and validity in previous studies. Spielberger (1983) collected normative data on the STAI from 855 college students (324 males, 531 females) enrolled in introductory

psychology courses. The mean state anxiety score for Spielberger's normative sample was 36.47 for males and 38.76 for females, and the mean trait anxiety score was 38.30 for males and 40.40 for females. The alpha reliabilities for the state form of the STAI were *a* = .91 for males and *a* = .93 for females, and for the trait form were *a* = .90 for males and *a* = .91 for females.

The state and trait anxiety data of the present participants were compared to that of Spielberger's (1983) normative sample of 855 college students (324 males, 531 females). The mean state anxiety score for males in the present study (M = 31.45) was at the 36th percentile in the norms for male students, and the mean for females (M = 34.50) was at the 44th percentile in the norms for female students. The mean trait anxiety score for males in the present study (M = 37.32) was at the 52nd percentile in the norms for male students, and the mean for females (M = 39.55) was at the 59th percentile in the norms for female students. Alpha reliability of the state anxiety form of the STAI was *a* = .93, and of the trait anxiety form was *a* = .91 in the present study.

The trait form of the STAI was completed by participants in Part I and the state form (with additional questions added) was completed in Part II, immediately after the solution generation task. The trait and state forms of the STAI appear in Appendix B. An 8-item scale developed by the researcher was attached to the state anxiety scale of the STAI, and was completed by participants during Part II. This scale assessed participants' reactions to the

experimental situation, as well as whether they were concerned with any stressful situations in their lives. The purpose of the additional questions was to further examine individuals' reports of high state anxiety, and to identify outliers. These additional questions appear after the state form of the STAI in Appendix B.

Problem structuring. One way to structure a problem is to provide objectives. Scherer and Billings (1999) defined problem objectives as the specific outcomes that the generated solutions are intended to achieve. Participants in the one-objective-at-a-time condition and the conflicting objectives condition were shown the identical set of four objectives. However, the conflicting objectives structuring method presented a pair of objectives that conflicted with one another whereas the one-objective-at-a-time structuring method presented one objective at a time. This study borrowed from research by Scherer and Billings (1999) to determine which objectives conflicted with one another. Scherer and Billings conducted pilot research in which ten graduate students were presented with a list of solutions and a list of objectives and were asked to identify which solutions addressed which objectives. Conflicting objectives were those that were positively correlated with certain objectives and negatively correlated with other objectives. That is, a pair of objectives were seen as conflicting to the extent that solutions that would address one objective tended to preclude the satisfaction of the other objective.

To carry out the structuring manipulation, participants were given an instruction sheet stapled to four pages. Participants in the one-objective-at-a-time condition and in the conflicting objectives condition each received four objectives. In the one-objective-at-a-time condition, one objective was placed on each page, and order of presentation was counterbalanced. In the conflicting objectives condition, two objectives were on the first page, then a blank page, then two more objectives, then a blank page. Order of objective presentation was counterbalanced. In the no objectives condition, instructions to generate all the alternatives one could think of was on the first page, followed by three blank pages. The number of pages received by participants in each condition was kept constant in order to eliminate effects of receiving less or more space to generate solutions. The experimental stimuli appear in Appendix A.

Dependent Variables

Overview. Solution quantity and quality were independently assessed by the researcher, one undergraduate student, and two graduate students, blind to experimental condition. Disagreements were settled through consensus. The scale used to rate resolving power appears in Appendix C.

Quantity of solutions. Quantity was defined as the number of non-repeating solutions generated by each participant.

Quality of solutions. The measure of solution quality was resolving power. Resolving power was defined by Upshaw (1975) as the degree to which a

solution addresses the conflicting components of the problem. It was operationalized in four ways, as: (a) the number of highly resolving solutions (those receiving a resolving power rating of 4, 5, or 6 on a 6-point scale, (b) the average resolving power of all solutions generated, (c) the proportion of highly resolving solutions (those rated 4, 5, or 6), and (d) the highest resolving power rating given to the participant's set of solutions. The process of assessing solution quality will be discussed in depth later in the chapter, but as an overview, the process involved condensing the set of verbatim thoughts/solutions to a set of non-repeating solutions, matching those non-repeating solutions back to the original data, and collecting independent ratings of the non-repeating solutions from two graduate students trained in the assessment of solution quality.

Other Measures

Need for cognition. Need for cognition refers to the tendency to actively engage in and enjoy effortful cognitive activities (Cacioppo, Petty, & Kao, 1984). The 18-item Need for Cognition Scale was developed to assess this individual difference. The purpose of including this scale in the packet distributed in Part I was to disguise the anxiety measure. Although no predictions were made for this measure, the scale results will be examined to see if differences among those high and low in trait anxiety exist. The alpha reliability of the Need for Cognition Scale was a = .90. The Need for Cognition Scale appears in Appendix B.

Social problem solving. Social problem solving refers to the process individuals engage in to cope with problems encountered in daily living (D'Zurilla & Nezu, 1982). The measure of social problem solving ability used in the present study was a variation of the Social Problem-Solving Inventory (D'Zurilla & Nezu, 1990). This social problem solving scale was used by Butler and Scherer (1997), who added 8 additional items to the 52-item scale. These additional items assess the extent to which the essential conflict and objectives of a problem are noted or considered by the problem solver. As with the Need for Cognition Scale, the purpose of including the measure of social problem solving ability was to disguise the anxiety measure. No predictions were made for this measure, but analyses will be conducted to see if trait anxiety is related to self-appraised social problem solving effectiveness. The alpha reliability of the scale was *a* = .94. The social problem solving measure appears in Appendix B.

Demographic questionnaire. This scale consisted of 12 items assessing participant characteristics such as sex, age, race, and number of college courses taken. Various versions of the scale have been used in several research studies at the University of Nebraska at Omaha. The purpose of the questionnaire was to collect information that could be used to compare groups of participants, for example, to determine whether males and females differ in their level of anxiety. The demographic questionnaire appears in Appendix B.

Verbal ability measure. The vocabulary subtest of the Multidimensional Aptitude Battery (Jackson, 1984) was administered to participants as the last measure in Part II. The Multidimensional Aptitude Battery (MAB) is a paper-and-pencil test consisting of two batteries of five subtests each. It is designed for adolescent and adult populations and has been used in clinical, research, and employment settings. Validity data of the various subtests were obtained by correlating the subtests with components of the WAIS-R (Wechsler, 1981, as cited in Jackson, 1984). With a sample of 145 respondents, the correlation between the vocabulary subtest and the WAIS-R was $r = .89$.

The vocabulary subtest is one of the measures in the Verbal Battery, and can be used on its own. The vocabulary subtest consists of 46 multiple choice items which the respondent has seven minutes to complete. The purpose of this scale was to assess whether differences in those high and low in trait anxiety were actually due to differences in verbal ability, not the level of anxiety itself. The vocabulary subtest of the MAB appears in Appendix B.

Procedure

Pilot study. The pilot study was designed to assess whether reports of trait anxiety, as assessed before the solution generation task, would be increased by the act of generating solutions. It was desired by the author to only measure trait anxiety once, earlier in time than the solution generation task, rather than before and after the task, to avoid sensitizing participants to the nature of the

investigation. The purpose of the pilot study was to ensure that reports of trait anxiety would not be influenced by the act of generating solutions under various objective conditions. It was expected that reports of trait anxiety would not significantly increase after generating solutions, because as Spielberger (1983) noted, "...it has been demonstrated that the T-Anxiety scale is relatively impervious to the conditions under which it is given" (p. 11). Trait anxiety is a personality characteristic which should be unaffected by changes in the situation or the task.

The design of the pilot study was a 2 x 2 between-subjects design, with position of the trait anxiety scale (before or after solution generation) and problem objectives (no objectives or conflicting objectives) as the manipulated variables. The trait form of the State-Trait Anxiety Inventory (STAI; Spielberger, 1983) was completed either before or after the problem solving task. Participants were randomly chosen to receive no objectives or conflicting objectives to consider while solving the problem. The one-objective-at-a-time condition was not pilot tested because it was perceived as the least likely condition to arouse anxiety in the participants.

A total of 48 participants were run in small groups ranging from one to eight individuals per session. They first read and signed a consent form explaining the purpose of the study. Participants then completed a packet of materials. They were told to complete the items in the order in which they were

presented. This method allowed for manipulation of the position of the trait anxiety form of the STAI (Spielberger, 1983). Attached to the trait anxiety scale was a set of three items developed by the author to assess whether the experimental task, or participating in experiments in general, made participants anxious, fearful, or nervous. These items, rated on a five-point scale, were as follows:

(1) Rate the extent to which being an experimental participant in general makes you feel anxious or nervous. Choose the number that corresponds to how anxious or nervous you generally feel in this situation.

(2) Rate the extent to which the previous task made you feel fearful. Choose the number that corresponds to how fearful the task made you feel.

(3) Rate the extent to which the previous task made you feel anxious or nervous. Choose the number that corresponds to how anxious or nervous the task made you feel.

Participants either generated solutions with various objectives and then completed the trait anxiety scale, or they completed the trait anxiety scale and then generated solutions with various objectives. Upon completion of these tasks, participants were debriefed and given credit for participating.

Analysis of variance was used to test for mean differences among the 48 participants in the pilot study. Descriptive statistics appear in Table 2. An alpha level of .05 was used for all statistical tests. The main effect of position of the trait anxiety scale was not statistically significant, ($F(1, 43) = .025$, $p > .05$). The main effect of objective condition was not statistically significant, ($F(1, 43) = 3.971$, $p > .05$). Finally, the interaction of position and objective condition was not statistically significant, ($F(1, 43) = .052$, $p > .05$).

Table 2

Means and Standard Deviations of the Average Scale Score by Cell for Pilot Study

Position of Trait Anxiety Scale	Objective Condition	Average Trait Anxiety Scale Score	Standard Deviation
After	Conflicting	2.24	.3755
After	None	1.97	.4361
Before	Conflicting	2.19	.4194
Before	None	1.98	.4120

The main effect for objective condition was nearly significant ($p = .053$) and was examined further. The result is somewhat puzzling, because half of the participants in each objective condition had not yet seen which objective condition they were in. The data were then sorted by position, and the analyses were run with only the after position data. The results of this analysis indicated that the main effect of objective condition was no longer significant, ($F(1, 22) = 2.577$, $p > .05$). The nearly significant main effect for objectives obtained with the

full sample was therefore probably a chance result, particularly because for half of the participants, the objective manipulation had not yet been carried out.

Results of the pilot study indicated that the act of generating solutions under conditions of conflicting objectives and no objectives did not significantly increase reports of trait anxiety. This allowed the author to place the trait anxiety measure earlier in time than the problem solving task, without jeopardizing the integrity of the trait anxiety scores.

Part I of main study. Potential participants were recruited from courses being held in the summer and fall sessions of 1997. Permission was obtained from instructors willing to offer course credit for research participation for one or more researchers to recruit volunteers at the end of their classes. Students were first given information regarding the nature and purpose of the study. They were informed that each part of the study would take approximately 30 minutes, and that Part I of the study could be completed at their convenience. They were also informed that completion of both parts of the study was required in order to receive research credit. Volunteers were then asked to sign up for a time that they could return to the lab for Part II. They were given a packet and instructions for completing the materials. They were instructed to first read the consent form and to decide whether they would like to participate. A label on each packet gave instructions for returning the uncompleted packet to the experimenter if a participant read the consent form and decided not to participate.

Part II of main study. Participants were run in small groups of one to eight individuals, with one to two experimenters present at each session. First, consent forms were collected from the packets so that participants' names would no longer be associated with their data. Participants were then asked to check the materials in their packets to insure that they responded to all the questionnaire items. Next, they completed a 12-item demographic scale. The problem objective manipulation was then carried out. Participants were given a packet with a cover that had printed instructions. The experimenter instructed participants to read the instructions as he/she read them aloud. Instructions on the packet were as follows:

> You will now read a problem and generate solutions to it. First, read the problem presented to you on the laminated card. Next, turn this page and follow the instructions on the next page. Do not look ahead or back in the packet. Do not turn any page until you have completed the instructions on that page. Feel free to re-read the problem as often as you like. List all the solutions that occur to you, even if you think they are not "good". Please do not evaluate your alternatives for their quality. Just concentrate on identifying as many possible courses of action the person in the problem could pursue as you can. When you have finished the entire packet, raise your hand and the experimenter will be right with you.

The purpose of explicit instructions to refrain from looking ahead or back in the packet was to preserve the objective manipulation. For example, if participants in the one-objective-at-a-time condition looked at all four objectives before generating any alternatives, it would in effect be a conflicting objectives condition. To further remind participants not to look ahead or back in the packet, a footer was placed on each page with these instructions:

Do not look ahead or back in the packet.

Finish this page before going on to the next page.

Observation of participants during the experimental sessions confirmed that they focused on one page at a time. Order of presentation of the objectives in the one at a time and conflicting conditions was counterbalanced.

The experimenters discretely recorded the start and finish times of the problem-solving task. After generating alternatives, participants completed a packet designed to assess their state anxiety. The first page was the state form of the State-Trait Anxiety Inventory (Spielberger, 1983). The second and third pages consisted of eight questions developed by the experimenter to further identify participants high in anxiety.

The final measure given in Part II was the vocabulary subscale of the Multidimensional Aptitude Battery (Jackson, 1984), a battery frequently used for adolescent and adult populations. The scale consists of 46 items, which the

respondent has seven minutes to complete. Upon completion of the vocabulary scale, participants were debriefed and thanked for their participation.

Solution Rating Procedure

The procedure used to analyze the qualitative (solution) data included several steps. The rating procedure will be discussed in the following sequence: (a) reducing solutions to set of non-repeating solutions, (b) assessing quantity of solutions, and (c) assessing quality of solutions.

Reducing solutions to set of non-repeating solutions. The purpose of this process was twofold: (a) to condense the raw set of solution generation data down to a set of non-repeating solutions (prototypes) suitable for resolving power rating, and (b) to establish the number of non-repeating solutions generated by each participant. The original file of raw solution generation data contained over 1,800 "thoughts" recorded by participants. However, these often included the same thought or solution repeated several times, or thoughts that were deemed "non-solutions", such as "Chris is an androgynous name," or "Dr. Bundt should not be so hard on Chris."

Several undergraduate students first transcribed the original set of thoughts/solutions into a table in Microsoft Word. Most participants had numbered their thoughts or separated them in some way, so it was possible for the typists to give each thought its own line in the table. The next step in the process of moving from raw solution generation data to a set of non-repeating

solutions suitable for analysis involved the researcher and an undergraduate student independently identifying "prototypes", or non-repeating solutions. Prototype was defined for the raters as a solution that is the same in text or meaning as other solutions.

The task, then, for the raters was to identify solutions that were essentially the same as other solutions. This task involved reading each "thought or solution" the participant generated and deciding whether it was a solution, and if so, whether it had been seen before. A list of prototypes was generated separately by each rater. If a solution was essentially the same as another solution, no prototype was added to the list. If it was different from the existing prototypes, another prototype was added. Often, this decision was easy to make because the two solutions were word-for-word duplicates. In other cases, however, the decision involved a subjective judgement. Two solutions were considered repeating if they met either of the following criteria: (a) the solutions were the same, but one gave an explanation, such as in, "Quit working for Dr. Bundt," versus "Quit working for Dr. Bundt because he's unappreciative," or (b) the *meaning* of the two solutions was the same, but the wording was different, such as in "Quit school," versus "Quit UNO." Raters were careful not to consider two solutions as the same just because their category was the same, such as in "Quit school," versus "Quit," versus "Quit research position." These were all considered different solutions. Each rater also had a prototype for non-solutions.

The experimenter identified 650 prototypes, while the undergraduate researcher identified 260 prototypes. This discrepancy was likely due to the large number of verbatim solutions (1,844) that had to be condensed. Because this process had not been used before, the initial listing of prototypes was not as useful as had been hoped. The experimenter was rigid in deciding whether two solutions were essentially the same, while the undergraduate rater had a more lenient view as to what constituted similarity. This discrepancy was resolved by examining each prototype each rater had listed, discussing the rationale involved in making the decision to add the prototype, and coming to consensus. The result of this independent rating and discussion process was a final list of 577 prototypes that both raters agreed were independent and non-repeating. Using the raters' judgement and previous work done by Scherer and Billings (1999) for the research problem, these 577 prototypes were organized into 25 categories. This list of categories appears in Appendix D.

The next step in preparing the solutions for the rating of resolving power was to match each verbatim solution to its prototype. The purpose of this step was to ensure that once the prototypes had been rated, the ratings could efficiently be transcribed back to the original data set and to individual participants. The researcher and an undergraduate student independently assigned a prototype number to each verbatim solution. Discrepancies in assigning prototypes to solutions were resolved by consensus. Of the 1,844

original thoughts/solutions, the two raters had initial agreement for 1,423 of the assignments, or 77%. Consensus was reached by discussion for the remaining 421 solutions.

Assessing quantity of solutions. Quantity of non-repeating solutions was assessed by counting the number of unique prototypes identified for each participant.

Assessing quality of solutions. Two graduate students independently rated the resolving power of each prototype, with disagreements settled through consensus. The raters received training on how to apply the anchors assigned to each rating of resolving power to the solutions. The training stressed the definition of resolving power as the extent to which a solution resolves the essential conflict of a problem. The essential conflict of the research problem was defined in prior research as follows: To have a satisfying experience without sacrificing long-term career opportunities. "Satisfying" was taken to mean enjoyable, non-stressful, and educational. The resolving power rating scale and anchors appear in Appendix C.

To obtain ratings of resolving power, two sets of the 577 prototypes were cut apart and then sorted by category. The categories were rated one-by-one to make the task more manageable. Raters were instructed to first read through the prototypes with the resolving power scale in mind. They then mixed up the stack and independently made a judgement as to whether the prototype seemed to

attempt to resolve both sides of the conflict. If it did, it was placed in the "4-6" pile. If it did not, it was placed in the "1-3" pile. The two raters then came to consensus about this initial decision for each prototype. The raters agreed initially on the classification of 491 of the 577 prototypes, or 85%. The raters then came to agreement on the dichotomous classification of the remaining 86 prototypes.

Next, the raters independently sorted the prototypes within the 1-3 group. Considering the essential conflict of the problem and the anchors for each rating of resolving power, they made finer distinctions among the prototypes in the pile, putting the 1-3 prototypes into 1, 2, and 3 piles. Next, the raters identified the prototypes for which there was perfect agreement and set those aside. Consensus was reached for the initial disagreement prototypes by discussing the rationale each used to make his/her decision. Then the process was repeated with the 4-6 pile. There was initial agreement between raters on the resolving power ratings of 388 of the prototypes, or 67%. The two raters then discussed their disagreements for the remaining 189 prototypes and came to consensus. The distribution of resolving power ratings for the 577 prototypes appears in Table 3.

A graphical presentation of the distribution of resolving power ratings, and the distribution of high and low resolving power ratings, appears in Figures 1 and 2, respectively.

Table 3

Frequency and Percentage of Solutions Within Each Category of Resolving Power

Resolving Power Rating	1	2	3	4	5	6	TOTAL
Frequency of Solutions	126	67	67	121	143	53	577
Percentage of Solutions	22%	12%	12%	21%	25%	9%	100%

Note. A rating of 1 is the lowest and a rating of 6 is the highest rating of resolving power.

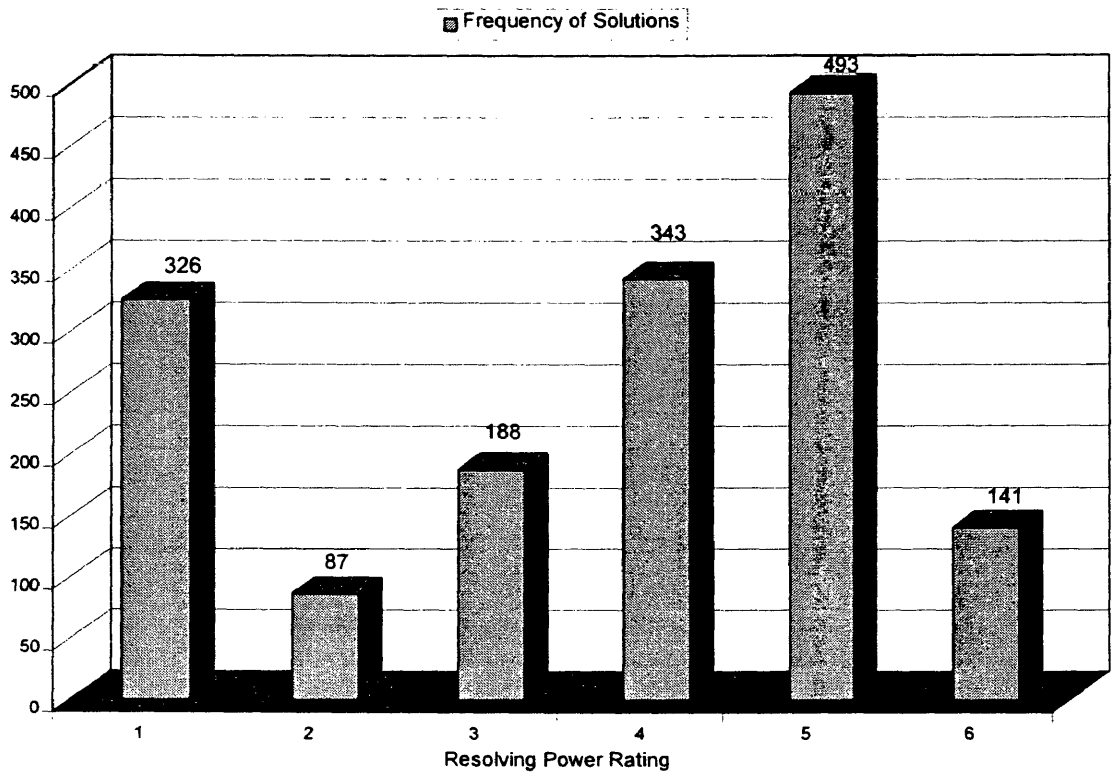

Figure Caption

Figure 1. Frequency distribution for resolving power ratings among solutions.

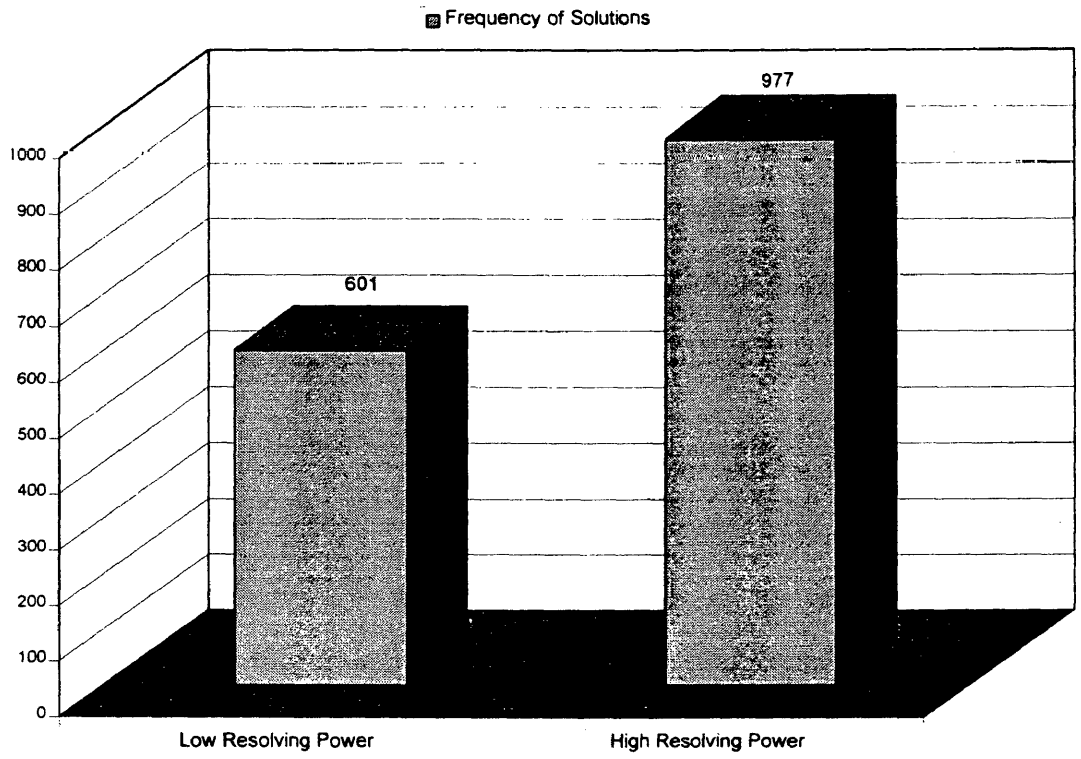

Figure Caption

Figure 2. Frequency distribution for high and low resolving power ratings among solutions.

Results

Overview of Analyses

The study was a 2 x 3 completely randomized design, with trait anxiety and problem structuring as between-subjects variables. Quantity and quality (resolving power) of alternatives generated were the dependent variables. The hypotheses were tested using a regression model. Regression analysis was chosen for this data because regression allows for continuous variables. Trait anxiety, as measured by the State-Trait Anxiety Inventory (Spielberger, 1983), is a continuous measure with no pre-defined levels of "high" and "low" trait anxiety. It was felt that using ANOVA, by making this continuous variable categorical, could result in some loss of power.

Examination of Demographic Variables

The demographic variables of gender (male, female), race (Caucasian, non-Caucasian), academic standing (freshman, sophomore, junior, senior, other/don't know), and verbal ability were analyzed to examine their possible impact on the dependent variables. This analysis was important as an examination of the impact of individual difference variables on anxiety and problem solving performance.

The regression of the dependent variables on gender and race was examined. Males and females did not differ significantly on any of the solution quantity, solution quality, or effort measures. The regression of the measures of

solution quantity and quality on race revealed no significant effects. The Caucasian group did not differ significantly from the non-Caucasian group on any of the solution quantity, solution quality, or effort measures.

The relationship between academic standing and the dependent measures was assessed using analysis of variance. No significant effects were found for the solution quantity, solution quality, or effort measures.

Verbal ability (as measured by the Multidimensional Aptitude Battery; Jackson, 1984) was a significant predictor of quantity of solutions generated ($F(1, 182) = 12.99$, $p < .01$) and number of highly resolving solutions ($F(1, 182) = 10.02$, $p < .01$). Males achieved an average verbal ability score significantly higher than that of females ($M = 24.81$ for males, $M = 21.51$ for females). In addition, verbal ability was significantly related to academic standing. The senior group achieved a significantly higher vocabulary test score than the freshman group, and the other/don't know group achieved a significantly higher score than the freshman and sophomore groups. Descriptive statistics for the demographic variables of gender, race, and academic standing appear in Table 4.

Table 4

Descriptive Statistics for Demographic Variables

Group	N	Number Non-Repeating	Number Highly Resolving	Average Resolving Power	Proportion Highly Resolving	Highest Resolving Solution	Minutes Spent Problem Solving	Verbal Ability
Male	48	9.04	5.42	3.53	0.61	5.51	12.17	24.81
Female	135	8.41	5.25	3.58	0.61	5.40	10.33	21.51
Caucasian	142	8.70	5.42	3.54	0.61	5.43	10.76	22.87
Non-Caucasian	42	8.17	4.93	3.68	0.61	5.46	11.36	20.88
Freshman	28	6.43	4.21	3.71	0.64	5.18	10.21	18.43
Sophomore	36	7.11	4.72	3.69	0.64	5.31	9.97	20.36
Junior	43	8.47	5.21	3.51	0.59	5.49	10.63	22.42
Senior	66	9.88	5.83	3.44	0.58	5.55	11.12	24.06
Other standing/ don't know	11	11.45	7.18	3.88	0.68	5.64	15.36	29.36

Descriptive Statistics for Problem Solving Data

Table 5 presents descriptive data for the distribution of resolving power ratings among the total number of non-repeating solutions generated. The distribution of resolving power ratings grouped into "high" resolving power (solutions rated 4, 5, or 6) and "low" resolving power (solutions rated 1, 2, or 3) appears in Table 6. A summary of the average quantity and quality of solutions generated appears in Table 7. Detailed descriptive information for the problem

solving data can be found in Appendix E (Tables E1 to E14 and Figures E1 to E3).

Table 5

Distribution of Resolving Power Ratings

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	326	87	188	343	493	141
Percentage of Solutions	21%	6%	12%	22%	31%	9%

Note. Total number of solutions = 1578.

Table 6

Distribution of High and Low Resolving Power

	Low Resolving Power	High Resolving Power
Number of Solutions	601	977
Percentage of Solutions	38%	62%

Note. Total number of solutions = 1578. Low resolving power = rating of 1, 2, or 3. High resolving power = rating of 4, 5, or 6.

Table 7

Average Quantity and Quality of Solutions

Number Non-Repeating	Number Highly Resolving	Average Resolving Power	Proportion Highly Resolving	Highest Resolving Solution	Minutes Spent Problem Solving
8.58	5.30	3.59	0.61	5.51	10.90

Note. N = 184.

Correlations Among Dependent Variables

Summary statistics for and correlations among all variables are presented in Table 8. There was a significant, positive correlation between state anxiety and trait anxiety (r = .5052, p < .01). Self-reported social problem solving ability was significantly, negatively correlated with both state and trait anxiety (r = -.3916, p < .01; r = -.5848, p < .01, respectively), indicating that elevated anxiety is associated with poorer self-reported social problem solving ability. Need for cognition was also significantly, negatively correlated with state and trait anxiety (r = -.1882, p < .05; r = -.2809, p < .01, respectively).

For the solution generation measures, number of non-repeating solutions was highly correlated with number of highly resolving solutions (r = .8952, p < .01), but not with average resolving power of solutions or with proportion of highly resolving solutions. This finding indicates that though generating a large number of solutions was associated with a greater number of "good" solutions, it was also associated with a greater number of "bad" solutions,

Table 8

Summary Statistics and Intercorrelations

	Mean	SD	Range	1	2	3	4	5	6	7	8	9	10	11
1. State anxiety	33.66	10.54	43.00	1.00										
2. Trait anxiety	38.92	10.00	42.00	.5052 (p<.01)	1.00									
3. Number of non-repeating solutions	8.82	5.20	26.00	-.1084	-.0947	1.00								
4. Number of resolving solutions	5.3	3.41	18.00	-.1110	-.1006	.8952 (p<.01)	1.00							
5. Average resolving power of solutions	3.57	0.97	6.00	.0197	.0008	.0690	.3171 (p<.01)	1.00						
6. Proportion of resolving solutions	0.61	0.23	1.00	.0580	.0056	.0579	.3724 (p<.01)	.8923 (p<.01)	1.00					
7. Highest resolving solution	5.44	0.68	5.00	-.0665	-.0081	.3412 (p<.01)	.4292 (p<.01)	.4191 (p<.01)	.3720 (p<.01)	1.00				
8. Time spent on solution generation	10.95	6.09	34.00	-.1131	-.0778	.4755 (p<.01)	.5265 (p<.01)	.0814	.1317	.2797 (p<.01)	1.00			
9. Need for cognition	63.75	12.49	67.00	-.1882 (p<.05)	-.2809 (p<.01)	.2291 (p<.01)	.2394 (p<.01)	.1252	.1509 (p<.05)	.0480	.1342	1.00		
10. Social problem solving	190.04	27.27	135.00	-.3916 (p<.01)	-.5848 (p<.01)	.2166 (p<.01)	.2083 (p<.01)	.0411	.0491	.0184	.2143 (p<.01)	.5683 (p<.01)	1.00	
11. Vocabulary test	22.41	7.17	34.00	-.1097	-.0316	.2581 (p<.01)	.2285 (p<.01)	.0332	.0410	.1250	.1045	.2007 (p<.01)	.1024	1.00

thus reducing the average resolving power and proportion of resolving solutions. The four operatationalizations of resolving power (number highly resolving, average resolving power, proportion highly resolving, and highest resolving solution) were all significantly, positively correlated with each other.

Solution Quantity

Hypothesis 1 predicted that participants presented with one objective at a time would generate more solutions than those presented with conflicting objectives simultaneously or no objectives. This hypothesis received strong support. The regression of number of non-repeating solutions on structuring, trait anxiety, and their interaction was tested. When structuring was entered first, the multiple correlation value was $R = .5420$. This value was significant at the .001 level ($F(2, 178) = 36.604$, $p < .001$). Variance accounted for was $R^2 = .2938$. This finding means that 30% of the variance in number of non-repeating solutions can be accounted for by structuring. The regression analysis revealed that the mean number of non-repeating solutions generated by participants receiving one objective at a time was significantly greater ($M = 12.67$, $SD = 5.36$) than the mean number generated by participants receiving no objectives ($M = 6.27$, $SD = 3.09$) or conflicting objectives ($M = 7.40$, $SD = 4.42$). When trait anxiety was added to the regression equation, the change in variance accounted for was $\Delta R^2 = .0021$ and was not significant ($F(2, 178) =$

.5317, $p > .05$). The interaction of structuring and trait anxiety was not significant ($F(2, 178) = .6711$, $p > .05$).

Resolving Power of Solutions

Resolving power was operationalized as (a) the number of highly resolving solutions, (b) the average resolving power of solutions, (c) the proportion of highly resolving solutions, and (d) the highest resolving power rating any solution received.

Hypothesis 2 predicted that individuals high in trait anxiety would generate solutions lower in resolving power in the no objectives and the conflicting objectives conditions than individuals low in trait anxiety. Support for this hypothesis would be represented by a significant interaction between structuring and trait anxiety. This hypothesis was not supported for any of the operationalizations of resolving power.

The regression of number of highly resolving solutions on structuring, trait anxiety, and their interaction was tested. When structuring was entered first, the multiple correlation value was $R = .5214$. This value was significant at the .001 level ($F(2, 178) = 32.86$, $p < .001$). Variance accounted for was $R^2 = .2719$. This finding means that 27% of the variance in number of highly resolving solutions can be accounted for by structuring. The regression analysis revealed that the mean number of non-repeating solutions generated by participants receiving one objective at a time was significantly greater ($M = 7.87$, $SD = 3.67$) than the mean

number generated by participants receiving no objectives (M = 3.78, SD = 2.37) or conflicting objectives (M = 4.64, SD = 2.53). When trait anxiety was added to the regression equation, the change in variance accounted for was ΔR^2 = .0021 and was not significant ($F(2, 178) = .6969$, $p > .05$). The interaction of structuring and trait anxiety was not significant ($F(2, 178) = 1.3106$, $p > .05$).

For resolving power operationalized as the average resolving power of solutions generated, there were no significant main effects, nor was there a significant interaction between structuring and trait anxiety.

For resolving power operationalized as the proportion of highly resolving alternatives (proportion receiving a resolving power rating of 4, 5, or 6), there were no significant main effects, nor was there a significant interaction between structuring and trait anxiety.

For resolving power operationalized as the highest resolving solution, there were no significant main effects, nor was there a significant interaction between structuring and trait anxiety. Nearly every participant had a value of 4, 5, or 6 on this variable, however, resulting in very little variance and violation of regression assumptions.

Hypothesis 2 was based on the assumption that state anxiety would be elevated in the conflicting objectives and no objectives conditions for those high in trait anxiety, as compared to the one-objective-at-a-time condition. ANOVA was used to examine differences in state anxiety level as a function of structuring

condition. Mean state anxiety level for those high in trait anxiety did not differ significantly across structuring conditions.

Participants in the present study were not constrained to spend a certain amount of time on the problem solving task. Participants in the one-objective-at-a-time condition spent an average of 14.59 minutes generating solutions, while participants in the conflicting objectives and no objectives conditions spent an average of 10.19 minutes and 7.92 minutes, respectively. The amount of time participants spent generating solutions was significantly, positively correlated with number of non-repeating solutions ($r = .4755$, $p < .01$), number of highly resolving solutions ($r = .5265$, $p < .01$), and highest resolving solution ($r = .2797$, $p < .01$). This finding indicates that the longer an individual spent thinking about the problem and generating solutions, the more solutions would be identified, the more "good" solutions would be identified, and the higher the resolving power of the highest rated solution would be.

Discussion

Summary of Results

It was predicted that the way a problem is structured would influence the quantity and quality of solutions generated to ill-structured problems, and that trait anxiety would moderate this relationship. Results indicated that problem structuring does indeed affect the quantity and resolving power of alternatives. Hypothesis 1 predicted that providing participants with one objective at a time would lead them to generate a greater number of alternatives than presenting them with no objectives or with conflicting objectives simultaneously. This hypothesis was strongly supported. Structuring the problem by considering one objective at a time led participants to generate nearly twice as many unique alternatives as those who considered conflicting objectives simultaneously or those who were provided with no objectives.

Hypothesis 2 predicted that trait anxiety would moderate the relationship between problem structuring and solution generation. Specifically, it was predicted that individuals high in trait anxiety would generate solutions lower in resolving power in the conflicting objectives and no objectives conditions than those low in trait anxiety. Prior research has shown that impairments in performance for those high in trait anxiety are generally found only under conditions of elevated state anxiety (e.g., Zarantonello, Slaymaker, Johnson, & Petzel, 1984), and/or when the task is difficult or complex (e.g., Spielberger,

1966). Hypothesis 2 was based on the premise that the task in the no objectives and conflicting objectives conditions would be more difficult and complex, and would therefore increase state anxiety for those participants high in trait anxiety. The difficulty of generating solutions when conflicting objectives are presented simultaneously may be indicated by the finding in the present study and in prior research that the presentation of one objective at a time leads to the generation of more alternatives than the presentation of conflicting objectives simultaneously.

As noted by Pitz et al. (1980), structuring may improve decision quality by insuring that all relevant alternatives are considered. It was predicted that the lack of a helpful structuring aid in the no objectives condition would make the task more difficult, and therefore elevate state anxiety. Prior research has shown that presenting individuals with conflicting objectives simultaneously leads them to generate fewer solutions than presenting them with one objective at a time (Butler & Scherer, 1997; Scherer & Billings, 1999). This finding can be taken as evidence that the task of generating solutions is more complex and/or difficult under the condition of conflicting objectives than under the one-objective-at-a-time condition. When presented with conflicting objectives simultaneously, participants are considering more information about the problem, and the essential conflict of the problem is made salient. Mayer (1977) found that trait anxiety is more likely to lead to performance decrements for complex tasks. The

premise of Hypothesis 2 was that presenting conflicting objectives simultaneously increases the complexity of the task, beyond that of the one-objective-at-a-time condition. Hypothesis 2 predicted that participants high in trait anxiety would suffer performance decrements (reductions in resolving power of solutions) in both the conflicting objectives and no objectives condition, but for different reasons. Support for this hypothesis would be demonstrated by a significant interaction between trait anxiety and structuring.

Hypothesis 2 was not supported. Examination of state anxiety across structuring conditions revealed that state anxiety for those high in trait anxiety was not significantly elevated in the no objectives or conflicting objectives conditions as compared to the one-objective-at-a-time condition. The means were in the predicted direction, but differences were not significant. Neither trait nor state anxiety was correlated with any of the measures of quantity and quality of solutions, nor was anxiety correlated with time spent generating solutions.

Several other interesting results emerged. One of the measures of resolving power was the number of highly resolving solutions. Results for this variable were quite similar to those obtained with the quantity measure, number of non-repeating solutions. Participants in the one-objective-at-a-time condition generated not only more solutions, but more high-quality solutions than those in either the no objectives or conflicting objectives conditions. In addition, number of non-repeating or unique solutions was highly correlated with number of highly

resolving solutions, but not with average resolving power of solutions nor with proportion of highly resolving solutions. This finding indicates that while generating a large number of solutions was associated with a large number of "good" solutions, it also was associated with a large number of "bad" solutions, thus reducing the average resolving power and proportion of resolving solutions.

Participants in the present study were not constrained to spend a certain amount of time on the problem solving task. Participants in the one-objective-at-a-time condition spent about 15 minutes generating solutions, while participants in the conflicting objectives and no objectives conditions spent about 10 minutes and 8 minutes, respectively. The amount of time participants spent generating solutions was significantly correlated with the quantity and resolving power (measured by number of highly resolving solutions and highest resolving solution) of solutions generated. This finding indicates that the longer an individual spent thinking about the problem and generating solutions, the more solutions would be identified, the more "good" solutions would be identified, and the higher the resolving power of the highest rated solution would be. The effort expended on the task, as measured by time spent, was directly related to performance.

Interpretation of Findings

A significant interaction between trait anxiety and problem structuring was predicted by Hypothesis 2, but was not supported for any of the four

operationalizations of resolving power (number of highly resolving solutions, average resolving power of solutions, proportion of highly resolving solutions, highest resolving solution). Anxiety did not influence task performance directly, nor did it influence performance indirectly via the relationship between effort and performance. Prior research has shown that impaired problem solving ability in individuals high in trait anxiety are generally only found under conditions of elevated state anxiety. It is the researcher's contention that the failure of high trait anxiety to induce impairments in resolving power was due to the insignificant elevations of state anxiety across structuring conditions. The manipulation of problem structuring was not sufficiently anxiety-provoking to induce deficits in performance for those high in trait anxiety. In the no objectives condition, perhaps the underlying conflict of the problem was sufficiently transparent, and the conflict sufficiently easy to resolve, that not having objectives to structure the problem was not problematic. In the conflicting objectives condition, participants generated fewer solutions than in the one objective at a time condition, but they also spent less time generating solutions. Perhaps if time spent generating solutions had been held constant, individuals in the conflicting objectives condition would have had difficulty continuing to think of solutions, their state anxiety would have been increased, and those also high in trait anxiety would have generated solutions of lower quality.

Regarding the relationship among effort and quantity and quality of

solutions, a likely interpretation would be that the problem, although complex and ill-structured, was only moderately difficult, such that the longer one spends on the task, the better one performs. If the task had been extremely difficult, spending more time on the task would not have been associated with better performance.

Context of Findings

Results of the present study are congruent with results of prior research for the effects of structuring on the quantity of alternatives generated. Consistent with Pitz et al. (1980), Scherer and Billings (1999), and Butler and Scherer (1997), presenting objectives one at a time resulted in the generation of a large number of alternatives. This finding seems to be robust, and it can be concluded that if one's goal is to generate a large number of alternatives to a complex problem, considering one objective at a time will greatly facilitate the process.

Regarding the effects of structuring on resolving power, the present results at first seem incongruent with prior research. Scherer and Billings (1999) found that for the research problem, the average resolving power in the conflicting objectives condition was higher than that in the one-objective-at-a-time condition, and that when the research problem was presented first, the conflicting objectives condition resulted in more highly resolving alternatives than any of the other conditions. In addition, the congruent objectives and one-objective-at-a-time condition resulted in more highly resolving alternatives than

the no objectives condition. In the present study, using the same problem, no structuring effects were found for resolving power as the average resolving power of solutions, the proportion of highly resolving solutions, or the highest resolving solution. For number of highly resolving solutions, the results indicated that the one-objective-at-a-time condition resulted in more highly resolving solutions than the conflicting objectives condition and the no objectives condition.

Several possible explanations for the differences in findings between the present study and Scherer and Billings (1999) were explored. In both studies, participants were undergraduate psychology students, but the studies were conducted at different universities. Perhaps there is something qualitatively different about the psychology students at Ohio State University versus the University of Nebraska at Omaha. The examination of individual difference variables in the present study revealed an effect of verbal ability on the number of solutions and the number of highly resolving solutions generated. In the future, individual differences such as cognitive ability that are likely to influence solution quantity and quality should be examined. Another possible explanation for the different findings is the minor differences in measurement of the dependent variables, in that the Scherer and Billings study rated resolving power on an 8-point scale and the present study utilized a 6-point scale.

Perhaps the most interesting explanation for the conflicting effects

between the present study and Scherer and Billings was that participants in the Scherer and Billings study were constrained to spend 20 minutes thinking about the problem and generating solutions, whereas in the present study, time spent was not controlled. In the present study, time spent was directly related to problem solving performance. Because time spent on the task was confounded with structuring, it is not clear whether problem solving performance was due to the structuring, time spent, or both.

The results of the present study can be interpreted in light of prior research on anxiety and problem solving, although this literature is vast and the results often conflicting. Prior research on the effects of state and trait anxiety on problem solving has generally indicated that high trait anxiety leads to problem solving impairments under conditions of elevated state anxiety, and/or when the task is difficult or complex.

In the present study, state anxiety was not significantly elevated, and this is one possible explanation for the lack of a moderating relationship between trait anxiety, problem structuring, and the quantity and quality of solutions generated. Whether or not state anxiety *should* have been elevated by the conflicting objectives condition and no objectives condition is a question worth examining. Riedel et al. (1983) found the performance of a divergent (creative) problem solving task led to a non-significant increase in state anxiety, compared to a convergent problem solving task and a control condition. The divergent task in

this study required participants to identify as many possible uses for thirty common objects as they could. Perhaps the task of generating as many solutions as one could for an ill-structured problem is similar in some respect to the task used by Riedel et al. If the task in the present study could be considered a creative problem solving task, perhaps increases in state anxiety would not be expected in any of the structuring conditions. To examine this possibility, the mean state anxiety score of the present participants (collected immediately after finishing the problem solving task) was compared to normative data offered by Spielberger (1983) in the manual for the State-Trait Anxiety Inventory. The mean state anxiety score for this males in this sample was at the 36th percentile in the norms for college students, and for females was at the 44th percentile, indicating that state anxiety was not elevated in any of the three structuring conditions, compared to the norm state anxiety score that would typically be found for college students.

Implications of Findings

The finding that presenting objectives one at a time leads to a large number of alternatives has been particularly robust. Consistent with prior research, the present study found that presenting problem solvers with one objective at a time greatly increases the number of alternatives they generate. As noted by Pitz et al. (1980), if the goal is to increase problem solving performance on ill-structured problems, one method is to structure the problem by considering

one objective at a time.

Problem structuring through the use of objectives affected task performance not only directly but also through the mechanism of time on task; spending more time on the task facilitated the generation of more alternatives overall, and more high quality alternatives. For ill-structured problems that are less difficult to decompose, getting people to spend more time on the problem solving task may enhance performance regardless of decision aid utilized. The author would speculate that decision aids would become more important relative to time spent on the task for more difficult problems. Thus, in an applied setting, it seems important to evaluate the complexity and difficulty of the problem. For easier problems, presenting one-objective-at-a-time would be likely to lead to a large number of alternatives, and spending longer on the problem solving task would be likely to lead to a greater number of high quality alternatives. For more difficult complex problems, structuring the problem using decision aids such as structuring would be likely to increase the quality of the alternatives.

Two possibilities seem likely as explanations for the results obtained for anxiety and problem solving: (a) trait anxiety does moderate the relationship between problem structuring and solution generation, but the task was not sufficiently state anxiety-provoking to detect this effect, (b) trait anxiety does not moderate the relationship between structuring and solution generation. Perhaps the effects of anxiety on performance that have been documented in other

domains and with other types of problems operate through other complex mechanisms involving person and situational variables.

Limitations

One limitation of the present study is that the difficulty of the problem solving task was not assessed. Hypothesis 2 was based on the premise that the task in the no objectives condition and the conflicting objectives condition would be more difficult or complex than the task in the one-objective-at-a-time condition, and thus would elevate state anxiety for those high in trait anxiety. This state anxiety elevation was expected to impair problem solving performance. The lack of data on the difficulty of the task in the various structuring conditions prevents a definitive interpretation of the results found for Hypothesis 2. It is possible that the presentation of conflicting objectives or no objectives did not increase the difficulty of the task compared to the presentation of one objective at a time, but it is also possible that difficult tasks do not elevate state anxiety. It has been unclear in some studies of anxiety whether performance decrements are due to the difficulty of the task, the elevation of state anxiety, or both. Measuring the difficulty of the task in each structuring condition would have aided in clarifying the relationship between task difficulty, anxiety, and problem solving.

Future Directions

The present study is part of a program of research examining the variables affecting solution generation. This study extends the research on anxiety and problem solving in that it examined a truly real-world problem. The researcher's contention is that prior research on the relationship between anxiety and problem solving failed to replicate the complexity of real-world problems (i.e., the problems used were difficult or complex, but still had one correct answer, such as anagrams). Future research should continue to examine problem solving as it exists in the real world, as this will increase the generalizability of problem solving research. The continued use of ill-structured, complex problems in research will contribute to the validity of recommendations made regarding how to increase the quality of solutions generated for problems in the work place.

Drawing conclusions regarding the effects of anxiety on the quantity and quality of solutions generated for ill-structured problems seems premature. The development of a generally agreed-upon definition and theory of anxiety, and further research on anxiety using ill-structured, real world problems, would facilitate the drawing of conclusions, and allow for recommendations to be made regarding whether anxiety should be reduced or controlled in order to improve an individual's problem solving performance.

Though not the focus of the present investigation, two individual difference measures of problem solving merit further study. Specifically, social

problem solving, which taps into a person's ability to solve problems, and need for cognition, an index of a person's motivation to solve problems, both were correlated with solution generation effectiveness. It was found in the present study that self-reported social problem solving ability was highly correlated with the effort expended in generating solutions (as measured by time spent), and that both social problem solving and need for cognition were positively correlated with the quantity and quality of solutions generated, and negatively correlated with both state and trait anxiety. Prior research in the area of social problem solving (Nezu, 1985) has indicated that self-reported ineffective problem solvers experience higher state and trait anxiety, report more frequent current problems and are more distressed by these problems, than self-reported effective problem solvers. Future research should be focused on these as well as other individual differences that may account for differences in problem solving success.

The finding that effort expended (time spent) on generating solutions was directly related to the quantity of solutions generated points to the likelihood that the problem, while ill-structured and complex, was rather easy. These findings should be replicated with more difficult, ill-structured problems.

References

Abelson, R. P., & Levi, A. (1985). Decision making and decision theory. In G. Lindzey & E. Aronson (Eds.), Handbook of social psychology (Vol. 1) (pp. 231-310). New York: Random House.

Baron, R. B., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173-1182.

Bazerman, M. H. (1986). Judgement in managerial decision making (2nd ed.) (pp. 3-5). New York: Wiley & Sons.

Borkovec, T. D. (1985). Worry: A potentially valuable concept. Behaviour Research and Therapy, 23, 481-482.

Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. Behaviour Research and Therapy, 21, 9-16.

Butler, A. B., & Scherer, L. L. (1997). The effects of elicitation aids, knowledge, and problem content on option quantity and quality. Organizational Behavior and Human Decision Processes, 72, 184-203.

Cacioppo, J. T., Petty, R. E., & Kao, C. F. (1984). The efficient assessment of need for cognition. Journal of Personality Assessment, 48, 306-307.

Cattell, R. B., & Scheier, I. H. (1960). Stimuli related to stress,

neuroticism, excitation, and anxiety response patterns. Journal of Abnormal and Social Psychology, 60, 195-204.

D'Zurilla, T. J., & Nezu, A. M. (1982). Social problem solving in adults. In P. C. Kendall (Ed.), Advances in cognitive-behavioral research and therapy (Vol. 1, pp. 201-274). New York: Academic Press.

D'Zurilla, T. J., & Nezu, A. M. (1990). Development and preliminary evaluation of the Social Problem-Solving Inventory. Psychological Assessment, 2, 156-163.

Eysenck, M. W. (1979). Anxiety, learning, and memory: A reconceptualization. Journal of Research in Personality, 13, 363-385.

Eysenck (1982). Attention and arousal: Cognition and performance. Berlin: Springer.

Eysenck, M. W. (1991). Trait anxiety and cognition. In C. D. Spielberger, I. G. Sarason (Eds.), Stress and emotion: Anxiety, anger, and curiosity. (Vol. 14). New York: Hemisphere Publishing Corp.

Eysenck, M. W. (1992). Anxiety: The cognitive perspective. Hove, UK: Lawrence Erlbaum Associates Ltd.

Fabry, R., & Dvorakova, T. (1992). Anxiety in operator's risk decision making. Studia Psychologica, 34, 167-174.

Heppner, P. P., Hibel, J., Neal, G. W., Weinstein, C. L., & Rabinowitz, F. E. (1982). Personal problem solving: A descriptive study of individual differences.

Journal of Counseling Psychology, 29, 580-590.

Heppner, P. P., & Petersen, C. H. (1982). The development and implications of a personal problem-solving inventory. Journal of Counseling Psychology, 29, 66-75.

Jackson, D. N. (1984). Multidimensional Aptitude Battery manual. Port Huron, MI: Research Psychologists Press, Inc.

Janis, I. L., & Mann, L. (1977). Decision making: A psychological analysis of conflict, choice, and commitment. New York: The Free Press.

Kepner, C. I., & Tregoe, B. B. (1965). The rational manager (Ch. 10). New York: McGraw-Hill.

Lazarus, R. S. (1966). Psychological stress and the coping process. New York: McGraw-Hill.

Leon, M. R. (1989). Anxiety and the inclusiveness of information processing. Journal of Research in Personality, 23, 85-98.

Levitt, E. E. (1980). The psychology of anxiety (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

MacLeod, C., & Donnellan, A. M. (1993). Individual differences in anxiety and the restriction of working memory capacity. Personality and Individual Differences, 15, 163-173.

Mayer, R. E. (1977). Problem-solving performance with task overload: Effects of self-pacing and trait anxiety. Bulletin of the Psychonomic Society, 9,

283-286.

McReynolds, P. (1989) Toward a general theory of anxiety. In C. D. Spielberger, I. G. Sarason, J. Strelau (Eds.), Stress and anxiety (Vol. 12). New York: Hemisphere Publishing Corp.

Montague, E. K. (1953). The role of anxiety in serial rote learning. Journal of Experimental Psychology, 45, 91-95.

Nezu, A. M. (1985). Differences in psychological distress between effective and ineffective problem solvers. Journal of Counseling Psychology, 32, 135-138.

O' Neill, G. W. (1985). Is worry a valuable concept? Behaviour Research and Therapy, 23, 479-480.

Patrick, J. R. (1934). Studies in rational behavior and emotional excitement: The effect of emotional excitement on rational behavior in human subjects. Journal of Comparative Psychology, 18, 153-195.

Paulman, R. G., & Kennelly, K. J. (1984). Test anxiety and ineffective test taking: Different names, same construct? Journal of Educational Psychology, 76, 279-288.

Pitz, G. F., Sachs, N. J., & Heerboth, J. (1980). Procedures for eliciting choices in the analysis of individual decisions. Organizational Behavior and Human Performance, 26, 396-408.

Riedel, H. P. R., Taylor, I. A., & Melnyk, W. T. (1983). Effects of creative

and noncreative problem-solving on anxiety. Perceptual and Motor Skills, 56, 835-844.

Sarason, I. G. (1960). Empirical findings and theoretical problems in the use of anxiety scales. Psychological Bulletin, 57, 403-415.

Scherer, L. L., & Billings, R. S. (1999). Impact of problem structuring on the quantity and quality of decision alternatives generated. Manuscript in preparation, University of Nebraska at Omaha.

Scherer, L. L., Weiss, R. J., Reiter-Palmon, R., & Goodman, D. F. (1996, November). Effect of solution generation on cognitive and affective reactions to problems. Paper presented at the Annual Meeting of the Society for Judgement and Decision Making, Chicago, IL.

Seyle, H. (1980). The stress concept today. In I. L. Kutash, L. B. Schlesinger, (Eds.), Handbook on stress and anxiety: Contemporary knowledge, theory, and treatment. San Francisco: Jossey-Bass, Inc.

Spence, J. T., & Spence, K. W. (1966). The motivational components of manifest anxiety: Drive and drive stimuli. In C. D. Spielberger, (Ed.), Anxiety and behavior. New York: Academic Press.

Spielberger, C. D. (1966). The effects of anxiety on complex learning and academic achievement. In C. D. Spielberger (Ed.), Anxiety and behavior. New York: Academic Press.

Spielberger, C. D. (1972). Anxiety as an emotional state. In C. D.

Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol. 1). New York: Academic Press.

Spielberger, C. D. (1976). The nature and measurement of anxiety. In C. D. Spielberger & R. Diaz-Guerrero (Eds.), Cross-cultural anxiety. Washington, DC: Hemisphere/Wiley.

Spielberger, C. D. (1983). State-Trait Anxiety Inventory for Adults (Form Y). Palo Alto, CA: Mind Garden.

Upshaw, H. S. (1975). Judgement and decision processes in the formation and change of social attitudes. In M. F. Kaplan & S. Schwartz (Eds.), Human judgement and decision processes. New York: Academic Press.

von Winterfeldt, D. (1980). Structuring decision problems for decision analysis. Acta Psychologica, 45, 71-93.

Zarantonello, M., Slaymaker, F., Johnson, J., & Petzel, T. (1984). Effects of anxiety and depression on anagram performance, ratings of cognitive interference, and the negative subjective evaluation of performance. Journal of Clinical Psychology, 40, 20-25.

Appendix A

Stimulus Materials

Chris's Problem

In order to increase available job opportunities upon graduation, Chris decided to work as a research assistant with a faculty member in the psychology department during junior and senior year. Chris was not sure who to work with. The head of the department, Dr. Johnson, suggested that Chris work with his good friend, Dr. Bundt, since Dr. Bundt is well known in his field, has good job contacts, and has many other students working with him. After working with Dr. Bundt for two months, Chris has realized that the job is not very enjoyable. The other students working with Dr. Bundt appear to be very happy, but Chris is not interested in the research project that the students were assigned to work on. In addition, Chris finds that the job requires a lot of work to do that is very time consuming, with very little guidance provided on how to do what is required. Dr. Bundt himself turns out to be unfriendly and difficult to please. Chris is not sure what to do.

Instructions to Participants

You will be participating in a study examining solutions generated to complex problems. On the following pages, you will find a problem, some instructions for generating solutions, and a questionnaire for you to complete. Please take your time when generating solutions and consider each question carefully in the questionnaire. When you have finished generating solutions and responding to the questionnaire, please turn all materials in to the experimenter.

Objectives for Chris's Problem

(Scherer & Billings, 1999)

1. To avoid excessive demands
2. To acquire a good reputation among faculty
3. To minimize inconvenience
4. To increase job opportunities

One-Objective-at-a-Time

An objective Chris is concerned with is:

To increase job opportunities

Please list all the alternatives you can think of in the space below.

Another objective Chris is concerned with is:

To avoid excessive demands

Please list all the alternatives you can think of in the space below.

Another objective Chris is concerned with is:

To acquire a good reputation among faculty

Please list all the alternatives you can think of in the space below.

Another objective Chris is concerned with is:

To minimize inconvenience

Please list all the alternatives you can think of in the space below.

Conflicting Objectives

Two objectives Chris is concerned with are:

To avoid excessive demands

To acquire a good reputation among faculty

Please list all the alternatives you can think of in the space below.

Two objectives Chris is concerned with are:

To increase job opportunities

To minimize inconvenience

Please list all the alternatives you can think of in the space below.

No Objectives

Please list all the alternatives which occur to you in the space below.

Debriefing

The purpose of the experiment was to see if giving people objectives to consider when solving a problem leads them to come up with more and/or better solutions. We also wanted to see if certain personality characteristics, such as the tendency to be calm or nervous, affect people's ability to solve problems effectively. If you would like more information about this study or if you would like to know the results when it is completed, you may contact the experimenter, Judy Wightman, at 554-4811, or 592-5993. You may also contact Dr. Lisa Scherer, at 554-2698. We ask that you please do not disclose the nature of this experiment to others because it can bias our results if participants know what to expect when they arrive.

Appendix B

Measures

(STAI-Trait; Spielberger, 1983)

Self-Evaluation Questionnaire

Directions:

A number of statements which people have used to describe themselves are given below. Read each statement and then use your answer sheet to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

1. I feel pleasant.
2. I feel nervous and restless.
3. I feel satisfied with myself.
4. I wish I could be as happy as others seem to be.
5. I feel like a failure.
6. I feel rested.
7. I am "calm, cool, and collected."
8. I feel that difficulties are piling up so that I cannot overcome them.
9. I worry too much over something that really doesn't matter.
10. I am happy.
11. I have disturbing thoughts.

12. I lack self-confidence.

13. I feel secure.

14. I make decisions easily.

15. I feel inadequate.

16. I am content.

17. Some unimportant thought runs through my mind and bothers me.

18. I take disappointments so keenly that I can't put them out of my mind.

19. I am a steady person.

20. I get in a state of tension or turmoil as I think over my recent concerns and interests.

Note. Participants responded using a four-point scale. 1 = Almost Never, 2 = Sometimes, 3 = Often, 4 = Almost Always.

(STAI-State; Spielberger, 1983)

Self-Evaluation Questionnaire

Directions:

A number of statements which people have used to describe themselves are given below. Read each statement and respond on your answer sheet to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1. I feel calm.
2. I feel secure.
3. I am tense.
4. I feel strained.
5. I feel at ease.
6. I feel upset.
7. I am presently worrying over possible misfortunes.
8. I feel satisfied.
9. I feel frightened.
10. I feel comfortable.
11. I feel self-confident.
12. I feel nervous.
13. I am jittery.

14. I feel indecisive.

15. I am relaxed.

16. I feel content.

17. I am worried.

18. I feel confused.

19. I feel steady.

20. I feel pleasant.

Note. Participants responded using a four-point scale. 1 = Not at All, 2 = Somewhat, 3 = Moderately So, 4 = Very Much So.

(Additional Questions)

21. Rate the extent to which being an experimental participant in general makes you feel anxious or nervous. Choose the number that corresponds to how anxious or nervous you generally feel in this situation and mark it on your answer sheet.

1	2	3	4	5
Not at all	A Little	Moderately	Very Much	Extremely

22. Rate the extent to which the previous task made you feel **fearful**. Choose the number that corresponds to how fearful the task made you feel and mark it on your answer sheet.

1	2	3	4	5
Not at all	A Little	Moderately	Very Much	Extremely

23. Rate the extent to which the previous task made you feel **anxious** or **nervous**. Choose the number that corresponds to how anxious or nervous the task made you feel and mark it on your answer sheet.

1	2	3	4	5
Not at all	A Little	Moderately	Very Much	Extremely

Please respond to the following items on your answer sheet using this scale:

1 Yes

2 No

24. Do you or did you have any exams today?

25. Is there anything going on in your life right now that is making you feel particularly anxious or nervous?

26. Is there any event that you are very worried about right now?

27. Do you have any papers or major projects due anytime in the next 3 days?

28. If so, are you finished with the paper or project?

(Need for Cognition Scale; Cacioppo, Petty, & Kao, 1984)

For each of the statements below, please indicate whether or not the statement is characteristic of you. If the statement is extremely uncharacteristic of you (not at all like you) please mark a "1" on your answer sheet; if the statement is extremely characteristic of you (very much like you) please mark a "5" on your answer sheet. You should use the following scale as you rate each of the statements below.

1 Extremely Uncharacteristic

2 Somewhat Uncharacteristic

3 Uncertain

4 Somewhat Characteristic

5 Extremely Characteristic

1. I prefer complex to simple problems.
2. I like to have the responsibility of handling a situation that requires a lot of thinking.
3. Thinking is not my idea of fun.
4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.
5. I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.
6. I find satisfaction in deliberating hard for long hours.

7. I only think as hard as I have to.
8. I prefer to think about small daily projects to long-term ones.
9. I like tasks that require little thought once I've learned them.
10. The idea of relying on thought to make my way to the top appeals to me.
11. I really enjoy a task that involves coming up with new solutions to problems.
12. Learning new ways to think doesn't excite me much.
13. I prefer my life to be filled with puzzles that I must solve.
14. The notion of thinking abstractly is appealing to me.
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort.
17. It's enough for me that something gets the job done; I don't care how or why it works.
18. I usually end up deliberating about issues even when they do not affect me personally.

(Social Problem Solving Scale; variation of

Social Problem-Solving Inventory, D'Zurilla & Nezu, 1990)

Instructions

Below are some statements that describe how some people might think, feel, and act when faced with important **PROBLEMS** in everyday living. We are not talking about the ordinary hassles and pressures that you deal with successfully every day. In this questionnaire, a problem is something important in your life that bothers you a lot but you don't immediately know how to make it better or stop it from bothering you so much. You know that you have a problem when you feel confused, uncertain, puzzled, or stumped about something. The problem could be something about yourself (e.g., family, friends, co-workers, employer), or your physical environment and possessions (e.g., your house, car, property, money). Read each statement carefully and select one of the numbers below that indicates how true the statement is of you. Consider yourself as you typically think, feel, and act when you are faced with important problems these days. Mark the number that you choose on your answer sheet.

1 = Not at all true of me

2 = Slightly true of me

3 = Moderately true of me

4 = Very true of me

5 = Extremely true of me

1. I spend too much time worrying about my problems instead of trying to solve them.
2. I feel threatened and afraid when I have an important problem to solve.
3. When making decisions, I do not evaluate all my options carefully enough.
4. When I have a decision to make, I often fail to consider the effects that each option is likely to have on the well-being of other people.
5. When I am trying to solve a problem, I often think of different solutions and then try to combine them to make a better solution.
6. I feel nervous and unsure of myself when I have an important decision to make.
7. When my first efforts to solve a problem fail, I know if I persist and do not give up too easily, I will be able to find a good solution eventually.
8. When I am attempting to solve a problem, I usually act on the first idea that occurs to me.
9. Whenever I have a problem, I usually believe that it can be solved.
10. I usually wait to see if a problem will resolve itself first, before trying to solve it myself.
11. When I have a problem to solve, one of the things I do is analyze the situation and try to identify what obstacles are keeping me from getting what I want.
12. When my first efforts to solve a problem fail, I get frustrated.

13. When I am faced with a difficult problem, I often doubt that I will be able to solve it on my own no matter how hard I try.
14. When a problem occurs in my life, I usually put off trying to solve it for as long as possible.
15. After carrying out a solution to a problem, I do not take the time to evaluate all of the results carefully.
16. I go out of my way to avoid having to deal with problems in my life.
17. Difficult problems make me very upset.
18. When I have a decision to make, I try to predict the positive and negative consequences of each option.
19. When problems occur in my life, I like to deal with them as soon as possible.
20. When I am attempting to solve a problem, I often try to be creative and think of new or original solutions.
21. When I am trying to solve a problem, I usually go with the first good idea that comes to mind.
22. When I try to think of different possible solutions to a problem, I cannot usually come up with many ideas.
23. I prefer to avoid thinking about the problems in my life instead of trying to solve them.
24. When making decisions, I usually consider both the immediate consequences and the long-term consequences of each option.

25. After carrying out my solution to a problem, I try to analyze what went right and what went wrong.
26. After carrying out my solution to a problem, I examine my feelings and evaluate how much they have changed for the better.
27. Before carrying out my solution to a problem, I often practice the solution in order to increase my chances of success.
28. When I am faced with a difficult problem, I believe I will be able to solve it on my own if I try hard enough.
29. When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible.
30. I often put off solving problems until it is too late to do anything about them.
31. I spend more time avoiding my problems than solving them.
32. When I am trying to solve a problem, I often get so upset that I cannot think clearly.
33. Before I try to solve a problem, I usually set a specific goal so that I know exactly what I want to accomplish.
34. When I have a decision to make, I do not take the time to consider the pros and cons of each option.
35. When the outcome of my solution to a problem is not satisfactory, I try to find out what went wrong and then I try again.
36. I hate having to solve the problems that occur in my life.

37. After carrying out my solution to a problem, I try to evaluate as carefully as possible how much the situation has changed for the better.
38. When I have a problem, I try to see it as a challenge, or opportunity to benefit in some positive way from having the problem.
39. When I am trying to solve a problem, I think of as many options as possible until I cannot come up with any more ideas.
40. When I have a decision to make, I weigh the consequences of each option and compare them against each other.
41. I often become depressed and immobilized when I have an important problem to solve.
42. When I am faced with a difficult problem, I usually go to someone else for help in solving it.
43. When I have a decision to make, I consider the effects that each option is likely to have on my personal feelings.
44. When I have a problem to solve, one of the things I do is examine what factors or circumstances in my environment might be contributing to the problem.
45. When making decisions, I usually go with my "gut feeling" without thinking too much about the consequences of each option.
46. When making decisions, I generally use a systematic method for judging and comparing alternatives.

47. When I am trying to solve a problem, I keep in mind what my goal is at all times.
48. When I am attempting to solve a problem, I try to approach it from as many different angles as possible.
49. When I am having trouble understanding a problem, I try to get more specific and concrete information about the problem to help clarify it.
50. When my first efforts to solve a problem fail, I get discouraged and depressed.
51. When a solution that I have carried out does not solve my problem satisfactorily, I do not take the time to examine carefully why it did not work.
52. I am too impulsive when it comes to making decisions.

(Additional Questions)

53. When I am generating solutions to a problem, I try to generate solutions that address the underlying conflict of the problem.
54. When I am generating solutions to a problem, I try to generate solutions that are practical.
55. When I am generating solutions to a problem, I try to generate solutions that satisfy the objective that is most important to me.
56. When I am generating solutions to a problem, I try to generate solutions that satisfy multiple objectives or goals.

57. When I am generating solutions to a problem, I try to think of solutions that represent compromises among the people involved in the problem.
58. When I am generating solutions to a problem, I try to generate solutions that resolve the conflicting aspects of the problem.

Demographic Questionnaire

For the following questions, please fill in the numbered circle on the answer sheet that corresponds to your answers below.

1. What is your gender? 1 Male 2 Female

2. What is your race? 1 Caucasian 4 Asian
   2 African American 5 Other
   3 Hispanic

3. What is your highest level of educational experience?
   1 High School Graduate
   2 Certificate or Dual Certificate
   3 Associate's or Dual Associate's Degree
   4 Some College
   5 Bachelor's Degree

4. How many semesters have you been enrolled in at least one college course?
   1 1 - 2 semesters 3 7 - 10 semesters
   2 3 - 6 semesters 4 more than 10 semesters

5. Which of the following best describes your academic standing?
   1 Freshman 3 Junior 5 Other/Don't know
   2 Sophomore 4 Senior

6. How many college courses have you taken?

1	0 - 7 courses	4	22 - 29 courses
2	8 - 14 courses	5	30 or more courses
3	15 - 21 courses		

7. How many psychology courses have you taken?

1	1 - 2 courses	4	7 - 9 courses
2	3 - 4 courses	5	10 or more courses
3	5 - 6 courses		

8. Is English your primary language? 1 Yes 2 No

9. Which number below best represents your <u>difficulty</u> in reading English?

1	None	4	Quite a bit
2	Very little	5	Lots
3	Some		

10. Are you currently employed? 1 Yes 2 No

11. Are you married? 1 Yes 2 No

12. Do you have children? 1 Yes 2 No

(Jackson, 1984)

Multidimensional Aptitude Battery

Vocabulary

This is a test of how many words you know. On your answer sheet, mark the one alternative that is nearest in meaning to the word given. You will have **seven minutes.**

Here are two examples:

quick
A. fast
B. slow
C. walk
D. lethal
E. run

fast is correct, so **A** should be marked.

crave
A. destroy
B. insane
C. desire
D. short
E. bend

desire is the correct answer, so **C** should be marked.

1. attempt
A. try
B. succeed
C. obtain
D. do
E. fail

2. mumble
A. mutter
B. complain
C. confuse
D. blunder
E. gossip

3. illusion
A. literary reference
B. originality
C. misleading image
D. idea
E. information

4. symbol
A. attitude
B. failure
C. importance
D. academy
E. representation

5. focus
A. blaze
B. ending
C. center
D. urgency
E. series

6. budget
A. public records
B. bank account
C. calendar
D. plan of systematic spending
E. movable

7. wharf
A. weak
B. dock
C. fishing boat
D. fishnet
E. meal

8. equip
A. hurry
B. train a horse
C. same weight
D. blend
E. furnish

9. mesmerize
A. polymerize
B. massage
C. masticate
D. hypnotize
E. pollute

10. gaudy
A. showy
B. religious
C. messy
D. windy
E. lonely

11. protocol
A. modesty
B. sapience
C. diplomatic etiquette
D. national security
E. plant or animal tissue

12. succumb
A. aid
B. follow
C. yield
D. obstruct
E. ponder

13. transient
A. permanent
B. secret
C. disguised
D. passing
E. ungrateful

14. degrade
A. argue
B. falsify
C. classify
D. debase
E. slope downward

15. autonomy
A. control by self
B. governmental system
C. oppression
D. car monopoly
E. anarchy

16. apathetic
A. callous
B. impulsive
C. hateful
D. meandering
E. uninterested

17. maelstrom
A. stateliness
B. conductor
C. suit of armor
D. turmoil
E. admiration

18. implicate
A. involve
B. extract
C. penetrate
D. conclude
E. reveal

19. etymology
A. study of the history of words
B. study of birds
C. comparative study of chemicals
D. knowledge of cause or origin
E. awkward phrasing

20. feign
A. pretend
B. diminish
C. prefer
D. designate
E. vanish

21. juxtapose
A. place above
B. move in a circle
C. place under
D. place side by side
E. move away from

GO TO NEXT PAGE

22. acclaim
A. affect
B. blame
C. attract
D. demand as right
E. hail loudly

23. voracious
A. destructive
B. truthful
C. affluent
D. beguiling
E. ravenous

24. deity
A. rule
B. decision
C. god
D. obligation
E. event

25. anachronism
A. recognition
B. aphorism
C. misplaced in time
D. bitter attack
E. misnomer

26. effrontery
A. prominence
B. insensibility
C. impudence
D. radiation
E. confrontation

27. facade
A. front
B. barricade
C. ornament
D. center
E. cover

28. spindle
A. wheel
B. shaft
C. hinge
D. sword
E. ball

29. austere
A. soft
B. kind
C. heavy
D. severe
E. solid

30. vigilant
A. selective
B. watchful
C. consistent
D. hostile
E. hard-working

31. vacillate
A. purify
B. fluctuate
C. lubricate
D. immunize
E. endure

32. augment
A. signify
B. oppose
C. adapt
D. believe
E. increase

33. epitome
A. typical representation
B. abuse
C. tomb inscription
D. long novel
E. lowest point

34. accrue
A. accumulate
B. decide
C. disagree
D. attribute
E. regret

35. rejoinder
A. appendix
B. reply
C. disagreement
D. removal
E. commencement

36. exonerate
A. exhibit
B. acquit
C. atone
D. exult
E. refute

37. exacerbate
A. generalize
B. make more severe
C. select
D. praise highly
E. frustrate

38. assiduous
A. accepting
B. simple
C. obstinate
D. diligent
E. hostile

39. phlegmatic
A. anxious
B. bilious
C. lethargic
D. anemic
E. criminal

40. erudite
A. diseased
B. hopeful
C. simplifying
D. punishing
E. scholarly

41. prestidigitation
A. sleight of hand
B. high reputation
C. digital computer
D. walking on the toes
E. dressed up

42. insipid
A. treacherous
B. enduring
C. poisonous
D. fearless
E. dull

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43. antediluvian
A. rebellious
B. evil
C. honorable
D. antiquated
E. futuristic

44. germane
A. supple
B. pertinent
C. ominous
D. revealing
E. persuasive

45. surreptitious
A. forceful
B. ambitious
C. delicious
D. cautious
E. clandestine

46. hirsute
A. lame
B. malefic
C. obtected
D. hairy
E. rangy

Appendix C

Rating Scale for Resolving Power

1 Solution doesn't do a very good job addressing any aspects/facets of the problem.

2 Solution addresses one aspect/facet of the problem moderately well.

3 Solution effectively addresses one aspect/facet of the problem.

4 Solution seems to attempt to address the conflicting aspects/facets of the problem.

5 Solution resolves the conflicting aspects/facets of the problem moderately well. (Another way to say this is "Incomplete resolution of both sides of the conflict.")

6 Solution does a very good job resolving the conflicting aspects/facets of the problem. (Another way to say this is "Complete resolution within the universe of solutions you have.")

Appendix D

Categories of Prototypes

1. Talk to Dr. Johnson
2. Talk to faculty not directly involved
3. Do another project
4. Quit
5. Consult third party for advice (other than Dr. Bundt or Dr. Johnson)
6. Carefully make a decision based on what's most important to you
7. Altering the work assignment or effort (whether good or bad)
8. Get someone to help (not talking)
9. Endure situation
10. Talk to Dr. Bundt about time problem
11. Make efficient use of time
12. Avoid Dr. Bundt
13. Don't worry about faculty
14. Think about situation or change perspective and attitude
15. Talk to Dr. Bundt about problems (not involving time)
16. Talk to multiple people
17. Involve Dr. Bundt and/or Dr. Johnson in career search and job decisions
18. Try to understand and get along with Dr. Bundt
19. Multiple action solutions

20. Ambiguous solutions
21. Miscellaneous solutions
22. Go outside university for experience or job searching
23. Organizing work
24. Alter coursework or major
25. If/then or contingency solutions

Appendix E

Descriptive Statistics for Problem Solving Data

Table E1

Distribution of Resolving Power for No Objectives Condition

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	97	9	42	71	125	32
Percentage of Solutions	26%	2%	11%	19%	33%	9%

Note. N = 61. Total number of solutions = 376.

Table E2

Distribution of Resolving Power for One-Objective-at-a-Time Condition

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	148	52	94	176	240	63
Percentage of Solutions	19%	7%	12%	23%	31%	8%

Note. N = 61. Total number of solutions = 773.

Table E3

Distribution of Resolving Power for Conflicting Objectives Condition

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	81	26	52	96	128	46
Percentage of Solutions	19%	6%	12%	22%	30%	11%

Note. N = 62. Total number of solutions = 429.

Table E4

Distribution of Resolving Power for Low Trait Anxiety

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	174	50	100	182	280	83
Percentage of Solutions	20%	6%	12%	21%	32%	10%

Note. N = 91. Total number of solutions = 869.

Table E5

Distribution of Resolving Power for High Trait Anxiety

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	152	37	88	161	213	58
Percentage of Solutions	21%	5%	12%	23%	30%	8%

Note. N = 93. Total number of solutions = 709.

Table E6

Distribution of Resolving Power for Low Trait Anxiety with No Objectives

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	48	3	18	32	61	19
Percentage of Solutions	27%	2%	10%	18%	34%	10%

Note. N = 26. Total number of solutions = 181.

Table E7

Distribution of Resolving Power for Low Trait Anxiety with One Objective at a Time

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	85	36	58	106	168	42
Percentage of Solutions	17%	7%	12%	21%	34%	8%

Note. N = 38. Total number of solutions = 495.

Table E8

Distribution of Resolving Power for Low Trait Anxiety with Conflicting Objectives

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	41	11	24	44	51	22
Percentage of Solutions	21%	6%	12%	23%	26%	11%

Note. N = 27. Total number of solutions = 193.

Table E9

Distribution of Resolving Power for High Trait Anxiety with No Objectives

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	49	6	24	39	64	13
Percentage of Solutions	25%	3%	12%	20%	33%	7%

Note. N = 35. Total number of solutions = 195.

Table E10

Distribution of Resolving Power for High Trait Anxiety with One Objective at a Time

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	63	16	36	70	72	21
Percentage of Solutions	23%	6%	13%	25%	26%	8%

Note. N = 23. Total number of solutions = 278.

Table E11

Distribution of Resolving Power for High Trait Anxiety with Conflicting Objectives

Resolving Power Rating	1	2	3	4	5	6
Number of Solutions	40	15	28	52	77	24
Percentage of Solutions	17%	6%	12%	22%	33%	10%

Note. N = 35. Total number of solutions = 236.

Table E12

Descriptive Statistics for Problem Solving Data by Structuring Condition

Condition	N	Number of Solutions	Number Highly Resolving	Average Resolving Power	Proportion Highly Resolving	Highest Resolving Solution	Minutes Spent Problem Solving
No Objectives	61	6.16	3.72	3.55	0.60	5.36	7.92
One Objective at a Time	61	12.67	7.87	3.66	0.63	5.62	14.59
Conflicting Objectives	62	6.92	4.34	3.56	0.60	5.55	10.19

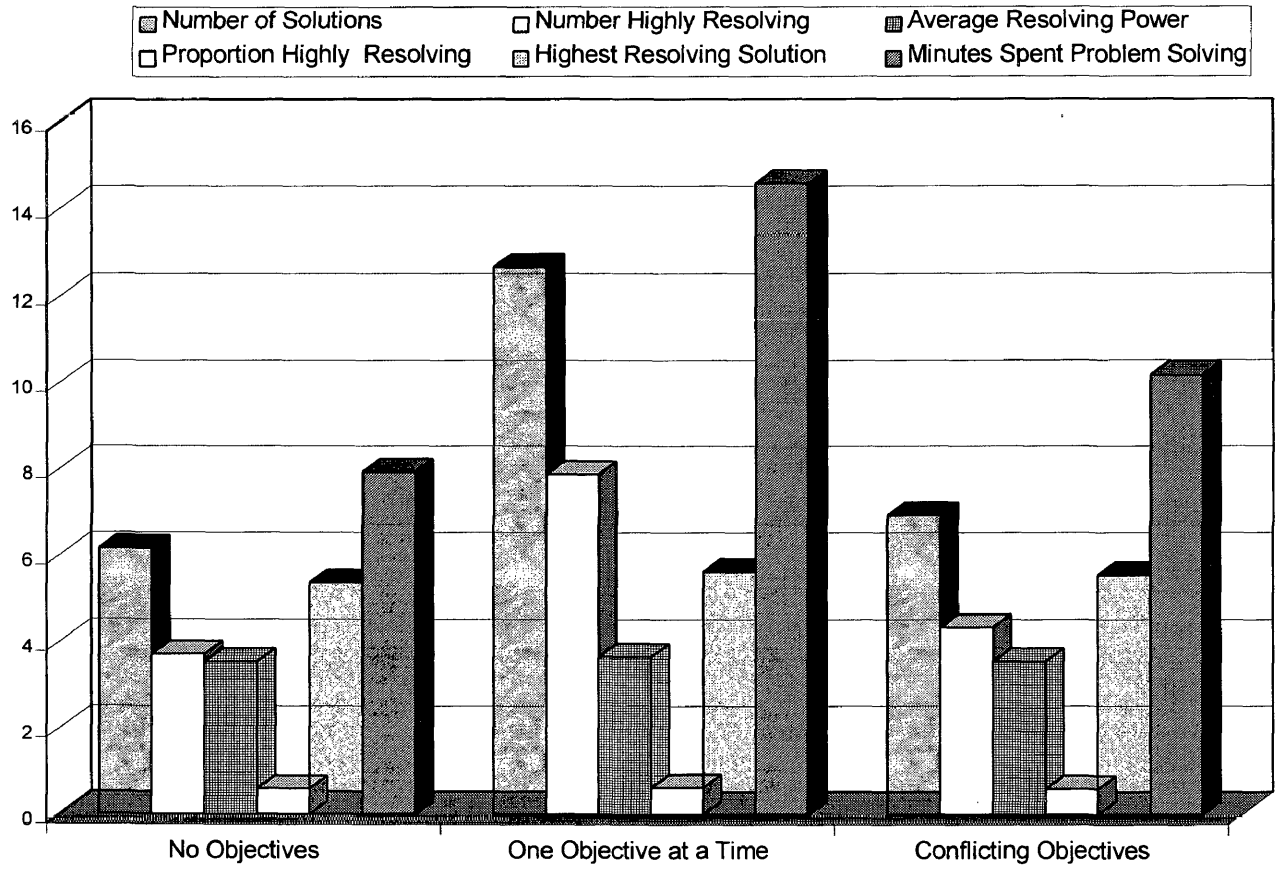

Figure Caption

Figure E1. Descriptive statistics for problem solving data by structuring condition.

Table E13

Descriptive Statistics for Problem Solving Data by Trait Anxiety Condition

Condition	N	Number of Solutions	Number Highly Resolving	Average Resolving Power	Propor-tion Highly Resolving	Highest Resolving Solution	Minutes Spent Problem Solving
Low Trait Anxiety	91	9.55	5.98	3.67	0.63	5.61	11.67
High Trait Anxiety	93	7.62	4.65	3.51	0.60	5.39	10.14

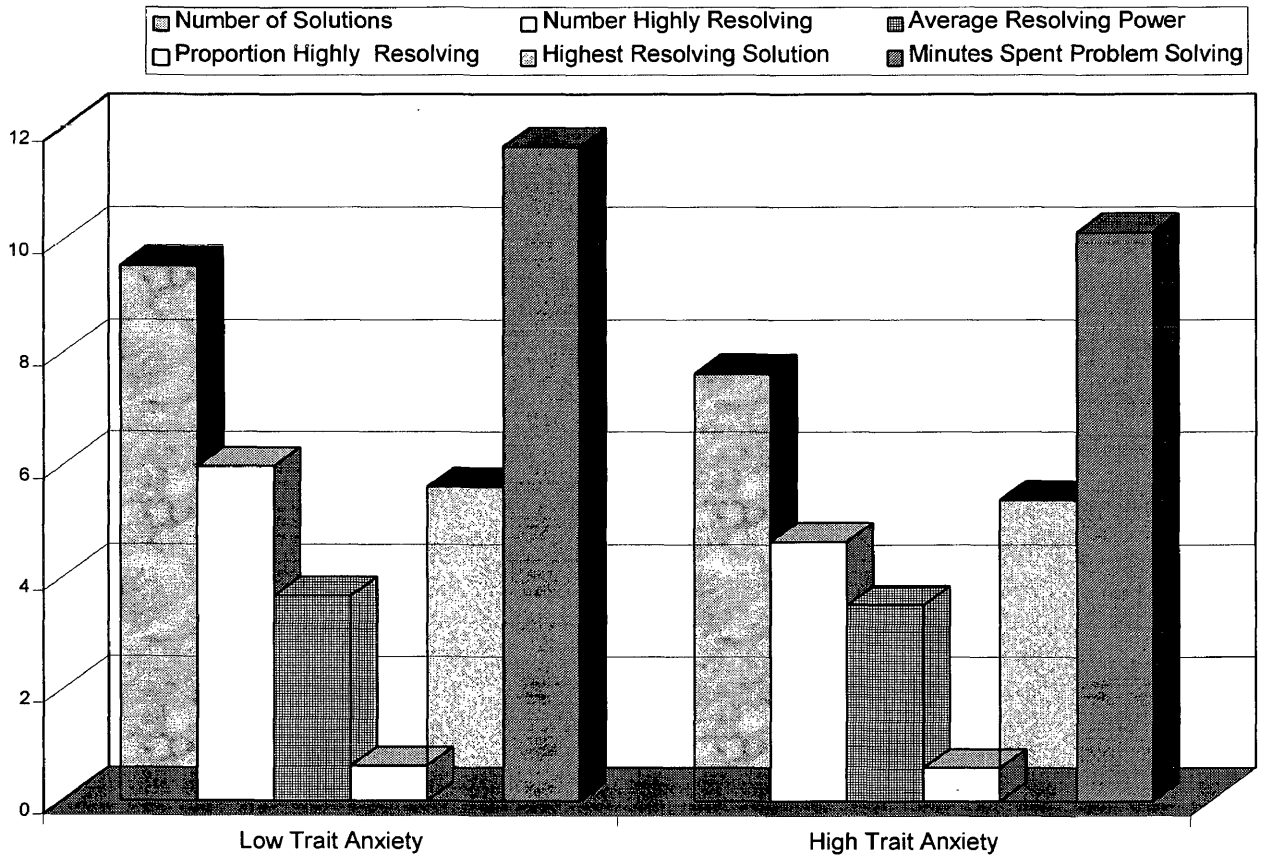

Figure Caption

Figure E2. Descriptive statistics for problem solving data by trait anxiety condition.

Table E14

Descriptive Statistics for Problem Solving Data by Structuring and Trait Anxiety Condition

Cell	N	Number of Solutions	Number Highly Resolving	Average Resolving Power	Propor-tion Highly Resolving	Highest Resolving Solution	Minutes Spent Problem Solving
1	26	6.96	4.31	3.47	0.60	5.56	8.38
2	38	13.03	8.34	3.76	0.66	5.68	14.84
3	27	7.15	4.26	3.72	0.61	5.56	10.37
4	35	5.57	3.29	3.60	0.60	5.21	7.57
5	23	12.09	7.09	3.49	0.57	5.53	14.17
6	35	6.74	4.4	3.43	0.60	5.54	10.06

Note. Cell 1 = Low trait anxiety, no objectives.
Cell 2 = Low trait anxiety, one objective at a time.
Cell 3 = Low trait anxiety, conflicting objectives.
Cell 4 = High trait anxiety, no objectives.
Cell 5 = High trait anxiety, one objective at a time.
Cell 6 = High trait anxiety, conflicting objectives.

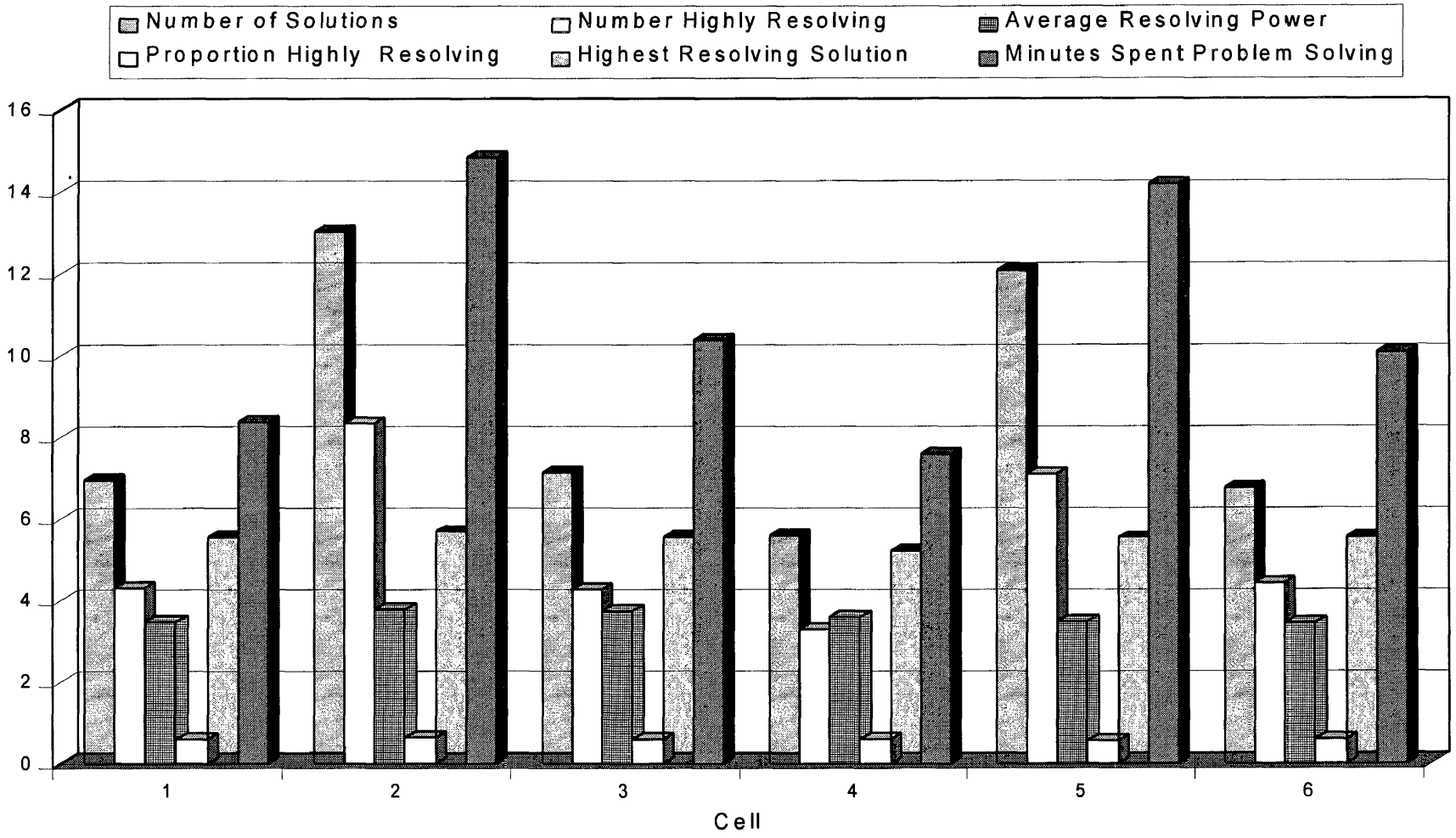

Figure Caption

Figure E3. Descriptive statistics for problem solving data by structuring and trait anxiety condition.