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Correlates of Creative Problem Solving

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13. ABSTRACT (Maximum 200 words) The purposes of this research were to (a) identify individual differences related to unstructured problem-solving capability and (b) evaluate the effectiveness of a training course designed to enhance performance in solving unstructured problems. One group underwent training designed to teach thinking process skills. The second group underwent instruction about thinking and problem solving that was content (not process) oriented. Four predictors accounted for 60% of the criterion's variance. They were, in order of importance, mental rotations, use of "intuition," use of "introversion" (both as assessed with the Myers-Briggs Type Indicator), and risk-taking propensity. Students taking the thinking process training significantly outscored those taught only about problems and errors in human judgment and decision making.				
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FOREWORD

This report documents an exploratory research effort undertaken as a second step in the development of a creative problem-solving instructional technology for the U.S. Army War College (AWC). It is the second in a series of reports documenting the development of the technology, its trial use, and its level of assessed acceptance in the AWC environment.

The research confirms some of the suppositions regarding factors involved in unstructured problem solving identified in a companion literature review. The report also documents the effectiveness of a genre of training that embodies factors suggested by this research and the literature that should enhance facility in creative problem solving. The work was part of the senior author's Ph.D. dissertation.

CORRELATES OF CREATIVE PROBLEM SOLVING

EXECUTIVE SUMMARY

Requirement:

This report documents the second portion of an overall research project undertaken to develop relevant input for a creative problem-solving instructional technology for use at the U.S. Army War College. The report documents a major phase of an overall research, development, and technology transfer project.

There were two explicit purposes for this research project. These were (a) to identify individual differences related to the capability to develop workable solutions for unstructured problems and (b) to evaluate the effectiveness of a training course designed to enhance the unstructured problem-solving capabilities of students.

Procedure:

Student volunteers from Psychology 371 (the control condition) and Art A&D 100B (the treatment condition) during the spring 1988 semester of Southern Illinois University (Carbondale Campus) participated in this project. They were given a material problem (to construct the tallest freestanding structure possible from two 5x8-inch index cards) and a set of verbal problems to solve at the beginning and end of the semester. At the beginning of the semester all volunteers responded to 12 individual difference measures that assessed such things as "tolerance for ambiguity" and "assertiveness."

Findings:

The participants' performance on the initial verbal and material problems served as criteria in two stepwise multiple regression analyses. Potential predictors included all the individual difference measures plus relevant demographics (e.g., sex and years of college completed). Four predictors accounted for 60% of the variance in the material criterion. Those were, in the order of variance accounted for, (a) mental rotation, (b) preference for the use of "intuition" in perception, (c) preference for "introversion" (as opposed to extraversion), and (d) "sensation seeking" (or risk-taking propensity). Only one variable was predictive (accounting for approximately 20% of

the variance) on the verbal criterion. That was the preference for "sensing" (as opposed to intuition) in perception.

Posttraining comparisons, while controlling for initial group performance differences, indicated that the training the experimental group received was effective for the material but not for the verbal criterion.

As a way of ascertaining what individual differences were influenced or changed the most by the training, another stepwise regression analysis was performed using the posttraining material problem as the criterion--where significant performance improvement was demonstrated. While controlling for initial performance, and by inference from the regression analysis results, the training increased tolerance for ambiguity, impacted older more than younger students, and enhanced attitude vis-à-vis solving unstructured problems in creative ways.

Utilization of Findings:

These findings and others derived through the instructional development process will ultimately be embodied in the creative problem-solving training for the U.S. Army War College.

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CORRELATES OF CREATIVE PROBLEM SOLVING

Background

Current and projected national and international circumstances demand that the U.S. Army develop a more flexible and cognitively aware officer corps. A pioneer in stating this need, who challenged our ability to meet it via the current officer training and education system, was Starry (1982). His vision came from his awareness of the fact that, historically, the U.S. military has had change forced upon it. The military has not been quick to sense shifting political, social, or economic currents in order to deal proactively with them. At times, it has even been resistant to adopting new technologies capable of enhancing its effectiveness. Simon Lake, who built a submarine that located mines at Newport News during the Spanish American War, was told by the Navy that what he said he had done was impossible--and that if he did it again he would be thrown in jail! **The U.S. would not buy the submarine.** So, Lake went to Russia and found a buyer (Manchester, 1943).

Starry saw the need to devise better ways of developing senior officers to be more adept at two conceptually distinct levels. At one, they must be skilled in the conduct of war-fighting. At another level, they must be capable of assuming a significant role in domestic and foreign policy-making. Evolving geo-political conditions especially require more strategic and statesman-like thinking. Functioning at either of these levels is becoming extremely complex as the following quotes suggest:

... the rate of advance in weapon systems, organizations and doctrine has quickened. The increased scope and complexity of operations, the accelerated tempo of battle and the rapid change in technology represent quantum change. Today's divisions must tomorrow operate like yesterday's corps. Today's battalion commanders must think like yesterday's generals. And today's logisticians must be bolder and more creative than their forbearers in order to maintain and resupply the fighting force (Richardson, 1984).

As for the statesman role required of senior military leaders, Crowe (1987) has described it this way:

From my own perspective as Chairman of the Joint Chiefs of Staff, I see that partnership operating at several levels, every day:

- o In the National Security Council arena civilian and military leaders work together to make top-level security policy
- o In the Department of Defense, civilian and military personnel are concerned with preparing our forces for combat and with directing them in war, and
- o In our society at large, mutual understandings between citizens and their defenders put down the roots needed to sustain any military establishment over the long haul.

When the American civil-military partnership has been united, with each element conscious of its utter dependence on the other, it has been unbeatable. But when its bonds have weakened, the Nation's defenses have withered, and our course on a troubled globe has wavered dangerously.

Leadership Initiatives: 1970s and 1980s

To improve leader development at all levels, several major leadership initiatives were undertaken by the Army during the last years of the 1970s and the decade of the 1980s:

- O The Review of Education and Training for Officers (RETO) study, which ended just at the turn of the decade, confirmed the validity of the concept of sequential and progressive leader development and set major new objectives for the Officer Education System.
- O The Center for Army Leadership (CAL) was established at Fort Leavenworth, Kansas to enhance the Army's capability for modernizing leadership doctrine and leader development.
- O The basic leadership doctrine for company-grade commissioned and noncommissioned officers (FM 22-100) underwent major revision for the first time, mandating the development of ethical and professional attributes to enhance leadership effectiveness.
- O The Army leadership community, led by CAL, endorsed the concept of a series of leadership doctrinal manuals to parallel "How-to-Fight" manuals, each dealing with its companion level of operations--in recognition that the nature of leadership tasks changes from one level of operations to the next.
- O A second year was established to follow the Command and General Staff Officers' Course (C&GSOC)--reminiscent of what had existed there before the outbreak of

WWII--that would be attended by a highly select group of first-year students retained for further intense and focused study. Essentially, this created a "shadow general staff."

O A second major study effort--the Professional Development of Officers Study (PDOS)--was established to complete the work begun by the RETO study. Its objective was to lay out the road map for a sequential and progressive leader development system that would have as its highest priority the creation of a "war reserve" of leaders capable of functioning on future battlefields.

Within that context, in 1986 the Department of the Army Deputy Chief of Staff for Personnel (DA DCSPER) energized the establishment of the Senior Leadership Coordination Committee (SLCC) to oversee development work at the senior levels. That General Officer group was responsible for formalizing policy in AR 600-100 to establish three "levels" of leadership: direct, embracing battalion and below; senior, encompassing brigade through division; and executive, defining corps and echelons above corps command. The SLCC also approved work to develop concept material that might lead to some form of executive-level doctrine. Unlike doctrine at the lower levels that is used for instructional purposes, this doctrine would establish a set of principles that would orient the whole system of leader development. In other words, it should establish "Capstone" leadership requirements against which a career-long developmental system could be defined. The Capstone principles would discipline this system to be purposively sequential and progressive. The Army Research Institute (ARI) was tasked to support the SLCC in developing the conceptual material.

ARI established the Strategic Leadership Technical Area (SLTA) to meeting the tasking. SLTA, in conjunction with the Leader Policy Division of the DA DCSPER, developed a long-range plan to address the issue. The first step of the plan was to gain an understanding of the nature of work at the executive level--the positions occupied by three- and four-star general officers and members of the Senior Executive Service (equivalent rank). With the aid of the DA DCSPER, a plan and schedule was established to interview as many of the Army's incumbent three- and four-star general officers as possible, as well as a sample of top-level members in the SES, about their work and how they conceptualize the issues--their frames of reference.

The primary tool selected to guide this research was a theory developed by Jaques (1978). The theory provides descriptions of requisitely structured organizations, and of the progressively more complex work required at each level. It was seen as a viable tool for understanding the nature of leadership at

various levels or strata of organization, and for structuring a sequential and progressive developmental process based on the requirements for leadership at the various levels.

Data collection consisted of structured interviews with nearly 70 three- and four-star general officers and SES members. Content analysis of those interviews identified broad competencies and cognitive skills required for effective performance at the Army's Executive Level. Those have been documented by Jaques, Clement, Rigby, and Jacobs (1986) and in Department of the Army Pamphlet 600-80 (1987) and AWC Special Text: Executive Leadership (1988). The data also confirmed the general utility of Jaques' (1978) models for describing and analyzing organizational functions and leadership requirements related to them. Jacobs and Jaques (1987, 1991) further document this theoretical and empirical research.

A primary finding from the general officer interviews was the cardinal importance of cognitive capacities and skills respondents described as necessary for effective performance at the Executive Levels. This, as a general conclusion, was consonant with a growing body of literature (Klaus, 1981; Kotter, 1982; Isenberg, 1985; Stamp, 1988).

A literature review of cognitive skills requisite for effective executive functioning (Markessini, in press) underscores previous interview findings and provides a more solid base for understanding cognitive skill development processes. This review served as the base from which Markessini (in-press) then developed a "Taxonomy of Cognitive Capabilities for Executives." The taxonomy identifies a number of cognitive skills subsumed by Strategic Control, which is identified as the highest level of Metacognitive Skill found to be required of incumbents at the most senior levels. This skill can be described as:

Executive Metacognitive Functions

Self-Management of the Learning Process

Knowing what you know, do not know, and need to know

Learning about learning

Learning to learn

Reflection upon experience to create new knowledge and sometimes build models without concurrent direct experiences

Awareness of

Independent cognitive processes

Cognitive style

How one's own (cognitive) characteristics interact with relevant situational characteristics

The highest form of cognitive skill falling under metacognition is Creative Thinking

These findings, coupled with previous ones, formed the basis for defining a major new project. It was undertaken to develop an instructional technology capable of developing metacognition and creative thinking capabilities. An immediate target for the technology would be Senior Service College students, because a portion of each of these classes will form the next generation of general officers. These students will be called upon (much more than even those of the immediate past) to deal with unprecedented change, as a new world order evolves.

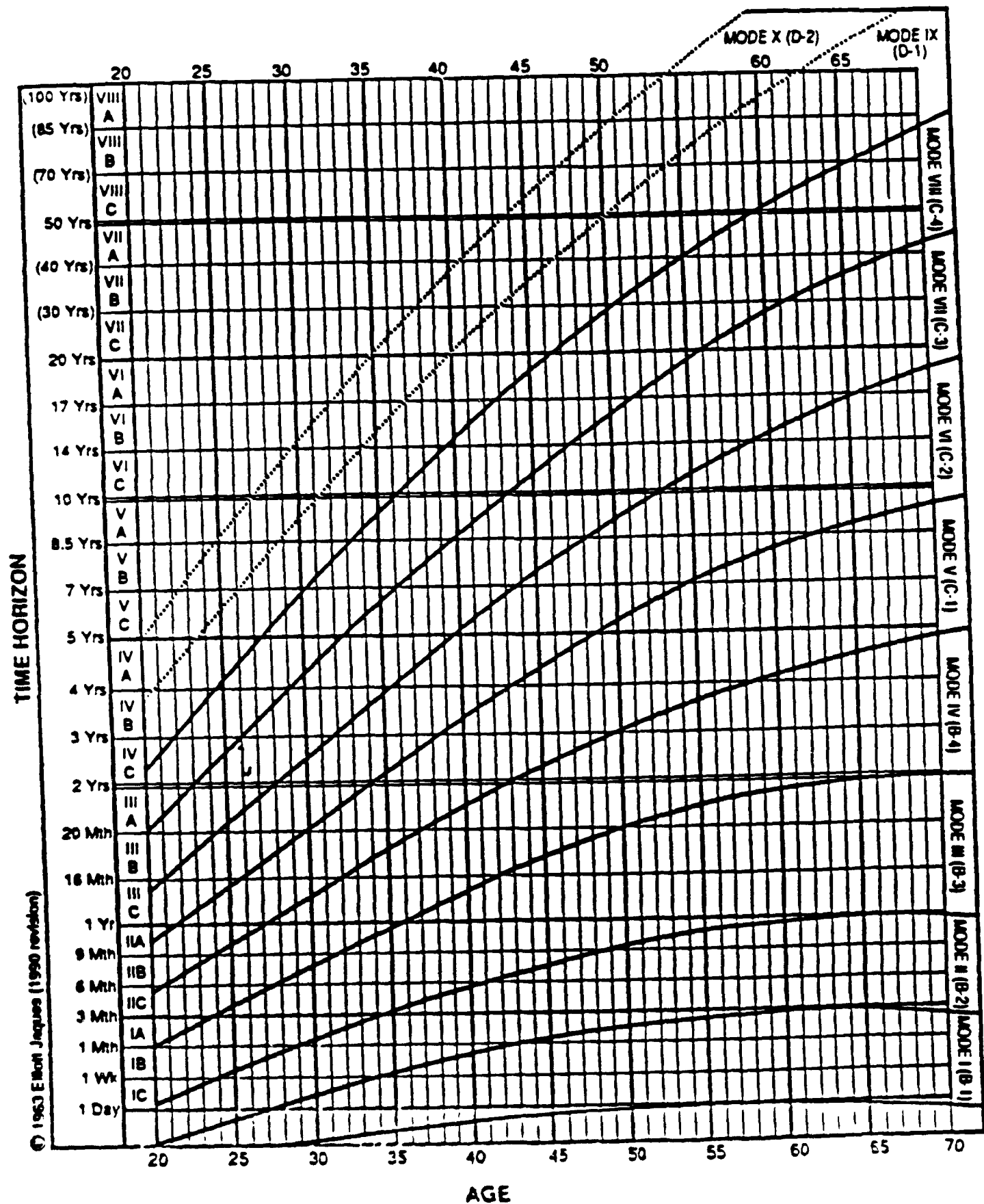
At a more general level, our task became one of designing an instructional approach capable of accelerating cognitive development--to teach about "learning to learn" and how to think more productively. It would develop metacognition, allowing the student to think creatively, and to self-regulate (manage) their own learning.

Figure 1 shows the family of curves Jaques and Clement (1991) derived from extensive observations of incumbents in bureaucracies. It reflects how far ahead individuals can project or develop plans for their own work. It is a measure of their time horizon. As can be seen, individuals vary widely in their ability to do this. The variation reflects how abstractly and complexly one can think, which we believe is related to their ability to solve unstructured problems. By knowing an individual's age, one can assess his or her current "planning horizon" and extrapolate potential "planning horizons" at different future dates (ages). Thus, the rate of acceleration of the curve reflects rate of growth in cognitive capability, discounting any intervention.

Insert Figure 1 about here

Can an instructional technology be designed and developed to positively accelerate cognitive growth? The intervention would allow students to actualize their potential much earlier than otherwise would be predicted. Such a process amounts to "compressing experience." We wanted the technology to have the potential for not only accelerating an advance along one "track," but also stimulate advancement to a higher-order growth curve.

Figure 1: Actual and Potential Planning Horizons



This would produce exponential, rather than just additive, immediate and potential effects in growth rate.

The AWC and the National Defense University (NDU) have been in the forefront in supporting such an educational challenge. Some of their initial thoughts are outlined by Lawrence (1985), the former President of the NDU, and by Graves (1988), a recent Commandant of the AWC.

The AWC requested EDRG to begin developing an Instructional Technology designed to help meet the challenge in the manner we have outlined. The technology would be designed to "stretch" students conceptually. It would teach methods for breaking out of conceptual sets and paradigms when dealing with unstructured problems. It would also promote reservation of judgment until many potentially viable solutions for a problem are explored in a nonpersonally threatening manner. Open-mindedness, forbearance, tolerance for others' opinions; and, generally, enhanced maturity are attributes the methodology should be designed to develop. Components of Metacognition are being designed in as well, which will allow students to manage their own learning in post-senior service college career assignments.

Purpose

Reported here are the results of one step in the process of developing the technology. It was an attempt to further pinpoint the importance of certain variables identified as important to "Creative Thinking" and to evaluate the effectiveness of a course identified as being capable of producing it. This effort builds upon the findings of work documented separately (Stewart and Angle, in press).

Research Objectives

There were two research objectives:

1. To determine what individual cognitive and personality (emotional and attitudinal) differences are related to creative problem-solving. (This objective, in part, was intended to confirm the impact of selected variables the literature suggested should be important.)

2. To determine if creative problem-solving can be enhanced through a particular type of training, and to identify aspects of it that seem most promising for a senior-level military student body.

In our review of the literature (Stewart and Angle, in press), we found that the term "creativity" has been used in many

different ways. For this research "creativity" and "unstructured problem-solving" will be used interchangeably.

We viewed "creativity" as a three-stage process: (a) Sensing the need for change; (b) developing through a process (itself definable) relevant courses of action and potential outcomes; and (c) developing effective implementation (selling) strategies for relevant constituencies. It is a process used to deal with the unknown or change.

The situations or problems faced are ones current collective wisdom provides no guide for action. Hence, they are "unstructured." Such problems have no "best" solution--only a range of potential solutions--some more effective than others when implemented. We were not concerned with examining how people determine that a problem exists (sensing the need). Rather, the problem-solving stage of the process and "selling" it were the foci of our attention.

Method

We accomplished two initial steps. First, we identified two courses purporting to "teach" creative problem-solving. One embodied elements the literature suggested should enhance unstructured problem-solving. The other did not. Second, a set of individual difference variables were selected for investigation. These actions are described more fully below.

Description of "Experimental" Training Course and Rationale for its Selection.

Southern Illinois University (SIU)--Carbondale, Illinois Campus--offers one course that stands out in relation to the rest of its liberal arts curriculum. The course teaches "how to think" (process); not "what to think" (content). Many former students report that the course markedly improved their unstructured problem-solving capability by its impact on their cognition and emotions--major variables the literature suggested as emphases for training. The course lasts an entire semester--thus increasing its chance of producing lasting behavioral changes, relative to most programs of this kind, typically lasting a week or less.

The course is the "foundation" of the Art and Design Department's curriculum (designated "Art and Design 100B"). It has been taught in slightly varying forms for over 15 years. It receives much public attention because its final project requires students to design and build a boat from ordinary corrugated cardboard. Each student then races his/her creation in front of about 25,000 local spectators and on national television (e.g., Cable News Network). This unusual project of invention has been adopted as an annual sporting event in many locations across the

United States and in selected cities abroad. Each race is called a "Cardboard Boat Regatta," and is conducted with a set of rules developed by the course instructor.

The course receives attention for a second reason. Its students (mostly freshmen) compete with others from the university and the local community against senior engineering students during "Engineering Week," an event sponsored by the Engineering School. Solutions to mechanical engineering problems are demonstrated on one of the five days. Mechanical engineering faculty grade the solutions. Students from A&D 100B consistently come up with better solutions--usually out-performing competitors on four of the five events. The A&D students' success seems to be based upon their flexible thinking and ability to improvise with whatever materials are available. The A&D students' solutions are usually "simpler," less costly, and more effective (practical).

To learn about the teaching philosophy, goals, and objectives of the course, an interview was conducted with its creator and principal instructor. A transcript of the interview appears in Appendix A. The techniques and tactics used to achieve desired ends were the topics of a second interview. A transcript of it appears in Appendix B. The contents of these interviews were abstracted. The relevant points that emerged were:

Objectives of A&D 100B

O To increase the problem-solving capabilities of students. (This represents a focus on cognitive functioning. It is the course's "how to" component.)

O To develop in the student very high feelings of self-confidence and self-worth. (This represents the "can do" or emotional maturational component. It encourages students to withstand the ridicule usually accompanying the development and expression of "out of norm" ideas. Risk-taking is promoted.)

O To emphasize the practical over the exotic and esoteric in solutions to problems. (This represents the "real world" test stressed in the literature as being important for solving problems creatively.)

O To sensitize students to the need for resource conservation and environmental protection. (Although this aspect was not stressed in the literature, it will become increasingly important as resources continue to dwindle and the military's mission becomes more diverse. It also relates to practicality.)

Implementation Principles/Processes

O A grading system is used as much for self-referencing (i.e., to allow each student to know where he/she stands in relation to peers) as for formal grading. Student standing is posted by ID number, so that relative class standing is anonymous. Students cannot fail, since they are guaranteed at least 50% credit on each of a series of projects. Emphasis is on learning from failure as well as success. The student can pass the course, even with failure to solve or complete all projects. Still, most students who complete the course do not fail all of the projects. A balance of successes and failures is usually achieved. This maintains self-esteem, while at the same time promotes risk-taking. This should promote greater learning, relative to conventional grading schemes.

O Graduate assistants are not allowed to "talk down" to students. When students make mistakes they are "self-recognized." They learn to be accountable for their own actions, which promotes self-insight. It is a practice disconcerting for many graduate assistants, because a primary conventional means of behavior control (putting others "down" to "demonstrate" who is in control) is prohibited. Most students come to realize they and the instructors are accountable for their learning (i.e., the notion of "symbiotic learning" is promoted).

O Outstanding performance is rewarded within the group context. The best performer for each project is awarded a gold star. Since all projects/problems assigned are "novel," solving them inherently involves risk. Hence, risk-taking is rewarded. The "best" solutions involve risk and very careful thought. Many projects are accomplished in class. Students are encouraged to share (observe what others are doing and attempt to enhance what they see). Accordingly, the award reinforces "cooperation" as a means of producing better outcomes. This demonstrates the value of "competing with" versus "competing against." An individual can excel within a group, promoting the utility of group cooperation and cohesion.

O The small group (section) is used as a support network. Besides the value of the group for problem-solving purposes per se, students stick together to cope with a classroom environment contrived to be ambiguous. The SYNECTICS researchers (Gordon, 1961) also found that the group format enhances the individual "daring" (risk-taking propensity) of its members.

O No syllabus is issued for the course. Nor do the students know from one class period to another what they will be facing. This familiarizes students with ambiguity. It simulates a business world environment where risk-taking is necessary for success. Such an environment allows the student to build self-confidence, to become emotionally comfortable when facing the unknown. Facing increasingly complex unstructured problems creates a series of "mini-terrors." Each "lesson" is emotionally marked in time, under the assumption that learning is enhanced with heightened emotional arousal.

O Failure also occurs in a group context. For example, one of the projects involves building a structure of toothpicks and glue that will support the student's own weight for a period of at least ten seconds. To demonstrate one's solution, the student must stand on it in front of the class. Success and failure is obvious to all. They "learn" to become comfortable with public failure. No amount of rationalization can be used to explain away a public failure. This teaches perseverance and accountability for one's actions. It represents another facet of emotional "toughening."

O Students are taught to break "the rules," conceptual sets or the boundaries of convention. This process itself creates ambiguity. The students have a perception of fixed order, since that is the nature of traditional instructional experiences. The course teaches that most rules governing conduct and "structured" problem-solving methods are arbitrary. Realization that their world is largely "made-up" is disconcerting for most students. They learn that each act of creation is also an act of destruction. It involves facing the unknown and change. Because of personal insecurity, we are intolerant of change. Maintaining the status quo (i.e., the current "illusion" of a "fixed" reality) is the preferred state.

O Experiential learning is stressed. Two related facets are involved in learning by doing. First, after completing each project, students discuss how and why some of their solutions were successes and others failures. This promotes reflection on past actions, thereby promoting the development of self-insight. The second aspect involves establishing a dialectic between the instructor and the students.

During the dialogue topics of a more general nature are discussed (e.g., world events and how daily life is affected by them). These discussions "expand the students' "horizons," exposing them to higher levels of abstract thinking.

The dialogue also helps to "concretize" the complexities and ambiguities the students will face in future work contexts. In this sense and several others, the course is designed to be developmental. It aids the student in scoping problems from successively broader perspectives where more possibilities can be visualized for solving them.

O The subject matter of the course is designed around the laws of three dimension. These include (a) support (as in pilings for bridges), (b) span (as in the laterals of a bridge), and (c) the combination of the first two, which creates a plane--the third dimension.

O The subject matter is learned as an integral part of completing projects (problems). Lessons learned from each project build upon those of their predecessors. Thus, content lessons are iterative and cumulative, just as are the process lessons involving general cognitive and emotional aspects of creative problem-solving. These "lessons" are not made explicit. Only through self-insight does learning occur. So, the student is in a perpetual state of "wonderment," intentionally designed to provoke depth of thinking.

The emphasis of the course is on process rather than content. Content is embedded within a process designed to allow the student to develop self-knowledge or insight (i.e., how one goes about solving unstructured problems and why). Students learn about their values and how these learned "vested interests" affect unstructured problem-solving. Assessing one's values and developing the ability to forfeit or change them when necessary is important in complex unstructured problem-solving.

Description of the "Control" Training Course and Rationale for its Selection.

Another "unstructured problem-solving" course is offered at SIU by the Psychology Department. Its author designed it (Psyc 371) to familiarize students with problem-solving facilitation techniques. It also covers errors in human judgment, decision-making, and problem solving identified through formal research. The author of the course was interviewed to obtain a description of it. A transcript of the interview appears in Appencix C. A careful examination of Appendixes A and B in relation to C reveals that the two courses differ in substantial ways, even though their stated objectives are the same. Major differences are:

O The focus of Psyc 371 is on teaching facts (content) about structured and unstructured problem-solving. Process is not a concern.

O Practical exercises accompany blocks of instruction in Psych 371 to illustrate significant teaching points. In A&D 100B, content and problem solving are inseparable--They form an integral whole.

O No attempt is made to "cause" or to "demonstrate" behavioral change in students taking Psych 371. The objective is only to make them aware of factors that can interfere with effective problem-solving. For A&D 100B, the opposite is true (i.e., students must actualize their learning).

O Psych 371 teaches content through a conventional textbook study/lecture/class discussion format. Experiential learning is not a component.

O In Psych 371 no attempt is made to develop the emotional side of self. Only memorization and recall of facts is emphasized.

O As a corollary, Psych 371 teaches students about problem solving. Alternatively, A&D 100B teaches students about how to problem-solve. In this sense, the A&D course develops self-insight, whereas the Psych course does not.

Psych 371 was selected as a control group to obtain a more conservative test of the "experimental" course's effectiveness. A comparison of the two courses--with identical purposes, but with markedly different instructional methods--should provide a more powerful test of the teaching effectiveness of the experimental group.

Individual Difference Variables and the Process Used to Identify Them.

The individual difference variables investigated were identified through a multi-step procedure. These steps were:

O The A&D course instructor was interviewed to obtain his views concerning individual differences he had observed that contribute to unstructured problem-solving proficiency. Appendix D is a transcript of that interview.

O The contents of Appendix D were analyzed to develop a list of the seemingly most impactful individual difference variables. The list was reviewed by the author and an expert in learning and cognitive styles. A rationale for selecting each variable was developed.

O The third step was to review relevant literature (Stewart and Angle, in press). It was focused, in part, by the

outcome of the second step. Yet, it was intended to be comprehensive in selected areas, thereby providing breadth to the initial listing. Training methods designed to teach "creativity" were also examined. Reviewing these programs provided insights into the parameters such training were designed to impact, which helped to locate additional variables to investigate.

O The outcome of the last two steps yielded a final list of variables. It was then extensively discussed with the A&D course instructor and the learning and cognitive style expert. These discussions addressed three issues: (a) the relative importance of each variable ("Is it important enough to include in the investigation?"); (b) the "level" of each variable judged necessary (e.g., "high," "moderate," or "low") to produce "good" unstructured problem-solving outcomes; and (c) the availability of measurement tools (only paper and pencil instruments were considered viable because of time and resource constraints). Consensus was reached on each issue.

O In the final step we developed a hypothetical "Creative Problem-Solver" profile (Figure 2.) Relevant person parameters are listed on the left. The source of the variable (variable set)--e.g., Schmeck, Ribich, & Ramaniah, 1977 and Davis, 1975) is shown where appropriate. These characteristics are posited to predict general unstructured problem-solving facility. They may be necessary for general problem-solving where "common sense" (general versus technical knowledge) is all that is needed. The level of each variable (either "high": maximum score; "medium": average score; or "low": lowest possible score) thought to predict optimum performance is also shown.

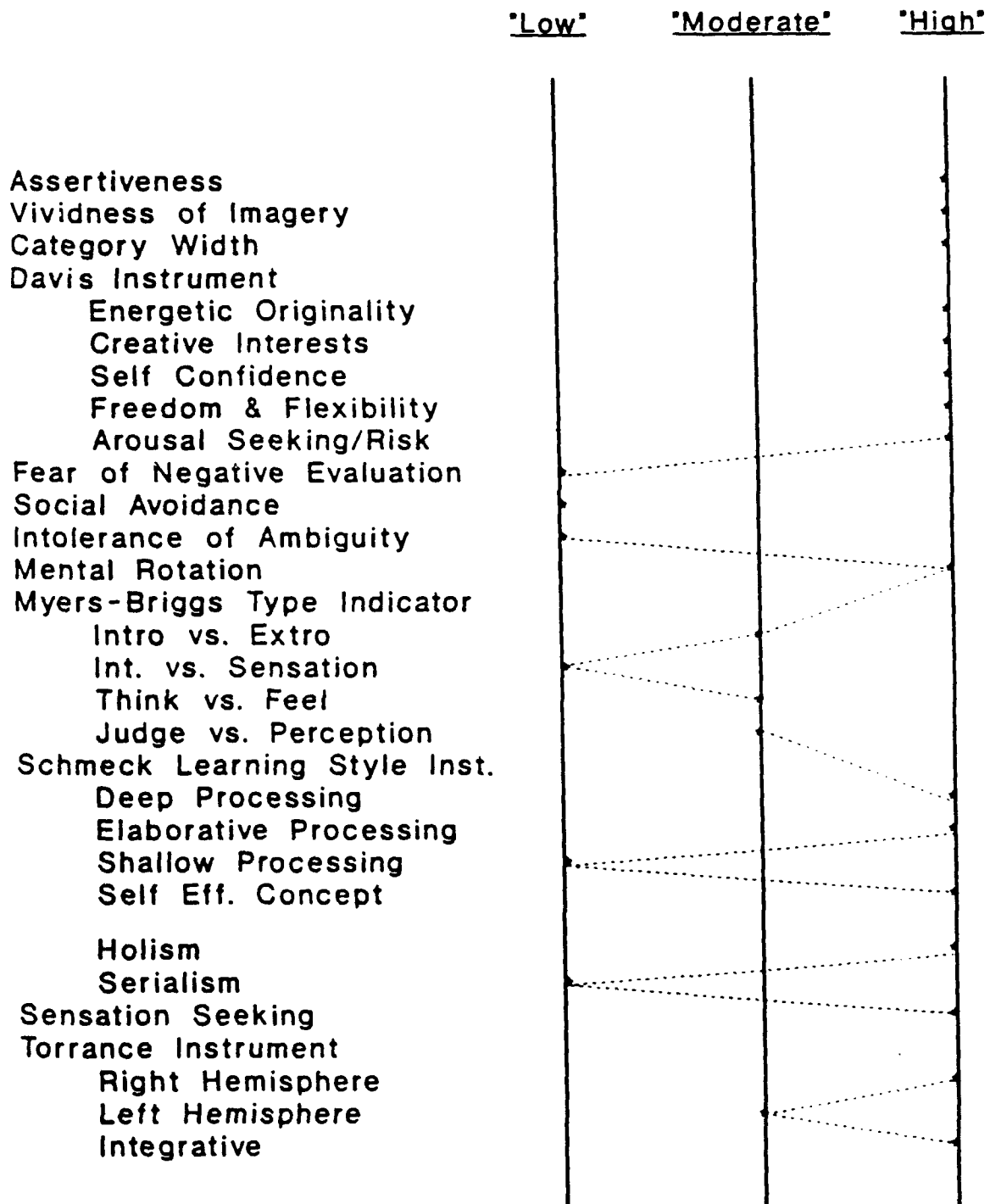
Insert Figure 2 about here

For the Myers-Briggs Type Indicator (MBTI), the values of "high" and "low" represent opposite poles of each respective dimension. For example, for the Introvert-Extrovert (I-E) dimension, "high" suggests an extreme "I" score and "low" suggests an extreme "E" score. "Medium" means "low" on both dimensions.

A thorough description of each variable and the test used to measure it is provided in Appendix E. Development, reliability and validity data for each is also provided.

Figure 2 presents a multidimensional hypothesis. Thus, we attempted to examine holistically and simultaneously the entire

Figure 2: Hypothetical Profile of the "Effective" Problem Solver



complement of factors posited to predict creative problem-solving capability. This was done because past efforts of this kind lacked comprehensiveness. Most investigations examined only a few predictors (three to four), and the amount of criterion variance accounted for has been uniformly low.

Participants.

Volunteers from the 1988 spring semester classes of A&D 100B and Psyc 371 participated. Seventy-six were from A&D 100B and 33 from Psych 371. The proportion of volunteers from each was nearly equivalent.

Those who volunteered should not have been different from those who didn't, since most volunteered. But, there was reason to suspect differences between the two groups. The Psychology students appeared to be older (mostly juniors majoring in Psychology). The Art students were mostly freshmen, and either Art or Design majors.

Selected quantitative comparisons were made to confirm our suspicion of differences. Table 1 summarizes them. The Table presents means (or proportions) of the groups for gender, age, years of college completed, "likes" (major subject area of concentration reported on the MBTI answer sheet), grade point average and ACT score. Using one-way analysis of variance (ANOVA) and chi square, the controls, relative to the experimentals, were significantly (a) older, (b) had completed more college, (c) had a higher grade point average, and (d) had higher ACT scores. The only nonsignificant difference is the proportion of males and females who volunteered.

Insert Table 1 about here

These data suggest our comparison of course impacts will be even more conservative than planned, since the control group has intellectual and experience advantages. They also suggest it would be unwise to combine the data across groups to predict unstructured problem-solving performance. The criterion and predictor relationships are likely to be different within groups. Thus, separate analyses were performed within groups.

Predictors and Criteria.

Predictors. These are listed in Figure 2. Again, they are described in detail in Appendix E.

Table 1

Demographic Characteristics of Participants Broken Down by
Experimental and Control Groups

		<u>SEX</u>			
		<u>Experimental</u>		<u>Control</u>	
		<u>Frequency</u>	<u>Percent</u>	<u>Frequency</u>	<u>Percent</u>
Female	37		48.7	19	57.6
Male	37		48.7	14	42.4
Missing	2		2.6	0	0
Total	<u>76</u>		<u>100</u>	<u>33</u>	<u>100</u>

$\chi^2 = .26, p > .05$

<u>AGE</u>			
	<u>Mean</u>	<u>Std Dev.</u>	<u>N</u>
Control	25.21	5.05	19
Experimental	22.23	3.24	43
Total	<u>23.15</u>	<u>3.24</u>	<u>62</u>

<u>ANOVA SUMMARY</u>					
Source	<u>SS</u>	<u>D.F.</u>	<u>MS</u>	<u>F</u>	<u>Sig.</u>
Between GP	116.86	1	116.86	7.8	.007
Within GP	898.83	60	14.98		

<u>YEARS OF COLLEGE COMPLETED</u>			
	<u>Mean</u>	<u>Std Dev.</u>	<u>N</u>
Control	2.58	.90	19
Experimental	1.86	.89	43
Within GP Total	<u>2.09</u>	<u>.95</u>	<u>62</u>

Table 1 (continued)

ANOVA SUMMARY

Source	<u>SS</u>	<u>D.E.</u>	<u>MS</u>	<u>F</u>	<u>Sig.</u>
Between GP	6.80	1	6.80	8.54	.005
Within GP	47.79	60	.797		

"LIKES"

	Experimental		Control	
	<u>Frequency</u>	<u>Percent</u>	<u>Frequency</u>	<u>Percent</u>
Math	1	3.0	--	--
English	6	18.2	6	7.9
Science	4	12.1	8	10.5
History	1	3.0	3	3.9
Practical Skills	4	12.1	4	5.3
Music	2	6.1	1	1.3
Art	1	3.0	21	27.6
Missing	<u>14</u>	<u>42.4</u>	<u>33</u>	<u>43.4</u>
Total	33	100	76	100

$\chi^2 = 14, p < .02$

GRADE POINT AVERAGE

	<u>Mean</u>	<u>Std Dev.</u>	<u>N</u>
Control	2.96	.65	19
Experimental	<u>2.55</u>	<u>.64</u>	<u>68</u>
Within GP Total	2.64	.64	87

Table 1 (continued)

ANOVA SUMMARY

Source	<u>SS</u>	<u>D.F.</u>	<u>MS</u>	<u>F</u>	<u>Sig.</u>
Between GP	2.56	1	2.56	6.2	.01
Within GP	35.13	85	.41		

ACT SCORES

	<u>Mean</u>	<u>Std Dev.</u>	<u>N</u>
Control	22.89	3.59	9
Experimental	<u>19.52</u>	<u>4.89</u>	<u>50</u>
Within GP Total	20.03	4.73	59

ANOVA SUMMARY

Source	<u>SS</u>	<u>D.F.</u>	<u>MS</u>	<u>F</u>	<u>Sig.</u>
Between GP	86.56	1	86.56	3.87	.05
Within GP	1273.37	57	22.34		

Criteria. A thorough description of these variables is provided at the beginning of Appendix E. Two types of criteria were selected. They were material and verbal in nature.

Material Problem

The material problem was to construct as high a free-standing structure as possible, out of two 5" X 8" index cards.

Verbal Problems

These were of three types. The first was analogous to the material criterion. They were totally unstructured (i.e., no formalism of any kind existed to aid in finding a workable solution. These problems are analogues of those found in A&D 100B. We wanted to find out if unstructured problem-solving learned through the hands-on use of material would generalize to different (verbal) tasks.

The second type closely resembled those used in Psyc 371. They are problems with "correct" and "incorrect" answers. We developed two sub-sets of them. One variety could be solved with set theory. The second set was designed to determine if students could identify problem-solving "foibles," errors in human judgment identified through research.

We used verbal analogies as the third type of verbal criterion. They were unrelated to content in either course.

We constructed Pre- and Post-Test booklets containing an equivalent number of each type of verbal problem. To do this, we generated a large item pool containing many more problems than would be needed for both booklets. Items were both randomly selected and assigned to the two booklets. This produced statistically equivalent tests.

Procedure

Paper-and-Pencil Instruments

The instruments used to measure the predictors and criteria were placed in randomized order in numbered envelopes. The numbers permitted linking Pre- and Post-Test data by individual.

During the first two weeks of the semester the envelopes were distributed. The instructions in Appendix F were read to volunteers, who were then told to open the envelope and locate the Test Booklet (labeled "Preliminary Exercise" in Appendix E). They were given the remainder of the class period (about 45 minutes) to complete these problems. They were told to return the remaining instruments (the predictors) in one week.

This sequence of events was repeated for volunteers about two weeks before the semester ended. But, only the verbal criteria were distributed. They were again given about 45 minutes to complete the problems. The students were then debriefed, because the true nature of the project had not been fully revealed.

Very few students reported to Psych 371 when the Experimenter visited at the end of the semester due to the beginning of spring festival. Because the Experimenter could not return, the regular course instructor carried the test booklets (verbal criteria) to volunteers attending the next regular class session. They were asked to complete the problems in no more than 45 minutes and to return them on the day of their final exam (in about one week).

ANOVAs were used to see if the four Post-Verbal criterion measures differed between groups. F's of .29, .004, .068, and .683 were obtained. With 1 and 16 dfs, there were no differences.

Scoring of Pre- and Post-Test verbal criterion measures was done by two individuals. They used pre-established guidelines (see Appendix E) to score a sample of each verbal criterion type. They compared results, and reasons for discrepancies were identified and discussed. Several consensus-building sessions occurred before commonality in procedure was achieved. After that, the raters scored items independently. Table 2 summarizes Pearson correlations between raters for Pre- and Post-Test measures. Inter-rater reliability was high, ranging from .91 to .98. So, the two raters' evaluations were combined for analysis purposes. Procedures specified in Appendix E were used to score the various predictor measures.

Insert Table 2 about here

Material Criterion

The same material problem (see Appendix E) was given at the beginning and near the end of the semester. The time of Pre-Test was about the same for both groups. This was not the case at the semester's end. Post-Test time differed by about two weeks between groups.

As an additional incentive, participants were offered up to 10 credit points for Post-Test participation. The problem was presented and graded by the A&D course instructor both times. The scoring procedure involved nothing more than determining if the structure would stand alone, and measuring its height. The

Table 2
Inter-rater Reliabilities of the Four Verbal Criteria on Pre-
and Post-Test Data From All Participants

		<u>Pre-Test</u>			
		Rater 1			
		Verbal 1	Verbal 2	Verbal 3	Verbal 4
<u>Rater 2</u>	Verbal 1	r = .979 p < .000 n = 88			
	Verbal 2		r = .916 p < .000 n = 88		
	Verbal 3			r = .970 p < .000 n = 88	
	Verbal 4				r = .980 p < .000 n = 88
~~~~~					
		<u>Post-Test</u>			
		Rater 1			
		Verbal 1	Verbal 2	Verbal 3	Verbal 4
<u>Rater 2</u>	Verbal 1	r = .974 p < .000 n = 54			
	Verbal 2		r = .975 p < .000 n = 54		
	Verbal 3			r = .975 p < .000 n = 54	
	Verbal 4				r = .958 p < .000 n = 54

tools available were a utility knife, a metal ruler, and a pair of scissors.

We used the same material task twice because it is difficult to develop problems of equal challenge. This would not have been as problematic, if there had been time to administer multiple problems (i.e., the probability of developing two problem pools of judged equivalence is higher than developing just two alone). Using the same problem twice was made more viable, because the A&D instructor "never gives the same problem twice." The Psych instructor told his students during Pre-Testing that they would never see the problem again. There was no reason then for either group of students to give the problem thought between testing sessions.

### Hypotheses

#### Objective 1

Hypothesis 1: The more an individual conforms to the profile in Figure 3, the greater should be their material and "unstructured" verbal criterion scores. A direct negative relationship was predicted. No significant relationship was expected for the remaining three types of verbal criteria.

Hypothesis 2: If participants are split at the median based on absolute profile discrepancy scores (DSs), differential rates of change/improvement from pre- to post-training assessments were predicted (See Figure 4). The degree of improvement in performance from Pre- to Post-testing was expected to vary by group membership, extent of conformity to the profile (those falling above and below the median of the DS distribution) and by criterion type. We expected those least capable initially (highest profile discrepancies) to gain the most from training.

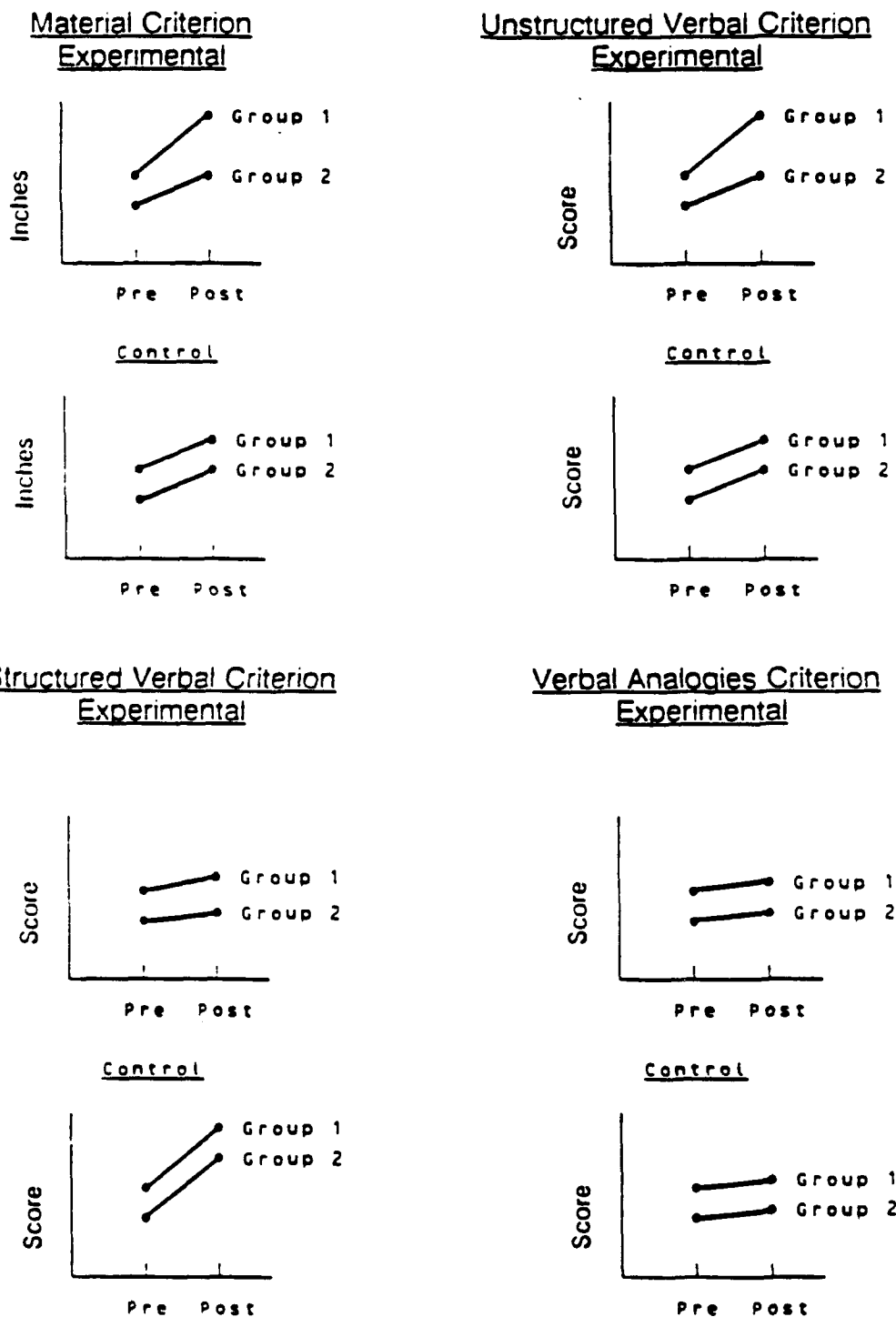
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Insert Figures 3 and 4 about here  
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No difference was expected between A&D students' structured verbal criterion Pre- and Post-testing performance, since they were not exposed to material relevant to these problems. No differences were expected for the verbal analogies, either within (median splits) or between groups.

#### Objective 2

Training effectiveness was at issue here involving these hypotheses:

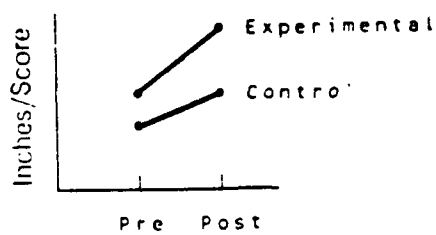
Figure 3: Depiction of Hypotheses Involving Within and Between Group Differences for Criterion Variables



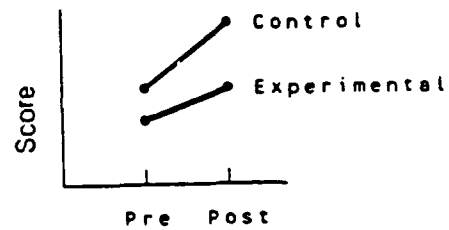
Group 1 = Conforms least with profile.  
Group 2 = Conforms most with profile.

Figure 4: Hypothesized Relations Between Experimental and Control Groups for Criterion Variables

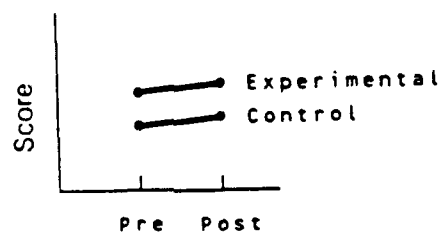
Material and Unstructured  
Verbal Criteria



Structured Verbal Criterion



Verbal Analogies Criterion



Hypothesis 1: A&D students should do significantly better than the controls on the material task. Between group Pre-Test performance should not differ, but Post-Test performance should. Pre- and Post-Test difference between groups should be multiplicative--not additive. A significant interaction was predicted (see Figure 4).

Hypothesis 2: These same predictions were made for the unstructured verbal tasks, since their general nature was the same.

Hypothesis 3: Psyc 371 students should significantly outperform their A&D counterparts on the Post-Test of "structured verbal" tasks. Pre-Test performance should not differ between groups, but Post-Test performance should beyond effects attributable to performing the same task twice. Post-Test differences between groups should be substantially larger than Pre-Test differences. Thus, a significant interaction was expected, because these criteria are directly related to Psyc 371 content.

Hypothesis 4: No significant between-group Pre- or Post-Test differences were expected for the verbal analogies criterion.

## Results

### Objective 1.

Hypothesis 1: To examine this, profile DSs were generated for each group. They were first standardized for each predictor variable. The absolute value of the standard score minus five standard deviation units or plus five standard deviation units was computed for the variables predicted to be "high" and "low" respectively. For "moderate" profile variable value predictions, the absolute value of the standard score alone was taken as the score. The resulting DSs were then summed to yield a total score. Low DSs suggest "high" profile conformity, and higher scores suggest "low" conformity.

The DSs were correlated with each criterion by group. These correlations are shown in Table 3. The verbal criteria, as they are listed, refer to the "unstructured," "set theory", "human information processing error," and "analogy" problems.

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Insert Table 3 about here  
-----

The correlations between the DSs and material and unstructured verbal criteria were predicted to be negative. Such

Table 3

Relationship of Overall Profile Discrepancy Measure to Each Criterion

<u>Criterion</u>	<u>Control</u>			<u>Experimental</u>		
	r	p	n	r	p	n
Material	-.35	.12	13	-.17	.16	35
Verbal 1	-.36	.07	18	-.13	.23	36
Verbal 2	.02	.46	18	-.61	.00	36
Verbal 3	.16	.27	18	-.46	.00	36
Verbal 4	.22	.19	18	-.29	.05	36

relationships were obtained for both groups, but they were insignificant. The only correlation approaching significance was for the unstructured verbal criterion of the control group.

No significant correlations were expected between the DSs and the remaining three verbal criteria. Yet, for the A&D (Experimental) group, strong and significant relationships were obtained. Low DSs are associated with higher performance.

In aggregate, the data in Table 3 do not support the first hypothesis. The only significant correlations were for the A&D group--involving criteria other than those predicted.

Discounting the control group because of its small size, an examination of the correlations for the A&D participants reveals a trend. The correlations are in the predicted direction. Considering significant and nonsignificant correlation groupings, those nonsignificant are for the material and unstructured verbal criteria--the variables where the strongest relationships were predicted. Correlations for the other criteria are strongly negative and highly significant.

There are at least two plausible reasons for this. First, the findings may be an artifact of the method used to measure the various predictors and criteria. One aggregated set of verbal predictors may, on average, correlate more highly with criteria derived through the same means. A second explanation may be that the profile is just a better predictor of structured (as opposed to unstructured) problem-solving.

Based on these suppositions, the various criterion measures were inter-correlated separately by group. Table 4 presents the results. On average, there is little relationship between the material criterion and the verbal criteria. But, on average, the correlations among the verbal criteria are positive and significant. This is especially true for the A&D group where sample size permitted estimating relationships more reliably. Because of these findings, a decision was made to consolidate the verbal criteria--thus examining only two criteria in remaining analyses (the material and an aggregated verbal measure).

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Insert Table 4 about here  
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From the findings up to that point, it appeared a significant amount of criterion variance could be captured by the predictors. Also, only the A&D group size was large enough to support multivariate data analysis. With these factors in mind, several post-hoc analyses were done. All potential predictors shown in Figure 2, plus gender, age, years of college completed,

Table 4  
Correlations Among Criterion Variables for the  
Experimental and Control Groups

<u>Control</u>					
	Material	Verbal 1	Verbal 2	Verbal 3	Verbal 4
Material	$r = 1.0$ $p = .00$ $n = 21$				
Verbal 1	$r = .13$ $p = .29$ $n = 21$	$r = 1.0$ $p = .00$ $n = 28$			
Verbal 2	$r = -.17$ $p = .22$ $n = 21$	$r = .13$ $p = .25$ $n = 28$	$r = 1.00$ $p = .00$ $n = 28$		
Verbal 3	$r = -.05$ $p = .40$ $n = 21$	$r = -.14$ $p = .24$ $n = 28$	$r = .48$ $p = .005$ $n = 28$	$r = 1.00$ $p = .00$ $n = 28$	
Verbal 4	$r = -.25$ $p = .14$ $n = 21$	$r = -.06$ $p = .37$ $n = 28$	$r = .17$ $p = .19$ $n = 28$	$r = .48$ $p = .004$ $n = 28$	$r = 1.00$ $p = .00$ $n = 28$
<u>Experimental</u>					
	Material	Verbal 1	Verbal 2	Verbal 3	Verbal 4
Material	$r = 1.00$ $p = .00$ $n = 57$				
Verbal 1	$r = .18$ $p = .09$ $n = 57$	$r = 1.0$ $p = .00$ $n = 60$			
Verbal 2	$r = .10$ $p = .24$ $n = 57$	$r = .30$ $p = .01$ $n = 60$	$r = 1.00$ $p = .00$ $n = 60$		
Verbal 3	$r = .17$ $p = .10$ $n = 57$	$r = .54$ $p = .00$ $n = 60$	$r = .33$ $p = .005$ $n = 60$	$r = 1.00$ $p = .00$ $n = 60$	
Verbal 4	$r = -.10$ $p = .23$ $n = 57$	$r = .15$ $p = .12$ $n = 60$	$r = .33$ $p = .005$ $n = 60$	$r = .41$ $p = .00$ $n = 60$	$r = 1.00$ $p = .00$ $n = 60$

ACT score, and grade point average were entered into two step-wise regression analyses. The only difference between these analyses was the criterion measure.

For the MBTI, separate scores were entered for each "pole" of the four dimensions. For example, separate scores were entered for "introversion" and "extroversion." Tables 5 and 6 summarize the two analyses.

-----  
Insert Tables 5 and 6 about here  
-----

Table 5 shows four predictors entered the equation before default cut-off criteria were met. These variables accounted for almost sixty percent (60%) of the variance on the material task. The predictors were almost orthogonal. Only two of them were significantly correlated. These correlations are probably spurious; or, for the MBTI-Introversion (MBTI-I) and MBTI-Intuition (MBTI-N) correlation, they are perhaps due to sharing common method variance.

Mental Rotation, an ability to visualize three-dimensional objects, accounted for the most variance. MBTI-N, as expected from literature review findings, accounted for about an equivalent amount. The other variables predicted less, but still significant amounts of variance.

Table 6 summarizes the step-wise regression for the verbal criterion. Only one variable, MBTI-Sensing, entered the equation. The correlation was  $-.448$ , accounting for only about 20% of the variance. Results in Tables 5 and 6 suggest that different variables are involved in predicting the two types of criteria. That is not surprising. The criteria are largely uncorrelated.

Opposing poles of a common MBTI dimension are involved in predicting the two outcomes. Thus, these MBTI measures may tap cognitive capabilities required by different general tasks. Three-quarters of the verbal problems required the use of formalized knowledge to solve. In this sense, they were "structured." On the other hand, there were no "rules" to guide solution development for the material task.

#### Intuition Versus Sensing

In Myers-Briggs terms, the individual who prefers to use sensing in perception has a memory for details, is focused on the present external environment and excels where following convention is required. Alternatively, the intuitive type does not

Table 5

Zero-Order Correlations of Material Criterion and Predictors  
and Regression Summary: Experimental Group

		<u>Zero Order Correlations</u>			Sensation Seeking	Material Criterion
		Mental RT	MBTI-N	MBTI-I		
Mental RT	r = 1.00 p = .00 n = 40					
MBTI-N	r = -.30 p = .03 n = 39		r = 1.00 p = .00 n = 39			
MBTI-I	r = .07 p = .33 n = 39		r = .27 p = .05 n = 40	r = 1.00 p = .00 n = 39		
Sensation Seeking	r = -.16 p = .15 n = 42	r = .19 p = .12 n = 39	r = .09 p = .29 n = 39	r = 1.00 p = .00 n = 42		
Material Criterion	r = .48 p = .001 n = 40	r = .28 p = .05 n = 39	r = -.11 p = .15 n = 39	r = .27 p = .05 n = 39	r = 1.00 p = .00 n = 40	

Multiple Regression (MR) Summary

MR STEP	VAR	MULT R	R ²	F	P	R ² CH	FCH	P	BETA
1	Mental RT	.478	.288	8.27	.008	.188	8.27	.008	.478
2	MBTI-N	.649	.421	9.84	.001	.194	9.03	.006	.461
3	MBTI-I	.713	.508	8.96	.000	.087	4.56	.042	-.311
4	Sensation Seeking	.777	.604	9.52	.000	.095	6.01	.022	.317

Table 6

Regression Summary of Predictors of Combined  
Verbal Criterion: Experimental Group

Multiple Regression (MR) Summary

<u>MR</u> <u>STEP</u>	<u>VAR</u>	<u>MULT R</u>	<u>R²</u>	<u>F</u>	<u>P</u>	<u>R²CH</u>	<u>FCH</u>	<u>P</u>	<u>BETA</u>
1	MBTI-S	.448	.198	6.91	.01	.198	6.91	.01	-.448

focus on what "is." They are concerned with possibilities, depth in meaning, and inter-relationships. The intuitive types have sudden perceptions of pattern in seemingly unrelated events. They do not rely as much on convention for deriving conclusions. Thus, it is not surprising to find "intuition" playing a key role in predicting the material criterion and "sensing" predicting success on verbal tasks requiring the use of formal procedures.

It is surprising that "sensing" is negatively correlated with the verbal measure. Sensing may be needed to deal with structured verbal problems. But, its overuse (or exclusive use) may be unproductive. If the formal logic required to solve a problem is unknown (as can be assumed to be the case for the A&D students), a strong preference for concrete thinking results in poor outcomes. Failure to use intuition as a guide, to "play" with the problem, may prevent "discovering" the required logic. Thus, the general nature of the "problem" itself, versus "knowledge domain," may be the major factor determining the impact of thinking preference. The generic nature of the task (versus say occupational pursuits--e.g., the arts, engineering, architecture, etc.), needs to be carefully examined in future research.

Hypothesis 2: This hypothesis involves change in Pre- to Post-Test performance for the two groups based upon conformance to the hypothetical profile (Figure 2). Figure 4 depicts the specific relationships predicted.

Because of sample size and the failure of DSs to predict the performance of either group, other analyses in keeping with original intent were performed. Only data from the A&D group were used. Step-wise multiple regression, using the Post-Test score as the criterion, was chosen as the new strategy. That permitted determining if predictors of Pre- and Post-Test performance are the same or different. Inferentially, this indicated which factors are most influenced by training.

Potential predictors were all those previously used (see Tables 5 and 6) plus the Pre-Test score. It was entered as a co-variate. The results are presented in Table 7. Besides Pre-Test standing, three other variables significantly contributed to prediction. Their zero-order inter-correlations are shown in Table 7 with the regression summary. The inter-correlations among the predictors are not high. Excluding pre-test, the other significant predictors were "Tolerance of Ambiguity," Years of College Completed, and Davis's "How-Do-You-Think Test "Creative Interests/Activities" Scale. The negative beta for "Tolerance of Ambiguity" is an artifact of scoring procedure. Larger scores suggest "Intolerance of Ambiguity."

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Insert Table 7 about here  
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The variables emerging from this analysis are different from those which predicted Pre-Test performance. Since they are significant beyond the initial set (as encompassed by the covariate), they represent factors that help explain the increase in performance (Pre- versus Post-Test) noted in the next subsection. The training increased participants' Tolerance for Ambiguity, influenced older more than younger students, and enhanced students' attitudes or pre-dispositions toward solving unstructured problems in creative ways.

## Objective 2

Hypothesis 1: The two groups were not expected to differ on the Pre-Test. But, we predicted they would on the Post-Test. The curves depicting this outcome should thus be nonparallel. Figure 5 shows the results. Plotted are the mean Pre- and Post-Test material criterion scores. If Figure 5 is compared to Figure 4 (initial prediction), there is much similarity. ANCOVA was used to assess the significance of the apparent effect. Pre-Test score was the covariate. Table 8 summarizes that analysis and gives standard deviations and N's for each mean. Post-Test group differences approached significance. The interaction was significant. This interaction is presumptive evidence of a training effect, in the absence of competing alternative explanations--which we judged there were none.

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Insert Figure 5 about here  
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Insert Table 8 about here  
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Hypothesis 2: In this revised set of circumstances we expected the material criterion predictions for training effects to hold for the verbal criterion. Figure 6 depicts the results. It shows mean Pre- and Post-Test verbal criterion scores for both groups. Discounting statistical significance, the data support the revised hypothesis. But the interaction was not significant. Table 9 summarizes the statistical results. Only Pre-Test standing significantly predicted Post-Test performance.

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Insert Figure 6 about here  
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Table 7

Zero-Order Correlations of Second Material Criterion and Predictors  
and Regression Summary: Experimental Group

<u>Zero Order Correlations</u>									
	<u>Material Criterion 1</u>	<u>Tolerance of Ambiguity</u>	<u>Yrs of College Completed</u>	<u>Hoyt Creative Interests</u>	<u>Material Criterion 2</u>				
<u>Material Criterion 1</u>	r = 1.00 p = .00 n = 73								
<u>Tolerance of Ambiguity</u>	r = .18 p = .14 n = 39	r = 1.00 p = .00 n = 41							
<u>Yrs of College Completed</u>	r = -.10 p = .27 n = 41	r = -.10 p = .27 n = 41	r = 1.00 p = .00 n = 43						
<u>Hoyt Creative Interests</u>	r = .005 p = .49 n = 41	r = .10 p = .27 n = 41	r = -.23 p = .07 n = 43	r = 1.00 p = .00 n = 43					
<u>Material Criterion 2</u>	r = .49 p = .00 n = 54	r = -.40 p = .01 n = 32	r = .40 p = .01 n = 33	r = .16 p = .19 n = 33	r = 1.00 p = .00 n = 57				
<u>Multiple Regression (MR) Summary</u>									
<u>MR STEP</u>	<u>VAR</u>	<u>MULT R</u>	<u>R²</u>	<u>F</u>	<u>P</u>	<u>R²CH</u>	<u>FCH</u>	<u>P</u>	<u>BETA</u>
1	Material Criterion 1	.492	.242	8.92	.006	.242	8.92	.006	.624
2	Tolerance of Ambiguity	.695	.483	12.62	.000	.241	12.61	.001	-.490
3	Yrs of College Completed	.805	.647	15.91	.000	.164	12.11	.001	.478
4	Hoyt Creative Interests	.859	.738	17.65	.000	.091	8.71	.007	.311

Figure 5: Mean Pre- and Post-Test Material Criterion Scores for Experimental and Control Groups

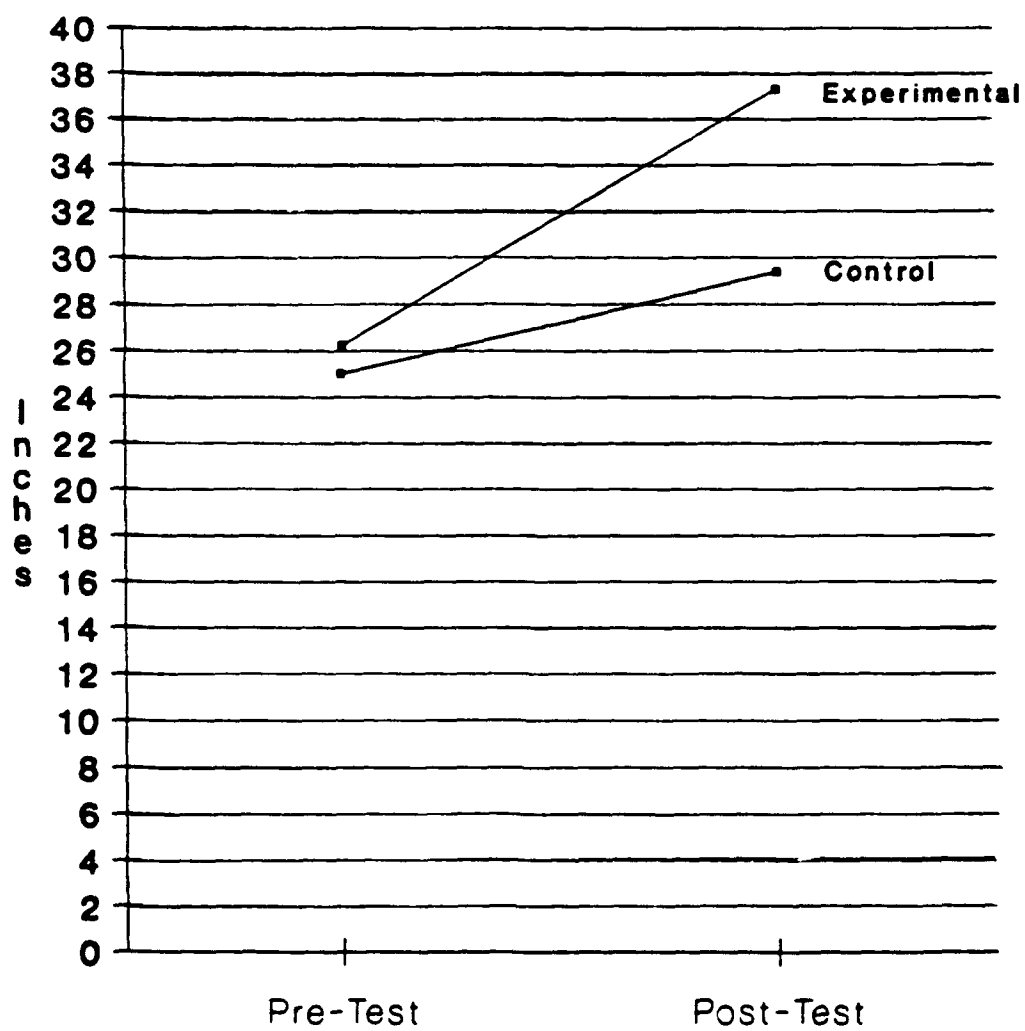


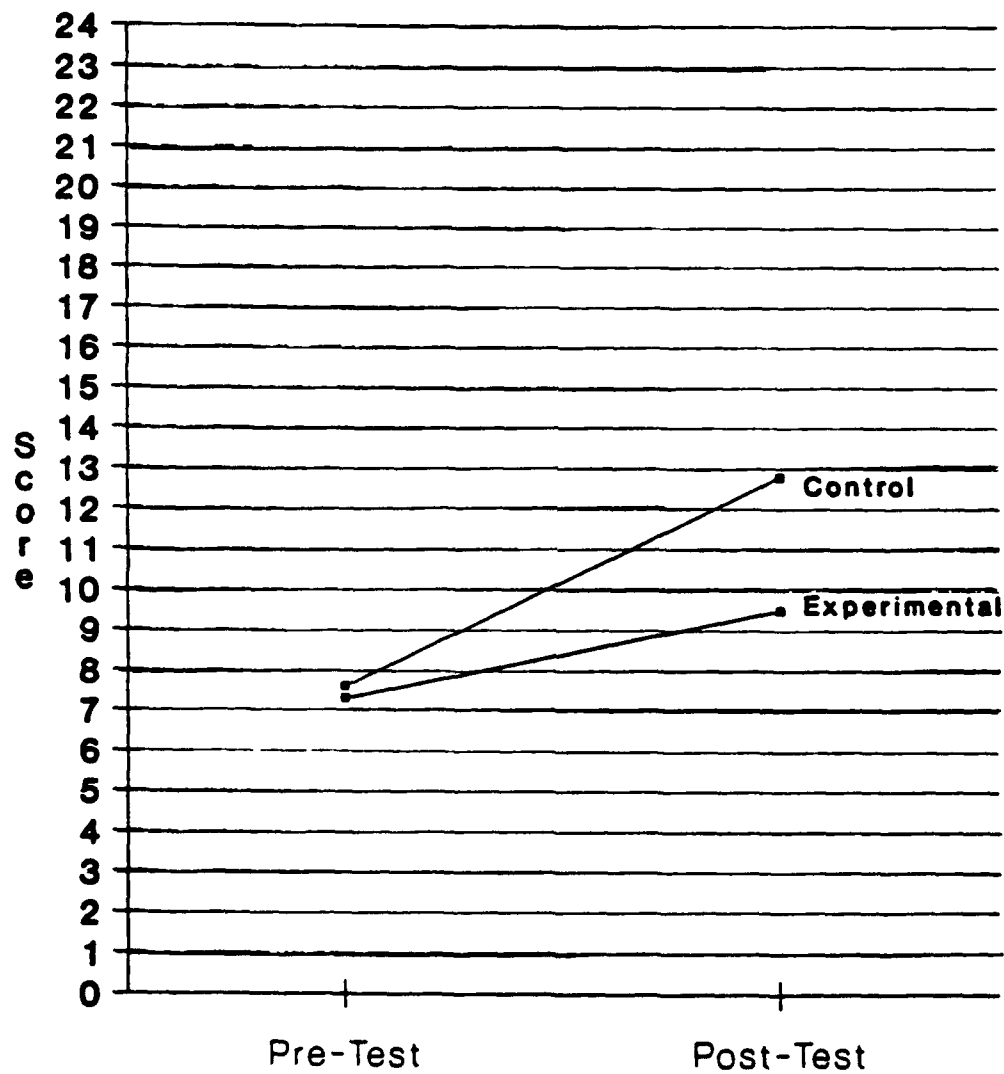
Table 8  
Post-Test Experimental and Control Group Comparison on  
Material Criterion Controlling for Pre-Test Performance

<u>Group</u>	<u>Pre-Test</u>			<u>Post-Test</u>		
	<u>$\bar{x}$</u>	<u>SD</u>	<u>n</u>	<u>$\bar{x}$</u>	<u>SD</u>	<u>n</u>
Control	25.06	5.5	8	29.38	11.36	8
Experimental	<u>26.18</u>	<u>11.5</u>	<u>54</u>	<u>37.12</u>	<u>12.45</u>	<u>54</u>
Total	26.04	10.9	62	36.12	12.33	62

ANCOVA Summary

<u>Source</u>	<u>SS</u>	<u>DF</u>	<u>MS</u>	<u>F</u>	<u>P</u>
Experimental/ Control	361.99	1	361.99	2.96	.09
Pre-Test	1638.41	1	1638.41	13.39	.001
Error	7216.70	59	122.32		
Pre-Test	66.0	1	66.0	.57	.45
Experimental/ Control	344.73	1	344.73	2.99	.09
Pre-Test x Experimental/ Control	534.41	1	534.41	4.64	.04
Error	6682.29	58	115.21		

**Figure 6: Mean Pre- and Post-Test Verbal Criterion Scores for Experimental and Control Groups**



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Insert Table 9 about here  
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These results and those for the material criterion suggest that improvements in problem-solving facility found in many investigations may be no more than a consequence of the type of criterion measure employed in relation to the content or medium used in training.

### Discussion

This discussion of findings is in two parts. The first relates present findings to previous ones identified in the literature (Stewart and Angle, in press). In the second, a set of research issues judged to be worthy of further investigation are presented.

#### Present and Past Findings

##### Individual Differences Predicting Outcomes

Sixty percent (60%) of the material task performance was accounted for by four variables. Mental Rotation, a specialized ability, contributed the most. That finding is inconsistent with previous research. Reviews by Stein (1968); Dellas and Gaier (1970); Torrance (1972); and Barron and Harrington (1981) found abilities, as a general category, to be nonpredictive of creative outcomes. For example, the most widely researched predictor has been general intelligence. But, correlations between general intelligence and a variety of criteria have been uniformly low, ranging from mildly negative ( $-.05$ ) to mildly and significantly positive ( $+.31$ ).

According to Simonton (1976), an average amount of general intelligence is required for effective unstructured problem-solving. After that, other factors seem to come into play. The work of Streufert and Streufert (1978) and Schroder, Driver, and Streufert (1967) confirms that. In the present investigation, two measures related to general intelligence were included as potential predictors. Those were ACT score and Grade Point Average. Neither contributed significantly to prediction, whereas a more specialized ability measure did. That suggests that innate abilities related to specific kinds of tasks are highly useful in predicting performance. General ability measures may or may not be related--depending upon the nature of the task. The material criterion required "spatial visualization," which must be captured in some sense by the mental rotation measure. Hence, it was found to be a useful predictor.

Table 9  
Post-Test Experimental and Control Group Comparison on  
Verbal Criterion Controlling for Pre-Test Performance

<u>Group</u>	<u>Pre-Test</u>			<u>Post-Test</u>		
	<u>$\bar{x}$</u>	<u>SD</u>	<u>n</u>	<u>$\bar{x}$</u>	<u>SD</u>	<u>n</u>
Control	7.60	3.19	18	12.78	3.83	18
Experimental	<u>7.33</u>	<u>3.13</u>	<u>35</u>	<u>9.46</u>	<u>3.91</u>	<u>35</u>
Total	7.42	3.12	53	10.59	3.59	53

ANCOVA Summary

<u>Source</u>	<u>SS</u>	<u>DF</u>	<u>MS</u>	<u>F</u>	<u>P</u>
Experimental/ Control	125.21	1	125.21	12.47	.001
Pre-Test	35.59	1	35.59	3.54	.066
Error	502.08	50	10.04		
Pre-Test	46.71	1	46.71	4.69	.035
Experimental/ Control	.68	1	.68	.068	.794
Pre-Test x Experimental/ Control	13.85	1	13.85	1.39	.244
Error	488.24	49	9.96		

The present findings might be better explained in terms of Gardner's (1983) conception of intelligence as a collection of separate capabilities or competencies, which traditionally may have been subsumed by "G-Factors." This occurred when "intelligence" became equated with G-factors derived via ad hoc statistical approaches. Gardner's view of "intelligence" might be more applicable, in concept, in helping to explain current findings, as outlined below.

### Personality

Factors, which normally are considered facets of "personality," were significant correlates of performance. These were Intuition and Introversion. But, they can be considered cognitive parameters. Humans tend to act (out) what they think (Vygotsky in Rieber and Carton, 1987).

Vaughan (1979) described intuition as "a way of knowing ... a way of recognizing the possibilities in any situation." It was the second most powerful determinant of material criterion performance. A wide body of empirical and qualitative evidence supports this. When dealing with novel or "experience neutral" problems, Jung (1959) found those who were good at solving them were also highly intuitive. They tended to be particularly good decision makers when precedent was not available as a guide. Such individuals can "see" new possibilities in situations where others cannot. They have a sense or vision of the future, and thus are better equipped to be proactive.

Bruner (1960) noted that intuitive individuals do not approach problem solving in well-planned steps. Rather, their problem solving tends to involve maneuvers based on an implicit perception of the total problem. "The intuitive thinker arrives at an answer which may be right or wrong, with little if any awareness of the process by which he reached it" (pp. 57-58). Jonas Salk (1983) and Buckminster Fuller (1979) have described the role of intuitive thinking in their most important discoveries in much the same way. Similarly, Agor (1986), in a survey of top executives, found they reported using "intuition" in making some of their most important decisions. These decisions involved highly ill-defined and complex problems and issues.

Myers and McCaulley (1985), using samples of architects (N = 40), mathematicians (N = 20), research scientists (N = 30), and writers (N = 17) had them rated by their peers for "creative" capability, and found all but three of their total sample showed a strong preference for using "intuition" in their thinking as measured by the MBTI. A comparison of their distribution with a random sample from a college population yielded a chi-square of more than 50, an occurrence expected based upon chance alone of less than once in a million times. Thus it was not surprising to

find "intuition" again playing a key role in determining problem-solving outcome.

### Introversion/Extraversion

There is not much evidence in the literature to suggest that Introversion should contribute to predicting unstructured problem-solving performance. But, there is a logical reason for finding a negative relationship between these variables. Introverts tend to be stimulated by an inner world of thought. They are energized by this inner world; not by interaction with others as are their extraverted counterparts. If anything, they can be intimidated and inhibited more than energized by the presence of others.

Pre-testing occurred during the first two weeks of a semester and in a group context. For introverts, the newness of the course, along with unknown classmates, could have affected their performance negatively. It may have inhibited their ability to concentrate on task demands. The only related finding was Kirton's (1976). In two large heterogeneous samples drawn from southeast England, he found a moderate correlation ( $r = .46$ ,  $N = 286$ ;  $r = .45$ ,  $N = 276$ ) between scores on his Adaption-Innovation Inventory and Eysenck and Eysenck's (1964) Extraversion scale. Scoring high on the "Innovation" scale is hypothesized to be related to unstructured problem-solving facility. Thus, it may be that extraverts are more adept at these kinds of tasks than are introverts in social contexts. This proposition needs to be investigated further.

The last significant performance predictor stands apart from the other three. This was "Risk Propensity," as measured by Zuckerman, Kolin, Price, and Zoob's (1964) Sensation Seeking scale. The reason it stands apart is because it reflects the emotional daring of the individual, as opposed to cognition. It indicates how likely an individual is to act in trying out something new or different. Gordon (1961) used "individual daring," as reflected in self-esteem, as a selection factor for unstructured problem-solving group membership. To be a contributor to the group problem-solving process, the individual had to be willing to risk his or her self-image in presenting ideas that normatively would have been strange, stupid or weird. Rollo May (1975) described how the "courage to create" is a requirement for people to make use of their Intuition. They will not publically expose novel concepts without it.

### Learning Style

Learning Style, as assessed in this investigation with Schmeck, Ribich, and Ramanaiah's (1977) Inventory of Learning Processes, did not predict performance as the literature suggested it should. In this case, style might have been adequately

captured by the MBTI measure; specifically, the Intuition versus Sensing dimensions. Intuition implies thinking abstractly and holistically. Sensing implies thinking serially (compartmentally) and building wholes from "pieces"--not working from the top down in solving unstructured problems.

Pask (1976a, 1976b) and Pask and Scott (1972) mapped the strategy participants used to solve complex unstructured problems. The problems involved "discovering" the phylogenetic structure underlying two hypothetical animal species. From problem-solving "traces," he categorized his participants into two groups, which he called "serialists" and "holists." The serialists used a trial-and-error process, working the problem from the bottom up. The solution was not obvious until they completed their work. The holists scoped the problem from the top down. They attempted to develop an understanding of the problem in its entirety before they began to work out the details. He labelled these two kinds of respondents "Operations" and "Comprehension" learners. One can easily speculate that these learning strategies would be the ones used by individuals with a preference for using "Sensing" versus "Intuitive" thought processes.

Streufert and Streufert (1978) obtained results similar to Pask's with executives responding to complex simulated environments. Participants who developed more optimal solutions over time showed a pattern in their decision strategies similar to the ones described by Pask. Streufert described such individuals as demonstrating the ability to be both good differentiators and integrators, which implies holistic thinking and high sensitivity to identifying potential variables operating in the "solution space."

Collectively, these results suggest that two generic factors may be important determinants of creative problem-solving facility. These are (a) being a cognitively intuitive, abstract, and holistic thinker, and (b) being willing to act in order to create something new or different. It is not enough to be capable of developing a new concept as a solution for a complex unstructured problem. The individual must be willing to publicly expose the concept either verbally and/or by making it a part of physical or social reality. Yet, one must also be sensitive or discriminating, which has both cognitive and emotional overtones. It would appear these factors interact in some way in producing outcomes. Martin's (1990) and Morgan's (1968) findings support these assertions. Together they found creative people to be generally less rigid in their thinking, open to new experience, and able to deal well with conflicting information. They were also less affected by either praise or criticism, which are characteristics of insecure, less emotionally mature individuals.

## Individual Differences Impacted by Training

Another major issue was whether some individuals could benefit more than others from the type of training investigated. Very few previous studies examined this question. Exceptions are the work of Basadur, Graen, and Graen (1982); Barron (1955); and Gordon (1961). In the present investigation, the results suggest that some of those parameters the instructor was trying to change were affected.

By inference, the training seemed to affect older more than younger students (perhaps suggesting maturity level may moderate training effects) and on those who initially were intolerant of ambiguity and had a nonpositive or skeptical attitude about approaching problems in novel ways. It is possible that changes in these variables are related to Pre- versus Post-Test performance gains. These all are related to level of emotional and/or cognitive maturation, of being more tolerant of differences, and more capable of dealing with the unknown or unfamiliar.

Of the three articles cited, the work of Basadur, Graen, and Graen (1982)--done in an industrial setting involving actual work problems--is probably the most comprehensive. The findings from that investigation are similar to those obtained here. The participants who received training scored significantly higher in preference for ideation in problem solving (an attitude), in the practice of ideation in both problem finding (being proactive), and in problem solving (putting attitudes into action), as evaluated by supervisory ratings of improvement (before versus after). Participants also became more tolerant of ambiguity.

## Training Effectiveness

### Material Criterion

The second major research objective was to decide whether the training program (A&D 100B) resulted in performance improvements beyond what was realized by participants taking another problem-solving course (Psyc 371). A qualified answer was obtained. In relative terms, the participants in the experimental condition significantly out-performed themselves on the second try on the material problem. A significant interaction confirmed the effect.

### Verbal Criteria

But, no such effect occurred for the verbal criterion. Still, discounting statistical significance, the position of the two groups was reversed--implying an interaction. These findings agree with previous ones. Whether the training is effective depends on the degree of relationship between content of instruction and criterion measure(s). If the relationship between the

two is high, the training is typically found to be effective (e.g., see Covington and Crutchfield (1965); Britton (1968); Rose and Lin (1984); Khatena (1978); and Khatena and Dickerson (1973)). Rather than treating the present results as such an artifact, another explanation is warranted.

#### Comparison of Experimental and Control Groups

The posttest performance of the experimentals and controls on the criterion tasks was observed for most of the participants. Pretest behavior was extensively sampled also--either by direct observation or via discussion with the instructors who gave the material problem. The controls performed with the same level of enthusiasm at the beginning and at the end of the semester on both tasks. The experimentals did not. The enthusiasm they showed in tackling the material problem a second time was quite high, relative to what it was at Pre-Test and to those in the control condition. They seemed to view the Post-Test as a challenge to their Pre-Test standing. They were competing against themselves or their previous achievement. These same participants showed no such enthusiasm about completing the verbal problems a second time.

#### Locus of Control

This behavior was to be expected, given that the training intervention seems to encourage self-examination, self-initiative, and accountability. If the individual does not accomplish an assigned task, blame for success or failure cannot be externalized. If they choose to embrace a task, they will give it maximum effort. If they do not, little effort will be expended--just enough to satisfy the requirement. They gain control of the situation rather than being controlled by it. They learn to be proactive. They also seem to learn to balance internal and external control influences. Self-esteem seems to be thereby enhanced.

It is this basic shift in locus of control that is offered as an explanation of findings. If the experimentals had been personally invested in some way in the verbal problems, the results might have been very different. The effects of training may have generalized across criteria.

#### Recommendations

The current investigation should be replicated with a sample size large enough to permit full exploration of the relationships intended. Also, because of this, the full impact of the training interventions in the two groups may not have been fully assessed. In any follow-on replication, several issues need to be very closely examined. These are:

## General versus Specialized Abilities

In the present investigation, a specialized ability, mental rotation, was a potent predictor of performance. But, surrogates of a more generalized one (Intelligence, as we traditionally think of it) were not. This suggests more specific measures of cognitive functioning may be selectively related to outcome, depending upon the task. The nature of the task might require cognitive abilities resident in the right, the left, or some combination of both cerebral hemispheres. Gur's (1982 and 1987) physiological experimentation suggests this. He found that tasks requiring spatial orientation, for example, activated certain areas in the right hemisphere. Tasks requiring serial processing (use of language and logic) activated portions of the left hemisphere. Mental rotation may be a specialized aspect of spatial orientation, characteristic of right-brain functioning.

## Intuition

Intuition was the second most powerful predictor. From descriptions provided by Myers and McCaulley (1985), it too appears to be associated with right-brain functioning. Since Intuition and Mental Rotation were negatively and mildly significantly correlated, they may be separate--but hemispherically related, cognitive capabilities.

Only one variable, the MBTI Sensing dimension, significantly predicted the verbal criterion. Descriptions of it suggest it may be a general left-brain capability. The only thing in common with the four types of verbal problems used was that they were verbal. This, with the findings for the material criterion, suggest distinct hemispherical functions may be required for given tasks, as suggested by Gur's (op. cit.) and others' results.

The number and the nature of right- and left-brain functions, aside from associated measurement methods, needs to be determined. How they are involved singly or in combination in solving unstructured problems should be explored in future work.

## Cognition and Emotion

This investigation suggests that two monolithic factors may be related to unstructured problem-solving. These are cognition and emotion. They seem to be related to unstructured problem-solving facility for different reasons. Cognitive functions (either right- and/or left-hemispherically based) are required to develop a concept for dealing with an unstructured problem. Some kind of thinking is required.

Whether the concept is actualized or not--either articulated verbally or made into a part of physical or social reality--appears to depend on the emotional fortitude of the individual. If they are emotionally mature enough to withstand the social pressure that nearly always accompanies introducing something new or different, their concept will be actualized. Alternatively, a kind of emotional fortitude may be necessary to engage cognitively in such a way as to produce novel thoughts, which could be internally frightening for some individuals. They just may not be capable, because of emotional factors, to think "strangely," necessary for the eventual actualization of new concepts.

That cognition and emotion are involved in creativity does not seem to be an issue. All available evidence suggests they are. How they are related to learning to solve unstructured problems is but one step in an ongoing process--and should be the focus of future research.

### Introversion and Extraversion

An explanation was offered for why Introversion was negatively related to unstructured problem-solving. But, this may or may not represent the actual state of affairs. Extraversion was not positively related to outcome, which suggests its mere presence may be enough. Whether these factors are related and how they are related to unstructured problem-solving in both the individual and group are issues worthy of future exploration.

### Locus of Control

Through observations of the experimental and control participants' behavior in Pre- and Post-Test situations, the training appeared to cause a shift in locus of control. Whether a problem was undertaken and how much effort was expended on it shifted from the beginning to the end of the semester for the experimentals. They seemed to be more in control of the situation after training. No measurement of this observed shift was pre-planned; but it should be built into any future work. The effect we observed was dramatic enough to warrant further exploration.

The training inherently seemed to "force" an intense self-examination. It taught participants something about how they approach unstructured problem-solving. And, perhaps much more importantly, something about how their personal biases or "filters" facilitated or inhibited their "creative" facility. Gaining control of or mastery over such filters may be responsible for the shift we saw.

More generally, what the students could have been learning was that they--not the instructor--were accountable and responsible for their own learning. They learned through the training

intervention that they would not be spoon-fed--either in that class or in the real world. They were never told how to do something or helped in whatever they decided to do. They apparently learned they were responsible; no one would do their thinking for them. But, they may also have learned that the role of the instructor in this kind of training is to provide experiences from which the student can learn, if they care to. The instructor structures the learning experience based on real-life scenarios.

To examine this observed effect, future endeavors should qualitatively assess what the students were experiencing during the process--What was happening to them cognitively and emotionally as the series of problems/experiences progressed? This could be accomplished through interviews or other means likely to provide additional insights not possible with only "fixed" Pre- and Post-tests. Interview data might help in explaining how and why the shift we observed occurred, and its effect on unstructured problem-solving.

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## APPENDIX A

### TEACHING PHILOSOPHY, GOALS AND OBJECTIVES, AND PERSONAL PHILOSOPHY FOR ART COURSE NUMBER 100B

My philosophy for teaching students is quite simple. I present students with ideas and problems which will challenge them enough to bring out creative solutions. At the same time, it is done in an atmosphere which is conducive to risk taking, but one which is not so threatening as to make failure cataclysmic.

Failure, more often times than not, can be more educational than success. Failure, thus, should not be rewarded with a good grade; but it should not be devastating either. Success, on the other hand, does not always insure a high quality education either. Only constant challenge in a supportive atmosphere can do that.

As far as personal teaching goals and objectives are concerned, they are as follows:

- o To develop an understanding in students of the environment in which design takes place--through applied research and community service projects.
- o To develop in students the ability to actualize their solutions to problems through acquisition of design skills and real world experience.
- o To instill in students problem-solving techniques which will serve them in future as well as present problem-solving endeavors.
- o To develop in students an understanding of the need for designers in areas not well recognized by society (e.g., activities and projects involving the handicapped and the elderly.)
- o To develop in students a consciousness that solutions to problems must be at an appropriate level of technology. In other words, a simple resource non-intensive solution is preferred to a complex resource intensive one.
- o To develop in students a deep appreciation for how their solutions to problems affect the environment and energy supplies of the world.
- o To develop in students deep feelings of self-confidence and self-worth.

## APPENDIX B

### INTERVIEW WITH A&D 100B INSTRUCTOR REGARDING TEACHING PRINCIPLES AND PROCESS

Interviewer: We've talked previously about the objectives of your course, which I assume haven't changed. To achieve those objectives, how do you go about it? How is it structured, and why do you have that particular structure and the steps in that structure?

Interviewee: O.K., Number one. The whole course--basic outline, and everything else--is aimed at one thing; and that is to increase the students' self-image/confidence. That is the single thing that runs through the whole course, and it controls the way we grade projects. For instance, if it is a 20 point project, no matter how bad they do on it, they can't get less than 10. We have a safety net under them so that they can never fall.

I spend a lot of time instructing grad assistants on how they are to talk to students. They are instructed to never talk down to them. They are to be familiar with them--not a professorial mode, if you will. They are to lower the barrier as low as we can get it so they become the primary contact and leave a little bit higher role for me. They are to never say "You have failed"--never. Those kinds of attitudes have no place in the course. I've actually fired grad assistants because they have the wrong attitude for teaching the class the way I want it taught.

The whole underlying theme--even the way we grade--is guided by this sort of attitude. For example, we have the grade sheet mounted down on the wall. At any given point in time a student can walk up and see how he is doing in relation to the class--not some given norm or some arbitrary standard out there--only to the rest of the class. We also have the stupid little thing where we give away gold stars. The best performer in each section--whoever does the best in each section--gets a gold star for that day. I'm telling you by three or four weeks into the class those kids will fight for a gold star. I have students come up and say, "wait a minute, I've had the best one and you haven't put the stars up yet," and if they're not up there by the next time, they are right back on you wanting to know where their gold star is.

I treat the whole thing like creative boot camp, and each battle--in other words each problem--they have survived. I was very intentional when I did it as to what we were trying to do, and it was all aimed at the general thing of keeping a student to the point where we are building their confidence. The only

confidence they have ever had in the past was "yes," "no;" "true," "false;" "right," "wrong." Everything is black and white and you are now trying to show them that there is this whole area out there where there are multitudes of options, almost infinite. That's frightening to them. Up to this point in time, they have been comfortable with "yes" or "no." One student came up to me one time and said, "You know what the worst thing about this class is? At least while I was in high school, I had a 50-50 chance of being right." He said it is a pretty frightening thing when you realize that there is a whole range of answers--not just one set you can choose from--and so that is part of that self-confidence thing.

Now, in order to make it more painful, because I do try to maintain some of that "boot camp mentality" in the class, there is no syllabus. I never tell them what is about to happen to them. I may give them instructions--like the other day, I said "Wear grubbies to class next time." I am not going to tell them--Remember when your Dad would tell you were going to get a spanking when you got home?--It's a very powerful experience in your life. You can just about remember every time. So I tell them to wear grubbies to class--and what we do--we did the little problem where we had to protect three tomatoes from the smasher down there. They have to stand within 18 inches of it, that way they have a personal involvement with the solution. Just like in a cardboard boat, they get in that thing. No, you don't just build it and set it on the water and look at it; you get in and paddle around. So it gives them an involvement; but also what it does--by never knowing what is going to happen when they come into class--all of a sudden they finally realize about halfway through the class that the only thing that they've got to depend upon is what's between their ears--themselves. There is nothing else.

Some days I give them 3 sheets of paper, one day a sheet of cardboard; and they've got to solve problems. They always want to know if they should bring a toolbox with them--It never fails. By about the third or fourth project they forget the toolbox--leave the security blanket at home; and realize that the biggest and best tool box they have is between their ears. But, by creating this ambiguity, they have that feeling.

Any time you are going to be in a creative field, no one is going to tell you you did it right; I hate to tell you. There is a range of ideas--not "right" and "wrong." You may have to invest a million and a half in it to find out if its even going to be a decent product. Chrysler invested \$800 million in the little mini-van before they found out it was the right product. Somebody's self-confidence had to be pretty damn high to invest \$800 million into a brand new car when the company was going down the tube. But it's paid off big time. It is the highest profit margin vehicle on the road right now.

So the ambiguity is there for several reasons. Some people can't live with it; but when you are dealing in a problem-solving area that is outside the standard structural formula, you are dealing in ambiguity. You do an accounting problem; it's easy. You turn to the last page--there is the answer. If I ask you to design a new hair dryer, there is no formula. We can talk about some plastics that have worked in past products, we can talk about some styles. I don't care how well you put it together; it may not work this time--and so you must keep trying.

I want that pain to be there. I want that pain of them not knowing what they are going to do, because eventually they realize the only thing they've got to trust is themselves. Each one of these projects we put the students through will create a range of feelings. As long as we can put them through as wide a range of terror as possible without physically hurting them--then when they get out there and actually have to solve a real problem--they aren't frightened of that terror. They have confidence.

I've had one student say "I was right in the middle of the meeting and there were three or four people asking questions and everything else. He said all he could think of was about when we were out on the float trip." The float trip is a three-day thing where we make them build their own boat. He said "I had four people on the boat and they were all yelling at me. Really the only thing we had to do was bail for a while because it wasn't coming in that fast and I finally told them "SHUT UP AND BAIL." He said "I was sitting there in this business meeting and I just looked at them and said 'SHUT UP AND BAIL' and everyone knew what had to be done. If you can put them through as near as you can get them to that terror that goes along with the creativity. The students tell me the adrenalin is pumping so hard when they get in that boat and pull up to the starting line."

I had a football player tell me he scored the winning touchdown in his high school homecoming game in his senior year, and that he had never built a damn thing in his life. Yet getting in that boat he said he knew the skin divers were holding him when they let go and he realized he was in his boat. And then the gun went off. He said he had never suffered adrenalin like that in his life. And he meant it. He broke a fiberglass kayak paddle right on the spot. I mean that is what I want to put them through--adrenalin highs.

They have to build a structure eight inches high and stand on it for 10 seconds. If I've heard it once I've heard it 100 times--"That's the longest [exp del] 10 seconds I've ever spent in my life." Every one of us can think back to when we had to make a decision or do something to survive--to that longest 10 seconds or 60 seconds. We experience the distortion of time that occurs. They will already know it--they stood on top of their toothpick structure for ten terrifying seconds. It's those little terrors

that usually keep people away from being creative. The first time they come up against it, they pull back. It is just so frightening to think of what could happen. I call a lot of what we do mental pushups. We could also call it emotional pushups.

One of the things I tell the grad assistants to do all the time is to create an "experience." We are to give it our best shot. If you think back to your time in college, the military, anywhere--the experiences you really cannot forget are the ones where you had a very heavy emotional involvement. Like where were you when Kennedy died? Everyone knows. So when we do the tomato smasher problem I mentioned earlier, they're only standing 18 inches away. If they get tomato all down the front of them, they turn around and there they are in front of the class with their clothes all obliterated with tomato seeds--project failed. I didn't have to tell them it did; they can see the tomato all over them. Now they have to live through the rest of the day with it on them--that's an emotional thing.

What I try to do is use emotion to mark a point in the continuum of time. I tell the grad assistants "Now hang all the [exp del] concepts on it you want to because they'll never forget them." When they are out there in their cardboard boat or when they are out there in their boat that they built for a float trip, you got a heavy emotional involvement. Standing on top of that damn toothpick structure. It's not me putting weight on it and it dying. They are now standing on what they built in front of the entire class. A whole different ballgame. And even if it fails, they're still going to get 10 points cause they have experienced it. I love it.

In education and in life we keep telling them you learn the most from your failures. But the bottom of the safety net is zero--not a C. In our class you always get at least half the points for showing up and executing the project. You can survive with a C in the course and never get a project right; but the thing is, by having the emotional marker points in time, most kids won't hang around. They lose two or three times--not any real pressure on them--but they realize this is not their thing. I have never thrown a kid out of class; I've flunked one or two because they didn't show up or do anything.

So I use this emotional marker in time. I've had hundreds of kids say they will never forget that feeling out there in that cardboard boat when that gun goes off. People tell me "My throat was just dry, my whole chest was just beating." I've had kids come in here and tell me they still have their toothpick structure. I had one tell me that he had a concrete block sitting on top of it in his living room. We're talking about a kid that had been out maybe 10, 12 years--said every so often someone will come and say that's toothpicks holding up a concrete block. I tell them "Yeah, by god, one time I stood on it."

Interviewer: You said you had sessions that meet on Monday and Friday and Tuesday and Thursday and then commonly on Wednesday. Is there any rhyme or reason to having it structured that way?

Interviewee: Sure is. One--I want it small so they can have the emotional security blanket of a small group. But at the same time I think one of the reasons we see a lot of dropouts in other classes, especially freshman, is that they don't really understand that they are a piece of a whole big experience. They aren't the only ones suffering. There is a whole group of these people who are suffering with the idea and mentality about this being creative boot camp. My class is a popular class.

However, at the same time, I hear: "Well how well did you survive Archer's class?" It's a little different the way they speak about it than it is: "Did you take Archer's class?" Rather, it is: "Did you survive it?" They are going to be on an emotional roller coaster in that class, because I use those emotions to mark those specific points in time. And when those points are that well marked you can then hang all the concepts on these things--thousands of concepts. If they are all hung in that boat--but win, lose, or draw--they are never going to forget it--'cause it is emotionally marked in time.

As I started to say earlier, if you look back at your experiences in the Army and everything else you begin to look at those that have an emotional marker on them that you remember. The one where you just sat there and you did 45 accounting problems, turned it in and you got a 79 on it. Fine, you passed. Good enough to go drinking Friday night. There is no marker there--no way for you to hang on to it in time. Not necessarily those things that hurt--but things you've got an emotional involvement in.

Interviewer: I guess they could be positive or negative emotions. What you are describing is sort of like a trial by fire.

Interviewee: Yeah. But there's the other safety net that no one's ever been hurt in the class. If I see someone who is beginning to fail, we pay real close attention to them till we get them back to where they are self-confident again. We get one or two of them a semester--that's all.

Interviewer: What you are describing is not so much design as it is person development.

Interviewee: Well, that is what I get criticized for right here in my own faculty. I say it is problem solving--they agree to that--and under that guise it's been said more than once at the end of the semester "I've got Archer's Army." Grad students

actually come in and say "What the hell are we going to do now? I can't control that class." You've got to stay on top of them, maintain control, but not by the normal means anymore. Here you are teaching people to break the rules, barriers. I've had more than one grad assistant who will try to drop back to an old control mode when he realizes he's losing control of the class. I try to point out to them that if the project gets done by 99% of the people, why worry about the control--The task is getting done. Don't make them salute.

In the beginning, it is just like boot camp. Boot camp is a very controlled environment. It at least gets a little better when you become a noncom, still better if you ever become an officer, and gets damn good if you ever become a general. We would not want a general living with the philosophy, "If it don't move, paint it; if it moves, salute it." We want the guy in boot camp that way. So, we start out with the class very structured, very tight; and as they begin to feel their oats, we can move the boundaries out. I love it.

By the end of the semester and the final cardboard boat race, there is literally a week there where we don't do anything because they're all so high. For many of them it's the first time they've ever created a three-dimensional object. You can give them any problem, a standard hour project, and they'll all finish it in 15 minutes--and all do very well. Then the rest of the time they want to sit around and tell war stories--that's fine. The task is getting accomplished, the problem in being solved, they can quit saluting.

Interviewer: What do you do in the common Wednesday lecture versus individual sessions?

Interviewee: Individual sessions we'll do a problem, like span the greatest distance possible with paper. In the session that is all together, we do several things. The lectures are a back-up to something they are about to do the next week. They provide the framework. In that case I don't want it handled by five different grad assistants. I want them all to get exactly the same information so I can maintain control over that parameter. I would call it common information given out, but each one would filter it. That's what helps create the range of solutions. The students never cease to be amazed that they all sat there and heard the same problem, from the same person--and look at the range of solutions. They can't believe it.

The other little trick that I play in this thing is to try to make the class as antidotal to life as I can. Because if you create, you're going to have the ambiguity. You can sit in a meeting and everybody get the same orders--and nobody will have heard it the same way. Most places don't like that--I like it.

So I want them to see that range. For instance, the night after the boat race (Wednesday night meeting) we show video or slides and "Oh, there's where I flipped" and everybody claps. Each one gets support from the group because they are now a member. All have been through it. The experience they've been through they can relate to when they get out there (the real world).

So part of what we teach them is time management and I only tell them that at the end of the semester. Do you realize how many times you guys hit the wall of a deadline? Well guess what? If you are going to be in design or art, if you don't like it, you had better get out now because that's the way it is. I've never seen an artist or designer who will finish things--anything--more than an hour before the deadline. It's part of the territory. They learn about themselves. If I've had this told to me once, I've had it told to me a hundred times--"You know the one thing this class taught me? I'm not the only one who puts things off till the last minute."

By having the big group, then, to support them, relating--they decide their own place in that social pecking order. They have a place to be. They don't have to be in a fraternity if they don't want to be; but if they're in the freshman class in this department they are going to know where they fit because they've seen the projects, they've seen the big grading sheet on the wall. It's not important whether it's the top dog or not. To three or four people--yeah, it'll be important. But to a very large majority that is not important, just that they know where it is--where they stand. Therefore, they have the right, if they choose to, to define themselves in terms of the group. Some people say that's a terrible thing to do; but I think we all do it in some way, shape, or form.

The nice thing about it is the way they have defined themselves in terms of the group. It is by the creative talent which they have displayed. "I remember that really neat thing you did." By seeing the range of the whole big group they understand that there are options and possibilities.

Interviewer: They are obviously learning some self respect, and the definition is by virtue of their peers.

Interviewee: And their relation to their peers in terms of that big grading card on the wall--not a secretive process. They can look any time and see how well they are doing in terms of the group. If a teacher doesn't post grades, they don't know. By using the big night section for things like that you also assign the big problems--the big 20-pointers. It's assigned at the same time so everybody hears the same problem addressed. Then when I

get a student that says "I thought you meant ...." another one says "No, he didn't say that; he said this." they begin to realize.

I can sit up there and talk to them all night about how they filter information; but when I demonstrate it with every single project, they no longer have to hear it coming from me. They now can see it with their own eyes (i.e., that every person has a different way of solving problems.) Besides, if I just stand up there and say it, why the hell should they believe me. Experience it. It fascinates me.

I said earlier we put this safety net under them so that if they fail they're going to get at least half the points. Have you ever noticed in education we have this thing you have to get 90 out of 100 right to get an A, 80 to get a B, 70 for a C, below a 70 you're a failure--roughly. Would you look at baseball. If you get one out of three and you're batting 300, you are a [exp del] hero. But I guess that's a game. It is utterly fascinating to me--one out of three times. If you get a hit, you're considered a hero and paid millions of dollars. In education if you only get one out of three you are considered a failure. I have yet to find a professor that will pass someone on 30%.

Interviewer: What you're talking about is strikingly similar, in some respects, with how the German general staff was developed before WWII. For example, they (the student officers) were given a problem. A lot hinges on how they work the problem, but in order to get the problem "right" or come up with a feasible solution, they have to disobey orders. That's kind of hard to do in a military-type environment.

Interviewee: But it is no different than what the creative person does in real life. If I designed a new hair dryer and you and I are designers for the same company--and your's is the top-selling hair dryer--if I design a new one and they tried to do a test market on it and it takes off, guess what? I've got to destroy you--not personally. It may personally destroy you, if you are not accustomed to what creativity means. Anytime you are being creative, you are disobeying an order somewhere along the way; otherwise it wouldn't be innovative--right?

So, yeah, I can see your analogy there because half the licks I've taken in life have been because I wouldn't listen to what I was supposed to do. Look at Van Gogh and all those creative people. I tell my students all the time, if you are getting along just fine with everybody around you, one of two things are happening. Number one, you are not being creative or you've got everyone around you buffaloed that they've learned to put up with your idiosyncratic behavior. That drives them up the wall. This is such a revelation to them--I do that in the big Wednesday night session. That's one of my stories--and it is

such a revelation to them. "You mean there are other people in this world that have as much trouble with their personal lives as I do?" Yeah, if you've got a creative bent--I'm sorry, it comes with the territory.

So when you say they had to disobey an order, it's no different than being creative, because somewhere along the way, anytime you create something new, something old almost has to be destroyed. Creative destruction. When you create Compact Disc players, LP's death warrant was signed. I'm sure there will be purest groups all over the country spring up to keep the LP alive. Being one that was never very good at keeping the record in the jacket, keeping them clean and everything else, I've never been so happy to see those damn things leave. Cassette was good. I could toss them around the truck and they didn't get hurt. Now compact disk is even a little bit better.

I've read a lot about how much of your personality may be developed by the time you are 18 months old. I think something happens in that time frame that will kick a student over the edge in terms of whether or not he's going to be creative. Something happens; I'd love to know what it is. Because by the time they get here, they've spent 12 or 13 years in formal education, having it beaten out of them. We've got them down to Pavlov's dogs, sitting in their little square boxes. The bell rings and they change boxes. It's "yes" or "no" on the test, "true" or "false." Most teachers won't even grade short essays any more. Consequently, the students we're getting can't write.

Somewhere in that first two years of life there is a spark ignited--that with all that tamping and everything else--does not go out. If there is enough left when they get to me, I can fan that sucker--and it'll go like a bonfire. I've seen it happen. I've seen the kids walk in here saying "I'm really not good at this kind of stuff," or "I have to take this class." I can get anybody to do it. That's my pat answer.

The first project we do is where I tell them to design a system out of two sheets of paper, two paper clips, and three inches of tape. "Go out in the hall and get it to cover the greatest distance down the hall." They build a paper airplane. They're out there throwing that damn paper airplane; and it'll glide a little ways. Nine times out of ten it's a girl who'll do it first. Stand out there watching all the macho men working on their paper airplanes that they had to perfect when they were in high school to fly out on the basketball court. Most of the girls are feeling a little upset at this point in time because that's not fair. The guys were the ones who built paper airplanes. They don't know anything about paper airplanes. One of them will get frustrated, wad up the paper, and throw it down the

hall. Hell, the damn thing will go ten times as far as the airplane. You watch this, and it's like a disease in the class room.

I predict this every time to new grad assistants. It's their first time in the class and they ask how do I know how it's going to happen. Even if I have to go out and wad up something and just toss it on the floor--just to get that idea out there if it doesn't happen. It's only happened once or twice in fourteen years. Somebody, and nine out of 10 times it's a woman, will figure this is stupid--playing out here with this paper airplane. And then, all of a sudden, they start to understand a whole lot about ballistics. They put the paperclips inside the paper, wad this all up; then put the tape on the outside, because it skids on the floor real nice.

We go back into the classroom after this little exercise. They have an hour to solve the problem; then we go out and test. Then we go back in to the classroom. I then go into a whole lecture on how they have just let the materials define the problem instead of them. I did not say an airplane; I said design a system. You thought it was paper; therefore, it was a paper airplane. Some of you got disgusted. You finally got mad enough to allow yourselves to break the norm.

I had one girl, after class, come up to me just bawling her eyes out over this project. Said "What am I going to do?" I said "I don't know. What's the problem?" She said "My father is a designer, and he said he was really looking forward to me being in design class. I can't call him up and tell him my first project in design class was to wad a piece of paper up and throw it down the hall." I said "You go back and you tell him that he's going to be proud of you." So she went and told him. She comes back on Monday and said "Do you know what he asked?" He asked me if I was the first one to throw it down the hall. She said "yes." Then her father said he was proud of her. She is now a product engineer for Spiegel--a top engineer. She had a hell of a rough go at first because she thought she'd be doing what her father would accept--not what was needed for the class.

So I go through this whole thing about defining the problem --not letting the materials, you know, do it for you--and that sets a scene for the whole rest of the class. The idea of breaking an order/disobeying an order is just like she had to do. She had to disobey the order from her father to create a paper airplane that was exotic--when just wadding the thing up and whipping it is the best way to solve the problem.

Interviewer: I see. So that you have the problems getting progressively more difficult?

Interviewee: Well, yes and no. We will progress for some people. They will become progressively more difficult. For others, we will hit spots that are very difficult for them. It just depends on where their experiences lie. For instance, take the cardboard boat problem. In the first stages of laying out the models and folding them up, I can spot every woman in the class who has ever done any sewing, because they understand patterns in the three dimensional objects. Most guys/girls don't. So if they've had that experience, what I try to do is by the time I get to the end of all of these experiences is to sort of norm them out. Fill in all the holes in their experiences. I have what I perceive as a range of things I take them through. At any given point in time, I'll have three to five people who will find this portion of a project or this particular project an absolute snap--that's good. That means that part of their experiences have been well covered.

Interviewer: Can you identify the experience? The range of experiences.

Interviewee: That I want them to go through? I think I can. Now, see, this has nothing to do with problem solving. This has to do with three-dimensional art and design. Understanding problem solving is the first one--not let the materials control. Then we'll do paper support where they have to take one sheet of paper and support as many reams as possible one inch off the table. You point out to them that if they support just one ream they've just designed something that supports something 500 times it's own weight. Cars won't do that, refrigerators won't do that, skyscrapers won't even do that. But then I also put an element of gamble in it. That is, you can either go one inch or higher and we'll multiply the height by the number of reams. Now it all of a sudden becomes a gamble. Which way are you going to go? Just confuse the issue--throw the options open.

That is basically teaching them about support, how they solve problems. There is enough complexity here that they have to make judgment calls. How good is your judgment? Was it a good call? The next thing we'll do is span. Does society learn to support things first?

Next thing they learn is to build from point A to point B, and the last thing I do is called cantilever. The span problem involves taking a sheet of Daily Egyptian and building it off the wall as far as you can. I have them write a number as to how far they think they can build off the wall. Most of them will be in the range of two to three feet. Good solutions will be in the range of six to seven feet. This just blows them away because they don't realize it until they start solving the problem.

The cantilever takes all those past experiences and ties them into one: support, learn that three points create a plane,

tension in terms of span. So they're kind of like laws of three dimension. The same way society learned them. Society never built cantilevers until they were well versed in bridges. So, maybe there is something back there in that primal brain that says it would be a lot better if we taught it the same way society has learned it--that may be the biggest theory fallacy I've had in years.

My theory is that what we ought to be looking into is how we teach things in schools. It ought to be done based on a model of how society has learned it. They did not learn subtraction before they learned to add  $8 + 8$ . In math we understand that pretty well. We teach addition to our first-graders, subtraction to our second-graders. We keep building on what was learned previously. But it seems to be the only place we do. History, as an example. Some kids start with Charlemagne and some start with the Civil War. I don't know where the right place is; but I think if we did an honest assessment of how societies came to create histories--what did they think was important--then we might have a better idea of how to teach it. If a whole society evolves something in a way, it must tell us something about the way we learn. But that is a wild theory.

What I try to do is give them a series of experiences that all come together in something. And then we'll come back out here and do a broad range of things to bring it back down again so that each project--it's the same way the Army and Air Force teach anything. Today you do this lesson, tomorrow you cover half of this one and to here, next day you start here. The retired Air Force instructor that has a whole series of math books out now--they are fantastic because each day you build on what you did the day before. Military knows that quite well.

If you go to classes around here nine out of 10 times there may not even be a relationship to what you did the day before. What I try to do is keep that same thought in mind. I'll take them from learning about the tension of paper, about the support, about the span and culminate that with cantilever. The great part about that is there will be a dozen of them that say you know this kind of takes in everything we've done up to now. It's working, there's hope!

I never tell them this ties everything together--I let them figure it out. If the experience is good enough, the answer--if there is such a thing--is going to be self evident. That's what I've done over the last 14 years. O.k. that didn't quite work so I tweak it; if that tweak holds--it may hold for three or four years. I used to do a thing called blind man sculpture where the kids had to build a sculpture, and then everybody else in the class had to feel it and identify it blindfolded. I dropped it out of my repertoire either two or three years ago because, for whatever reason, all I got were these [exp del] "penises".

Girls were complaining to the Chair (of the department) and things like that, so I dropped that project. There was a moral code that fell. Not that I am in favor of moral codes or anything else. I am merely saying something snapped.

Interviewer: In the spring semester, what kind of terminal project are you talking about?

Interviewee: Boat racing. That's the final--a 40-point project. The biggest project they'll have had up to then is a 20-pointer. Accounts for 1/5 of their grade. The grade is not based on how the boat does; it's based on creativity and craftsmanship.

Interviewer: What I was saying was have everybody build an orange like I was talking about before.

Interviewee: Well, a week after the race we could do another project. A quickie.

Interviewer: The time I took the course the project I was given was a small test tube--maybe five inches long--with a big nail in it; and told to design something out of paper and tape that would protect it if dropped from a distance of six feet onto solid concrete. If we could do something like that that would be doable.

Interviewee: There may be a variable there in that the students in my class have done nothing but work with materials. I worry about finding a common medium to both classes. We may have to do the test tube drop thing and a verbal problem. That may give us too many things we don't even know what we've got after it. I'm a little worried that the flaw is that one class is accustomed to working with material in this medium and another in this medium; and then you tested in the medium that skewed things toward this or that group.

Interviewer: I think we could gin up some written problems--a problem where there is no obvious answer.

Interviewee: I have a bunch of them. what do stones say to each other? I have a whole series of those.

Interviewer: OK, I'm going to have to get some of those from you.

## APPENDIX C

### INTERVIEW WITH PSYCHOLOGY 371 INSTRUCTOR REGARDING COURSE CONTENT AND PRACTICES

Interviewer: Could you tell me something about the content and objectives of Psyc 371?

Interviewee: Yes. I consider there to be two kinds of basic knowledge. These two are declarative knowledge and procedural knowledge. Declarative knowledge is knowing certain facts, and procedural knowledge is knowing certain procedures or skills. And what one would think of as skilled thinking would come under that latter heading. I don't think one does much to improve cognitive skills in a one-semester course. The best you can hope for is to teach certain facts.

Now, I am willing to subscribe to theories like that of John Anderson and others who say that the acquisition of a skill involves extensive practice--translating declarative knowledge into procedural skills. This process can take years. So, what I am trying to do, in essence, is to teach certain facts about problem solving and decision making with some minimum kinds of practice--using those techniques, with, I suppose, some hope that somewhere down the line these facts will get translated into usable skills.

Interviewer: Do you worry about anything other than the transference of information? In other words, do you have or do you use any strategy that might "work" on person variables other than the person's intellect?

Interviewee: No, not any deliberate strategies. If there is any impact in that regard, it is purely accidental.

Interviewer: So, there is no conscious attempt on your part to work on, say, the emotional side of self?

Interviewee: No. Not at all.

Interviewer: Then, in terms of the type of content you try to cover, what's the basic content structure of the course?

Interviewee: I think there are three main topics that I divide into problem solving, decision making, and memory. The third topic is probably the least emphasized because there are other courses which deal specifically with that. So, most of my emphasis is on the first two topics--problem solving and decision making techniques. Also, one of the things behind the course is to take psychological theory in those areas and try to translate it into useful techniques.

Interviewer: Ok, could you give me some examples?

Interviewee: Yes. The decision-making area is probably the easiest one to provide good examples for. The research background on human information processing, decision heuristic, errors, and biases is most extensive. The methods of coping with those problems is, in part, just making people aware of them and helping them to recognize classic errors in judgment and, in part, by exposing them to decomposition methods of decision analysis--these sorts of things.

In the problem-solving area, the focus is on such things as adequate representation of the problem, ways of looking for multiple or novel ways of looking at the problem if you are "stuck", different problem-solving strategies that have been described, the inherent problem that might be involved in an avenue you are pursuing--so that you then have to back up and look for alternative strategies.

Interviewer: When you say you want to give them something when they are "stuck," what kinds of things would you give them or try to provide?

Interviewee: I give them a sort of a three-fold classification of decision processes--into representation, strategy, and operators. The representation being how you select the critical elements of the problem and how you define the problem for yourself. The strategy being how you go about establishing a global set of plans for how to go about achieving a solution, and the operators being the moment-to-moment cognitive operations that are going on from this point to this point. Most of the emphasis I have is on how to solve problems on which you are "stuck"--deals with the first two.

In the case of representation, I point out the classic examples where people have failed to see that the elements they see as part of the problem definition could be used in novel ways, or that they are defining boundary conditions that don't really exist. So, misdefining the boundaries becomes part of problem definition.

Interviewer: So you are really talking about the assumptions underlying the problem?

Interviewee: Right. That is part of it. It is more than just assumptions, I think. I think it also is a matter of how you look at the features of the problem and describe them to yourself. There is the classical textbook example, the Meyers Pendulum Problem, which you solve by looking at a pair of pliers where you say how could I use these as a heavy weight to send one wire around another. I could think of a number of examples where

they would see something that would normally represent to themselves in one way as having a particular function, but fail to see that it could serve another function.

Interviewer: When we talked on the phone you described a textbook that you use, and I remember I copied down the name someplace. Do you stick with that more or less?

Interviewee: I use that to set the syllabus with, but I try to go beyond the textbook in providing further examples. There is one chapter in the textbook on probabilistic thinking that I don't think is really good. I try to supplement this and add some other stuff on decision making that is beyond the textbook.

Interviewer: Do you have an extra copy of that text?

Interviewee: No. But I have the copy which I use which you can borrow if you want to.

Interviewer: I see here a chapter on propaganda.

Interviewee: Yes, that is a chapter I deal only lightly with, though it is related to some other stuff concerning the use of language, role schemes, and understanding language.

Interviewer: The material looks like a lot of the old social psychological literature which they have resurrected here. This has not been a topic of vogue for a great while, as I recall.

Interviewee: No, there may have been some more subtle stuff recently in this area; again, related to schema theory where the persuasive effect comes from slanting the way a person understands a story by setting them up in a certain initial schema.

Interviewer: Do you have the students solve any problems as a normal part of the course?

Interviewee: Yes. I try to use a lot of examples, concrete exercises. The first time I taught the course there was less of that than I would have wanted, just because I am building the course as I go along. I hope to create many more examples this time around. The last two to three weeks I have them do a term project which is largely of their own choosing. It does have to be related to one of the areas we have talked about; or they have to turn in a prospectus, meaning there is a problem area they are interested in studying. They would have to specify how they would use the materials they have studied in this course which deals with that problem.

Interviewer: Do the problems which they are given to solve have "right" answers?

Interviewee: Some do and some don't. One of my definitions of decision making is that it is problem solving when there is no answer.

Interviewer: Could you give me an example of one of the problems they are given where there is no "right" answer? I guess you may have done this because I do remember one of the ones you already sent me was of this variety. Could you provide any additional examples of this type of problem?

Interviewee: Some of the classic brainstorming and creativity problems, divergent thinking problems. Also decision-making problems that involve trade-offs between conflicting objectives. I use examples like kidney transplants. There is a group of people who need kidneys. You have fewer kidney transplants available than those who need them. Who gets them?

Interviewer: That's really a prioritization problem.

Interviewee: Yes, that's right. The reason for bringing in that sort of problem is to start to talk about values which is an issue that is left out of a lot of discussions of problem solving and creativity. Divergent thinking, as it is usually described in the textbooks, doesn't require a person to evaluate in terms of "good" or "bad," but when you deal with things like "Who gets the kidney?" you have to make value judgments about things like the fact that someone is wealthy; does that qualify them more than someone who is poor? Is age important? etc.

Interviewer: I guess, though, that there is supposed to be a process by which there are ideas to be generated; and then, after some point in time, that is when you apply judgment. Do you approach teaching it in that way?

Interviewee: I hadn't thought of it in that way.

Interviewer: In other words, if you want to be simplistic, you can divide problem solving into say two stages where in the first stage ideation is involved and in the second stage evaluation is brought into the equation. Do you approach problem solving in this way?

Interviewee: Yes I do; but I emphasize that that is an iterative process, the results of which can be the generation of further ideas.

Interviewer: OK. I see that Chapter 10 of the text here deals with creative thinking. Do you dwell on that very much?

Interviewee: Yes. However, I think it is a theoretical topic which needs much more careful treatment than it has ever been afforded. What I have found in there and in the literature in general is sort of a catalog of procedures which people have developed, such as brainstorming. Those things may or may not be effective because they don't have the theoretical foundation that would connect them to other processes in general. I try to give my ideas as to how they might tie into other ideas on problem solving.

Interviewer: Is there anything about your course that you would define as unique?

Interviewee: No. I think the introduction I created last year--I said there was no reason to believe a psychologist could do any better job at teaching someone than a philosopher or an artist or a chemist, for that matter. If there is something unique, it's that in psychology you at least have a set of theoretical constructs to describe and explain what is going on. But that does not mean that is going to lead to any greater impact.

Interviewer: So what you are telling me is that you believe dealing constructively with problems or being a problem solver or whatever is not discipline-bound? So content is sort of irrelevant of the capability, do you think?

Interviewee: No. I think the evidence is clear that the quality of the thinking is in large part dependent upon what are the facts, the information you have available in the area. But, given someone with a certain knowledge base who says I now want to learn to solve problems better whether they be in my area of expertise or related to problems in day-to-day living, I don't think the psychologist can help that person any more than could someone approaching "thinking" from a different discipline.

Interviewer: Ok. What is the most important point or thing you try to convey to the students, if there is a most important one, and why?

Interviewee: I guess the message I want to convey that I never make explicit is that thinking is an interesting process, and one can take sort of a rationalist approach of saying "Let's take a look at thinking with a view toward understanding it; understanding why it goes wrong--understand what happens when it goes right and that is what the psychologist does. Psychology is an interesting discipline; I love it, it has been my life for thirty years. So I would like for you to become interested in it too.

Interviewer: That's fair enough. Is there anything you would like to add before we complete the interview?

Interviewee: No. However, you might ask me again at the end of the semester. I might have changed my mind by then.

## APPENDIX D

### INTERVIEW WITH A&D 100B INSTRUCTOR REGARDING PERSON ATTRIBUTES OF GOOD DESIGNERS AND/OR PROBLEM SOLVERS IN THE DESIGN DOMAIN

Interviewer: What does it take to be a good student of design or a good designer?

Interviewee: It makes a difference if you are talking about Product Design or about Graphics Design.

Interviewer: How is this so?

Interviewee: Product designers are "gearheads," like automobile mechanics. They have the ability to deal in three-dimensional space. On the other hand, Graphics Design people deal well in two-dimensional space. These are distinct abilities. I am in Product Design. I tried my hand at Graphics Design while in school. It was during my fourth course in Graphics Design that my instructor told me to forget it. He said that I would never have any real talent to be "creative" or good in the area, and that I might as well give it up. So I did! He was right. I am, however, good in product design.

Interviewer: Have you noted any sex differences in Graphics versus Product Design students?

Interviewee: Yes, definitely. There are always exceptions you understand. However, on the average, men predominate in Product Design. On the other hand, women predominate in Graphics Design. There are exceptions, as I said. One in particular comes to mind--a female who was a true car nut. She could tear apart and rebuild any automobile engine, transmission, drive train, etc. You name it and she could fix it. She was also outstanding in Product Design. She had the true "gearhead" mentality for it--a true three-dimensional perspective.

Interviewer: What else is it about Design people?

Interviewee: Design people are not analytical. They do not analyze things into fine detail. They spend their lives looking at things and seeing relationships in space between them. If anything, these people have the ability to synthesize--to make the connections and associations.

Interviewer: What kinds of associations?

Interviewee: There are two kinds: "patterns" and "connections." Pattern thinking involves looking/identifying all the pieces that exist; the only thing missing is the last step of putting all the pieces together as a whole. Someone else may

have invented or created the separate pieces; but the good Design person will see how all the pieces fit together.

The second type of thinking involves connections (i.e., you see many different things and somehow you see something new that can be made out of something that already exists.) I'll give you an example of these sorts of things. I was aware of the process involved in producing methanol to supplement our fuel supplies. The principal by-products of this process are carbon dioxide and water. I was talking with a friend of mine in the horticulture business who was complaining about the costs of buying carbon dioxide to nurture the plants in his greenhouse. Suddenly, there was the answer. We built a still just outside his green-house. He produced alcohol for sale, and the by-products were used to nature his plants.

Interviewer: What else can you tell me about the good Product Design person?

Interviewee: There are two groups now converging on one another. They are the astronomers on the one hand and the nuclear physicists on the other. Both are acquiring the necessary tools to gain a better perspective on the universe. In the case of the astronomers, this involves the ability to see how our system of planets fits together and inter-operates. In the case of the nuclear physicists, this involves the ability to deal with the complexity of the relationships shared among subatomic particles. The commonality is, obviously, the ability to deal with the complexity of the relationships both of these disciplines address. They are acquiring the tools to "see" more clearly natural relationships and interrelationships.

Interviewer: What else makes for a good Product Designer?

Interviewee: Engineering students make horrible Product Designers. They seem to see things in terms of "black and white." A good Designer sees everything on a continuum. The engineers seem to have a "bean counter" mentality. They are bad Designers. You have to have a perspective of the whole, and from the whole move down to the individual pieces. If you see only the whole or the pieces, you can't be any good in Product Design. Thus, you find many who can "see the problem," but there are not that many who can solve it. That is--carry through with making the solution work--once the problem is understood.

Interviewer: What else?

Interviewee: A good Product Designer is a tormented soul. They are not complacent. They are constantly in motion wanting to experience new things. In this regard, they are self-confident and doubting at the same time. This leads to agitation, the perpetual motion phenomenon. It is paradoxical.

The torment is inside; always on the inside. Otherwise, they would not react to external stimulation the way do. They see things differently than other people do.

Interviewer: What about motivation, as far as whatever else you have said?

Interviewee: Motivation is very important. They have to want to accomplish whatever it is they have set out to do.

Interviewer: How do Product Design people solve problems?

Interviewee: This involves a goal.

Interviewer: Is the goal clear?

Interviewee: No, the goal is usually fuzzy. They have some kind of idea about generally what they want to achieve or accomplish.

Interviewer: How do they proceed in achieving this fuzzy goal?

Interviewee: They constantly experiment about one thing and the other. Therefore, the path to the goal is not straightforward. Many dead-ends may be encountered on the way to achieving the established ends. The process can be likened to a funnel with a relatively loose far end representing the fuzzy goal. The process is much like that which I have sketched.

Interviewer: What are the personal habits of a good Designer?

Interviewee: They tend to be gregarious. Males predominate in Product Design. You find very few health nuts. They don't care about themselves. They are tolerant of uncertainty. They don't worry about everyday things such as balancing their checkbook.

Interviewer: What about their dress?

Interviewee: They are sloppy.

Interviewer: How do they go about solving problems?

Interviewee: I have a problem that usually works in sorting out who are good Designers from those who aren't. The problem is this: There are two trains sitting on a one hundred-mile track, facing each other. There is a bee on the beacon of one train that flies to the beacon of the other train and back to the original, etc. The trains start moving towards one another at the same time at a speed of 60 miles per hour. The bee travels

back and forth from one train to another at a speed of 70 miles per hour. The questions are: (1) When will the trains collide? and (2) how far will the bee travel before the trains collide? The "engineering" types will play around with this problem forever trying to figure out an equation that will take all sorts of variables into account. A good Design type will give the answer immediately. The trains will collide in one hour and the bee will have traveled 70 miles. They see the "whole." They don't try to break things down into tiny pieces.

Interviewer: Could you describe how a good Design student would go about solving a problem?

Interviewee: Yes. There is one problem I give them. It is to develop a structure using only toothpicks and glue that will fully support the weight of a human being. A good student will first study carefully the structural properties of toothpicks. He/she will experiment by breaking them to learn something about their structural properties. The good designer will learn that strong toothpicks are those that are structurally "pure" (i.e., they don't have any pronounced grain or other imperfection about them that would cause them to break easily under reasonable degrees of stress.) Now, if they've learned that, they have part of the problem solved.

They must next make a study of glues. You know there are a wide variety of glues suitable for various purposes. They must survey all these kinds of glues. One of the best for solving this particular problem is model airplane glue--not the kid stuff--but the type of glue that real model builders use to construct the plane out of wood and various types of covering materials. This glue is extremely strong when bonding wood.

They then have to "visualize" the type of structure they will have to create, given what they have learned about structural properties of toothpicks and the glue, in order to support the specified weight. This may take some trial and error, but if they've figured out the structural properties--well, they will come up with a reasonable solution.

Interviewer: What range of talent do you usually have in your initial design courses?

Interviewee: There is a wide range. Anyone can take these courses. We have people from all across the university taking these courses.

Interviewer: Do you have anything that you would like to add?

Interviewee: No.

## Appendix E

This appendix is broken down into two parts. In the first is presented a description of the predictors and criteria investigated. The predictors are presented first in alphabetical order. The genesis of each and reliability and validity data for it are provided along with references where it was deemed appropriate. The criterion measures are then described. Copies of the measurement instruments are presented in the second part of this Appendix in the order they appear in the first section.

### PART 1. DESCRIPTION OF PREDICTORS AND CRITERIA

#### PREDICTORS

##### 1. ASSERTIVENESS SCALE. (p. E-25 through E-28)

Galassi, Delo, Galassi and Bastien (1974) developed the College Self-Expression Scale as a measure of assertiveness based upon the previous work of Lazarus (1971), Wolpe (1969) and Wolpe and Lazarus (1966). Impetus for its development stemmed from the fact that past research had relied upon instruments not specifically designed to measure the construct (Hedquist and Wienhold, 1970), or which tapped only limited aspects of it (McFall and Lississand, 1971).

The instrument itself is a fairly short (50 Item) self-report measure. It uses a five-point Likert response scale format (0-4). Twenty-one of the items are positively worded, and the remaining ones are negatively worded. The scale attempts to measure three aspects of assertiveness (viz., positive, negative, and self-denial). A total score is obtained by summing all positively worded items and reverse-scoring all negatively worded items. Low scores, then, are indicative of a generalized nonassertive pattern.

To obtain reliability and validity estimates for the scale, normative data were collected on four separate samples. Those involved 91 introductory psychology students enrolled at West Virginia University, 47 upper-division and graduate students enrolled in a personality theory course, and 41 elementary and 82 secondary school student teachers at Fairmont State College.

Test-retest reliability data were collected for the two samples of students over a two-week period. Pearson product moment correlation coefficients were computed for each group on total scores for the two occasions. The test-retest reliability

coefficients for the two samples identified above were .89 and .90 respectively, which represents reasonable results for the type of instrument being described.

Two kinds of validity data, construct and concurrent, were obtained for the scale. The former was established by correlating the scale's scores with 24 scales of the Adjective Check List (ACL). The ACL was administered to 72 of the 91 introductory psychology course students. The latter--concurrent validity--was obtained by correlating the scale's scores of the combined sample of 121 student teachers with ratings of assertiveness provided by their immediate supervisor. Each student was given a rating on a five-point "Behavioral Rating Form for Observers."

In terms of construct validity, the Assertiveness scores correlated positively and significantly with the following scales: Self-Confidence, Achievement, Dominance, Intraception, gender, Exhibition, Autonomy, and Change. Gough and Heilbrun's (1965) definition of these scales suggests characteristics which typify assertiveness. As predicted, significant negative correlations were obtained with the ACL scales of Unfavorable, Succorance, Abasement, Deference, and Counseling Readiness. These results are consistent with nonassertiveness and indicate an inadequate and negative self-evaluation, feelings of inferiority, a tendency to be over-solicitous of emotional support from others, and excessive personal anxiety. Finally, as hypothesized, variables thought to be unrelated to Assertiveness, in fact, were. These included Self-Control, Endurance, Order, Nurturance, Affiliation, and Aggression.

In terms of concurrent validity, the findings were not terribly encouraging. The correlation between Assertiveness scale scores and supervisory ratings of same was significant and positive (.19,  $p < .05$ ) but is also discouragingly low. However, in light of a student teacher's position relative to the regular instructors and the fact the relationship between the two was not longstanding, this finding is not surprising. The authors hypothesized that the use of raters who were trained in observation and evaluation of the construct of Assertiveness and who are acquainted with the participants behavior in a variety of situations would undoubtedly raise the concurrent validity coefficient.

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## 2. Betts's MENTAL IMAGERY TEST. (p. E-29 through E-36)

Sheehan (1967a) reports the results of an investigation designed to determine if the psychometric properties of Bett's 150-item Questionnaire Upon Mental Imagery (Betts, 1909) could be preserved with a shortened form. The original 150-item instrument was administered to 140 male and 140 female Australian University students. It assessed individual differences in vividness of imagery among participants in seven different sensory modalities (viz., visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic.) A shortened form was constructed of 35 items--five for each of the seven modalities just enumerated. Extensive psychometric analyses of the short form showed that it measured the general ability to image. Cross-validation of the scale in an independent sample of 60 participants produced a correlation of .99 between the long and short forms.

Sheehan (1967b) reports on the reliability of the "Short Form of Mental Imagery" and assesses its ability for testing with American College students. The 35-item short form was administered to 62 male American students on two testing occasions--separated by an average time interval of seven months. They responded to each item in terms of the vividness it engendered in them on a seven-point scale, ranging from the high end of 7 (no image at all) to the low end of 1 (perfectly clear and vivid.) These ratings were averaged over scale items to give

both modality and total imagery scale scores. The test-retest reliabilities as assessed through the Pearson correlation method were significant and acceptably high (.78). There was only one difference between the Australian and American participants which had to do with the "organic" modality. For items such as "classify the image suggested by failure," American participants reported more vivid imagery than did their Australian counterparts ( $t = 2.12$ ,  $df = 200$ ,  $p < .05$ ). However, the size of the difference and the probability that such a comparison could have been obtained by chance (given the number of significance tests run) probably should lead one to discount this finding.

The author concludes that the data available thus far show the imagery test measures a general ability to image and is a reliable and valid scale suitable for measuring it.

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  - o Sheehan, P. W. (1967b). Reliability of a short test of imagery. Perceptual and Motor Skills, 25, 744.
3. CATEGORY WIDTH SCALE. (p. E-37 through E-43)

Pettigrew (1958) developed this scale as a paper-and-pencil measure of an observation made by earlier researchers (Bruner, Goodnow, and Austin, 1956) that subjects revealed marked consistency in the range or width of their cognitive categories. Using standard laboratory equipment (e.g., color-mixing wheels and audio-oscillators), the latter-mentioned investigators asked their participants to select extremes (e.g., the darkest or the lightest or the highest or the lowest) of a variety of categories. For such diverse categories it was found that participants tended to be consistently broad, medium, or narrow in their category widths relative to the total sample. Initial and subsequent research with this construct seems to indicate it is a measure of breadth of thinking ability; and that it is, therefore, more a measure of cognitive functioning than a personality variable.

After several iterations of paper-and-pencil replications of the Bruner, et al. phenomenon, a final and more easily scored 20-item version of the scale was devised which used fixed choice alternatives. The alternative choices offered for the items were empirically derived by choosing the 10th-, 35th-, 65th-, and 90th-percentile choices of 750 college students who took earlier

open-ended forms of the scale. Scoring of the items is based on how far from the given mean of the category the alternative is: + 3 is assigned the alternative farthest from the mean, + 2 for the next farthest, etc. Hence, the higher the score, the broader the category width.

Test/re-test reliability of the instrument was assessed by administering odd and even split-half forms of the test to 97 University of North Carolina undergraduates at Times 1 and 2 (an interval of six weeks). The even and odd forms of the test were reversed in order of presentation to two groups of participants. The Spearman-Brown correlation coefficient obtained with this procedure was + .72.

The instrument was administered to five college samples, varying in size from 42 to 64. Spearman-Brown corrected odd-even reliabilities ranged from + .86 to + .93. With all samples combined, the coefficient was + .90.

The validity of the paper-and-pencil measure to assess category width was determined by examining this measure against category width rankings obtained from laboratory procedures similar to those originally employed by Bruner. Five laboratory tasks were used. The average correlation between the laboratory tasks and the paper-and-pencil measure was found to be .57 ( $p < .01$ ) which indicated that the paper-and-pencil task (given error in the rankings of the laboratory tasks) is probably tapping the same phenomenon as was assessed through other methods in the laboratory.

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#### 4. DAVIS HOW DO YOU THINK TEST (HDYT). (p. E-44 through E-48)

Davis (1975) developed the HDYT based upon previous work in the area of creative behavior; for example--Domino (1970), Smith and Schaefer (1968), Gough (1952), and Schaefer (1970)--and upon his a priori thinking about the attitudes, motivations, values, beliefs, and other personality and biographical matters which should be related to creative behavior. The version of the "attitude questionnaire" the author now recommends using is the fifth one to be produced (Form E), which taps eight dimensions. These include "Energetic Originality," "Creative Interests and Activities," "Creative Writing," "Attraction to the Complex," "Self-Confidence and Sense of Humor," "Freedom and Flexibility,"

"Belief in Psychical Phenomenon," and "Arousal Seeking, Risk Taking and Playfulness."

To assess reliabilities, previous versions of the instrument were used. They were administered to 134 University of Wisconsin students (Form A). Form A consists of 111 items designed to assess the characteristics enumerated above. Each item was rated on a five-point scale (disagree to agree). Reliability as reflected in the HDYT statistic for this sample was .924; and when nine items were discarded due to poor individual item statistics, the correlation was increased slightly to .933.

The 102-item version of the questionnaire (Form B) was administered to an additional sample of 62 University of Wisconsin undergraduates enrolled in a course on creative thinking. The students responded to the questionnaire on the first day of class "before anything was said about creativity or creative people." After the course had been in session for two and one half months the students, as part of the course requirements, turned in (a) a creative writing project; (b) an art or handicraft project; (c) ideas for two inventions; and (d) ideas for a creative teaching strategy. Each student's projects were rated on a seven-point scale of "creativeness." Based upon two raters, inter-rater reliability was calculated to be .78 (Bartlett and Davis, 1974). Reliability on the HDYT was assessed at .94 for this sample.

In terms of validity or the relationship between HDYT scores and the ratings of class projects as "creative," a correlation of .42 ( $p < .01$ ) was obtained. For males, the correlation was higher ( $r = .64$ ,  $p < .01$ ) and for females it was smaller ( $r = .36$ ,  $p < .01$ ) but still significant.

The HDYT (Form B) was analyzed using a nonmetric multidimensional scaling program, MINISSA-I (Raskam and Lingo, 1970). The grouping of items enumerated above was identified through this procedure for the 68 students included in the second sample. These groupings were not replicated with a hold-out or another completely separate sample.

Regardless of the limitations of the process that went into development of the instrument described in this sub-section, if there are attitudinal predispositions and high energy levels (as may be reflected in self-reports), for example, involved in problem solving as the literature suggests there are, this instrument is probably as good as any other in attempting to tap them.

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##### 5. FEAR OF NEGATIVE EVALUATION AND SOCIAL AVOIDANCE AND DISTRESS SCALES (p. E-49 through E-52)

These two scales are discussed together because they were developed in tandem to measure dimensions which previous research suggested might be related to a more generalized construct, "Social Evaluative Anxiety." More specifically, social evaluative anxiety was originally defined by Watson and Friend (1969)--the developers of the two scales identified at the outset of this paragraph--as the experience of distress, discomfort, fear, anxiety, etc., in social situations; as the deliberate avoidance of social situations; and, finally, as a fear of receiving negative evaluation from others. The authors combined the first two aspects into a Social Avoidance and Distress (SAD) Scale. The final factor was employed to compose a Fear of Negative Evaluation (FNE) Scale.

The Jackson (1966a) sequential method of scale construction was used to develop the scales. One hundred and forty five (145) items were selected by rational analysis from a much larger pool, and these were then subjected to an empirical test in order to arrive at the 58 items which constitute the two scales. The SAD is evenly divided between true and false items--14 of each. The FNE scale has 17 true and 13 false items.

The 145 items initially selected were administered to 297 undergraduates at the University of Toronto. The Crowne-Marlowe Social Desirability Scale and the first ten items of Jackson's (1966b) Infrequency Scale were administered. The latter was used to control for pseudo-random responding. Participants who answered any of these items incorrectly were dropped from all subsequent analyses. The basic steps of the Jacksonian (1966a) method were generally followed to establish convergent and discriminant validity and reliability estimates.

In terms of reliability, test-retest reliabilities for a subset of the original sample were .78 and .68 for the FNE and SAD scales respectively. A second subset of the sample (n = 29)

gave reliabilities for the two scales in the respective order as above of .94 and .79. Collectively, these were considered to be acceptable.

The two scales were not uncorrelated with each other (.51 in the larger sample and .32 in a smaller hold-out sample) and the

correlations were significant. Watson and Friend note that the failure to eliminate common variance between the two scales may be due to the actual overlap of the constructs (i.e., probably some people score highly on SAD because they are fearful in social-evaluative situations, a fact which was highlighted at the outset.)

The FNE and SAD were correlated with Taylor's Manifest Anxiety Scale, Rotter's Locus of Control Scale, Alpert and Haber's Achievement Anxiety Scale, Endler-Hunt's S-R Inventory, Paivios' Audience Sensitivity Index, and eleven subscales of Jackson's Personality Research Form--Social Approval, Affiliation, Desirability, Autonomy, Dependence, Achievement, Aggression, Dominance, Abasement, Exhibitionism, and Impulsivity. By and large, the SAD and FNE showed reasonable convergent and discriminate validity with those scales just mentioned in the hypothesized "directions" according to Jackson's criteria. It should be noted that the multi-trait/multi-method format or procedure was not strictly followed. Emphasis was more on examining trait- (as opposed to method) variance implications.

In sum, the SAD and FNE scales were shown to have reasonable reliabilities and convergent and discriminate validities, although they are not orthogonal in terms of the concepts which are being measured. It is highly likely that they are measuring two related aspects of a more general phenomenon which has to do with facility in dealing with or in social situations.

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#### 6. INTOLERANCE OF AMBIGUITY SCALE (p. E-53 through E-54)

This scale was developed by Budner (1960) as part of his Doctoral Dissertation work. It relates, in part, to the identification of variables related to an authoritarian syndrome (Frenkel-Brunswik, 1949, 1951). Budner defined intolerance of ambiguity as "the tendency to perceive (interpret) ambiguous situations as sources of threat" whereas tolerance of ambiguity can be perceived as "the tendency to perceive ambiguous situations as desirable." To clarify, an ambiguous situation is

defined as one not adequately structured or categorized by the individual because of the lack of sufficient cues. A situation such as that can be such because: the situation is completely new, when there are no familiar cues; the situation is complex, containing a great number of cues to be taken into account; and the situation is one in which there are contradictory elements which suggest different structures; and, as such, it is characterized by novelty, complexity, and insolubility.

An initial pool of 33 items was constructed. Two criteria related to the definition provided above were used for inclusion of items. These were: an item had to tap at least one of four postulated indicators of perceived threat (viz., phenomenological submission, phenomenological denial, operative submission, or operative denial; and an item had to refer to at least one of three types of ambiguous situation (viz., novelty, complexity, or insolubility.)

The 33 items identified in this manner were administered to three samples of the total of 16 that were used for the validation and to establish reliability. Total scores for each of these three samples were dichotomized at the median. The same procedure was followed with item scores; and then tetrachoric correlations were computed. A correlation of .35 was significant for the sample size involved; and that was taken as the criterion for including an item in the final version of the scale. Ten positively worded items and eight negatively worded items met this criterion. To achieve an equal balance of items, the two positively worded items with the lowest average correlation were omitted, leaving a total of 16 items.

The 16-item version of the scale was administered to fourteen other samples that included high school students, community college students, women's college students, medical students, and nonresident students at one university. Reliability (as computed by Cronbach's Alpha) ranged from a high of .62 to a low of .39, and averaged .49.

Attempts were made to assess the convergent validity of the scale by correlating scores with scores from three other scales (viz., the Coulter Scale, the Work Scale, and the Princeton Scale (Eysenck, 1954; O'Conner, 1952; and Saunders, 1955 respectively). The correlations between the present scale and the other three ranged from .36 to .54, indicating moderate convergence of the present scale with others designed to measure the same construct.

Peer ratings and ratings by "judges" (a clinical psychologist, a teacher, and a sociology student, judged familiar with one of the samples employed in the validation study through their attending class together and autobiographies the participants wrote for the peers and judges respectively) also provided convergent validation data. There was a modest but significant

correlation ( $r = .34$ ,  $p < .01$ ) between the peer group judgments of participants' tolerance for ambiguity and their self-reports on Budner's (1960) Intolerance of Ambiguity Scale. The rankings assigned to autobiographies by the judges correlated .55 (significant at the .01 level) with their scores on the Intolerance for Ambiguity Scale.

Empirical correlates of intolerance for ambiguity were also examined in an attempt at external validation. Scores on the ambiguity scale were shown to correlate with conventionality, belief in divine power, attendance at religious services, dogmatism about one's religious beliefs, and with favorable attitudes toward censorship. It also correlated positively with authoritarianism and expressed attitudes of idealization of and submission to parents, and negatively with Machiavellian attitudes. Finally, the Intolerance for Ambiguity Scale correlated with career choices among medical students, to acceptance of the role of social and psychological factors in medical treatment, and with evaluation of one's preferred field of practice in terms of structure/lack-of-structure.

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#### 7. MENTAL ROTATIONS TEST. (p. E-55 through E-60)

Vandenberg and Kuse (1978) developed a paper-and-pencil test of spatial visualization based upon the stimuli used by Shepard and Metzler (1971) in a study of chronometric mental imagery. In the latter study, the stimuli used were two-dimensional drawings of three-dimensional objects produced by a computer. In that study, a near-perfect correlation was found between (a) the amount of rotation of each stimulus from the position of a comparison stimulus, and (b) the time it took individual participants to decide whether or not the two objects were identical except for rotation.

The Mental Rotations Test under consideration here consists of a criterion figure, two correct alternatives, and two incorrect ones or distractors. Correct alternatives are always identical to the criterion, except they are in a rotated position. The test contains 20 items in five sets of four items. For half of the items, the distractors are rotated mirror images of the criterion, while distractors in the other ten items are rotated images of one or two of the other criteria.

The test was administered to university, high school, and grade school students for the purpose of assessing reliability. In a sample of 3,268 subjects (aged 14 years or older) the Kuder-Richardson 20 was .88. In a similar sample of 336 subjects, the test-retest correlation was .83 after an interval of one year or more. In an age-corrected sample, the test-retest reliability after a year or more was .70 (Kuse, 1977).

Correlations between the Mental Rotations Test and a number of other spatial tests were computed as a way of assessing convergent validity. The following tests of spatial ability were administered to 197 female and 115 male introductory psychology students at the University of Colorado: the Differential Abilities Test, the Chair-Window Test, and the Identical Blocks Test. Correlations among these tests and mental rotations ranged from a high of .68 to a low of .31, with the average running around .55, indicating moderately strong convergent validation.

Correlations were also calculated between the Mental Rotations Test and tests of verbal abilities (e.g., vocabulary, word endings and verbal reasoning), which yielded low (.10 - .25) and insignificant relationships.

In terms of all the spatial ability tests used in the Vandenberg and Kuse investigation, clear gender differences were obtained, with males significantly outscoring females on all tests of spatial ability employed. The results strongly suggest that, in general, males should be expected to outperform females on those tasks which require mental visualization of objects in three-dimensional space.

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#### 8. MYERS-BRIGGS TYPE INDICATOR (MBTI) (p. E-61)

This instrument was developed by Briggs-Myers (1962) to make the theory of psychological types described by Jung (1921/1971) understandable and useful in people's lives. The essence of the theory is that much seemingly random variation in behavior is actually quite orderly and consistent, being due to basic differences in the way individuals prefer to use their perception and judgment. The former involves all the ways of becoming aware of things, people, happenings, or ideas. The latter, on the other hand, involves all the ways of coming to conclusions about what has been perceived. If people differ systematically in what they perceive and in how they reach conclusions, then it is only reasonable for them to differ correspondingly in their reactions, interests, values, motivations, skills, and interests.

The MBTI contains four separate indices. Each index reflects one of four basic preferences which, according to Jung's theory, direct the use of perception and judgment. The preferences affect not only what an individual attends to in any given situation, but also how they draw conclusions about what they perceive. These four dimensions are identified and discussed more fully below.

##### INTROVERSION-EXTROVERSION (I-E).

This dimension is designed to reflect whether a person is an extrovert or an introvert in the sense intended by Jung. These characteristics are regarded as "mutually complementary" attitudes whose differences "generate the tension that both the individual and society need for the maintenance of life." Extroverts are oriented primarily toward the outer world; thus they tend to focus their perception and judgment on people and objects. Introverts are oriented primarily toward the inner world; and, accordingly, tend to focus their perception and judgment upon concepts and ideas.

##### SENSING-INTUITION (S-N)

This dimension is designed to reflect a person's preference between opposing ways of perceiving. Some persons rely primarily on the mode of sensing which reports observable facts or happenings through one or more of the five senses; other persons rely primarily upon the less obvious process of intuition which (as a process) reports meanings, relationships and/or possibilities which have been worked out beyond the reach of the conscious mind. Another way of expressing the difference is that a sens-

ing type tends to be a "black and white" or quite literal thinker, whereas an intuitive type will see "black and white" as well as all shades of "gray," or the nonobvious possibilities.

#### THINKING-FEELING (T-F)

This index was developed to reflect a person's preference for using one of two contrasting modes of judgment. A person may rely primarily on thinking (i.e., prefer to make judgments through impersonality and logic), or to rely primarily on feelings to make decisions on the basis of personal or social values. The thinking type tends to be more independent than the feeling type; thus, less easily offended or intimidated in social situations.

#### JUDGMENT-PERCEPTION (J-P)

This dimension is designed to describe an individual's primary mode of dealing with the outside world (or with the extroverted part of life.) A person who prefers judgment has reported a preference for using either thinking or feeling in dealing with the outer world.

A person who prefers perception as their dominant mode prefers to use either sensing or intuition in dealing with the outer world.

The MBTI differs from many other personality instruments in the following ways:

- o It is designed to implement a theory. The theory must therefore be understood to understand the scores generated by the instrument itself.

- o The theory postulates dichotomies; therefore, some of the psychometric properties of the index are unusual.

- o Based on the theory, there are specific dynamic relationships among the scales which describe and characterize 16 unique "types."

- o The "type" characteristics and descriptions and the theory include a model of development that continues throughout life.

- o The scales, as described briefly above, are concerned with basic functions of perception and judgment that enter into almost every behavior; therefore, the scope of practical applications is very wide.

Descriptions of the 16 "types" which can be derived through the instrument are provided in the reference identified at the

outset of this section. Reliability and validity data (derived from a wealth of different studies) are included as well. Those data will be only briefly summarized here. The internal consistency reliability of the instrument is fairly high. For a sample of almost 10,000 respondents, reliabilities across the four dimensions ranged from .79 to .85 for Pearson product-moment correlations of split halves of the instrument. Test-retest reliabilities also tended to fall within the same range.

Validity of the MBTI has been assessed in various ways. For example, theory has been used to predict what types will be attracted to given professions; and, then, actual distributions of type by profession as assessed via the MBTI have been compiled. By and large, comparisons have shown that the predictions have been accurate and/or that the MBTI is adequately tapping the dimensions hypothesized in theory to exist.

MBTI dimension scores have been correlated with other scale scores of other personality assessment devices (e.g., the Adjective Check List, Edwards Personality Preference Survey, the Emotions Profile Index, and the Eysenck Personality Questionnaire) which were thought should and should not be related. By and large that convergent and discriminate validity work, although not carried out in the method recommended by Jackson, has shown the MBTI to be robust in terms of this form of validity.

Creativity has been found to be related to some of the MBTI dimensions. One very definitive study in this area was accomplished at the Institute for Personality Assessment and Research (IPAR) by MacKinnon and his associates (e.g., MacKinnon 1960, 1971). Four samples of creative individuals (as determined by peer nomination) were studied. They included forty architects, twenty mathematicians, thirty research scientists and seventeen writers. The common factor among the four groups was found to be the preference for use of intuition. The field in which they worked made very little difference, although writers tended to be NF and the scientists tended to be NT.

To put these results in some kind of perspective, the frequency of intuitive types in the general population is roughly estimated to be 25%. Even in a selected group of liberal arts students from a superior college, only about two-thirds were found to be intuitive types. In the four IPAR samples of creative individuals, only three individuals were not intuitive types. Comparison of this distribution of type with even the college sample yields a chi-square of more than 50.0--a result that would occur by chance about once in a million times.

If intuition is a key factor in creativity, as the theory predicts, then groups rated at different levels of creativity should also differ in the proportion of intuitive types. The IPAR architect data provide an example. Three groups of indi-

viduals were formed with this data. In the first group were those judged to be highly creative. In the second group were those architects who were working with one of the individuals in the first group. In the final group were architects who were members of the American Institute of Architects and who had been matched in terms of age and geographic location to the highly creative architects.

The proportion of intuitive types decreased significantly between the first, second and the third groups. The contrast between the first and third groups yielded a chi-square of 17.0 ( $p < .001$ ). Not only does the proportion of intuitive types increase with level of creativity, but there is also an increase in the intuition preference score. The mean score for intuition was 36.2 for the highly creative group, 29.6 for their colleges, and 27.5 for the representative sample of architects.

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#### 9. SCHMECK INVENTORY OF LEARNING PROCESSES (p. E-62 through E-65)

This inventory of what could be described to consist of both cognitive processing and personality (self-image) attributes of individuals was originally developed by Schmeck, Ribich, and Ramamaiah (1977). The instrument consists of eight dimensions which were labeled the following: Deep Processing, Elaborative Processing, Shallow Processing, Self-Efficacy, Conceptualization, Memorizing, Methodological Study, Serialism, and Holism. The two self-efficacy dimensions would appear to be more self-perception items; and are thought to be related to confidence in one's ability at conceptualizing and memorizing respectively. More precise and full definitions of the self-efficacy variables and

In that reference the more cognitively oriented ones can be found in Schmeck, et al. (1977), Schmeck (1981), Schmeck (1983), and Schmeck and Lockhart (1983), and Schmeck and Meier (1984).

Although there have been various versions of the instrument described in this section, as is the case with most of the others described in this Appendix, the procedure used to create the seminal version will be described here. First a group of experts in the areas of human learning and memory prepared a list of the processes which had either been derived through research or had been advocated as being important by major theories in relevant areas. The experts then individually wrote behavioral descriptions of the processes by phrasing them in terms of the environment and activities of the typical college student. For example, "encoding" was defined as a process by which the learner transforms new information into a form that can be related to old information already stored in memory. Items were then generated that would serve as a manifestation of the existence of such a processing activity. For example, for the process just defined, an actual item might be: "I learn new concepts by expressing them in my own words" or "I learn new words by visualizing a situation in which they occur."

The group of experts met regularly to examine and critique each other's work. Thus, through a rational and iterative process, an initial pool of 121 items was generated. They were administered to 503 undergraduate students at Southern Illinois University. Intercorrelations among the items were subjected to a principal components factor analysis, and the scree test was used to determine the number of factors for retention. The factors retained were then rotated to a Varimax criterion using the principal factor method with squared multiple correlations, serving as estimates of communalities. Only those factors which emerged from this process with loadings of .25 or greater were retained for the initial version of the instrument. The inventory thus derived contained 62 items, grouped into four scales.

After additional work, Schmeck, et al. (1977) examined the intercorrelations among the factors, and determined their reliabilities. The scales, as might be expected both from the conceptual and analytical processes through which they were derived, were not independent (or orthogonal.) Correlations between the scales ranged from a low of .13 to a high of .45. Reliabilities were found to be acceptably high, ranging from .79 to .88. That represented test-retest reliabilities over a two-week interval.

A substantial amount of validation work has been done with the initial version of the scales whose development is described above, as well as with subsequent versions and refinements; and, therefore, no attempt will be made to review all that work here. Rather, representative examples only will be provided. The

reader interested in further details is referred to the references presented at the end of this section. The Deep Processing Scale has been found to be related to critical thinking ability (Schmeck and Ribich, 1978), reading comprehension (Schmeck, 1980), verbal ability (Tracy, et al., 1980), and the ability to build conceptual tree structures (Ribich, 1977). The Elaborative Processing Scale has been found to be related to writing performance (Meier, 1981), use of mental imagery (Schmeck and Ribich, 1978), subjective organization of recall of word lists (Ribich and Schmeck, 1979), and the tendency to organize word lists around rhymes (Mueller and Fisher, 1980).

Schmeck and Ribich (1978) also found that fact retention related positively to conforming achievement--striving behaviors--and negatively to anxiety, while elaborative processing related positively to curiosity and mental imagery ability. These findings suggest that the person who scores high on fact retention is prone to follow instructions carefully, to be bound by the course syllabus, and to process details, while the person who is high on elaborative processing is able to elaborate and personalize information verbally as well as through imagery.

Schmeck and Grove (1979) also found a complex relationship between scores on the scales comprising the inventory and college GPA (High and Low) and American College Test (ACT) scores (again, High and Low). For example, students with High GPA and High ACT scores tended also to score high on deep processing, retention of fact, and elaborative processing. Those with High ACT scores scored lower on the methodological study scale than did others, suggesting that people who score high on methodological study may lack the skills necessary to engage in deep and elaborative study. Methodological study suggests a systematic method of memorization rather than thinking ability, which the deep and elaborative processing scales are more reminiscent of.

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#### 10. SENSATION SEEKING SCALE (p. E-66 through E-68)

The Sensation Seeking Scale (SSS) was developed by Zuckerman and his associates (Zuckerman, et al., 1964 and Zuckerman, et al., 1978) in an attempt to provide an operational measure of the construct of Optimal Level of Stimulation (OLS), which was allegedly first formulated by Wundt (1873). Interest in OLS was not great until the 1950s and early 1960s when many theoretical propositions (e.g., those of Berlyne (1960), Fisk and Maddi (1961), Hebb (1955), and Leuba (1955) suggested that optimum levels of arousal could be substituted for OLS since the arousal construct could accommodate stimulus parameters such as novelty versus constancy and complexity.

Since the SSS is fairly old, this review will concentrate on the work that went into developing the version of the scale used in the present endeavor. That version (Form V) of the scale was developed for studying cross-cultural differences in sensation

seeking, concentrating on American and English participants. It is in this light or under this set of ground rules that the remainder of the materials on the SSS are provided.

The original version of the SSS was developed using a factor analytic methodology. Four dominant factors were identified and shown to have good reliability and validity. The first factor was called "Thrill and Adventure Seeking (TAS)," and it contained items expressing a desire to engage in sports or other activities involving speed and danger. The second factor was called "Experience Seeking (ES)," and it represented the seeking of experience through the mind and senses, travel, and a nonconforming life-style. The third factor was labeled "Disinhibition (Dis)," which seemed to represent the desire for social disinhibition. The fourth factor was called "Boredom Susceptibility (BS)," and represented an aversion to repetition, routine and dull people, and restlessness in an unstimulating environment.

Zuckerman's, et al. (1978) original scale was subsequently further revised and refined, leading to Forms IV and V. In his 1978 study of cross-cultural differences in English and American subjects, Zuckerman used Form IV. The English sample consisted of 254 males and 693 females from the Maudsley Twin Register, ranging in age from 16 to 70. They were given Form IV of the SSS.

After data from this sample were analyzed to repeat the factor structure and to "prune items," a new form (Form V) consisting of 40 items was developed. That version was administered to 97 male and female undergraduates from two large sections of psychology students at the University of Delaware and to 160 male and 172 female undergraduates taking psychology courses at Temple University. Thus, six samples were formed: English male/English female; English male/U.S. male; English male/U.S. female; English female/U.S. male; English female/U.S. female; U.S. Male/ U.S. female. All responded to essentially the same items, albeit on two different versions of the same scale.

Since one of the aims of the research being described here was to reduce the length of the scales with no loss in reliability and validity--cross-cultural differences notwithstanding--these six samples provided a robust means of accomplishing this goal.

Internal reliability for Forms IV and V of the SSS scales were examined. The reliability for Form V was expected to be somewhat lower than for Form IV since it was a shortened version --10 items versus 14 to 18 items. However, there was only one substantial drop in reliability, which was for the Experience Seeking (ES) Scale. Reliabilities fell from .7 and .8 to .6; but remained within acceptable limits. The most homogeneous scales, TAS and Dis, showed little loss of reliability in the new form.

The Boredom Susceptibility (BS) Scale remained in the borderline range with a high of .5.

The correlations among the factor scales in Forms IV and V were also examined. It was hoped the scales in the shortened Form V would be more independent than in Form IV, although some significant correlation was still expected. Correlations among the sub-scales, particularly among ES, Dis, and BS in Form IV were reduced in Form V. TAS continued to correlate significantly with ES as in Form IV, but showed very low and sometimes insignificant correlation with Dis and BS.

Gender differences were again found in "propensity for sensation seeking" in general, with males displaying more of a propensity to engage in such behaviors. There were also consistent age differences in "propensity for sensation seeking," showing a progressive and gradual decline with increasing age. Some cross-cultural differences were noted, although overall those differences were not significant.

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11. TORRANCE TEST OF YOUR STYLE OF LEARNING AND THINKING (p. E-69 through E-74)

This test was first published in the open literature by Torrance and his colleagues in 1977 (Torrance, et al., 1977) . Apparently it had not been available for very long in the copyrighted literature. That may account for the fact that it was not widely used. As a result, not much was known about its properties for predicting various potential outcomes. The test purports to measure brain hemispherical functioning, revealing an individual's preferred mode of thinking--either left brain, right brain, or an integrative right-left brain capability. Two alternate forms of the instrument were published in the below-cited reference.

Limited reliability data were published with the test. Based on undergraduates who took alternate forms of the test, the following reliability results were obtained: right brain specialization,  $r = .84$ ; left brain specialization,  $r = .74$ ; and for integrative style,  $r = .85$ . For test re-test reliability, with a sample of 20 undergraduates taking one form of the test at a six-week interval, a correlation of .84 was obtained. No validity data were published. In considering those things which some believe are related to right and left brain functioning--and the consequences of a specialization of function in either hemisphere relative to an integrative style--the instrument, by and large, has some face validity.

It is not known whether or not any other refined versions of this instrument have been published. None could be found in the open literature. Therefore, the purpose to which the test has been put here will have to be viewed with these facts in mind (i.e., the instrument seems to be measuring something consistently, but no one is sure at this time exactly what.)

REFERENCE

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CRITERIA (p. E-75 through E-92)

Multiple criteria were used to determine the extent to which creativity might transfer from structured to unstructured problems in the material and verbal tasks for the experimental (Art course) and Psychology course (control group.) Two types of criterion measures were employed in this investigation--one dealing in a material medium and the other in a verbal medium. As explained in the main body of this text, that was done to insure that any findings which might emerge could not be attributed to being an artifact of the criteria examined. That is to

say, the Art and Design course (the experimental condition) used various materials (e.g., paper, cardboard, and toothpicks) to teach problem solving in a hands-on mode. The Psyc course (the "foil" or control condition), on the other hand, used a more conventional method, using verbal media (i.e., a textbook, lecture and discussion format.) For the Art course to be considered truly effective it was reasoned that students from that course should demonstrate an increase in problem-solving ability in both material and verbal media--and not just in the one which they had used throughout the semester. These two types of problems or tasks are described below, along with an articulation of the logic or criteria used to evaluate the students' effectiveness at accomplishing both.

### 1. MATERIAL TASK

This task is very simple in nature, and has produced wide variation in students' responses to it in the past. It consists of providing each participant two 5 x 8-inch index cards, along with the following instructions: "Build the tallest free-standing structure you can with these two cards."

The logic used to evaluate the outcome is also straightforward. It is simply the measured height, in inches, of the structure which each student constructs. Implicitly, however, there are actually two criteria involved in establishing the worth of the structure. The first is that some amount of uniqueness or novelty will be demonstrated if the student constructs a very "large" structure. One in which that uniqueness is not shown will simply not be too tall. Second, there is an element of practicality. If the structure is not free-standing, by definition it is "not a good structure." Therefore, uniqueness without practicality is by definition a failure.

### 2. VERBAL TASK

This task consisted of four parts designed to tap reasoning abilities and/or problem-solving capability. In the first section of the instrument which embodied this task five problems were presented, which were by and large totally unstructured. Those items presented participants with a problematic situation, to or for which they were asked to devise a solution. Care was taken to design the items in such a way that there was no conventional or stereotypic response.

Each of these items were assigned 10 points for the purpose of scoring. Five were allocated independently by two judges in terms of uniqueness in relation to all of the responses received. Thus, a normative standard was employed to establish the "uniqueness/novelty" criterion.

The second five points allocated for scoring these five problems was again allocated independently by two judges based on "practicality" (i.e., in the judgment of the rater would the proposed solution work, its novelty notwithstanding?) Unworkable solutions were judged to be of no value.

These two criteria are more orthogonal than the criteria for the material task described above. It is more probable one could obtain a novel solution in this situation that would be unworkable than in the material problem. That is true because "workability" is a matter of judgment here, where it is a matter of physical reality for the material problem.

In the second section of the questionnaire, assessing verbal problem-solving capability, a series of syllogistic or "set theory" reasoning problems was presented. Examples of these items can be found in a copy of the instrument itself, which is contained in the second part of this Appendix. For each of the arguments, participants were asked to indicate why some people are likely to consider the conclusion stated to be valid and to indicate why it was invalid. These items have answers which are more correct or incorrect than those unstructured ones contained in the first section. Three points were assigned to each of the two parts of each of the five items. They were assessed as to pre-established answers, thought to be correct by the judges on the basis of logic.

In the third section of the questionnaire were five items which assessed participants' knowledge of biases in human judgment found to exist from psychological research. It was expected that the participants might not have labels to put on the fallacies, but that they might be able to explain in their own words what the biases might be. For each item, the participant was asked to state whether or not there was something wrong with the reasoning involved; and, if so, to state in their own words what the flaw(s) might be. Again, three points were assigned to each of the latter-mentioned parts of each of the five items. "Standard" answers were developed for each one, and scoring was accomplished by two raters independently as to how the participants' answer "matched" the model which had been developed.

In the final and fourth section of the instrument ten items were presented. For each item participants were asked to develop an analogy describing the relationship(s) which might exist between two objects. For example, one item was: "Compare a mountain and a mole hill." These items have no "right" or "wrong" answers, nor does the answer necessarily have to be practical--as was the case with the other verbal problems. The participants were given the opportunity to show how creative or "rich" they could be in developing "answers."

For scoring purposes, five points were assigned to each of these ten items. They were scored on the basis of "originality" or "uniqueness" and upon the "elaborateness" of the answer on a normative basis (i.e., on the basis of the judges' developing a frame of reference for these variables by examining all participants' responses before beginning the evaluation process.

As before, two judges made independent ratings of each participant's responses. Up to two and one-half points were assigned for "originality," and up to two and one-half points were assigned for "elaborateness."

Two versions of this instrument were developed. They can be considered as alternative forms--one to be used at the beginning of the semester and one at the end. A pool of items of each of the four problem types was developed. From that pool an equivalent number of items of each type was selected. Those were then used to develop the alternative forms for the verbal criterion measure.

## PART 2. PREDICTOR AND CRITERION INSTRUMENTS

What follows are copies of each of the predictor and criterion instruments described in Part 1 of this Appendix, with the exception of the material criterion problem. That problem was described earlier by and large exactly as it was to participants. Thus, there is no need to repeat it here.

## THE COLLEGE SELF-EXPRESSION SCALE

**Instructions.** The following inventory is designed to provide information about the way in which you express yourself. Please answer each question by putting the number on the line following each question that best represents your position according to the scale presented below:

4, Always or almost Always; 3, Usually; 2, Sometimes; 1, Seldom; 0, Never or rarely.

1. Do you ignore it when someone pushes you in line? ____
2. When you decide that you no longer wish to date someone, do you have marked difficulty telling the person of your decision? ____
3. Would you exchange a purchase you discover to be faulty? ____
4. If you decided to change your major to a field which your parents will not approve, would you have difficulty telling them? ____
5. Are you inclined to be over-apologetic? ____
6. If you were studying and if your roommate were making too much noise, would you ask him/her to stop? ____
7. Is it difficult for you to compliment and praise others? ____
8. If you are angry at your parents, can you tell them? ____
9. Do you insist that your roommate does his/her fair share of the cleaning?  
____
10. If you find yourself becoming fond of someone you are dating, would you have difficulty expressing these feelings to that person? ____
11. If a friend who has borrowed \$5.00 from you seems to have forgotten about it, would you remind this person? ____
12. Are you overly careful to avoid hurting other people's feelings? ____
13. If you have a close friend whom your parents dislike and constantly criticize, would you inform your parents that you disagree with them and tell them of your friends assets? ____
14. Do you find it difficult to ask a friend to do a favor for you? ____

15. If food which is not to your satisfaction is served in a restaurant, would you complain about it to the waiter? ____
16. If your roommate without your permission eats food that he/she knows you have been saving, can you express your displeasure to him/her? ____
17. If a salesman has gone to considerable trouble to show you some merchandise which is not quite suitable, do you have difficulty in saying so? ____
18. Do you keep your opinions to yourself? ____
19. If friends visit when you want to study, do you ask them to return at a more convenient time? ____
20. Are you able to express love and affection to people for whom you care? ____
21. If you were in a small seminar and the professor made a statement that you considered untrue, would you question it? ____
22. If a person of the opposite sex whom you have been wanting to meet smiles or directs attention to you at a party, would you take the initiative in beginning a conversation? ____
23. If someone you respect expresses opinions with which you strongly disagree, would you venture to state your own point of view? ____
24. Do you go out of your way to avoid trouble with other people? ____
25. If a friend is wearing a new outfit which you like, do you tell that person so? ____
26. If after leaving a store you realize that you have been "short-changed", do you go back and request the correct amount? ____
27. If a friend makes what you consider to be an unreasonable request, are you able to refuse? ____
28. If a close and respected relative were annoying you, would you hide your feelings rather than express your annoyance? ____
29. If your parents want you to come home for a weekend but you have made important plans, would you tell them of your preference? ____
30. Do you express anger or annoyance toward the opposite sex when it is justified? ____

31. If a friend does an errand for you, do you tell that person how much you appreciate it? ____
32. When a person is blatantly unfair, so you fail to say something about it to him/her? ____
33. Do you avoid social contacts for fear of doing or saying something wrong? ____
34. If a friend betrays your confidence, would you hesitate to express annoyance to that person? ____
35. When a clerk in a store waits on someone who has come in after you, do you call his/her attention to the matter? ____
36. If you are particularly happy about someone's good fortune, can you express this to that person? ____
37. Would you be hesitant about asking a good friend to lend you a few dollars? ____
38. If a person teases you to the point that it is no longer fun, do you have difficulty expressing your displeasure? ____
39. If you arrive late for a meeting, would you rather stand than go to a front seat which could only be secured with a fair degree of conspicuousness? ____
40. If your date calls on Saturday night 15 minutes before you are supposed to meet and says that she (he) has to study for an important exam and cannot make it, would you express your annoyance? ____
41. If someone keeps kicking the back of your chair in a movie, would you ask him/her to stop? ____
42. If someone interrupts you in the middle of an important conversation, do you request that the person wait until you have finished? ____
43. Do you freely volunteer information or opinions in class discussions? ____
44. Are you reluctant to speak to an attractive acquaintance of the opposite sex? ____
45. If you lived in an apartment and the landlord failed to make certain necessary repairs after promising to do so, would you insist on it? ____

46. If your parents want you home by a certain time which you feel is much too early and unreasonable, do you attempt to discuss or negotiate this with them? ____
47. Do you find it difficult to stand up for your rights? ____
48. If a friend unjustifiably criticizes you, do you express your resentment there and then? ____
49. Do you express your feelings to others? ____
50. Do you avoid asking questions in class for fear of feeling self-conscious? ____

## **THE BETTS OMI VIVIDNESS OF IMAGERY SCALE**

### **Instructions:**

The aim of this test is to determine the vividness of your imagery. The items of the test will bring certain images to your mind. You are to rate the vividness of each image by reference to the accompanying rating scale, which is shown at the bottom of the page. For example, if your image is "vague and dim" you give it a rating of 5. Record your answer in the brackets provided after each item. Just write the appropriate number after each item. Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. A copy of the rating scale will be printed on each page. Please do not turn to the next page until you have completed the items on the page you are doing, and do not turn back to check on other items you have done. Complete each page before moving on to the next page. Try to do each item

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The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience ..Rating 1

Very clear and comparable in vividness to the actual experience ..Rating 2

Moderately clear and vivid ..Rating 3

Not clear and vivid, but recognizable ..Rating 4

Vague and dim ..Rating 5

So vague and dim as to be hardly discernable ..Rating 6

No image present at all, you only "knowing" that you are thinking of the object ..Rating

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An example of an item on the test would be one which asked you to consider an image which comes to your mind's eye of a red apple. If your visual image was moderately clear and vivid you would check the rating scale and mark "3" in the brackets as follows:

<u>Item</u>	<u>Rating</u>
5. A red apple	(3)

Now turn to the next page when you have understood these instructions and begin the test.

Think of some relative or friend whom you frequently see, considering carefully the picture that rises before your mind's eye. Classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

Item	Rating
1. The exact contour of face, head, shoulders and body .....	( )
2. Characteristic poses of head, attitudes of body, etc. ....	( )
3. The precise carriage, length of step, etc. in walking .....	( )
4. The different colors worn in some familiar costume .....	( )

Think of seeing each of the following, considering carefully the picture which comes before your mind's eye; and classify the image suggested by each of the following questions as indicated by the degrees of clearness and vividness indicated on the Rating Scale.

5. The sun as it is sinking below the horizon .. ( )

#### Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience ..Rating 1

Very clear and comparable in vividness to the actual experience ..Rating 2

Moderately clear and vivid ..Rating 3

Not clear and vivid, but recognizable ..Rating 4

Vague and dim ..Rating 5

So vague and dim as to be hardly discernable ..Rating 6

No image present at all, you only "knowing" that you are thinking of the object ..Rating 7

Think of each of the following sounds, considering carefully the image which comes to your mind's ear, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
6. The whistle of a locomotive . . . . .	( )
7. The honk of an automobile . . . . .	( )
8. The mewing of a cat . . . . .	( )
9. The sound of escaping steam . . . . .	( )
10. The clapping of hands in applause . . . . .	( )

Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience ..Rating 1

Very clear and comparable in vividness to the actual experience ..Rating 2

Moderately clear and vivid ..Rating 3

Not clear or vivid, but recognizable ..Rating 4

Vague and dim ..Rating 5

So vague and dim as to be hardly discernible ..Rating 6

No image present at all, you only "knowing" that you are thinking of the object ..Rating 7

Think of "feeling" or touching each of the following, considering carefully the image which comes to your mind's touch, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
11. Sand .....	( )
12. Linen .....	( )
13. Fur .....	( )
14. The prick of a pin .....	( )
15. The warmth of a tepid bath .....	( )

#### Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience ..Rating 1

Very clear and comparable in vividness to the actual experience ..Rating 2

Moderately clear and vivid ..Rating 3

Not clear or vivid, but recognizable ..Rating 4

Vague and dim ..Rating 5

So vague and dim as to be hardly discernible ..Rating 6

No image present at all, you only "knowing" that you are thinking of the object ..Rating 7

Think of performing each of the following acts, considering carefully the image which comes to your mind's arms, legs, lips, etc., and classify the images suggested as indicated by the degree of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
16. Running upstairs . . . . . ( )	
17. Springing across a gutter . . . . . ( )	
18. Drawing a circle on paper . . . . . ( )	
19. Reaching up to a high shelf . . . . . ( )	
20. Kicking something out of your way. ( )	

Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience	..Rating 1
Very clear and comparable in vividness to the actual experience	..Rating 2
Moderately clear and vivid	..Rating 3
Not clear or vivid, but recognizable	..Rating 4
Vague and dim	..Rating 5
So vague and dim as to be hardly discernible	..Rating 6
No image present at all, you only "knowing" that you are thinking of the object	..Rating 7

Think of tasting each of the following considering carefully the image which comes to your mind's mouth, and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
21. Salt . . . . .	( )
22. Granulated (white) sugar . . . . .	( )
23. Oranges . . . . .	( )
24. Jelly . . . . .	( )
25. Your favorite soup . . . . .	( )

Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and vivid as the actual experience	..Rating 1
Very clear and comparable in vividness to the actual experience	..Rating 2
Moderately clear and vivid	..Rating 3
Not clear or vivid, but recognizable	..Rating 4
Vague and dim	..Rating 5
So vague and dim as to be hardly discernible	..Rating 6
No image present at all, you only "knowing" that you are thinking of the object	..Rating 7

Think of smelling each of the following, considering carefully the image which comes to your mind's nose and classify the images suggested by each of the following questions as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
26. An ill-ventilated room . . . . .	( )
27. Cooking cabbage . . . . .	( )
28. Roast beef . . . . .	( )
29. Fresh paint . . . . .	( )
30. New leather . . . . .	( )

Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience	..Rating 1
Very clear and comparable in vividness to the actual experience	..Rating 2
Moderately clear and vivid	..Rating 3
Not clear or vivid, but recognizable	..Rating 4
Vague and dim	..Rating 5
So vague and dim as to be hardly discernible	..Rating 6
No image present at all, you only "knowing" that you are thinking of the object	..Rating 7

Think of each of the following sensations, considering carefully the image which comes before your mind, and classify the images suggested as indicated by the degrees of clearness and vividness specified on the Rating Scale.

<u>Item</u>	<u>Rating</u>
31. Fatigue . . . . .	( )
32. Hunger . . . . .	( )
33. A sore throat . . . . .	( )
34. Drowsiness . . . . .	( )
35. Repletion as from a very full meal .	( )

Rating Scale

The image aroused by an item of this test may be -

Perfectly clear and as vivid as the actual experience	..Rating 1
Very clear and comparable in vividness to the actual experience	..Rating 2
Moderately clear and vivid	..Rating 3
Not clear or vivid, but recognizable	..Rating 4
Vague and dim	..Rating 5
So vague and dim as to be hardly discernible	..Rating 6
No image present at all, you only "knowing" that you are thinking of the object	..Rating 7

## ESTIMATION QUESTIONNAIRE

Instructions. Below are listed twenty (20) questions which request that you provide two estimates, one "high" and one "low" after you have been given an "anchor" in the stem of the question. Be sure to circle the answer for each of the subparts of the question with which you most agree.

Item Number.

1. It has been estimated that the average width of windows is 34 inches.  
What do you think:
  - a. is the width of the widest window...
    1. 1,363 inches                      3. 48 inches
    2. 341 inches                      4. 81 inches
  - b. is the width of the narrowest window...
    1. 3 inches                      3. 11 inches
    2. 18 inches                      4. 1 inch
2. Ornithologists tell us that the best guess of the average speed of birds in flight would be about 17 mph. What do you think:
  - a. is the speed of flight of the fastest bird...
    1. 25mph                      3. 73mph
    2. 105mph                      4. 34mph
  - b. is the speed of flight of the slowest bird...
    1. 10mph                      3. 12mph
    2. 3mph                      4. 5mph
3. The average length of whales in the Atlantic Ocean has been estimated by zoologists to be roughly 65 feet. What do you think:
  - a. is the length of the longest whale in the Atlantic Ocean...
    1. 120 ft.                      3. 86 ft.
    2. 190 ft.                      4. 75 ft.
  - b. is the length of the shortest whale in the Atlantic Ocean...
    1. 6 ft.                      3. 52 ft.
    2. 43 ft.                      4. 21 ft.

4. Shipping authorities have calculated that the average weight of merchant ships registered with the U.S. Maritime Commission in 1946 was 5,705 tons. What do you think:
- a. is the weight of the heaviest ship registered...
    - 1. 10,500 tons                      3. 23,000 tons
    - 2. 62,000 tons                     4. 7,500 tons
  - b. is the weight of the lightest ship registered...
    - 1. 3,900 tons                      3. 2,700 tons
    - 2. 1,100 tons                     4. 2 tons
5. Weather officials report that during this century Washington, D.C. has received an average rainfall of 41.1 inches annually. What do you think:
- a. is the largest amount of rain that Washington has received in a single year during this century...
    - 1. 82.4 inches                      3. 63.7 inches
    - 2. 45.8 inches                     4. 51.2 inches
  - b. is the smallest amount of rain that Washington has received in a single year during this century...
    - 1. 20.2 inches                      3. 9.9 inches
    - 2. 36.3 inches                     4. 29.7 inches
6. An average of 58 ships entered or left New York harbor daily during the period from 1950 through 1955. What do you think:
- a. was the largest number of ships to enter or leave New York in a single day during this period...
    - 1. 69 ships                      3. 76 ships
    - 2. 153 ships                     4. 102 ships
  - b. was the smallest number of ships to enter or leave New York in a single day during this period...
    - 1. 34 ships                      3. 16 ships
    - 2. 3 ships                      4. 46 ships

7. During the past twenty years, Alaska's population has increased an average 3,210 people per year. What do you think:
- a. was the greatest increase in Alaska's population in a single year during these twenty years...
- |           |          |
|-----------|----------|
| 1. 6,300  | 3. 3,900 |
| 2. 21,500 | 4. 4,800 |
- b. was the smallest increase in Alaska's population in a single year during these twenty years...
- |          |          |
|----------|----------|
| 1. 470   | 3. 980   |
| 2. 1,960 | 4. 2,520 |
8. Boating experts estimate that the average speed of all sailing craft in America is around 4.1 knots. What do you think:
- a. is the speed of the fastest sailing boat in America...
- |               |               |
|---------------|---------------|
| 1. 8.2 knots  | 3. 5.9 knots  |
| 2. 30.7 knots | 4. 21.3 knots |
- b. is the speed of the slowest sailing boat in America...
- |              |              |
|--------------|--------------|
| 1. 3.3 knots | 3. 2.2 knots |
| 2. 0.6 knots | 4. 1.2 knots |
9. Book reviewer editors guess that around 300 new American novels have appeared annually since WWII. What do you think:
- a. is the largest number of novels to be published in America in a single year during this period...
- |               |               |
|---------------|---------------|
| 1. 380 novels | 3. 870 novels |
| 2. 495 novels | 4. 620 novels |
- b. is the smallest number of novels to be published in America in a single year during this period...
- |               |               |
|---------------|---------------|
| 1. 145 novels | 3. 90 novels  |
| 2. 205 novels | 4. 260 novels |

10. Between 1900 and 1940 there was an average of 48 lynchings per year in the United States. What do you think:
- a. was the largest number of lynchings in any one year during this period in the United States...
- |       |        |
|-------|--------|
| 1. 79 | 3. 53  |
| 2. 63 | 4. 135 |
- b. was the smallest number of lynchings in any one year during this period in the United States...
- |       |       |
|-------|-------|
| 1. 1  | 3. 33 |
| 2. 11 | 4. 19 |
11. It has been calculated that the average time for all trains in 1953 from New York City to Washington, D.C. was 285 minutes (4 hours and 45 minutes). What do you think:
- a. was the time of the slowest train from New York City to Washington in 1953...
- |                |                |
|----------------|----------------|
| 1. 337 minutes | 3. 396 minutes |
| 2. 304 minutes | 4. 483 minutes |
- b. was the time of the fastest train from New York City to Washington in 1953...
- |                |                |
|----------------|----------------|
| 1. 236 minutes | 3. 268 minutes |
| 2. 202 minutes | 4. 145 minutes |
12. The average number of births in the world per day during 1955 has been computed to be 27,440. What do you think:
- a. was the largest number of births in the world in any one day during 1955...
- |           |           |
|-----------|-----------|
| 1. 36,501 | 3. 49,876 |
| 2. 28,207 | 4. 30,023 |
- b. was the smallest number of births in the world in any one day during 1955...
- |           |           |
|-----------|-----------|
| 1. 26,340 | 3. 14,330 |
| 2. 24,725 | 4. 19,704 |

13. When all of the world's written languages are considered, linguists tell us that the average number of verbs per language must be somewhere around 15,000. What do you think:

a. is the largest number of verbs in any single language...

- |           |           |
|-----------|-----------|
| 1. 21,000 | 3. 50,000 |
| 2. 18,000 | 4. 30,000 |

b. is the smallest number of verbs in any single language...

- |           |           |
|-----------|-----------|
| 1. 1,000  | 3. 5,000  |
| 2. 13,000 | 4. 10,000 |

14. The average muzzle to tail length of a sample of 1,000 German Shepherd dogs is 40.3 inches. What do you think:

a. is the length of the longest Shepherd dog in the sample...

- |                |                |
|----------------|----------------|
| 1. 60.4 inches | 3. 44.1 inches |
| 2. 47.8 inches | 4. 54.2 inches |

b. is the length of the shortest Shepherd dog in the sample...

- |                |                |
|----------------|----------------|
| 1. 34.6 inches | 3. 19.7 inches |
| 2. 28.4 inches | 4. 36.9 inches |

15. The average population of South American countries is approximately 8.6 million people each. What do you think:

a. is the population of the most populated country in South America..

- |                 |                  |
|-----------------|------------------|
| 1. 11.2 million | 3. 23.6 million  |
| 2. 54.7 million | 4. 129.1 million |

b. is the population of the least populated country in South America..

- |                |                |
|----------------|----------------|
| 1. 7,000       | 3. 2.4 million |
| 2. 6.2 million | 4. 29,000      |

16. A Stanford University home economist has estimated that the average American spends around 55 minutes of their day eating.  
What do you think:

a. is the longest eating time of any single American...

- |                |                |
|----------------|----------------|
| 1. 185 minutes | 3. 245 minutes |
| 2. 125 minutes | 4. 90 minutes  |

b. is the shortest eating time of any single American...

- |               |               |
|---------------|---------------|
| 1. 16 minutes | 3. 38 minutes |
| 2. 4 minutes  | 4. 27 minutes |

17. In 1946 the average number of births per state was 68,000.  
What do you think:

a. was the highest number of births in a single state...

- |            |            |
|------------|------------|
| 1. 87,000  | 3. 71,000  |
| 2. 122,000 | 4. 254,000 |

b. was the lowest number of births in a single state...

- |           |           |
|-----------|-----------|
| 1. 29,000 | 3. 14,000 |
| 2. 53,000 | 4. 900    |

18. Immediately after WWII, the average number of submarines owned by the largest seven navies in the world was 58.  
What do you think:

a. was the largest number of submarines owned by one of these navies...

- |        |        |
|--------|--------|
| 1. 159 | 3. 118 |
| 2. 91  | 4. 69  |

b. was the smallest number of submarines owned by one of these navies...

- |       |       |
|-------|-------|
| 1. 22 | 3. 36 |
| 2. 9  | 4. 47 |

19. The average number of churches per religious denomination in the United States is estimated to be 511. What do you think:

a. is the largest number of churches if a single religious denomination in the USA...

1. 4,833

3. 1,1219

2. 757

4. 39,801

b. is the smallest number of churches of a single religious denomination in the USA...

1. 313

3. 1

2. 146

4. 23

20. In the years 1916 through 1946, according to the U.S. Weather Bureau, there was an average of 140 tornadoes a year in the United States. What do you think:

a. Was the largest number of tornadoes in a single year in the U.S. during this period...

1. 154

3. 312

2. 243

4. 197

b. was the smallest number of tornadoes in a single year in the U.S. during this period...

1. 103

3. 61

2. 122

4. 28

## DAVIS "HOW DO YOU THINK TEST"

**INSTRUCTIONS:** These questions ask about your interests, attitudes, and self-perceptions. All questions are in a rating-scale form which allows you to indicate the degree to which the statement applies to you, or the degree to which you agree with or accept the statement. There are no "right" or "wrong" answers, just be honest.

**Part A.** Indicate the degree to which each statement applies to you. Mark your answers in the space provided at the end of each item.

- a. No
- b. To a small extent
- c. Average
- d. More than average
- e. Definitely

1. I enjoy the confusion of a big city. _____
2. I often thing like a child. _____
3. I am sophisticated. _____
4. I am very independent. _____
5. I am very likely to do things on impulse. _____
6. I choke-up or sob in many movies. _____
7. I would like to live and work in a foreign country. _____
8. When I was young, I was always building things. _____
9. I would like to learn mountain-climbing. _____
10. I usually value others' opinions more than my own. _____
11. I have a great many interests. _____
12. I am unconventional in many ways. _____
13. I prefer to pre-plan and schedule vacations carefully. _____
14. I have done a lot of creative writing. _____
15. My parents participate in, or were highly interested in, art or writing. _____
16. My parents were always in some form of hobbies or handicrafts. _____

17. I am a sensitive person. _____
18. I am very artistic. _____
19. I am neat and well-ordered. _____
20. I would like to have lived in the early unsettled days of our American history. _____
21. I am quite absent-minded. _____
22. I worry about being considered foolish. _____
23. I am often inventive or ingenious. _____
24. I enjoy trying new approaches to problems. _____
25. I usually jump right into a lake or pool, instead of slowly getting used to it. _____
26. I am a risk taker. _____
27. I would like to be hypnotized. _____
28. I like a cold, brisk day. _____

*****

Part B. Indicate the degree to which you accept or believe the seven statements below. Use the following scale.

- a. False
- b. Probably False
- c. Don't Know (neutral)
- d. Might be True
- e. True

29. Many people can mentally communicate with others through extra-sensory perception (ESP). _____
30. Psychics truly possess a mysterious ability to know things about a person's past and future. _____
31. Psychics also are able to predict such things as national disasters, election results, political assassinations, etc. _____
32. Many stories of mysterious, psychical happenings are true. _____
33. Spirits may be contacted by mediums or others with special psychic powers. _____

34. Flying saucers are visitors from outer space. _____
35. Strong mental concentration can exert a slight physical force. _____

Part C. Indicate how strongly you agree or disagree with the statements below. Use the following scale.

- a. Totally disagree
- b. Mostly disagree
- c. Neutral
- d. Mostly agree
- e. Totally agree

36. It is important to be able to laugh at ourselves. _____
37. It is better to be calm and even tempered than emotionally expressive. _____
38. The world would be better off if youth were disciplined more severely. _____
39. A good painting should give you a jolt. _____
40. I know what I will be doing ten years from now. _____
41. I would rate myself high in self-confidence. _____

Part D. Indicate the degree to which each statement applies to you. Use the following scale.

- a. Totally disagree
- b. Mostly disagree
- c. Neutral
- d. Mostly agree
- e. Totally agree

42. I am confident in my intellectual ability. _____
43. I worry about making mistakes. _____
44. I tend to be cynical. _____
45. I would like a career which involves much traveling. _____
46. I have a great sense of humor. _____
47. I have always been active in drawing or painting. _____
48. I prefer activities which are predictable. _____

49. I am a very active, energetic person. _____
50. I enjoy thinking of new and better ways of doing things. _____
51. I am very curious. _____
52. I tend to become childishly involved with simple things. _____
53. I am quite original and imaginative. _____
54. I have had many hobbies. _____
55. Some of my past or present hobbies would be considered "unusual". _____
56. I am very idealistic. _____
57. I like the nonsense forms and bright colors of modern art. _____
58. I enjoy some amount of ambiguity in my life. _____
59. I would like to be considered courteous and emotionally stable. _____
60. I am very concerned about what others think of me. _____
61. I like to play tag, hopscotch, etc., with the kids. _____
62. I have a peaceful, non-enthusiastic approach to life. _____
63. I am very "reflective." _____
64. I avoid activities which are a little frightening. _____
65. I would take a college course which 50 percent flunked. _____
66. I am able to work intensely on a project for many hours. _____
67. I like trying new ideas and new approaches to problems. _____
68. I am witty. _____
69. I often become totally engrossed in a new idea. _____
70. I live in a room which is usually a mess. _____
71. On vacation, I prefer a good motel to camping. _____
72. I am absolutely against drugs which might produce hallucinations or other  
strange effects. _____
73. I would like to take up skiing. _____

74. I am very conscious of aesthetic considerations. _____
75. Most of my friends are unconventional. _____
76. The word "quick" describes me. _____
77. I try to use metaphors and analogies in my writing. _____
78. I am moody. _____
79. I could be considered a "spontaneous" person. _____
80. I have engaged in a lot of creative activities. _____
81. I take a playful approach to most things. _____
82. I am always open to new ideas and new activities. _____
83. Throughout my education, I had a lot of part-time jobs. _____
84. I have participated in theatrical productions. _____
85. I am usually outspoken in my opinions. _____
86. Financial success is highly important to me. _____
87. I often reflect on my personal values. _____
88. I often attend concerts. _____
89. My parents visit art galleries and museums. _____
90. I enjoy a job with unforeseeable difficulties. _____
91. I think it's fun to explore museums. _____
92. I can sometimes "get lost" in the library for hours, just looking at interesting books. _____
93. Sometimes I get so interested in a new idea that I neglect what I should be doing. _____
94. I have taken things apart just to find out how they work. _____

## SOCIAL EXPERIENCE AND OPINION QUESTIONNAIRE

### Instructions

Below are listed fifty eight (58) statements which may or may not be true about yourself in social situations. Indicate for each statement whether you think it is "true" or "false" about yourself. There are no "right" and "wrong" answers. Express what you feel.

Item Number.	TRUE	FALSE
1. I feel relaxed even in unfamiliar social situations.	---	---
2. I try to avoid situations which force me to be very sociable.	---	---
3. It is easy for me to relax when I am with strangers.	---	---
4. I have no particular desire to avoid people.	---	---
5. I often find social occasions upsetting.	---	---
6. I usually feel calm and comfortable at social occasions.	---	---
7. I am usually at ease when talking to someone of the opposite sex.	---	---
8. I try to avoid talking to people unless I know them well.	---	---
9. If the chance comes to meet new people, I often take it.	---	---
10. I often feel nervous or tense in casual get-togethers in which both sexes are present.	---	---
11. I am usually nervous with people unless I know them well.	---	---
12. I usually feel relaxed when I am with a group of people.	---	---
13. I often want to get away from people.	---	---
14. I usually feel uncomfortable when I am in a group of people I don't know.	---	---

	TRUE	FALSE
15. I usually feel relaxed when I meet someone for the first time.	---	---
16. Being introduced to people makes me tense and nervous.	---	---
17. Even though a room is full of strangers, I may enter it anyway.	---	---
18. I would avoid walking up and joining a large group of people.	---	---
19. When my superiors want to talk with me, I talk willingly.	---	---
20. I often feel on edge when I am with a group of people.	---	---
21. I tend to withdraw from people.	---	---
22. I don't mind talking to people at parties or social gatherings.	---	---
23. I am seldom at ease in a large group of people.	---	---
24. I often think-up excuses in order to avoid social engagements.	---	---
25. I sometimes take the responsibility for introducing people to each other.	---	---
26. I try to avoid formal social occasions.	---	---
27. I usually go to whatever social engagements I have.	---	---
28. I find it easy to relax with other people.	---	---
29. I rarely worry about seeming foolish to others.	---	---
30. I worry about what people will think of me even when I know it doesn't make any difference.	---	---
31. I become tense and jittery if I know someone is sizing me up.	---	---
32. I am unconcerned even if I know people are forming an unfavorable impression of me.	---	---
33. I feel very upset when I commit some social error.	---	---

	TRUE	FALSE
34. The opinions that important people have of me cause me little concern.	---	---
35. I am often afraid that I may look ridiculous or make a fool of myself.	---	---
36. I react very little when other people disapprove of me.	---	---
37. I am frequently afraid of other people noticing my shortcomings.	---	---
38. The disapproval of others would have little effect on me.	---	---
39. If someone is evaluating me I tend to expect the worst.	---	---
40. I rarely worry about what kind of impression I am making on someone.	---	---
41. I am afraid others will not approve of me.	---	---
42. I am afraid that people will find fault with me.	---	---
43. Other peoples opinions of me do not bother me.	---	---
44. I am not necessarily upset if I do not please someone.	---	---
45. When I am talking to someone, I worry about what they may be thinking of me.	---	---
46. I feel that you can't help making social errors sometimes, so why worry about it.	---	---
47. I am usually worried about what kind of impression I make.	---	---
48. I worry a lot about what my superiors think of me.	---	---
49. If I know someone is judging me, it has little effect on me.	---	---
50. I worry that others will think I am not worthwhile.	---	---

	TRUE	FALSE
51. I worry very little about what others may think of me.	---	---
52. Sometimes I think I am too concerned with what other people think of me.	---	---
53. I often worry that I will say or do the wrong things.	---	---
54. I am often indifferent to the opinions others have of me.	---	---
55. I am usually confident that others will have a favorable impression of me.	---	---
56. I often worry that people who are important to me won't think very much of me.	---	---
57. I brood about the opinions my friends have about me.	---	---
58. I become tense and jittery if I know I am being judged by my superiors.	---	---

## SITUATION OPINION QUESTIONNAIRE

**Instructions.** Sixteen statements are listed below. Please use the following scale to indicate how much you agree/disagree with each of the statements.

**7=Strongly Agree, 6=Moderately Agree, 5=Slightly Agree, 4=Neither Agree or Disagree, 3=Slightly Disagree, 2=Moderately Disagree, 1=Strongly Disagree**

**Place the number that best represents your opinion in the blank provided at the end of each statement.**

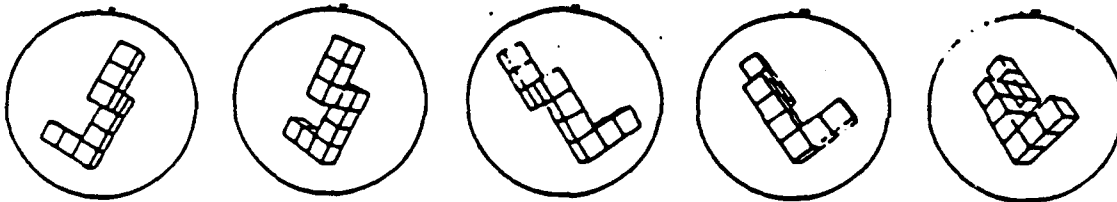
1. An expert who doesn't come up with a definite answer probably doesn't know too much. ____
2. I would like to live in a foreign country for a while. ____
3. There is really no such thing as a problem that can't be solved. ____
4. A good job is one where what is to be done and how it is to be done are always clear. ____
5. People who fit their lives to a schedule probably miss most of the joy of living. ____
6. It is more fun to tackle a complicated problem than to solve a simple one. ____
7. In the long run it is possible to get more done by tackling small, simple problems rather than large complicated ones. ____
8. What we are used to is always preferable to what is unfamiliar. ____
9. Often the most interesting and stimulating people are those who don't mind being different and original. ____
10. People who insist upon a yes or no answer just don't know how complicated things really are. ____
11. A person who leads an even, regular life in which few surprises or unexpected happenings arise, really has a lot to be grateful for. ____
12. I like parties where I know most of the people more than ones where all or most of the people are complete strangers. ____
13. Many of our most important decisions are based upon insufficient information. ____

14. Teachers or supervisors who hand out vague assignments give a chance for one to show initiative and originality. ____
15. The sooner we all acquire similar values and ideals the better. ____
16. A good teacher is one who makes you wonder about your way of looking at things. ____

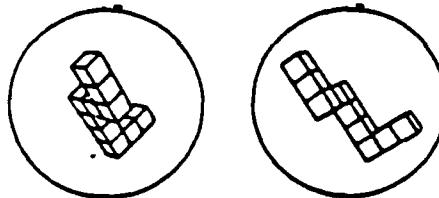
M.R.T. Test

Name _____  
 Date _____  
 _____

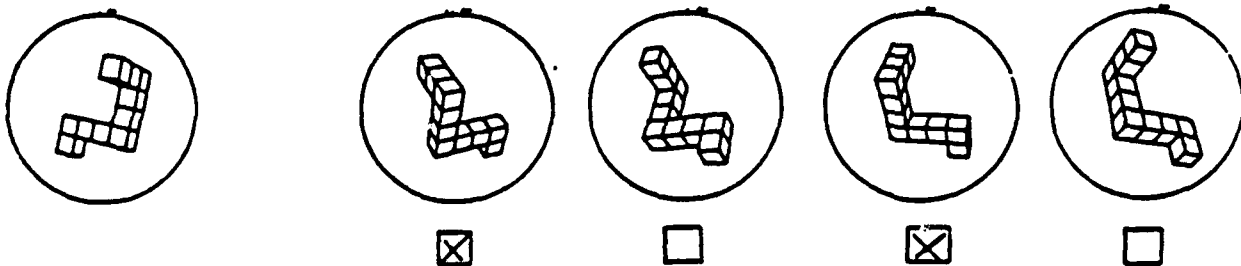
This is a test of your ability to look at a drawing of a given object and find the same object within a set of dissimilar objects. The only difference between the original object and the chosen object will be that they are presented at different angles. An illustration of this principle is given below, where the same single object is given in five different positions. Look at each of them to satisfy yourself that they are only presented at different angles from one another.



Below are two drawings of new objects. They cannot be made to match the above five drawings. Please note that you may not turn over the objects. Satisfy yourself that they are different from the above.

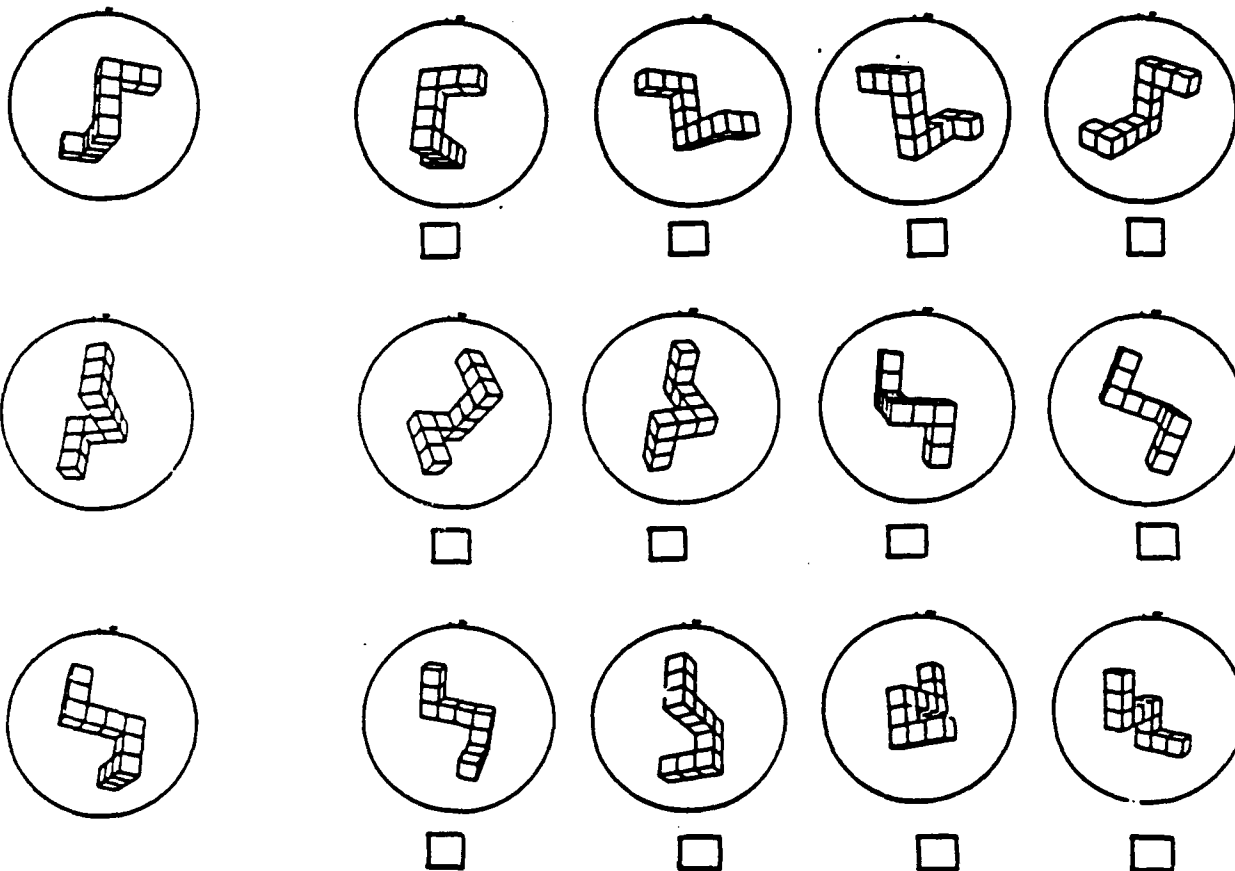


Now let's do some sample problems. For each problem there is a primary object on the far left. You are to determine which two of four objects to the right are the same object given on the far left. In each problem always two of the four drawings are the same object as the one on the left. You are to put Xs in the boxes below the correct ones, and leave the incorrect ones blank. The first sample problem is done for you.



Go to the next page

Do the rest of the sample problems yourself. Which two drawings of the four on the right show the same object as the one on the left? There are always two and only two correct answers for each problem. Put an X under the two correct drawings.

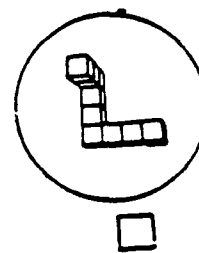
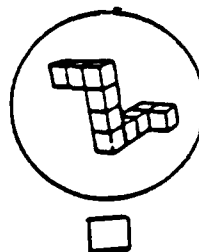
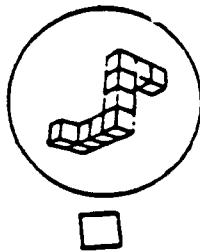
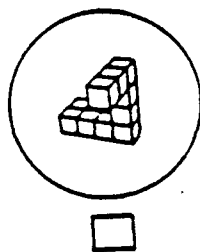
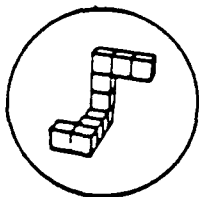


Answers: (1) first and second drawings are correct  
 (2) first and third drawings are correct  
 (3) second and third drawings are correct

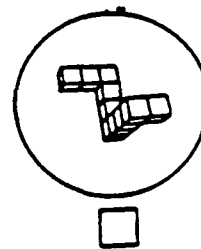
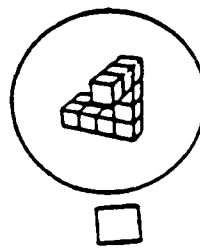
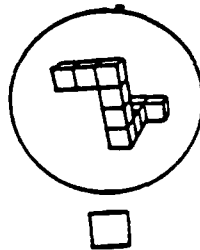
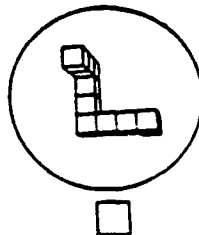
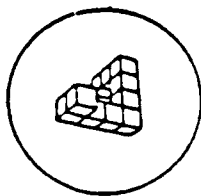
This test has two parts. You will have 3 minutes for each of the two parts. Each part has two pages. You must time yourself, so an honor system is in effect. Do not exceed the 3 minute limit. When you have finished Part 1, STOP and record how much time you spent on the task. Then go on to Part 2 and spend no more than 3 minutes at the task. Record your time after the last item of Part 2. Remember: There are always two and only two correct answers for each item. Work as quickly as you can without sacrificing accuracy. Your score on this test will reflect both the correct and incorrect responses. Therefore, it will not be to your advantage to guess unless you have some idea which choice is correct.

TURN THE PAGE NOW AND BEGIN TIMING YOURSELF

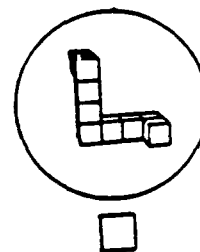
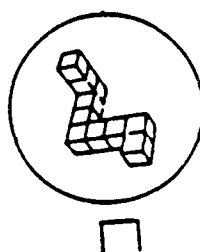
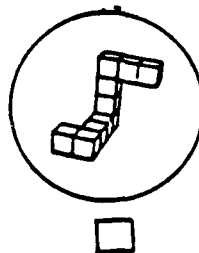
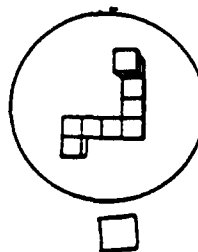
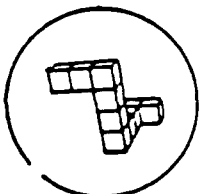
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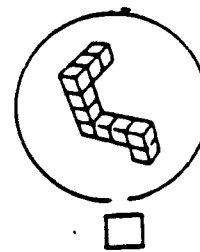
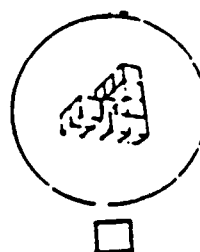
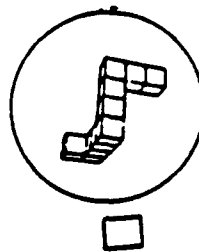
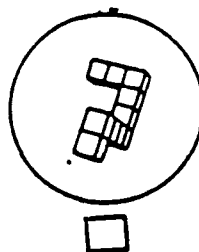
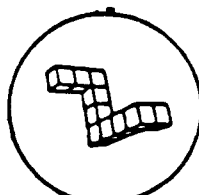
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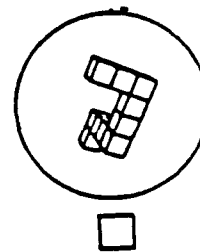
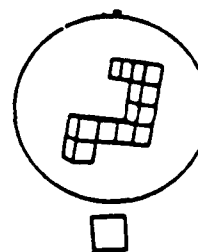
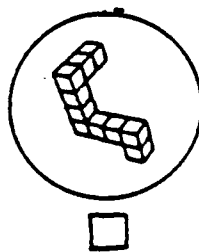
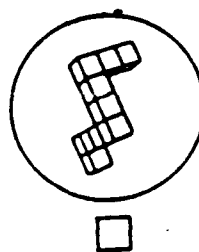
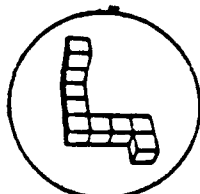
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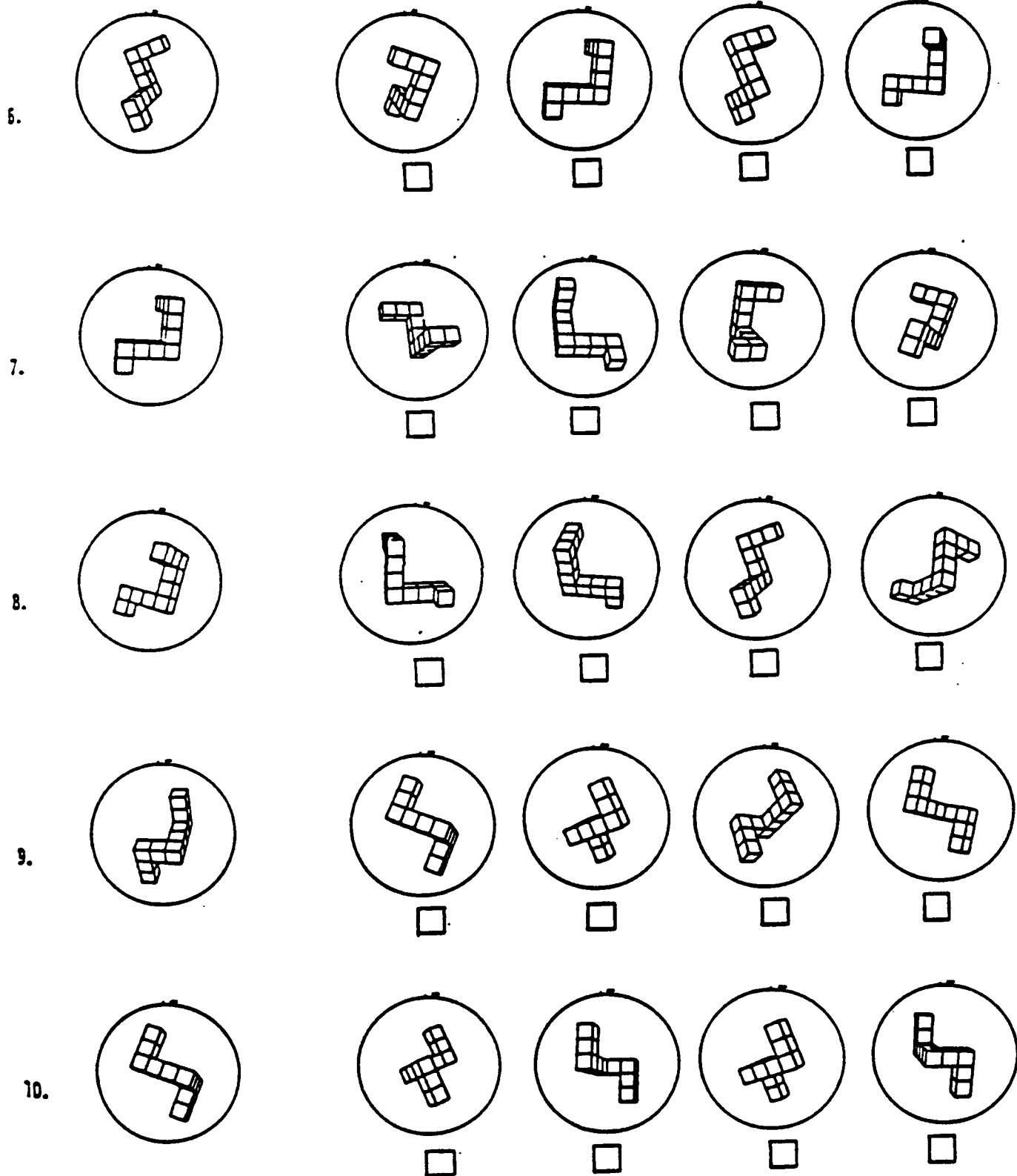


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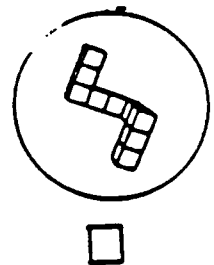
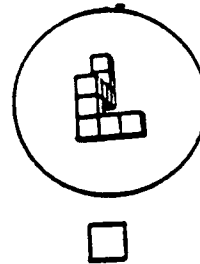
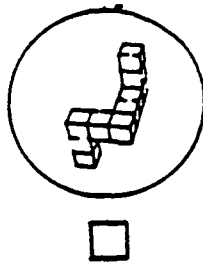
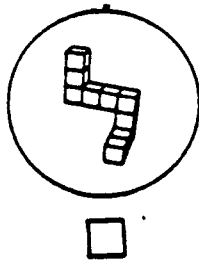
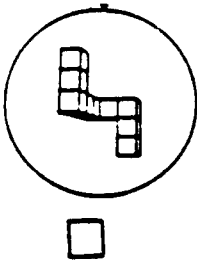


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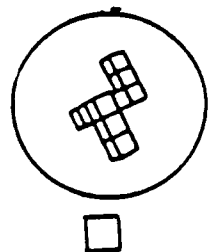
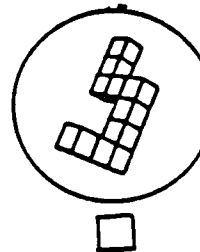
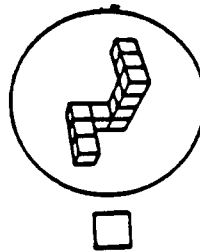
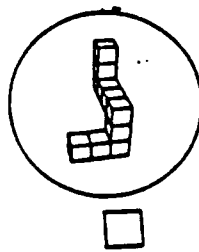
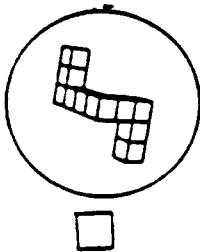




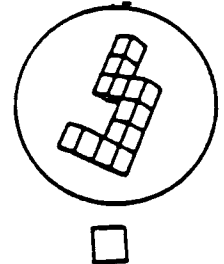
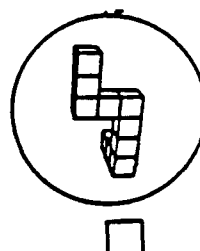
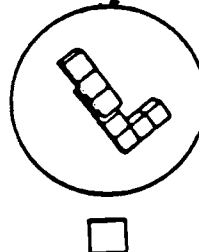
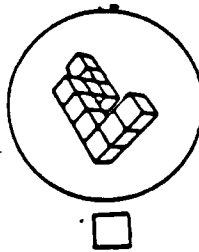
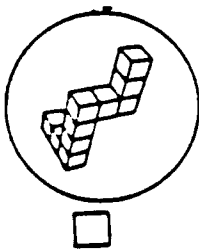
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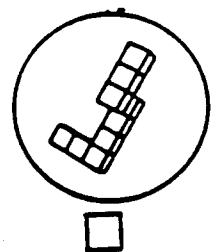
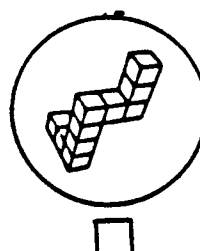
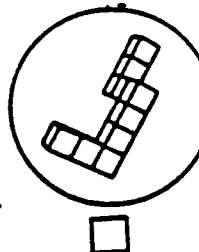
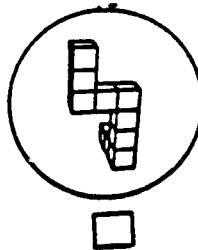
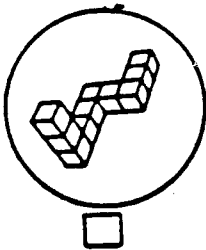
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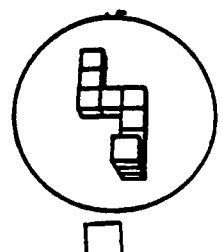
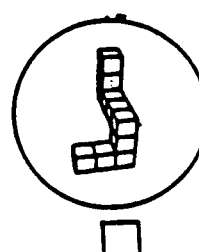
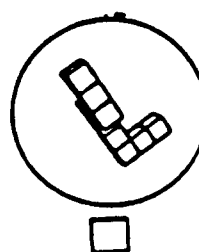
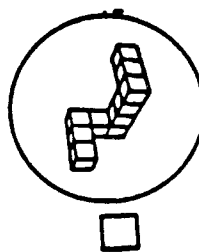
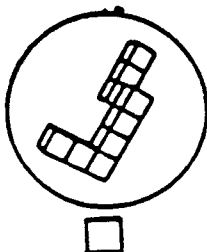
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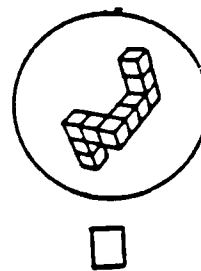
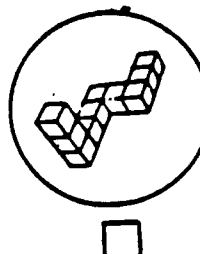
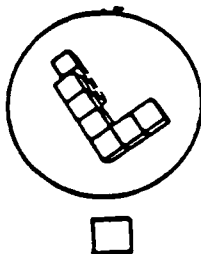
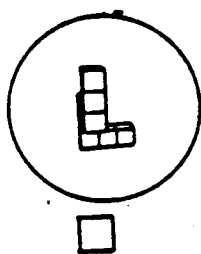
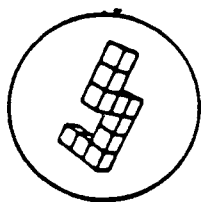


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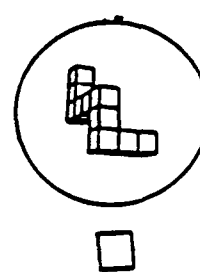
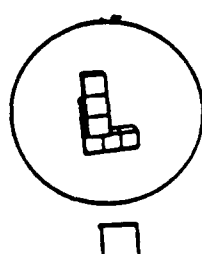
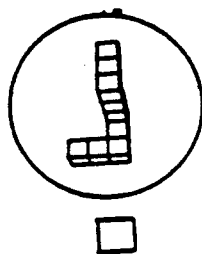
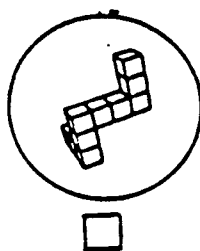
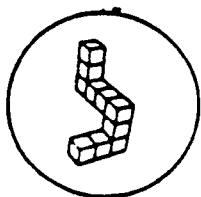


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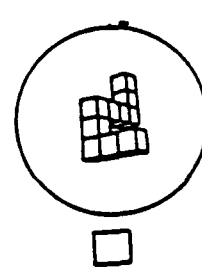
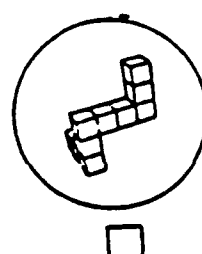
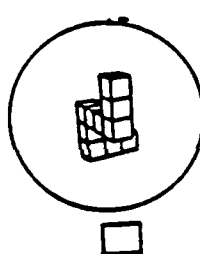
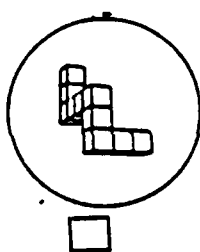
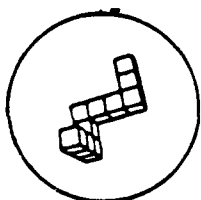
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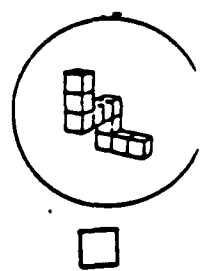
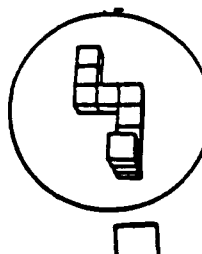
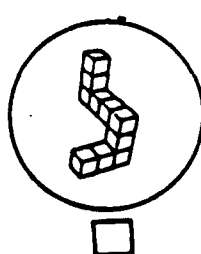
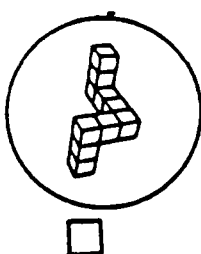
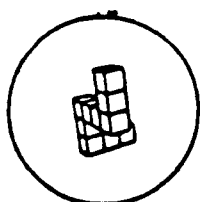
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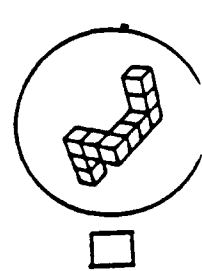
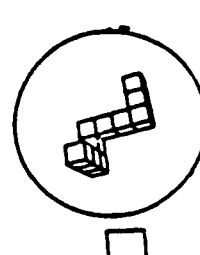
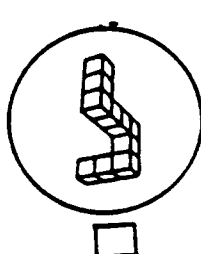
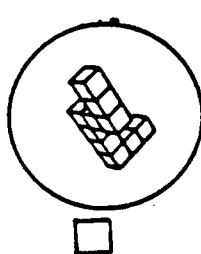
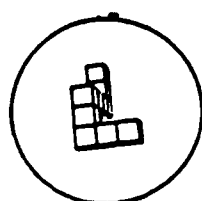
18.



19.



20.



STOP. Time Spent = _____ Minutes _____ Seconds

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## LEARNING STYLE QUESTIONNAIRE

Instructions. For each of the items listed below, circle the alternative which best describes your strengths and preferences as accurately as possible.

1. (a) not good at remembering faces.  
(b) not good at remembering names.  
(c) equally good at remembering names and faces.
2. (a) respond best to verbal instructions.  
(b) respond best to instruction by example.  
(c) equally responsive to verbal instruction and instruction by example.
3. (a) able to express feelings and emotions freely.  
(b) controlled in expression of feelings and emotions.  
(c) inhibited in expression of feelings and emotions.
4. (a) playful and loose in experimenting (in sports, art, extra curricular activities, etc.).  
(b) systematic and controlled in experimenting.  
(c) equal preference for playful/loose and systematic/controlled ways of experimenting.
5. (a) prefer classes where I have one assignment at a time.  
(b) prefer classes where I am studying or working on many things at once.  
(c) I have equal preference for the above type classes.
6. (a) preference for multiple-choice tests.  
(b) preference for essay tests.  
(c) equal preference for multiple-choice and essay tests.
7. (a) good at interpreting body language or the tone aspect of verbal communication.  
(b) poor at interpreting body language; dependent upon what people say.  
(c) equally good at interpreting body language and verbal expression.
8. (a) good at thinking up funny things to say and/or do.  
(b) poor at thinking up funny things to say and/or do.  
(c) moderately good at thinking up funny things to say or do.
9. (a) prefer classes in which I am moving and doing things.  
(b) prefer classes in which I listen to others.  
(c) equal preference for classes in which I am moving and doing things and those in which I listen.

10. (a) use factual, objective information in making judgments.  
(b) use personal experiences and feelings in making judgments.  
(c) make equal use of factual, objective information and personal experiences/feelings in making judgments.
11. (a) playful approach in solving problems.  
(b) serious, all-business approach to solving problems.  
(c) combination of playful and serious approach in solving problems.
12. (a) mentally receptive and responsive to sounds and images more than to people.  
(b) essentially self acting and creative mentally with groups of other people.  
(c) equally receptive and self acting mentally regardless of setting.
13. (a) almost always am able to use freely whatever is available to get work done.  
(b) at times am able to use whatever is available to get work done.  
(c) prefer working with proper materials, using things for what they are intended to be used for.
14. (a) like for my classes or work to be planned and know exactly what I am supposed to do.  
(b) like for my classes or work to be open with opportunities for flexibility and change as I go along.  
(c) equal preferences for classes and work that is planned and those that are open to change.
15. (a) very inventive.  
(b) occasionally inventive.  
(c) never inventive.
16. (a) think best while lying flat on back.  
(b) think best while sitting upright.  
(c) think best while walking or moving about.
17. (a) like classes where the work has clear and immediate applications (e.g., mechanical drawing, shop, home economics).  
(b) like classes where the work does not have a clearly practical application (literature, algebra, history).  
(c) equal preference for the above type of classes.
18. (a) like to play hunches and make guesses when I am unsure about things.  
(b) rather guess or play a hunch when in doubt.  
(c) play hunches and make guesses in some situations.
19. (a) like to express feelings and ideas in plain language.  
(b) like to express feelings and ideas in poetry, song, dance, etc.  
(c) equal preference for expressing feelings and ideas in plain language or in poetry, song, dance, etc.

20. (a) usually get many new insights from poetry, symbols, etc.  
(b) occasionally get new insights from poetry, symbols, etc.  
(c) rarely ever get new insights from poetry, symbols, etc.
21. (a) preference for simple problems.  
(b) preference for complex problems.  
(c) equal preference for simple and complex problems.
22. (a) responsive to emotional appeals.  
(b) responsive to logical, verbal appeals.  
(c) equally responsive to emotional and verbal appeals.
23. (a) preference for dealing with one problem at a time.  
(b) preference for dealing with several problems at a time.  
(c) equal preference for dealing with problems sequentially or simultaneously.
24. (a) prefer to learn the well established parts of a subject.  
(b) prefer to deal with theory and speculations about new subject matter.  
(c) prefer to have equal parts of the two above approaches to learning.
25. (a) preference for critical and analytical reading as for a book review, criticism of a movie, etc.  
(b) preference for creative, synthesizing reading as for making applications and using information to solve problems.  
(c) equal preference for critical and creative reading.
26. (a) preference for intuitive approach in solving problems.  
(b) preference for logical approach to solving problems.  
(c) equal preference for logical and intuitive approaches to solving problems.
27. (a) prefer use of visualization and imagery in problem solving.  
(b) prefer language and analysis of a problem in order to find solutions.  
(c) no preference for either method.
28. (a) preference for solving problems logically.  
(b) preference for solving problems through experience.  
(c) equal preference for solving problems logically or through experience.
29. (a) skilled in giving verbal explanations.  
(b) skilled in showing by movement and action.  
(c) equally able to give verbal explanation and visual presentation.
30. (a) learn best from teaching which uses verbal explanation.  
(b) learn best from teaching which uses visual presentation.  
(c) equal preference for verbal explanations and explanations by action and movement.

31. (a) primary reliance on language in remembering and thinking.  
(b) primary reliance on images in remembering and thinking.  
(c) equal reliance on language and images.
32. (a) preference for analyzing something that has already been completed.  
(b) preference for organizing and completing something that is unfinished.  
(c) no real preference for either activity.
33. (a) enjoyment of talking and writing.  
(b) enjoyment of drawing or manipulating objects.  
(c) enjoyment of both talking/writing and drawing/manipulating.
34. (a) easily lost even in familiar surroundings.  
(b) easily find directions even in strange surroundings.  
(c) moderately skilled in finding directions.
35. (a) more creative than intellectual.  
(b) more intellectual than creative.  
(c) equally creative and intellectual.
36. (a) like to be in noisy, crowded places where lots of things are happening at once.  
(b) like to be in a place where I can concentrate on one activity to the best of my ability.  
(c) sometimes like both of the above and no real preference for one over the other.
37. (a) primary outside interests are aesthetically oriented, that is, artistic, musical, dance, etc.  
(b) primary outside interests are primarily practical and applied, that is, working, scouts, team sports, cheerleading, etc.  
(c) participate equally in the above two types of activities.
38. (a) vocational interests are primarily in the general areas of business, economics, and the hard sciences, i.e., chemistry, biology, physics, etc.  
(b) vocational interests are primarily in the general areas of the humanities and soft sciences, i.e., history, sociology, psychology, etc.  
(c) am undecided or have no preference at this time.
39. (a) prefer to learn details and specific facts.  
(b) prefer a general overview of a subject, i.e., look at the whole picture.  
(c) prefer overview intermixed with specific facts and details.
40. (a) mentally receptive and responsive to what I hear and read.  
(b) mentally searching, questioning, and self-initiating in learning.  
(c) equally receptive/responsive and searching/self-initiating.

## EXPERIENCE QUESTIONNAIRE

**Instructions.** Below are listed forty (40) statements which may or may not be true about yourself. Indicate for each statement whether you think it is "true" or "false" about yourself. For example, if for the statement "I like some of the earthy body smells" you do enjoy experiencing such smells on occasion, mark "true", otherwise mark "false". Make sure that you respond to all 40 items.

Item Number	TRUE	FALSE
1. I like wild "uninhibited" parties.	—	—
2. I can't stand watching a movie that I have seen before.	—	—
3. I often wish I could be a mountain climber.	—	—
4. I like some of the earthy smells.	—	—
5. I get bored seeing the same old faces.	—	—
6. I like to explore a strange city or section of town myself, even if it means getting lost.	—	—
7. When you can predict almost everything a person will do and say, he or she must be a bore.	—	—
8. I usually don't enjoy a movie or a play where I can predict what will happen in advance.	—	—
9. I have tried marijuana or would like to.	—	—
10. I would like to try some of the drugs that produce hallucinations.	—	—
11. I sometimes like to do things that are a little frightening.	—	—
12. I enjoy the company of real "swingers."	—	—
13. I often like to get high (drinking liquor or smoking marijuana).	—	—
14. I like to try new foods that I have never tasted before.	—	—
15. Looking at someone's home movies or travel slides bores me tremendously.	—	—
16. I would like to take up the sport of water skiing.	—	—

	TRUE	FALSE
17. I would like to try surfboard riding.	---	---
18. I would like to take off on a trip with no preplanned or definite routes or timetables.	---	---
19. I would like to make friends in some of the "far-out" groups like artists or sculptors.	---	---
20. I would like to learn to fly an airplane.	---	---
21. I would like to go scuba diving.	---	---
22. I would like to meet some persons who are homosexual (men or women).	---	---
23. I would like to try parachute jumping.	---	---
24. I prefer friends who are excitingly unpredictable.	---	---
25. I like to have new and exciting experiences and sensations even if they are a little unconventional or illegal.	---	---
26. I often find beauty in the "clashing" colors and irregular form of modern painting.	---	---
27. I get very restless if I have to stay around home for any length of time.	---	---
28. I like to dive off the high board.	---	---
29. I like to date members of the opposite sex who are physically exciting.	---	---
30. Keeping the drinks full is the key to a good party.	---	---
31. The worst social sin is to be a bore.	---	---
32. A person should have considerable sexual experience before marriage.	---	---
33. I could conceive of myself seeking pleasures around the world with the "jet set."	---	---
34. I like people who are sharp and witty even if they do sometimes insult others.	---	---

	TRUE	FALSE
35. I enjoy watching many of the "sexy" scenes in movies.	—	—
36. I feel best after taking a couple of drinks.	—	—
37. People should dress in individual ways even if the effects are sometimes strange.	—	—
38. I would like to sail a long distance in a small but seaworthy craft.	—	—
39. I have no patience with dull or boring persons.	—	—
40. I think I would enjoy the sensations of skiing very fast down a high mountain slope.	—	—

## STYLE QUESTIONNAIRE

Instructions. Answer each of the statements in this questionnaire using the following scale:

Definitely Disagree	Slightly Disagree	Uncertain	Slightly Agree	Definitely Agree
1	2	3	4	5

Indicate your answer on the line at the end of each statement. If a particular statement definitely applies to you, mark 5 in the space provided. If a particular statement definitely does not apply to you, mark 1 in the space provided. In answering each question, try to think in terms of how you go about learning in general, rather than thinking of a specific course or subject area. Be accurate and honest in your answers and be sure to complete all items.

1. When studying for an exam, I prepare a list of probable questions and answers. ____.
2. I have trouble making logical inferences. ____.
3. I find that I concentrate on memorizing a lot of what we have to learn. ____.
4. I increase my vocabulary by building lists of new terms. ____.
5. I am very good at learning formulas, names and dates. ____.
6. New concepts rarely make me think of many other similar concepts. ____.
7. Even when I feel that I've learned the material, I continue to study it. ____.
8. I have trouble organizing the information that I remember. ____.
9. Even when I know I have carefully learned the material, I have trouble remembering it for an exam. ____.
10. I usually don't have time to think about the implications of what I read. ____.
11. I make simple charts and diagrams to help me remember material. ____.
12. I rarely write an outline of the material I read. ____.
13. I do not try to convert facts into "rules of thumb." ____.
14. I do well on tests requiring definitions. ____.
15. Professors seem to delight in making the simple truth unnecessarily complicated. ____.

**Definitely  
Disagree**

**Slightly  
Disagree**

**Uncertain**

**Slightly  
Agree**

**Definitely  
Agree**

**1**

**2**

**3**

**4**

**5**

16. I usually refer to several sources in order to understand a concept. ____
17. I try to resolve conflicts between the information obtained from different sources. ____.
18. I learn new words or ideas by visualizing a situation in which they occur. ____.
19. I spend less time studying than most of my friends. ____.
20. I learn new concepts by expressing them in my own words. ____.
21. I often memorize material that I don't understand. ____.
22. For exams, I memorize the material as given in the text or class notes. ____.
23. I carefully complete all course assignments. ____.
24. I have difficulty planning work when confronted with a complex task. ____.
25. I "debate" with the material as I study it. ____.
26. I remember new words and ideas by associating them with words and ideas I already know. ____.
27. I review course material periodically during the semester. ____.
28. I often have difficulty finding the right words for expressing my ideas. ____.
29. Toward the end of a course, I prepare an overview of all material covered. ____.
30. I can easily handle questions requiring comparison of different concepts. ____.
31. I rarely read beyond what is assigned in class. ____.
32. I have difficulty learning how to study for a course. ____.
33. I rarely sit and think about a unit of material which I have just read. ____
34. I try to relate ideas in one subject to those in others whenever possible. ____.

Definitely Disagree	Slightly Disagree	Uncertain	Slightly Agree	Definitely Agree
1	2	3	4	5

35. I have a regular place to study. ____.
36. I read critically. ____.
37. I "daydream" about things I've studied. ____.
38. I do poorly on completion items. ____.
39. I rarely use a dictionary. ____.
40. Although I generally remember facts and details, I find it difficult to fit them together into an overall picture. ____.
41. I learn new ideas by relating them to similar ideas. ____.
42. When learning a unit of material, I usually summarize it in my own words. ____.
43. I maintain a daily schedule of study hours. ____.
44. I think fast. ____.
45. While learning new concepts, their practical applications don't usually come to my mind. ____.
46. I get good grades on term papers. ____.
47. Getting myself to begin studying is usually difficult. ____.
48. I have difficulty locating particular passages in a textbook when necessary. ____.
49. I can usually formulate a good guess even when I don't know the answer. ____.
50. I have trouble remembering definitions. ____.
51. I would rather read a summary of an article than the original article. ____.
52. While studying, I attempt to find answers to questions I have in mind. ____.
53. I can usually state the underlying message of films and readings. ____.
54. I do not usually work through practice exercises and sample problems. ____.

Definitely Disagree	Slightly Disagree	Uncertain	Slightly Agree	Definitely Agree
1	2	3	4	5

55. I find it difficult to handle questions requiring critical evaluation. ____.
56. When I rehearse something, I usually just repeat it over and over to myself. ____.
57. I have regular weekly review periods. ____.
58. I do well on exams requiring much factual information. ____.
59. Most of my instructors lecture too fast. ____.
60. I rarely look for reasons behind the facts. ____.
61. I cram for exams. ____.
62. I find that I remember things best if I concentrate on the order in which the lecturer presented them. ____.
63. When I study something, I devise a system for recalling it later. ____.
64. I have trouble seeing the difference between apparently similar ideas. ____.
65. I always make a special effort to get all the details. ____.
66. I prepare a set of notes integrating the information from all sources in a course. ____.
67. My memory is actually pretty poor. ____.
68. I am rarely able to design procedures for solving problems. ____.
69. I do so well on essay tests. ____.
70. I rarely use the library. ____.
71. Professors seem to want me to be more adventurous in making use of my own ideas. ____.
72. I suppose that I'm more interested in the college degree that I'll get than I am in the courses that I'm taking. ____.
73. I often find myself questioning things that I hear in lectures or read in books. ____.
74. In trying to understand new ideas, I often try to relate them to real life situations. ____.

<b>Definitely Disagree</b>	<b>Slightly Disagree</b>	<b>Uncertain</b>	<b>Slightly Agree</b>	<b>Definitely Agree</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

75. I choose courses more from the way they fit in with my career plans than from my own interests. _____.

76. I find it difficult to switch tracks when working on a problem: I prefer to follow each line of thought as far as it will go. _____.

77. I like to play around with ideas of my own even if they don't seem to get me very far. _____.

78. When reading about research, I like to try to work out several alternative ways of interpreting the findings. _____.

79. In trying to understand a new topic, I often explain it to myself in ways that other people don't seem to follow. _____.

80. I find it better to start right off with the details of a new topic and build up an overall picture in that way. _____.

81. When I'm reading books, the ideas often produce vivid images. _____.

82. When I'm reading an article or research report, I generally examine the evidence carefully to decide whether the conclusion is justified. _____.

83. I remember things in the "real world" better than in school. _____.

84. I hate school. _____.

85. I have a good imagination. _____.

86. I seem to be able to think without words, more like feeling than thinking. _____.

87. When I start something, I stick with it until it's finished. _____.

88. For me, school means future social status. _____.

89. I just learn what I'm told to learn. _____.

90. When I'm studying, I stop and think every now and then about what I'm reading. _____.

91. Education helps you to grow personally. _____.

92. In the long run, I learn for myself not for the teachers. _____.

93. Mostly school is interesting. _____.

Definitely Disagree	Slightly Disagree	Uncertain	Slightly Agree	Definitely Agree
1	2	3	4	5

94. More than anything else, I don't want to be a failure. ____.

95. It's the teacher's job to tell me the answers. ____.

96. Learning is growing up. ____.

97. Learning is thinking. ____.

98. I like people. ____.

99. I seem to often think in pictures. ____.

100. I like to compare different theories. ____.

## **PRELIMINARY EXERCISE**

1. For each of the following problems, specify: (1) how you would solve it and (2) why the proposed solution will work. Your solution must be practical.

(a). You have been given a contract which requires you to produce several new and high risk (from the point of view of actually being able to build them) electronic devices. However, if you are successful, you will be paid a great sum of money, but there are provisions for failure or non-producing that are quite high in terms of money costs and loss of prestige and future business. You have been placed in a locked room and told you have thirty minutes to make-up your mind and sign the contract. If the contract is not signed when the room is re-opened, you will not get the contract. After thinking about the terms for fifteen minutes, you decide you want to sign. However, you discover you have no pen or pencil with you and none are available in the room. How would you go about signing?

(b). You have gotten out of your car in a deserted area and have inadvertently locked your keys inside. You are at least fifteen miles from any help. What would you do?

(c). Suppose you were alone in a row boat in the middle of a large lake, say three miles or so across. The boat then sprang a large leak such that you only have approximately five minutes before it sinks. You cannot swim. What would you do?

(d). You are a victim of a ship wreck which occurred several miles off the shore of a small uninhabited island. All crew and passengers were lost except you. You made your way to the island on a small life raft which you managed to salvage before everything else went down with the ship. Because of where you are (location) and the fact the ship had not been in radio contact with anyone for several days, it is highly unlikely anyone will have any precise indication of what the ship's position might have been when it went down. You are sure someone will be looking for you sooner or later, however. There is plenty of fresh water on the island and it is forested. There is an abundant supply of minerals. What would you do to be rescued?

(e). You and a friend are staying for a weekend in an old cabin which is deep in the isolated and densely wooded hills of Northern Georgia. On Saturday you are taking a hike and stumble across the location of a still and some moonshiners. The moonshiners see you before you can slip away undetected. They come after you. You run back toward your cabin in an attempt to elude the moonshiners. However, you can't shake them. You reach your cabin several minutes before the moonshiners do. The only items you have available for defense in the cabin are two broom handles and a coil of rope. What will you do to get away or back down the mountain to safety?

2. For each of the following arguments, explain (a) why the

conclusion is invalid, and (b) why people are likely to consider the conclusion to be valid (there may be more than one reason--give as many as you can).

(a). If a president always tells the truth, he will avoid problems with the press. President Reagan did not tell the truth about the Iran affair. Therefore, he encountered problems with the press.

(b). All fridgets are balcats; some balcats are not gumbans; therefore, some gumbans are not fridgets.

(c). All students work hard. Joe works hard, so he must be a student.

(d). Some students work hard, and some students are poor, therefore some poor people work hard.

(e). The athletics Director said before the game that either SIU won or the coach was out of a job next year. Fortunately SIU won, so the coach can count on his job for another year.

3. For each of the following explanations or arguments, first state whether or not there is something wrong with the reasoning involved. If there is, state in your own words what the flaw(s) is.

(a). My roommate claims that President Reagan is not sincere, because he told us he would never deal with terrorists, but he did. I think my roommate is wrong. The fact that people are so ready to believe the President, no matter what he says, shows that he is very sincere.

(b). Murder rates are much higher in the United States than

they are in Europe, and European countries have stricter gun control laws. It's obvious, therefore, that gun control laws prevent murder.

(c). I don't like my regular doctor. Any time I'm sick he is never sure what it is, and he never seems to be certain about the treatment he prescribes. I'm going to see Dr. Kingsfield. He is always so confident about everything he does.

(d). My son had the highest batting average in Little League last season. This year he's done all right, but some other kid beat him out for the batting championship. I wonder why his performance slipped like that.

(e). I never used to believe in ESP or clairvoyance, but

last year my wife had a terrible dream -- full of screams and terrified faces -- the night before a big airline disaster. Now I'm convinced people do have premonitions.

4. In twenty five (25) words or less, make each of the following comparisons:

(a). Compare a mountain and a mole hill.

(b). Compare a lollipop and a manhole cover.

(c). Compare a lion and a mouse.

(d). Compare a cactus and a rose.

(e). Compare blue and green.

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(f). Compare a door and a mousetrap.

(g). Compare a river and a skyscraper.

(h). Compare Christmas and a flag.

(i). Compare baseball and checkers.

(j). Compare calendars and ballpoint pens.

1. For each of the following problems, specify: (1) How you would solve it and (2) why the proposed solution will work. Your solution must be practical.

(a). You are a victim of a ship wreck which occurred several miles off the shore of a small uninhabited island. All crew and passengers were lost except you. You made your way to the island on a small life raft which you managed to salvage before everything else went down with the ship. Because of where you are (remote location) and the fact the ship had not been in radio contact with anyone for several days, it is highly unlikely anyone will have any precise indication of what the ship's position might have been when it went down. It is, therefore, unlikely that you will be rescued in any timely manner. It might take weeks or months. After scouting the island, you find there is an abundant supply of minerals and the island is forested. You also find that there is a food supply in the form of nuts, berries and the like. What you cannot locate, however, is a supply of fresh water. You reason that there must be fresh water because of all of the vegetation and it must be somewhere below the surface of the ground. How would you go about getting to it? (Be very specific). Your survival, until you can be rescued, depends upon securing a source of drinking water.

(b). You are working in a storeroom on the fourth floor of a large warehouse. Your job consists of stacking a recently arrived shipment of goods which are packaged in cardboard boxes. Each box is approximately three feet tall and two feet wide and weighs about fifty pounds. The boxes contain an inert powdered substance which by itself is harmless. However, when mixed with a liquid chemical, xenon, a powerful unstable explosive is produced which can be set off with a slight jolt. Several barrels of xenon are also present in the room and this concerns you a bit because you know what would happen if the material in the boxes and the xenon became mixed--a volatile explosive would be produced. Nothing else is in the room except a number of oil soaked rags piled in one corner and a three foot length of hollow steel pipe which has been crushed at one end. There is one door for entry into and exit from the room. There are two windows in the room also but neither of them has a fire escape located next to it. The ground below the windows consists of a mass of jagged rocks which stand about two feet high. Jumping from the windows unprotected in some way onto the rocks would be certain death. As you work, a fire breaks out via spontaneous combustion in the pile of oil soaked rags. The fire spreads rapidly. You try the door, but it is jammed shut because of something on the other side. You estimate that you have at most five minutes before you are consumed by the fire. What would you do to escape the fire and get to safety?

(c). You and three other friends are exploring a limestone cave whose entrance is in the bluffs overlooking the Missouri river near Columbia, Missouri. The cave is small such that about 90% of the time you can't stand-up; rather, you must crawl instead. There are also many passageways going off in all directions. You freely explore these. You have not explored the cave before and you have no map of or prior knowledge of the cave's configuration. Because of this, you attempt to leave a trail to find your way back out by making chalk marks on the wall about every 100 meters or so. After you have been exploring for about five to six hours, you decide it is time to leave in order to get out and back to your car before nightfall. As you begin to re-trace your path, you discover that the high moisture content on the walls of the cave has washed away your chalk marks. Each of you has a flashlight and an extra set of batteries. How would you go about finding your way out of the cave before all of your light is expended and/or before you starve to death?

(d). You have been kidnapped by two heavily armed men. They take you to an old wooden shack in a remote heavily wooded area. One of the men stays outside the cabin to guard you while the other one leaves to attempt to collect a ransom for you from your parents. They are asking one million dollars. The kidnappers have stated that they will kill you if they don't get the ransom and you fully believe they will -- they strike you as being willing to stop at or spare nothing. You know your parent's financial condition and, although, they are relatively well-off, you also know there is no way they can raise the million dollars in the period of time the kidnappers have in mind. Therefore, in order to save your life, you must escape. The shack has no windows and only one door. The kidnapper who is guarding you is just outside this door. The cabin is bare save for an old wood burning stove, a pile of newspapers, and one electric lamp with a small 28 watt bulb. How would you go about escaping?

(e). You and a friend are driving across the desert in Nevada on your way to California. You have just gotten something to eat at a truck stop which is located only a few hundred meters from the boundary of the reservation of a nuclear test site. As you climb into the passenger side of the car, a strange looking man approaches you carrying a box. He holds you at gunpoint and tells you he is a terrorist and that the box contains a bomb which has the power to blow-up everything within a three hundred meter radius. He forces you to take the bomb and he then arms it by pushing a button on the side of the box. He tells you that if you try to walk or run more than 18 meters with the bomb, it will explode. He also says it cannot be set down either or it will detonate. He gives you a walkie-talkie and tells you to drive to the test site. He says you are to place the bomb along side a large "heavy water" vat near building no. 444. He further indicates that from where you will have to park to get as close to the vat as possible, ten meters will be required to reach the vat. To walk any further will detonate the bomb. He will provide you with instructions via the walkie-talkie as to how to proceed in setting the bomb down without it exploding when you reach the vat. He also has a radio control with which he can detonate the bomb at any time and he says he will be following you at a distance. If you do not do what he demands, he will detonate the bomb. How would you get rid of the bomb without destroying yourself or the building the terrorist wants destroyed?

2. For each of the following arguments, explain (a) why the conclusion is invalid, and (b) why people are likely to consider the conclusion to be valid (there may be more than one reason--give as many as you can).

(a). If a person is always truthful, he/she will never get into trouble. Lieutenant Colonel North did not tell the truth about Iran-Scam. Therefore, he got into trouble.

(b). All stingrays are rays; some rays are not fish; therefore, some fish are not stingrays.

(c). All professors write books. John wrote a book, so he must be a professor.

(d). Some gamblers consistently win, and some gamblers are rich, therefore, some winning people are rich.

(e). The professor told Martha that either she passed the upcoming test or she would fail the course. Martha passed the test so she is now assured of passing the course.

3. For each of the following explanations or arguments, first state whether or not there is something wrong with the reasoning involve. If there is, state in your own words what the flaw(s) is.

(a). My brother-in-law had the highest sales record of anyone on the sales team at IBM last year. He has again done extremely well this year, but a new salesman managed to top his old record. I guess my brother-in-law is just getting old and slower.

(b). John and Joe are two consultants that were brought in by the University President to advise him on diversification plans. John presented four fixed options and defended each one. Joe, on the other hand, presented a wide range of options and didn't seem to know which one or ones were the best. It is obvious that John is the best consultant.

(c). People in California are much friendlier than the people in New York City and California has more liberal laws than does the state of New York. Therefore, people who live in states with more liberal laws are friendlier.

(d). Before every football game SIU won during this past season the weather was bad. It is obvious then that there is a connection between the weather and SIU's ability to win a football game.

(e). John is the student body president. John promised the students he would never side with the university administration on the issue of increases in medical insurance premiums, but he did. Most of the students still believe in and support John, so he must be trustworthy.

4. In twenty five (25) words or less, make each of the following comparisons/contrasts:

(a). Compare and contrast black and purple.

(b). Compare and contrast graduation and holidays.

(c). Compare and contrast sense and nonsense.

(d). Compare and contrast cows and ants.

(e). Compare and contrast brick and grass.

(f). Compare and contrast young and bell.

(g). Compare and contrast hope and rainbow.

(h). Compare and contrast job and money.

(i). Compare and contrast love and like.

## APPENDIX F

### INSTRUCTIONS ADMINISTERED IN CLASS TO POTENTIAL PARTICIPANTS PRIOR TO DISTRIBUTION OF INSTRUMENT PACKETS

My name is _____. I am a member of a group of researchers who are conducting a study for the university that hopefully will lead to better structuring of courses to meet student needs. The basic intent of the study is to examine personality and learning styles of students to provide a data base from which it may be possible to better structure course and other instructional delivery mechanisms. The bottom line is: "Can we structure instructional materials in such a way as to make it easier for you to learn and, accordingly, get better grades?"

This course was selected at random along with a number of others from all the courses offered here at SIU. Your instructor (either X or Y for the Art and Psyc course in question) was contacted and asked if he would volunteer some of his course time for the project and offer his students the opportunity to participate in the study, which he did. However, I must emphasize that your individual participation is voluntary. You can refuse to participate, but, if the project is successful, you as well as many others may benefit.

If you do decide to participate, the following is what will be required of you. For each of you, a packet of Personality and Learning Style measuring instruments has been prepared. Each packet contains twelve instruments. Ten of them have no "right" or "wrong" answers. They ask for your estimates, opinions, attitudes, performances, etc. The other two instruments do have best answers for each of the questions. You will respond to one of the instruments in the packet where there are "right" or better answers here in class before you leave today. This exercise deals with your ability to solve various kinds of verbal problems. I am asking you to complete this one exercise in class because it is especially important that we assess YOUR ability in this area and not your ability as it might be assisted by room-mates or friends. We also wanted to be able to control the amount of time you spend on this task.

For the remaining eleven instruments in the packet, you will have one week to fill them out and return them or your packet to this class at this same time. We cannot accept late packets so, again, if you volunteer, you agree to return the completed packet in a one week period.

I will now pass out the packets. Would those who want to volunteer now please raise your hands?

(PASS OUT PACKETS)

I will now circulate a piece of paper on which I would like for you to put your name and the number on the packet which you received. We are doing this so that we can temporarily identify who has received which packet. This is being done for two reasons. First, if we need to follow-up with you concerning incompleteness of questionnaire responses or failure to complete an entire instrument, we can do so. Second, we will again administer this set of materials (or a variant thereof) at the end of the semester to validate that we have true measures of your attitudes, opinions, learning style, etc. This is very important to insure that the recommendations we make on the basis of the data are what they should be. It is very important, then, that for both now and later you give candid responses. If you do not, the data as well as this study will be meaningless.

Would you please open your packet now and look for a form which has a "red flag" on top and is entitled "Preliminary Exercise." I want you to complete this instrument now to the best of your ability and you have the remainder of the current hour to do so. I will be available also for the remainder of the hour, so if you have questions about anything, please let me know.

## APPENDIX G

### EXPERIMENTAL DESIGN AND CRITERION CONTAMINATION

The purpose of this appendix is to address a comment made by one reviewer, to the effect that criterion contamination occurred as a result of the experimental design. In this design, the instructor of the course designated as the experimental treatment administered the pre- and post-tests in both the experimental and control conditions. One reviewer raised the possibility that this would have created demand conditions favorable to confirmation of the experimental hypothesis.

There hardly can be any question that this possibility exists, as in any experiment in which a given experimenter administers both experimental and control conditions. The literature provides extensive evidence for these situational demands. In the present case, this is not viewed as crippling, for three reasons.

- . First, there was no satisfactory alternative. The instructor in the control condition was not experienced in administering the type of criterion measure used, so the risk of introducing an unquantifiable experimenter effect would still have remained.
- . Second, the objective of the experiment was not so much to determine if the students in the experimental condition improved as it was to find correlates of improvement. The instructor in the experimental condition was less knowledgeable about the individual difference variables under investigation than the instructor in the control condition. Thus, the existing design might actually have been cleaner than alternatives.
- . Third, there is external evidence that students in the experimental class do improve on tasks of this nature. They regularly compete, as the report notes, in an all-campus contest involving unstructured problem solving, and consistently score very well. Thus, if the criterion is a performance task focusing on unstructured problem solving, it seems fruitless to try to explain away the performance of the experimental students. The real questions were whether the course produces improvement (i.e., it is not self-selection), and -- more importantly -- what correlates with improvement if it does occur.

T. O. Jacobs  
Chief, SLTA